SYSTEMS SIMULATION OF PUBLIC POLICY STRATEGIES FOR MULTICOUNTY DISTRICT ECONOMIC DEVELOPMENT

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PREFACE

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CHAPTER I

INTRODUCTION

Many rural areas are plagued with problems of poverty, declining population, inadequate schools and other services, and a high ratio of dependent to nondependent population. Many urban areas are plagued by slums, crowding, deteriorating public transportation, suburban sprawl, sharply rising welfare costs, increasing alienation, crime, pollution, and severe fiscal pressures on central city governments. The mass exodus of people from rural areas to urban areas has been a panacea to neither area. In fact, many of the problems of both urban and rural areas can be related, either directly or indirectly, to rural-urban migration and the adjustments that such migration necessitates. However, some elements of success are apparent:

> In recent decades, the poor, like others, have migrated to metropolitan areas in large numbers. And they have come for much the same reasons: to seek improved income and employment opportunities...However bad conditions are in urban slums, the migration has been successful. Real incomes and employment opportunities are better in urban than rural areas, and the incidence of poverty is lower despite the immigration of poor (Mills, 1972, p. 145).

These success elements notwithstanding, there is considerable evidence that public policies could have been used more effectively to reduce problems of migrants. Furthermore, many problems remain. In 1969, only 27 percent of the population of the United States lived in rural areas. However, 36 percent of the people in poverty lived in rural areas. The incidence of poverty was 18 percent in non-metropolitan

areas and only 10 percent in metropolitan areas. Over half of the blacks in rural areas were in poverty while only 30 percent of the blacks in urban areas were so classified. Mean family income was $2,500 less in rural than in urban areas. In 1970, more than 55 percent of the adult urban population had a high school education. In contrast, only 44 percent of the adult rural population had a high school education and less than seven percent had a college education.

Area development programs (including related public assistance and manpower programs) have expanded markedly in recent years to deal with the problems of both rural and urban areas. Federal funds for community and regional development increased by 3.8 times from 1961 to 1971 when they totaled $55 billion.[1] Federal expenditures on labor and manpower programs increased from $809 million in 1961 to $2.6 billion in 1971. Federal public assistance payments increased from $2.2 billion in 1961 to $7.8 billion in 1971 (U. S. Bureau of Census, 1972b).

In 1965 federal legislation was passed which formed the Economic Development Administration (EDA). The EDA was charged with providing assistance necessary to permanently eliminate substantial and persistent unemployment and underemployment in economically distressed areas. The primary influence in preparing the EDA legislation was the experience acquired from the Area Redevelopment Administration (ARA) which existed from 1961 to 1965. "The ARA was regarded as an experimental program to give legislative support to the declaration of the Full Employment Act of 1946" (Economic Development Administration, 1972, p. 1). The ARA was

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[1]Includes outlays for agriculture and rural development, natural resources, commerce and transportation, community development and housing, health, education and manpower, but excludes social security.

involved primarily in piece-meal project-by-project development activities. "One worthy objective in reconstituting the Area Redevelopment Administration as the Economic Development Administration in 1965 was to place greater emphasis on regional development plans" (Tweeten, 1970, p. 401).

In 1965, EDA expenditures were $55 million. In 1966, their first full year of operation, EDA expenditures grew to $72 million (Executive Office of the President, 1966). EDA outlays for 1973 included expenditures of about $217 million and loans of about $47 million. The $217 million expenditures included $162 million for development facilities grants; $22 million for planning, technical assistance and research; $22 million for operations and administration; and $11 million for other expenditures (Executive Office of the President, 1972). The development facilities grants were made to state, local or nonprofit organizations to be used for the purchase or construction of facilities to improve opportunities for the establishment or expansion of industrial or commercial firms. The funds for planning, technical assistance and research were used to aid communities and districts in their planning for economic development. The loans were low-interest, long-maturity loans for the construction of commercial, industrial and development facilities.

Other sources of major development related projects have been the Manpower Development and Training Administration and the Office of Economic Opportunity. These agencies were formed by federal legislation enacted in 1962 and 1964 respectively. Their programs included labor mobility projects, education and training—including retraining and on-the-job training. These programs were aimed at the unemployed and underemployed and at minority groups with goals of alleviating poverty and insuring equal opportunity.

Three stages of rural area development research are apparent. The first stage, documenting the dimensions of the problem, began as early as the 1790 census of population. The phase peaked in the 1950's with numerous special personal interview surveys of rural areas. It continues through the present though it now receives less relative effort than previously. The second phase, planning programs for development, gained prominence in the 1960's. Major development programs of the Manpower Development and Training Administration and the Office of Economic Opportunity were originated during this time. Spurred by the program planning and budgeting emphasis, many of these programs were evaluated for cost-effectiveness. But the evaluations failed to view development programs as a package and to recognize the need for coordination of programs in reaching a critical mass for rural development. The second stage, however, provided the foundation for a third stage, programming plans. In contrast to planning programs as separate entities, the third stage recognizes the need to coordinate programs and to determine the level and mix of programs required to reach development goals efficiently. The third stage can be methodologically conceptualized within the dynamic context of systems planning (Tweeten, 1974a).

The systems approach developed in this study can improve both classroom instruction and public policy in rural area development. Shortcomings of legislation and inadequate planning have resulted in fragmented, inefficient and overlapping programs. Previous studies have not considered the many possible programs for economic development as part of a comprehensive system. Economic evaluation of the efficiencies of various programs, viewed in the context of systems planning, can help public policy decision makers decide which public programs to expand and

which to contract, and what total level of funds is required to reach development targets. Systems planning can be used to devise an efficient rural development strategy that makes limited public funds go as far as possible to reach development targets.

In the classroom, the systems approach, organized as a rural development game, allows students to gain "experience" in devising a development strategy. It serves as a method to make students aware of the complicated relationships which exist among demographic factors and policy activities within the system of an area economy. Students' development program plans for a specific time interval can be fed into a computerized simulation model which provides a printout of outcomes. In subsequent planning sessions, students revise their development plans and the results are printed. This process is continued until the game is complete and targets are met, "public funds" for development are exhausted or the simulated time within the development planning horizon has passed. The gaming approach has been used in other problem areas with success, and has generated enthusiasm, experience and feedback that are important for effective learning.

Objectives

The purpose of this study is to develop and utilize an exemplary model to simulate and evaluate the results of potential rural area development policies. The model is applicable to classroom instruction and to the evaluation of "real world" public policy packages directed at rural area development. The formal objectives of the study are as follows:

1. Estimate technical efficiency coefficients for alternative area development activities.

2. Evaluate the effectiveness of potential rural area development policy packages in attaining alternative goals.
3. Compare the simulated effectiveness of policy packages which are currently politically feasible with the simulated effectiveness of ideal policy packages deemed potentially possible.

Methodology

Policy makers must specify area development goals and estimate the results of alternative policies before the policies can be evaluated and courses of action can be selected. The results of regional development policies, especially when viewed in a dynamic framework, are dependent upon the interaction of many variables within a complicated, interrelated system of social, economic, political and demographic factors. Each of these factors can be taken as a subsystem. Each subsystem can be broken into still lesser systems, and, at least conceptually, this process can be continued until the complete hierarchy of systems of a rural area is identified.

The immediate practical problems of this endeavor are obvious. The conceptual dynamic interrelationships of even relatively simple systems mushroom until they become "mind-boggling." Also such systems develop voracious appetities for minutely detailed data. These two problems can be countered to some extent by the utilization of modern computer hardware. However, even with computer assistance, the ability to conceptualize comprehensive systems can easily exceed the technical capabilities for simulating the workings of such systems.

Still, to predict or estimate the results of alternative development policies, some system of policies and results must be simulated in a more or less formal manner. A formal quantitative systems simulation model, while of necessity abstracting from many real world exigencies, can substantially improve on the decision making frameworks now in use by planners, and can give useful and hitherto unavailable estimates of the efficient level and mix of public policies required to reach specified development targets.

Estimation of Efficiency Coefficients for Development Activities

Numerous publicly supported programs are available to improve the well-being of the inhabitants of an underdeveloped area. Examples are welfare payments, investment in human capital, programs to move people to jobs outside the area and programs to generate local jobs through industrial development.

Efficiency coefficients, meaning the impact of these alternative development activities on various subpopulations within the study area, will be estimated from primary and secondary sources. A considerable body of literature dealing with analysis of individual development projects currently exists. Project efficiency coefficients are calculated in many of these studies. While these secondary data do not always apply to the areas examined in this study, the coefficients can be modified to fill data needs. In other instances, coefficients will be calculated from raw data available from state and federal agencies.

Ordinarily, allocation of development funds to welfare (public assistance) programs is not considered to be an efficient use of such

funds. Welfare programs providing only cash assistance to the poor do not constitute an investment in human capital that generates a future income stream. Welfare programs do bring immediate gains in buying power, and for some people (those who are physically or mentally incapable of work), welfare payments may be a cost-effective way to eliminate poverty. Outlays to upgrade skills of those who are most disadvantaged generate incomes for instructors but not for the disadvantaged.

Human capital investments in the form of education and training do, indeed, increase the productive potential of some people in an underdeveloped area. One use of such funds is to keep potential dropouts in school. Neighborhood Youth Corps programs administered by the Office of Economic Opportunity and other sources yield estimates of the cost effectiveness of such programs to keep dropouts in school (Somers and Stormsdorfer, 1972). Information from manpower projects as well as age-earnings profiles generated from census data indicate the increased individual earning potential which can be expected to result from staying in school. Another use of human capital investment funds is for vocational training (or retraining) programs. Several estimates of cost effectiveness coefficients for such programs are available in the literature (Shallah and Tweeten, 1970; Goldstein, 1972). However, people who have increased their earning potential through education and training must have jobs to utilize their newly developed capabilities before this potential can be realized.[2]

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[2] "Improved skills will be of little value in an economy which provides no market for these skills" (Hirsch, 1973, p. 167). Thus programs to move people to jobs (labor mobility programs) and jobs to people (industrial development programs) are likely to serve as the basis for most successful comprehensive area development programs. And even these programs can only be successful if national full employment policies are in effect--a presumption that underlies the rural development model.

Programs to move people to jobs outside underdeveloped areas have the advantage of increasing income fairly rapidly (much more so than human capital investment programs). However, such programs can face considerable problems. Studies of labor mobility projects in rural poverty areas indicate that a significant proportion of the migrants who are outside the home area return each year (Nelson and Tweeten, 1973). Other individuals who could raise incomes by employment elsewhere cannot be moved at all. Also, political obstacles preclude moving large numbers of people out of underdeveloped areas. Thus programs to move jobs to people in underdeveloped areas can usefully supplement other programs. But the coordination of such programs with other development efforts is important. Estimates of cost effectiveness coefficients for labor mobility projects will, for this study, be made from data available on Manpower Development and Training Administration labor mobility projects (Fairchild, 1970; Nelson and Tweeten, 1973).

Because of limited opportunities for local job expansion and high initial costs of attracting industry, public programs to generate jobs locally generally provide less income to people in the short run for a given public outlay than either welfare programs or labor mobility programs. However, job creating industrial development programs can yield favorable returns over time. A review of the literature relating to recent Economic Development Administration (EDA) industrial development projects provides data which are used in this study to estimate the cost effectiveness of creating jobs for people in underdeveloped areas (Boise Cascade Center for Community Development, 1970; Economic Development Administration, 1970). This same literature on EDA projects provides information used in this study to estimate the percentages of jobs

attributable to such projects which go to the poor and which are filled from local labor sources.

A study of plant location and expansion in the state of Oklahoma (Childs, 1973) provides data used in this study to estimate the expected industrial mix of jobs attributable to EDA projects. This industry mix data plus employment multiplier estimates for a rural Oklahoma area (Muncrief, 1972) and data on direct, indirect and induced income resulting from government expenditures in Oklahoma (Doeksen, 1971 and 1972) are used to estimate the full effects on employment and income of public funds spent on industrialization and other development activities in the rural area considered in this study.

Some development programs are not easily grouped with welfare, human capital investment and job creation programs. One such program considered in this study is family planning. The importance of family planning to the economic well-being of individuals has been noted by economists since at least 1798 when Thomas R. Malthus published his Essay on the Principle of Population (McCleary, 1953). Malthus recognized that the poor or the working class were the ones whose economic well-being was most hindered by large family size. This condition still persists. "Progress in reducing poverty in recent years is greatest among small-sized families; it is also more difficult for a large family to exit from poverty" (Sheppard, 1967, p. 22). Consequently family planning programs, to allow the poor to have the number of children they desire, can be viewed as one possible alternative use for development program funds.

A family planning program would provide information and contraceptives to the poor to allow them to have the number of children they desire. Studies show that such programs would decrease the number of

children born into poverty. Estimates of cost effectiveness of such family planning programs (Kershaw and Courant, 1970) are used in this study to evaluate the effects of public expenditures for family planning on rural poverty.

Evaluation of the Effectiveness of Development Policy Packages

Economic development of an area is defined as an increase in the well-being of the area's inhabitants wherever they eventually reside. Because well-being cannot be measured directly, it is necessary to use more immediate and measurable goals such as income, poverty and employment in a quantitative model of economic development. Ideally, the evaluation of area development policies and activities requires specification of the goals of the area's inhabitants. The trade-offs among goals which are not perfectly compatible pose conceptual problems. Personal goals often include the maximization or attainment of satisficing levels of such diverse and sometimes incompatible elements as income, wealth, leisure, prestige and political power. Goals also vary over time.

To evaluate area development activities, the individual personal goals of the inhabitants of the region considered must be aggregated. Such aggregation necessitates the use of a common denominator to measure personal goals. Since income is the means to many goals sought by individuals, it can serve as one easily aggregated economic proxy for many human goals. The selection of income to measure development still leaves unsolved the problems of income distribution among inhabitants of an area and over time. While public debate and political rhetoric clearly point

to income distribution as an important issue, it is not possible to set forth an ideal income distribution without making heroic assumptions.

Goals of equity and efficiency conflict in many programs. Some development activities generate relatively large amounts of income but help only a few poor people. Other equally costly projects generate less income but remove more people from poverty. Some projects generate relatively large amounts of future income and little current income while other programs do the opposite. These choices are resolved in this study only by showing alternatives.

The approach in this study is to assume various goals and then search for public policy strategies which best satisfy these goals. Hopefully, the range of goals or objectives considered is broad enough to include discogent opinions on the part of citizens, community leaders and policymakers of what constitutes an optimal set of goals. Once development project evaluation criteria have been established, policy makers can use the model developed herein to estimate the results of alternative policy packages and select courses of action which satisfy area development goals as fully as possible.

The use of a model such as the one described herein can make decision makers aware of complex relationships over time which are difficult to conceptualize informally, and help decision makers predict ranges into which results of specific policy actions can be expected to fall. Decision makers responsible for investing development funds can examine the results of alternative courses of action without actually having to invest funds in the alternative activities. A course of action with desirable results can be singled out for consideration, and unforeseen problems can be identified before they occur in real situations.

Organization of Study

The following chapter includes a discussion of the model developed and utilized in this study to simulate rural area development. Some other studies utilizing systems simulation to evaluate development activities are discussed briefly, the theoretical bases for the model are examined and technical aspects of the model are discussed.

Chapter III includes a definition and description of the rural area to which this study pertains. Socio-demographic data on the study area, cross-classified as necessitated for simulation, are presented in the chapter. Estimates of the technical and efficiency coefficients required for operation of the model are presented in Chapter IV. Literature sources continuing information used for coefficient estimation are discussed in the chapter.

Results of alternative development plans are specified and discussed in Chapter V. Chapter VI summarizes the study. Conclusions and implications are discussed in the chapter.

CHAPTER II

THE MODEL

A rural area development planning model is developed in this study to simulate results over time of potential rural area development policy packages or strategies. Simulation is "essentially a technique that involves setting up a model of a real situation and then performing experiments on the model" (Naylor, et al., 1966, p. 2). For a simulation model to be a useful tool in applied research, it must be a logically complete though simplified representation of a segment of reality which can be operated on mathematically or by other systematic means to yield quantitative or at least interpretable results. A useful model must have sound theoretical bases and be technically operable.

Extensive use of simulation to construct and experiment upon economic and other potentially complicated systems developed concurrently with digital computers. Increasing capacity of computers reduced computational constraints and made possible increasingly greater depth of analysis. "With simulation one is limited in depth only by his knowledge and capacity to handle data management problems that arise when he attempts to model reality more closely" (Eidman, 1971, p. 8).

Simulation then, in contrast to other analytical models, accomodates the study of highly complex relationships. Conceptually, the complexity of relationships that can be simulated is almost unlimited. These can include discontinuous relationships, time lags, indivisibilities and

non-linear relationships. Realistically, of course, the usefulness of simulation is limited by such things as the abilities of the researcher to recognize relationships and state them in mathematical terms, the abilities of the researcher to obtain and manage large quantities of accurate data, and the programming capacity of available computer hardware.

Simulation is not ordinarily used as an optimizing procedure. Economic optimizing models generally determine activity levels endogenously. Activity levels must usually be specified as exogenous variables for a system being simulated. However, after these exogenous variables are specified, the researcher can compare the implications and results of various levels of alternative variable combinations to select those which best satisfy some previously determined criteria.

The following section reviews selected studies which applied systems simulation techniques to problems of economic development and public policy evaluation. The last two sections of the chapter discuss the theoretical bases and technical aspects of the model developed for this research.

Some Recent Development Studies Utilizing Systems Simulation

Other researchers have applied systems simulation to research questions of economic development and public policy evaluation. These studies have addressed development questions from various levels of aggregation ranging from local regions to the nation as a whole. Similarities and differences in these studies and the research presented in this thesis are noted.

A Regional Macroeconomic Model

Eddleman and Tyner (1972) present a macroeconomic simulation model for evaluating the supply and demand factors influencing production in a regional economy. The model can be used to simulate "a region's growth over a previous time period and for projecting future levels of employment, income and regional balance of payments" (Eddleman and Tyner, 1972, p. 195). Using this model a researcher can set target levels for growth measured in output terms and then examine the feasibility of the target levels in terms of human, natural and financial resource constraints. The model presented by Eddleman and Tyner, simulates area development from the standpoint of production in the area. It provides little information on the effects of public policies and programs to supplement the human, natural and financial resources of an area if target levels of output cannot be obtained with existing resources. Also, the Eddleman-Tyner model does not consider the distributional aspects of the income generated by the area's production.

A National Rural-Urban Model

A model to simulate rural and urban population, income and employment in the United States was developed in the U. S. Department of Agriculture, Economic Research Service (Edwards and De Pass, 1971). Using this model and current national trends, Edwards and De Pass predicted population, income and employment for the rural and urban sectors of the nation to the year 2020. Then the effects of changes in rural-urban migration rates, changes in population growth rates in both sectors, job creation (especially in rural areas) and increased labor productivity (especially in rural areas) were simulated to the year 2020. Thus,

conclusions could be drawn about the changes necessary to attain, over time, specified population, income and employment targets. This model makes it possible to simulate the effects of some rather broad types of economic development policies. However, these effects are simulated on a national basis, and the distributional aspects of the results and the costs of carrying out the policies used are not considered.

A National Microanalytic Model

In recent years the Urban Institute has worked on the development and application of a microanalytic simulation model designed to provide a dynamic representation of the population of the United States which can be used to trace the effects of public policies on the behavior and well-being of individuals and families over time. An auxiliary macroanalytic model has also been developed to provide a simulated environment for the microanalytic model (Orcutt, et al., 1971). These models make possible the simulation of such demographic and economic factors as births, deaths, educational attainment, income, and employment for the population of the United States. Then, if the simple effects of various public policies on individuals in the nation can be specified, the aggregate affects of individual policies or groups of policies on the population can be simulated (Guthrie, 1972). The Urban Institute Micro-analytic Simulation Model could be used to simulate the impacts of public policies on the population of the nation in much the same way the model used in this research allows the simulation of public policy impacts on a rural region. The Urban Institute model, however, does not directly incorporate the cost effectiveness of alternative public programs into the simulated results.

A State Simulating Model

A Leontief input-output type simulation model for the economy of the state of Oklahoma has been developed and utilized by Gerald A. Doeksen (1972). Doeksen used data from the Oklahoma social accounts to simulate levels of state economic variables from 1963 to 1980. Using input-output multipliers, such impact parameters as the effects of new plants by sectors, the expected investment cost per job created by sectors and the effects of increased government spending were estimated. Then it was demonstrated how such projections and impact estimates could be used by a community for planning its public services. The study by Doeksen provides impact estimates of the effects of broad development policies and activities. Also, income and employment multipliers such as those estimated by Doeksen are necessary inputs into a specific area development policy planning model such as is used in this thesis.

General Comaprisons

The studies discussed above are only a few of those recently completed or in progress applying simulation techniques to economic development and public policy evaluation. They indicate the types of issues to which simulation has been applied in the development area. The model developed and utilized in this study draws from concepts and estimates of simulation studies discussed in this section. Using systems simulation to estimate the general impact of public development policies is common to all of the studies discussed here and to the model used in this thesis. The demographic aspects of the Urban Institute Model (Orcutt, et al., 1971) are similar to those used in this research. The multiplier estimates made by Doeksen (1972) as well as other similar

input-output multipliers are used in this study to estimate the effects on income and employment in an area resulting from public expenditures on development programs.

This study, however, is different from the ones discussed above in that the specific effects (rather than the broad, general effects) of various public policy decisions, and the resulting mix of specific development programs are simulated for an underdeveloped multicounty area. The model used in this study utilizes cost effectiveness estimates for different development programs to simulate the impacts of various program combinations on measures of the well-being of the people in a particular area. Well-being, as discussed in the previous chapter, is measured only indirectly by income, poverty and employment in a quantitative model of economic development.

Theoretical Bases

Neoclassical economic theory explains income, poverty and employment and so is discussed in this section. Also discussed in this section is a theory of development planning which explains how regional development decision makers can act to vary instrumental variables for an area, thus causing changes in target variables such as income, poverty and employment.

Neoclassical Theory

Neoclassical economic theory tells us that if all resources, including labor, are mobile and knowledge is complete then economic activity gravitates to locations with comparative advantage. An area has comparative advantage in a particular commodity if the profit it can

make from producing and selling that commodity is greater than it can make on any other commodity. Thus a particular area may make more profit per unit of a particular commodity than any other area (a situation of absolute advantage), yet it may specialize in another commodity on which it can make an even greater profit (a situation of comparative advantage) (Tweeten, 1974b). What products an area will produce depends not only on the area's productive capabilities for particular commodities, but also on the relative productive capabilities of other areas.

Once competitive equilibrium is attained, equivalent resources receive the same returns in all areas. In the case of labor, neoclassical theory states that higher wages offered in one location than in another constitute a disequilibrium situation which the market will move to resolve. In considering disequilibrium, assume an economy consisting of two areas, A and B. The economy is static in the sense of constant total population and production functions invariant over time. Assume further that area A has a natural advantage in production. Consequently its value of marginal product of labor is greater than that of area B (Figure 1). Say that initially the amount of labor in area A is L_{A1} and the amount of labor in area B is L_{B1}. Because wages are higher in A than in B, some B labor will move to A until wages in both areas are equal at P_o (Hoch, 1972).

Thus a perfect market will equate wage rates (or returns to any other resources) among areas. There is evidence, however, of market failure in enticing labor to migrate to its highest wage location. "Unfortunately for some areas, labor earnings are chronically depressed over an extended period" (Tweeten, 1974b, p. 7). Also, the possibility of market failure in firm locational decisions is suggested by many undesirable environmental effects associated with cities (Tolley, 1971).

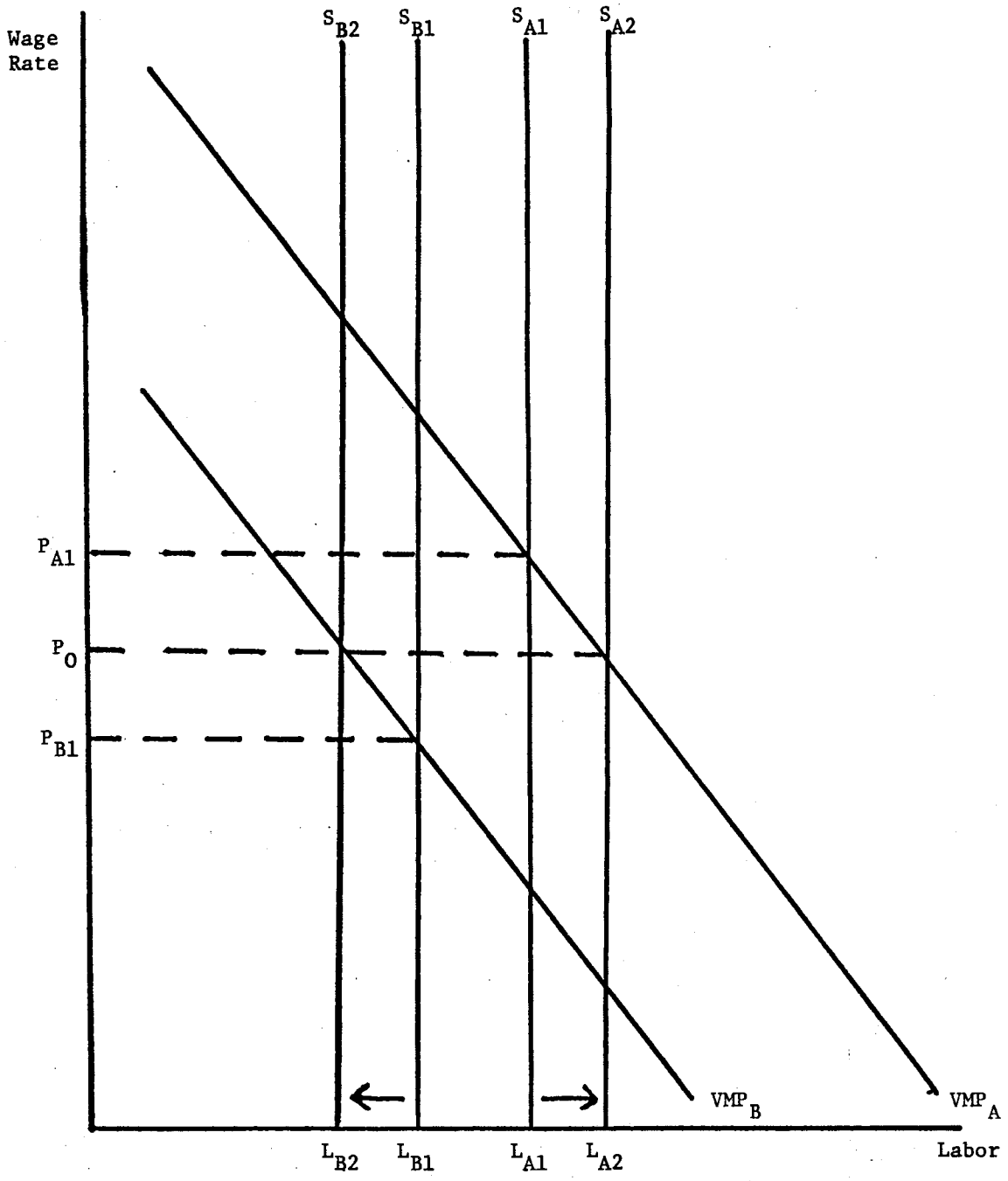

Figure 1. Equilibrating Wage Rates Between Areas

Such market failures arise from externalities not priced in the market and exogenous restrictions and rigidities imposed by outside institutions. Externalities which are not priced in the market system are especially in evidence in urban areas with problems of congestion, pollution and crime. Exogenously imposed restrictions and rigidities are apparent in all sectors of the market. There is some evidence that real returns to labor (Schreiner and Knutson, 1974) and capital (Janssen, 1974) do not differ widely among areas, but that market imperfections such as minimum wages, union wage patterns and other rigidities create improper incentives in a capital and labor market that functions reasonably well. For overall economic efficiency, it is necessary, in such situations, to intervene in the market to alter incentives in line with social incentives. Because these market imperfections have worked to the disadvantage of depressed rural areas, public intervention seems warranted to make the actual market perform more nearly like a perfect market (Tweeten, 1973).

Neoclassical theory provides insight into how such intervention can increase economic activity in an area and how this increased economic activity can be maintained. According to neoclassical theory, an underdeveloped area characterized by low wages attracts labor intensive industries. These industries cause increased area output and investment in infrastructure and in other material and human capital. Thus the price of capital falls relative to the price of labor. More capital intensive industries are now enticed into the area, bidding labor away from low wage, labor intensive industries which gradually phased out (Tweeten, 1974b).

This pattern characterizes the New England area where the labor intensive textile industry was gradually replaced by electronics and other

capital intensive industries. The textile industry shifted to the Piedmont. Now the Piedmont is likewise moving toward more capital intensive industry. One conclusion is that a depressed area may appropriately begin making economic progress with labor intensive, low-wage industry and then rely to a degree on the impersonal working of the price system for self sustaining economic progress as accumulation of capital sets the stage for further growth in capital and income.

The analysis reported herein is based on the assumption that, to achieve efficiency "in the large" or equity, policy makers make a decision to assist depressed areas. Given this assumption, this research is specifically involved with the analysis of efficiency "in the small," addressing the issue of the least cost public programs required to reach certain development targets in a depressed area. The systems simulation procedures utilized in this study are designed to assist decision makers in evaluating the effects of such public programs on the economy of an area to which they are applied.

A Theory of Development Planning

To utilize a systems simulation approach to area development program evaluation the economy of an area can be conceptualized as follows:

$$f_1 (X_1, X_2, \ldots, X_n, Z_1, Z_2, \ldots Z_m) = 0$$

$$f_2 (X_1, X_2, \ldots, X_n, Z_1, Z_2, \ldots Z_m) = 0$$

$$\vdots$$

$$f_n (X_1, X_2, \ldots, X_n, Z_1, Z_2, \ldots Z_m) = 0$$

where:

X_i's are variables endogenous to the system of the area economy.

X_j's are variables exogenous to the system of the area economy.

The above system of implicit equations could be solved to yield the following explicit functional statements:

$$X_1 = g_1 (Z_1, Z_2, \ldots, Z_m)$$

$$X_2 = g_2 (Z_1, Z_2, \ldots, Z_m)$$

$$\vdots$$

$$X_n = g_n (Z_1, Z_2, \ldots, Z_m)$$

Some group of endogenous variables (X_1, X_2, ..., X_k)can be selected as target variables and their desired levels determined by the goals of policy makers. Then, if some subset of the exogenous variables (Z_1, Z_2, ..., Z_h) can be manipulated as instrument variables, some or all of the goals may be attainable. If the number of instrumental variables (h) equals the number of target variables (k), then all of the goals can be attained. If k is greater than h, the desired goals can be reached in more than one manner. If k is less than h the desired goals cannot all be attained simultaneously (Tinbergen, 1956).

The simulation model used in this study is designed to approximate this conceptual decision making framework. Using simulation procedures, the levels of exogenous instrumental variables in the model can be varied and the resulting attainment of various assumed goals can be noted. In such a manner the effectiveness of potential packages of rural development policies in attaining alternative goals can be compared and evaluated.

Existing political and legal restrictions constrain all types of public policy. These restrictions may reflect legitimate social or economic considerations consistent with the goals of society, or they may reflect political compromise and logrolling. Logrolling and political compromise may be unavoidable, but such compromises are not without costs. These costs are in evidence when alternative goals are made unreachable by compromised public policy.

Such costs can be viewed in the context of the generalized economic system discussed above as a constrained maximum problem. The constrained function can be stated as follows:

$$W_\lambda = W(X_1, X_2, \ldots, X_n) + \lambda_1 f_1(X_1, X_2, \ldots, X_n, Z_1, Z_2, \ldots, Z_m) + \lambda_2 f_2(X_1, X_2, \ldots, X_n, Z_1, Z_2, Z_m) + \ldots, \lambda_e f_e(X_1, X_2, \ldots, X_n, Z_1, Z_2, \ldots, Z_m)$$

where,

W is a constrained social welfare function,

W is an unconstrainted social welfare function,

λ_1 through λ_e are Lagrangian multipliers, and

f_1 through f_e are constraints.

This constrained social welfare function could be maximized, the optimum levels of all variables determined and the results compared with those from an unconstrained solution. Systems simulation will be used in this study to estimate the results in terms of goal attainment of alternative constrained and unconstrained development policy decisions on an area economic system. Differences in results between constrained and unconstrained solutions measure the opportunity cost of political and other impediments to development, and alternatively the gain to society if it chooses to remove them.

Technical Aspects

The simulation model developed and demonstrated in this study simulates economic development in a specified underdeveloped area (as evidenced by high rates of unemployment, underemployment, and poverty). The population in the area is divided into socio-demographic categories based on income, work eligibility, age and levels of education and training. It is assumed that a decision making authority has funds available on an annual basis which can be spent on programs which influence measure of well-being of the people in the area.

The allocation decisions of the decision making authority are entered into a computerized simulation model (see Appendix). The model simulates adjustment of the population by births, deaths and aging. It also simulates changes in the population resulting from changes in educational and training levels, birth rates and the number of people in poverty caused by the allocation decisions of the decision making authority. The output of the computerized model describes, at the end of each simulated year, the simulated new situation of subpopulations in the area considered and the simulated aggregate economic condition of the area as a whole.

Socio-Demographic Data

Impacts of public programs vary for a developing area depending on the socio-demographic situation of the area. Also, the socio-demographic situation of an area can suggest to decision makers what types of development programs are most needed for an area. For the simulator used in this research, the population of the area considered is cross-classified into 21 socio-demographic categories depending on income, age, ability to work and levels of education and training.

The poor in the area are categorized according to their ability to work as salvageable or unsalvageable—those incapable of supporting themselves by working being classified as unsalvageable. Unsalvageable poor are further categorized as working age (15-64) or above working age (65 and over). Salvageable poor are cross-classified by age, attainment of a high school education and possession of technical training. The nonpoor in the area are categorized by age and income level.

Young unsalvageable poor (age 15-64) are those who are working age but cannot hold a job for reasons of physical or mental disability. Most of these people are capable of performing "make-work" tasks. Thus, if closely supervised, they could be employed by public agencies for such work as grounds maintenance, litter clean up and other physical tasks. Such public employment is a form of welfare but allows the recipient to maintain a certain degree of dignity for performing a service to the community. Unlike older unsalvageable poor, many of these people have children to support.

Elderly unsalvageable poor (age 65 and over) are assumed to be physically incapable of work. It is assumed that the only way to remove these people from poverty is to give them public assistance grants.

The salvageable poor are defined as capable of holding conventional jobs in the labor market. In this model there are two ways to provide jobs for the salvageable poor. They can be employed in new jobs created in the underdeveloped region in which case they move into nonpoor classifications, or they can be moved out of the area to be employed in vacant jobs in other areas. It is assumed that such jobs are available in other areas, but there is a cost associated with moving people to the jobs. Also it is assumed that a certain percentage of movers return to

their home area every year even though no job awaits them. Thus, over time, many poor who are moved out to get jobs will return to poverty rolls in their home areas.

It is assumed that poor children and students are moved out of poverty only as their parents are taken off poverty rolls. Thus the simulated number of poor children and students decreases as the number of poor parents decreases.

Alternative Development Activities

It is assumed that the decision making authority responsible for dispersing development funds in the area can allocate these funds among the following alternative activities:

1. To unsalvageable poor over age 65 (public assistance grants).
2. To unsalvageable poor, ages 15-64 (public assistance grants).
3. To education (school dropout prevention).
4. To technical training.
5. To family planning.
6. To industrialization.
7. To labor mobility subsidization.

These alternative activities, as considered in this study, represent special development activities which can be initiated over and above "typical" public investments in an area. It is assumed in this study that roads, schools, and other services and infrastructure are adequately funded in the area considered.[1]

[1]Data are unavailable for estimating the economic payoff from additional investment in infrastructure. One hypothesis is that the most efficient approach to development is to generate an economic base, then depend on the local community to decide how they wish to devote additional income to investment in infrastructure. Findings of White and

Unsalvageable poor are removed from poverty by continuous transfer payments. People in the salvageable poor categories who reach age 65 and are still not employed go on the roles of unsalvageable poor over age 65.

Funds allocated to education are used to keep students from dropping out of school. Funds allocated to technical training are used to train untrained poor.[2] These activities do not directly provide income to poor people. However, when people are employed they receive higher incomes if they have high school education or training.

Funds allocated to family planning are used to make information and contraceptives available to the poor and thus reduce the birth rate. Such a reduction of the birth rate decreases, over time, the number of young children and students in poverty.

Funds allocated to industrialization and labor mobility subsidization make jobs available to the poor. Jobs made available by industrialization and labor mobility subsidization go first to the best educated, best trained and youngest poor. All jobs made available by industrialization are filled first, then jobs outside the region made accessible by labor mobility subsidization are filled. Wages paid to people taking new jobs in the area vary according to the levels of education and training of the workers.

Tweeten (1973) showed differences in socio-economic background of students rather than differences in quality of education accounted for low schooling achievement in under-developed areas of Oklahoma. No studies were available showing the portion of public investments in such infrastructure items as roads and water and sewer systems going to the poor in underdeveloped areas.

[2]Vocational-technical schools currently operating in the multicounty study area have adequate existing capacity to train "conventional" students in skills required.

Funds for industrialization also create new jobs for the nonpoor. It is assumed that some of these new jobs are filled by local nonpoor who vacate their old jobs to the poor, and some are filled by nonpoor who migrate into the area. While funds allocated to activities other than industrialization do not create permanent jobs in the area, such expenditures do create income for both the nonpoor and the poor in the area. This income varies as the expenditures vary.

All development allocations are assumed to have indirect effects as well as direct effects. In the case of allocations to industrialization, the direct jobs created in the area are assumed to be permanent, and are assumed to generate indirect jobs in the area. The total jobs created (direct and indirect) result in increased income for the area which continues after the industrialization programs have ended. Jobs to area residents who obtain jobs elsewhere from labor mobility allocations also create continuing income to the area in accordance with the definition of development given earlier. However, since the jobs are outside the area, no indirect income results. Allocations to other development activities create both direct and indirect income for the area, but it is of a temporary nature since no permanent jobs are created, and the area income continues only as long as the activities or programs are continued.

Technical Coefficients

The simulated effects of development strategies on the population of a developing area depend on the values assigned to technical coefficients in the simulator. The values of these coefficients must be determined or estimated exogenously and entered into the simulator along with socio-demographic data and decisions about the levels of alternative development activities to be simulated.

The technical coefficients required for this simulator are of four types: demographic coefficients, income coefficients, employment coefficients and development activity efficiency coefficients. Demographic coefficients describe demographic activity of the population of the study area. These coefficients include birth rates, death rates and net migration rates for socio-demographic categories. Income and employment coefficients describe the economic conditions of the population of the study area. Income coefficients include income thresholds for socio-demographic categories, potential earnings for salvageable poor, area income resulting per dollar of public funds expenditure and the percentage of area income going to the poor. Employment coefficients include labor force participation rates and unemployment and underemployment rates for socio-demographic categories. Development activity coefficients define expected direct effects on the study area population of alternative development activities. Most development activity coefficients are stated in cost effectiveness terms.

Simulator Output

The output of the simulator includes, for each year simulated, a reclassification by socio-demographic categories of the population of the study area, measures of income generated by simulated development activities, public costs of such activities, comparisons of income generated to public costs and measures of the incidence of poverty in the study area.

The simulator results allow a researcher to examine and evaluate potential outcomes over time of different allocation decisions. If public policy goals can be stated in terms of the variables specified in

the results of the simulator, alternative allocation strategies can be evaluated according to the extent to which they attain these goals.

The model has been programmed for computer use both for rural development research purposes and as a classroom game at Oklahoma State University (see Appendix). The model has been applied to alternative comprehensive development strategies for an underdeveloped area in eastern Oklahoma. This application of the model and the consequent simulated results are discussed in the following chapters of this thesis.

CHAPTER III

STUDY AREA AND SOCIO-DEMOGRAPHIC DATA

The model developed in this research and discussed in the previous chapter was designed to simulate the effects of development activities on an underdeveloped rural area. The specific underdeveloped area to which the model is applied is described in this chapter. Geographic, economic and socio-demographic data descriptive of the study area and dictated by the requirements of the model are presented.

Study Area

The study area includes Adair, Cherokee, McIntosh, Muskogee, Okmulgee, Sequoyah and Wagoner counties in eastern Oklahoma (Figure 2). This area comprises the Eastern Oklahoma Economic Development District and is a part of the Ozarks Economic Development Region. Like most of the Ozarks region, the study area has a high incidence of poverty. Approximately 40 percent of the area's population had family equivalent incomes less than $4,000 in 1970 (calculated from U. S. Bureau of Census, 1971, and U. S. Bureau of Census, 1972a). Unemployment in the area averaged six percent in 1970. This was well above the average for Oklahoma and the nation which were four and five percent respectively. Underemployment in the area is quite high. Kampe and Lindamood (1969) estimated 1960 rates of underemployment for males in the study area counties ranging from 19 to 41 percent. The study classified underemployment of over

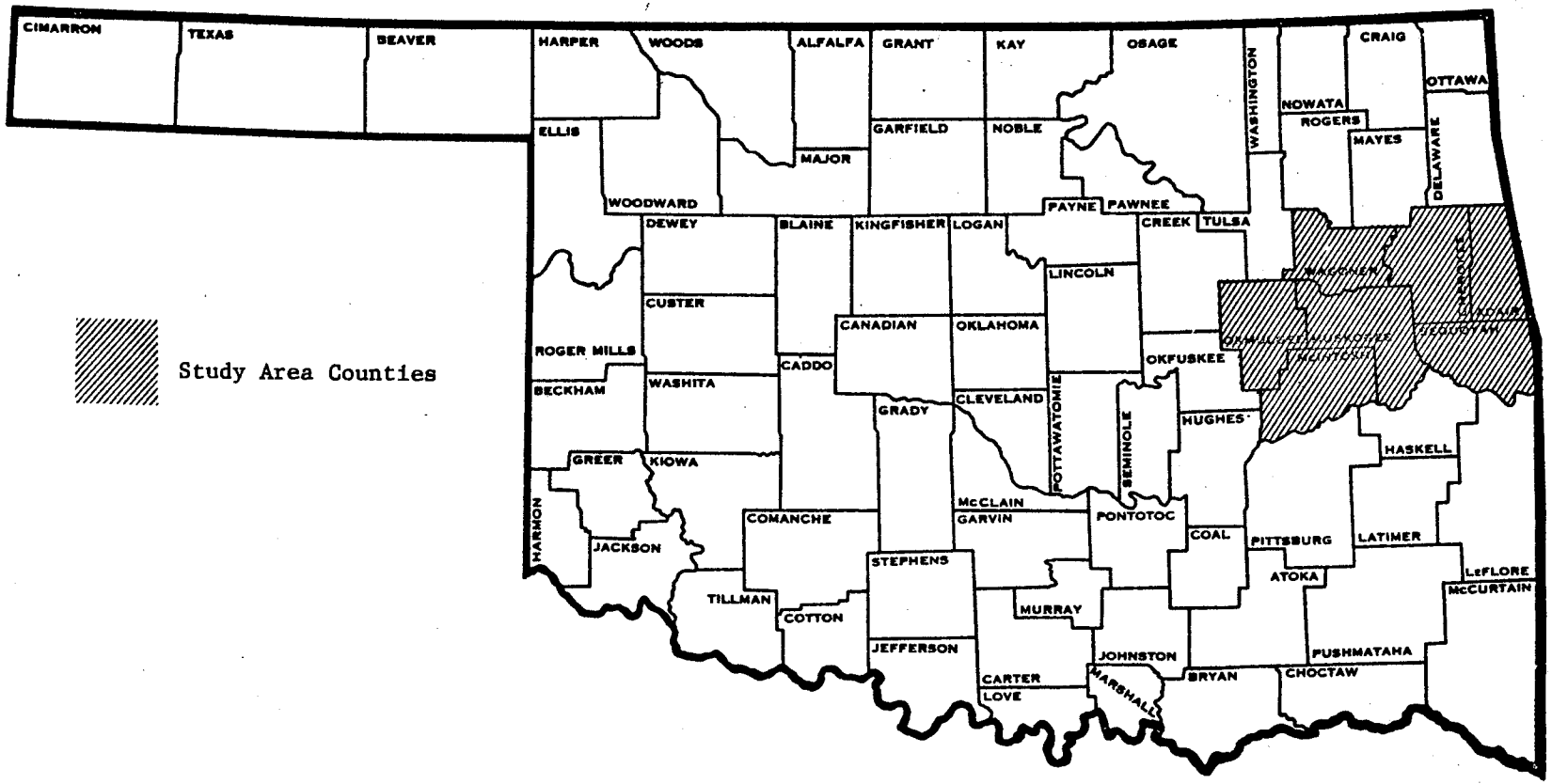

Figure 2. Study Area Counties

20 percent as severe. They found that all but one county (Muskogee) in the study area had severe underemployment.

The topography of the area varies from rolling hills to mountains. Much of the land is in timber. However, much of the timber is not properly sited, managed or of the quality required for commercial utilization. Much of the land is unsuited to agriculture (McCoy, 1970). Still, the population of the area is predominately rural, and in three of the seven counties 75 to 100 percent of the population is rural. Many residents either are unemployed or are underemployed in agriculture or in small business and industry in area communities.

Four communities in the area had 1970 populations of between 2500 and 20,000 people, and only one city (Muskogee) had over 20,000 population (U. S. Bureau of Census, 1971). The area borders the Tulsa metropolitan area to the northwest and the Fort Smith metropolitan area to the southeast. The area has excellent highway arteries (Muskogee Turnpike and Indian Nation Turnpike) and one major national highway artery (Interstate 40).

Several large reservoirs are located wholly or partially within the study area. Eufaula, Robert S. Kerr, Webbers Falls, Tenkiller and Fort Gibson Reservoirs provide water for recreation, flood control, power generation and for navigation in the Arkansas-Verdigris Waterway. This waterway begins at the Port of Catoosa, a suburb of Tulsa, crosses the study area from northwest to southeast, and follows the Arkansas River channel to join the Mississippi River some 250 miles to the east. Thus, the area has barge transportation linkage with the Mississippi River and the Gulf of Mexico.

The city of Muskogee is located in the geographic center of the area. It is approximately 30 miles from Muskogee to either the north or south borders of the study area, and approximately 50 miles to either the east or west borders of the area. Muskogee can also be described as the economic center of the area. In 1970, Muskogee had a population of 37,331, more than twice that of the next largest town (Okmulgee, population of 15,180) in the study area and more than four times as large as any other town in the area. It is also the headquarters of the Eastern Oklahoma Economic Development District, an organization charged with coordinating the economic development of the study area. The city of Muskogee is the primary growth center of the area from the standpoint of both economic activity and spatial accessibility.

Socio-Demographic Data

The classification of socio-demographic data from the study area for use in this study was dictated by the requirements of the simulator used. The population of the study area was cross-classified into 21 socio-demographic categories (Table I). The nonpoor population of the are was cross-classified by age, level of education and training, and ability to work (salvageable and unsalvageable).

All persons with family income equivalents of less than $4,000 per year were classified as poor. The low income, nonpoor classification includes all persons with family income equivalents from $4,000 to $8,000 per year. The medium income classification includes all persons with family income equivalents from $8,000 to $15,000 per year. All persons with family income equivalents greater than $15,000 per year were classified as high income.

TABLE I

SOCIO-DEMOGRAPHIC DATA FOR THE EASTERN OKLAHOMA DEVELOPMENT DISTRICT--1970[a]

	Number of Persons	
Nonpoor		
Less than age 20	114,104	
School dropouts (low income)		1,376
Young children and students		38,609
Age 20-39		
High income		2,931
Medium income		12,016
Low income		14,361
Age 40-64		
High income		3,535
Medium income		14,492
Low income		17,319
Age 65 and over		9,465
Poor		
Unsalvageable	77,090	
Age 15-64		15,298
Age 65 and over		17,147
Young children and students		29,813
Salvageable		
Age 20-39		
With high school education and training		312
With high school education and no training		1,024
With training and no high school education		1,201
With neither high school education nor training		3,958
Age 40-64		
With high school education and training		362
With high school education and no training		1,205
With training and no high school education		1,407
With neither high school education nor training		4,633
Age 15-19		
With neither high school education nor training (school dropouts)		730

[a]Calculated from: U. S. Bureau of Census, Census of Population: 1970--General Population Characteristics, Oklahoma, 1971, and General Social and Economic Characteristics, Oklahoma, 1972.

CHAPTER IV

TECHNICAL COEFFICIENTS

The values of technical coefficients specified for the rural development simulator determine the simulated economic and other changes which occur in the study area over the time period simulated. Some of these changes are affected by development activities while others are independent of such activities. The population constitutes a dynamic environment, over time, whether or not development activities are initiated in the area.

Technical coefficients are discussed in this chapter as demographic coefficients, income coefficients, employment coefficients and development activity efficiency coefficients. The coefficients were obtained from numerous sources. These sources are discussed along with the coefficients. All of the coefficients are summarized in the last section of the chapter.

Demographic Coefficients

Demographic coefficients on birth rates, death rates and population growth rate for the study area population were estimated from census data. The annual birth rate per nonpoor adult, not in school, age 15-40 was estimated to be 6.65 per 100 for the study area (U. S. Bureau of Census, 1972a). The birth rate for the poor was estimated to be 10.48 per 100. Death rates applicable to the study area for people age 65 and over,

people age 40-64 and unsalvageable poor, age 15-64 were estimated to be 6.4469 per 100, 0.8075 per 100 and 0.4137 per 100 respectively (U. S. Bureau of Census, 1971, and U. S. Bureau of Census, 1972b). A population growth rate for the area, based on data for the 1960-1970 decade (U. S. Bureau of Census, 1971) was estimated as a positive 0.0085 per year.

Income Coefficients

The income coefficients specified for the simulator include poverty income thresholds for socio-demographic categories of the study area population, potential earnings for the area's poor who take jobs created by development activities, total income resulting in the area per dollar of public funds spent on development activities, and the percentage of the area's income which goes to the area's poor.

As indicated in the previous chapter, the nonpoor population of the area was cross-classified by age and income levels. The minimum annual family income levels for low, medium and high income nonpoor were assumed to be, respectively, $4,000, $8,000 and $15,000.[1]

For purposes of this study all poor were aggregated into family groups. It was estimated from information reported by the U. S. Bureau of Census (1972a) that, for unsalvageable poor age 65 and over, an annual income of $1704 per person is equivalent to the annual family income poverty threshold of $4,000. For unsalvageable poor age 15-64, such a poverty threshold was estimated as $2,777 per year per person. The

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[1] When considered on a family by family basis these income thresholds would vary with family size. However, for the level of aggregation of this study, specification of these income thresholds based on average family size were deemed sufficient.

composition of the family groups into which the poor population were aggregated indicated that the provision of family poverty threshold income ($4,000) to one salvageable poor adult would remove 1.4406 poor adults from poverty on the average. Thus it was estimated that the provision to a poor person of one job, paying an annual wage of $4,000 or more, from poverty 1.4406 adults.

Potential annual earnings for the area's poor who take jobs created by development activities were estimated from information reported by the U. S. Bureau of Census (1972a) on median earnings of Oklahoma workers by occupation groups. These estimates are as follows:

1. $9,231 for job recipients with a high school education and technical training.
2. $6,882 for job recipients with a high school education and no training or with training and no high school education.
3. $5,821 for job recipients age 20 or over, with neither a high school education nor training.
4. $4,000 for job recipients, less than age 20, with neither a high school education nor training (school dropouts).

Total income resulting in the study area per dollar of public funds spent on development activities includes direct, indirect and induced income created. In a study aimed at developing a social accounting system for Oklahoma and using this system for input into a Leontief input-output type simulation model, Doeksen (1971), reported the household income directly resulting from federal expenditure in Oklahoma in 1963 as $806,650,000. He also reported the total federal expenditure in the state for the same year as $1,219,000,000. From this information an

income input-output ratio for the federal government sector in Oklahoma was estimated as 0.6617. In a related study, Doeksen (1972) estimated an income multiplier including direct, indirect and induced effects for income from federal sources in Oklahoma of 1.62. Multiplying this multiplier times the income-output ratio for the federal government sector, estimated above, yields an estimate of income resulting in the study area per dollar of public funds spent in development activities of $1.0720.

The proportion of the income of the study area going to the area's poor was calculated from 1970 data of the U. S. Bureau of Census (1972b) as 13.09 percent.

Employment Coefficients

The simulator requires the specification of three coefficients descriptive of the labor force of the area considered. These include the percentage of "normal," working age adults in the labor force; the percentage of poor in the labor force who have jobs but are underemployed; and the percent underemployment of the underemployed poor. The proportion of normal, working age adults in the study area labor force in 1970 was calculated from U. S. Bureau of Census (1972a) information as 77.39 percent. The number of poor in the labor force was calculated as 11,478, of which 3,418 were unemployed. It was assumed that all people who were employed but still poor were underemployed. Thus the proportion of poor in the labor force who, in 1970, had jobs but were underemployed was estimated as 70.22 percent ((11,478 - 3,418)/11,478). It was assumed that, had these underemployed poor been fully employed, they would have been in the low income nonpoor category. Thus the percent underemployment of

underemployed poor was estimated by dividing the median income of underemployed poor by the median income of low income nonpoor. The resulting estimate is that underemployed poor are 66.67 percent underemployed on the average.

Development Activity Efficiency Coefficients

Numerous pilot projects have been conducted in the last 10-15 years to determine the effects of development activities. Most of these projects have involved only one development activity such as industrialization or subsidized labor mobility. Programs to provide concerted sets of activities were too poorly funded and evaluated to be of use for this study. As discussed in the previous chapter, one of the major objectives of this study is to evaluate the effects of potential rural area policy packages. Such policy packages or strategies contain multiple development activities. Linkages among these activities cause the total effects of the policy packages to differ from the summation of the single program effects taken separately. In this study estimates of effects of each activity (activity efficiency coefficients) serve as a starting point for estimating total effects of strategies containing multiple development activities. The development activity efficiency coefficients utilized in this study include those describing labor mobility programs, industrialization programs, school dropout prevention programs, technical training programs and family planning programs.

Labor Mobility Programs

Necessary simulator input information for labor mobility programs includes a basic cost effectiveness coefficient, a coefficient stating

what portion of program funds goes to purposes other than relocation assistance allowances (such as to administration) and coefficients describing the expected dropout or attrition rate for programs. In a study published in 1970, Charles Fairchild evaluated the cost effectiveness of 67 labor mobility projects funded by the Manpower Administration of the U. S. Department of Labor from 1965 through 1969. Fairchild calculated average public expenditure per relocated worker as $867. However, 16 of the 67 projects were conducted to assist the urban disadvantaged and people affected by mass layoffs. Since these are problems not dealt with in this study of rural area development, the cost effectiveness coefficients reported above were reestimated with these projects excluded. The average public expenditure per relocated worker was calculated as $820 after these projects were excluded. Adjusted for inflation by the implicit price deflator for total GNP, this cost effectiveness coefficient, in 1970 dollars is $935 per relocatee. The reciprocal of this coefficient (0.001070) was used in this study as an estimate of the number of relocatees expected per public dollar of expenditure on labor mobility programs in the study area.

An estimate of the percentage of labor mobility allocation funds which goes to purposes other than relocation assistance allowances (administrative and operational expenses) was also calculated from the information reported by Fairchild. For the projects reported by Fairchild, 34 percent of direct public expenditures went to relocation assistance allowances. The remainder (66 percent) went to such activities as administration, pre-relocation training and counseling, and post-relocation follow-up and counseling. It was assumed that this same percentage (66 percent) of public labor mobility allocation funds went to

purposes other than relocation assistance allowances for all projects simulated for the study area.

Two coefficients describe expected labor mobility program attrition. A limit to program attrition is specified as a percentage of program relocatees who remain outside the study area permanently. An annual attrition or backmovement rate is specified as a percentage of the number of labor mobility relocatees remaining outside the study area in any year. This annual attrition rate is applicable only until the liminal attrition level mentioned above is reached. Estimates of both of these coefficients were taken from a study by Nelson and Tweeten (1973). They estimated individual rates of return (negative to 33 percent) to five labor mobility projects as well as an aggregate rate of return (33 percent) to 67 projects reported by Fairchild and mentioned above. They concluded that on the average approximately one-third of relocatees remain outside the supply area permanently and that approximately 30 percent of relocatees return each year to be unemployed or underemployed in their home area until this liminal level of attrition is attained. These labor mobility program attrition coefficients were utilized for the labor mobility projects simulated in this study.

Industrialization Programs

Many rural communities made great efforts to seek industry in the 1960's (Tweeten, 1974). However, several studies conducted during that time (Advisory Committee on Intergovernmental Relations, 1967; Stinson, 1968; Hansen, 1969), concluded that such efforts were not only ineffective but also inappropriate from the standpoint of national efficiency. This conclusion implicitly assumed the public cost of generating a new

job in a depressed area was infinite. These economists reasoned that industry required traditionally metropolitan endowments such as agglomeration economies, nearness to markets and skilled labor.

Subsequent studies, however, have indicated that industry is decentralizing (Haren, 1974), that profit rates do not differ significantly by sector location (Janssen, 1974), and that major net economic benefits do accrue to communities attracting industry (Shaffer, 1972). In a comprehensive article on industry location incentives, Neil Singer (1971) concluded that subsidies of approximately $17,000 were required to generate a new job in industry.

Jackie Smith (1974) used multiple regression to analyze the cost effectiveness of industrialization programs. Independent variables regressed on public outlays per direct job generated included measures of population, unemployment, income, welfare, government expenditures and proximity to centers of population and interstate highways for locations of industrialization programs. Smith used data on 103 Economic Development Administration (EDA) industrialization projects, each of which created at least some jobs from 1965 to 1970 (Economic Development Administration, 1970; Boise Cascade Center for Community Development, 1970). Regression analysis excluded data reported by EDA and Boise Cascade on 73 other projects which were conducted specifically to create jobs by encouraging industrialization, but which were unsuccessful in generating jobs.

Using Smith's coefficients and values of the independent variables for communities in the eastern Oklahoma study area, cost effectiveness coefficients were estimated for industrial development. This procedure yielded a cost effectiveness estimate for industrial development in

Muskogee of 5,582 public dollars per direct job created. The estimates for Muskogee showed much more favorable cost effectiveness than estimates for any other community in the study area. This is not surprising since, as mentioned in Chapter III, Muskogee is both the economic and geographic center of the study area and is readily accessible from almost all of the rest of the study area.

The industrialization cost effectiveness coefficient stated above (5,582 public dollars per direct job created) is quite optimistic, since it assumes that decision makers can tie public investment in industrialization to job creation, thus subsidizing no unsuccessful programs.[2] Another estimate of cost effectiveness of industrialization programs (one that appears to be more realistic) was obtained by adjusting the estimate stated above by the proportion of industrialization projects sampled which were successful (103/176). This procedure yielded a cost effectiveness estimate of 9,538 public dollars per direct job created and is considered to be the most realistic of the industrial-development coefficients.

The reciprocals of the two industrialization project cost effectiveness estimates stated above were used as "upper limit" and "most realistic" estimates of cost effectiveness coefficients for industrialization activities in the simulator in this study. These reciprocals are 0.00179 direct jobs generated per public dollar (upper estimate) and 0.000105 direct jobs generated per public dollar (middle estimate).

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[2]The unsuccessful efforts to generate jobs entailed outlays for public services in hopes of attracting industry. If monetary inducements for industrial development were carefully managed, providing funds only when job creation was assured, cost effectiveness of $5,582 might be realistic.

The final estimate of cost effectiveness for industrialization, the effects of which were simulated in this research, was arbitrarily set at 20,000 public dollars per direct job created or 0.00005 direct jobs generated per public dollar spent on industrialization. This coefficient was chosen as a lower estimate of cost effectiveness. It is indicative of the effectiveness (or lack of it) hypothesized by researchers who, in the relatively near past, first began to seriously examine the potential roles of industry location subsidies in rural development (Singer, 1971).

Jobs created directly by industrialization projects result in indirect and induced jobs. The number of indirect and induced jobs depends on the multiplier effects which result from the direct jobs created. These multiplier effects vary depending on the economic conditions and constraints in effect in the area under consideration. Within a particular area, multiplier effects vary by industry. So the number of indirect and induced jobs resulting from the jobs indirectly created by industrialization in an area depends on the industries in which the direct jobs are created.

Milburn Childs (1973) analyzed the number of jobs created by new plant locations and plant expansions in Oklahoma from 1963 to 1971. These new and expanding plants were classified by SIC codes. Thus the types of industries creating new jobs in Oklahoma were determined. Data developed by Childs on new jobs created by industries in Oklahoma's Economic District I[3] were used to calculate the percentages of these new

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[3]Oklahoma Economic District I is one of three Oklahoma districts delineated by C. H. Little (1967). His delineations are based on similar economic activity within each district. The study area for this research lies within Economic District I. EDA data from which cost per job coefficients were estimated gave inadequate information to tailor the coefficients to type of industry. The EDA results for a typical mix

jobs attributable to different industry types. These percentages were used to weight employment multipliers for the different industry types (Muncrief, 1972)[4] and calculate a generalized employment multiplier of 2.3031. This multiplier is an estimate of the ratio of direct, indirect and induced jobs to direct jobs created by new and expanded plants in Oklahoma Economic District I. As such, it was used in the simulator as a coefficient of total study area jobs (direct, indirect and induced) resulting per direct job generated by industrialization programs.

When new jobs are formed in an area they may be filled by poor and nonpoor workers from within and without the area. When workers take new jobs, they vacate jobs which may be refilled. Three coefficients required for the simulator describe how simulated jobs generated by industrialization are distributed. These coefficients are the percentage of new jobs which go to the area's poor, the new jobs going to workers outside the area as a percentage of new jobs going to people other than the area's poor, and the percentage of old jobs vacated by nonpoor workers which are refilled.

Estimates of these coefficients were calculated from information reported by Shaffer (1972), Economic Development Administration (EDA) (1970), Boise Cascade Center for Community Development (1970) and Kuehn et al. (1972). All of these studies considered impacts of new industry on underdeveloped area economies. The EDA, Boise Cascade and Kuehn, et

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of industry do not appear to be markedly out of line with the types of industry assumed in the analysis.

[4]These multipliers calculated by Muncrief (1972) are for industries in Oklahoma Planning Region Nine, a predominantly rural area in Southern Oklahoma. Planning Region Nine does not coincide with Economic District I. However, since both are rural Oklahoma areas, economic multipliers for the two areas should not differ greatly.

al. studies each evaluated industrialization impacts on several diverse areas while Shaffer's work considered only one region. Consequently more data were available from each of the EDA, Boise Cascade and Kuehn, et al. studies. The Shaffer, EDA and Boise Cascade studies each considered the effects of public industrial development activities in generating new jobs. Kuehn, et al. studied the results of new and expanding industry in underdeveloped rural areas without regard to public development activities in the areas.

The study by Shaffer of the impact of new industry on rural communities in eastern Oklahoma, indicated that approximately one-half of the new jobs in a community go to the poor, the same proportion as indicated by the data reported by EDA and Boise Cascade. For data considered by Kuehn, et al., on the average one-quarter of new jobs went to the poor. Data presented by Shaffer show the ratio of the number of new jobs going to workers from outside the area to the number of new jobs going to the nonpoor as 0.09. Data presented by EDA and Boise Cascade show the ratio to be 0.24, and the Kuehn, et al. findings indicate that the ratio is 0.31. Data reported by Shaffer indicate that approximately 78 percent of jobs vacated by workers who take new jobs are refilled.

The information from the studies discussed above provided guidelines for the estimation of coefficients entered into the simulator to describe how simulated jobs generated by industrialization are distributed. The coefficient of the proportion of new jobs which go to the area's poor was entered as 33 percent. The coefficient of new jobs going to workers outside the area as a percentage of new jobs going to people other than the area's poor was entered as 24 percent. The coefficient

the proportion of old jobs vacated by nonpoor workers which are refilled was entered as 78 percent.

Education Programs--School Dropout Prevention

During the 1960's Neighborhood Youth Corps programs administered by the Office of Economic Opportunity were conducted with a primary objective of keeping potential dropouts in school. Several studies of the effects of these programs have since been conducted (Somers and Stormsdorfer, 1972; Borus, et al., 1970; Woltman and Walton, 1969). Somers and Stormsdorfer, who conducted the most comprehensive of these studies, calculated the public costs of Neighborhood Youth Corps (NYC) programs and evaluated the extent to which such programs reduced the high school dropout rate for their enrollees. Based on 780 observations of NYC participants and control persons, the authors estimated average federal government costs of the NYC programs in fiscal years 1966 and 1967 as $313 per participant for in-school and summer programs combined. Adjusting for inflation by the implicit price deflator for GNP (Council of Economic Advisors, 1971) the average public cost per participant is $372 in 1970 dollars. The findings of Somers and Stormsdorfer indicate that an upper limit to cost effectiveness of NYC type programs is approximately $2,000 (1970 dollars) public funds per potential dropout kept in school, and a more realistic cost effectiveness estimate is $4,000 public investment per potential dropout kept in school.

The $4,000 estimate of public investment per potential dropout kept in school was assumed applicable in this study. The reciprocal of this estimate--0.00027 dropouts kept in school per dollar of public

expenditure—was entered into the simulator to describe cost effectiveness of school dropout prevention programs.

Technical Training Programs

The number of people trained per public dollar spent on vocational training is a necessary input coefficient for the simulator. Shallah and Tweeten (1970)[5] evaluated the economic benefits from investment in different fields of study at Oklahoma State Tech, a post high school technical school in eastern Oklahoma. The annual public costs per student for different types of programs from 1960-1965 ranged from $832 to $1,576 in 1959 dollars.

To estimate a generalized coefficient of people trained per dollar of public expenditure on technical education programs, the average annual public cost per student (1960-1965) in each type of program at Oklahoma State Tech was weighted by the number of students in each program. The resulting estimated average annual public cost per student was $1098 in 1959 dollars and, adjusting for inflation by the implicit price deflator for total GNP, is $1461 in 1970 dollars. The reciprocal of this cost estimate—0.000684 people trained per dollar of public expenditure—was entered into the simulator as a coefficient of cost effectiveness of technical training programs.

Family Planning Programs

The effects of family planning programs on area development are

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[5]Many other studies of co-tech programs are in evidence in the literature. Findings of Shallah and Tweeten (1970) were used to estimate cost effectiveness of such programs for this research because their data was more comprehensive than most and was specific to the study are considered herein.

considered in this study even though family planning may not be a conventional development activity. Kershaw and Courant (1970) estimated the cost effectiveness of such family planning programs under two different sets of assumptions. First they assumed that family planning programs reached 50 percent of the women at which they were directed, and, after the program, they bore children at the same rate as nonpoor women. For the second estimate they assumed that such programs reached 75 percent of the women at which they were directed, and that these women stopped having children after joining the program. For both cases a $50 cost per women per year was assumed. These estimates yielded cost effectiveness coefficients ranging from 293 to 1,667 public dollars per unplanned poor birth avoided.

For purposes of this study the midpoint of this range ($980) was taken as a best estimate of public dollar expenditure per unplanned poor birth avoided. Thus this coefficient's reciprocal (0.0010204) was entered into the simulator as the coefficient of the expected number of unplanned poor births avoided per public dollar of family planning expenditure.

Summary of Technical Coefficients

The technical coefficients presented above constitute the foundation of the rural development planning simulator used in this research. No single coefficient determines the full effect of any development strategy. Rather, the entire set of technical coefficients is necessary to describe the results of each of the strategies simulated. For clarification and reference, all of these coefficients are summarized in Table II.

TABLE II

SUMMARY OF SIMULATOR TECHNICAL COEFFICIENTS FOR THE EASTERN OKLAHOMA DEVELOPMENT DISTRICT

Demographic Coefficients	
Annual birth rate per nonpoor adult, not in school, age 15-40	0.0665
Annual birth rate per poor adult, not in school, age 15-40	0.1048
Annual death rate for persons age 65 and over	0.064469
Annual death rate for persons age 46-64	0.008075
Annual death rate for unsalvageable poor, age 15-64	0.0004137
Annual area population growth rate	0.0085
Income Coefficients	
Minimum family income levels for non-poor categories (annual income)	
Low income	$4,000
Medium income	$8,000
High income	$15,000
Poverty Thresholds (annual income)	
Salvageable poor (per family)	$4,000
Unsalvageable poor--age 65 and over (per person)	$1,704
Unsalvageable poor--age 15-64 (per person)	$2,777
Number of adults removed from poverty per non-poverty family income unit provided for the poor	1.4406
Average annual earnings for poor persons employed in jobs generated by development activities	
Persons with a high school education and training	$9,231
Persons with a high school education but no training or with training but no high school education	$6,882
Persons, age 20 or over, with neither a high school education nor training	$5,821
Persons less than age 20 with neither a high school education nor training (school dropouts)	$4,000
Area income resulting per dollar of public funds spent on development activities	$1.0720
Percent of area income which goes to the poor	13.09%

TABLE II (Continued)

Employment Coefficients	
Percent of normal working age adults in labor force	77.39%
Proportion of poor in the labor force who have jobs but are unemployed	70.22%
Percent underemployment of underemployed poor	66.67%
Development Activity Coefficients	
Labor Mobility Programs	
Number of people moved to jobs per dollar of public expenditure on labor mobility programs	0.001070
Proportion of labor mobility allocation funds which goes to purposes other than relocation assistance allowances (administration, training and counseling)	66%
Proportion of relocatees who remain outside study area permanently (limit to program attrition)	33%
Proportion of relocatees who return to study area each year (until liminal attrition level is reached)	30%
Industrialization Programs	
Number of jobs directly created per dollar of public expenditure on industrialization programs	
Estimate 1 ("upper limit")	0.000179
Estimate 2 ("most realistic")	0.000105
Estimate 3 ("lower limit")	0.00005
Total area jobs resulting per direct job generated by industrialization	2.3031
Proportion of jobs generated by industrialization which goes to area's poor	33%
New jobs going to workers outside the area as a percentage of new jobs going to people other than the area's poor	24%
The proportion of jobs vacated by nonpoor workers which are refilled	78%
Education Programs--School Dropout Prevention	
Number of potential dropouts kept in school per dollar of public expenditure on education programs	0.00025

TABLE II (Continued)

Technical Training Programs	
Number of people trained per dollar of public expenditure on training programs	0.000684
Family Planning Programs	
Number of unplanned poor births avoided per dollar of public expenditure on family planning programs	0.0010204

CHAPTER V

RESULTS

The quantitative model developed in this research was utilized to simulate the effects of alternative development strategies on the population of the eastern Oklahoma study area. A strategy is defined as a set of public programs. In this chapter the simulated results of alternative strategies are discussed and the strategies are compared and evaluated in light of various development goals. The development goals assumed in this study were amelioration of poverty in the study area and the generation of income for the people of the study area.

Simulated poverty amelioration in the study area was measured by the number of simulated years required for alternative strategies to eliminate poverty, and by the simulated person poverty years accumulated for alternative strategies over the time horizon considered. Of these two measures, person poverty years accumulated is the most complete. It is defined as the sum over all years simulated of the number of people remaining in poverty in the study area at the end of each simulated year. Thus, it is one measure of the relative effectiveness of alternative development strategies in removing people from poverty and keeping them out of poverty over time.

Simulated efficiencies of alternative strategies in generating income for the people of the study area were measured by two different efficiency ratios calculated within the simulator. These ratios included

a ratio of present value of simulated total regional income generated by each strategy to the present value of simulated total public costs of the strategy (including transfer payments) and a ratio of present value of simulated income generated for the study area's poor by each strategy to the present value of simulated total public costs of the strategy (including transfer payments). For all of the efficiency ratios reported herein, a discount rate of six percent was used to calculate present values of incomes generated by development activities and present values of costs of development activities.

Conceptually these efficiency ratios are similar to traditional benefit-cost ratios, but the two concepts are not equivalent. The ratios calculated in this study do not account for all future benefits and are only indexes of income generation efficiency for the strategies considered. They were only calculated over the 15 year planning horizon of the study (until all of the strategies that had the potential to alleviate poverty had done so). Because benefits beyond this 15 year horizon were not simulated, none were included in the efficiency ratios calculated. Consequently, while these efficiency ratios are indexes to compare income generation efficiencies of alternative strategies, caution is necessary in their interpretation because of incomplete accounting for the eventual payoffs from long term investments.

Strategies Simulated

The number of strategies which could be simulated was almost unlimited. To counter this problem, those possible development strategies which appeared to be the most reasonable and feasible from the standpoint of social, economic and political practicality were simulated. The

strategies simulated were also selected so that their results would be comparable from strategy to strategy. This made it possible for the researcher to compare the effects on the study area of alternative combinations of development activities in light of exogenous restrictions--economic, political or otherwise--and differing goal hierarchies.

Preliminary work with the simulator indicated that the input coefficient of the number of jobs directly created per public dollar spent on industrialization is of critical importance to results of many strategies. Consequently, some of the strategies simulated included the same development activities as other strategies, but were based on different assumptions about the cost effectiveness of industrialization programs.

It was assumed that a major objective for development activities in the study area is to remove from poverty those poor who, for reasons of mental or physical incapabilities, cannot work to support themselves (unsalvageable poor). Almost $50 million were allocated to this purpose (public assistance) in the study area in 1970 (U. S. Office of Economic Opportunity, 1970). Preliminary work with the simulator indicated that grants totaling almost $72 million per year in the early years of a development planning horizon would be required to remove all of these unsalvageable poor from poverty. This preliminary work also indicated that, to exert an appreciable influence toward the amelioration of poverty among salvageable poor in the area within a meaningful time horizon (less than 20 years), annual development allocations of from two to four million dollars in excess of allocations to unsalvageable poor are necessary.

To facilitate comparisons among programs by holding selected variables constant, a limit of annual funds available for development activities of $75 million was imposed for the strategies simulated. For one

of the strategies considered (a strategy of continuing programs in effect in 1970) simulated annual allocations remained well under $75 million. For the other strategies considered, simulated annual allocations were at this limit in early years, then decreased as development program effects were felt.

This annual development allocation limit spreads development strategy results over a longer, more realistic period. "Overnight" development would likely result in undesirable political, social and physical disruptions in an area even if it were technically and economically feasible.

For all but two of the strategies considered simulated poverty in the study area was virtually eliminated in 15 or fewer years, attaining, as completely as possible, the goal of poverty reduction. The only simulated poverty in the area beyond this point resulted from the few children of unsalvageable poor who entered the area labor market each year and did not find jobs immediately. Such poverty is primarily a structural phenomenon. Beyond the point of eliminating all but residual, structural poverty, most simulated development allocations went to welfare or public assistance grants, with only enough funds going to industrialization to provide jobs for these structurally impoverished. In reality, even these funds might not be necessary, since self sustaining economic growth (see Chapter III) might create enough jobs for these people.

As discussed in Chapter IV, three different estimates of cost effectiveness for industrialization programs were calculated in this study. For Strategies 1-8 the middle estimate (9,538 public dollars per direct job created) was assumed; for Strategies 9 and 10 the upper estimate

(5,582 public dollars per direct job created) was assumed; and for Strategies 11 and 12 the lower estimate (20,000 public dollars per direct job created) was assumed (Table III). Strategy 13 included no allocations to industrialization so no estimate of industrialization cost effectiveness was necessary.

Strategy 1

Strategy 1 continued programs in effect in 1970 (Table III). The major factor differentiating this strategy from others simulated is the fact that funds for public assistance grants were sufficiently limited that, while the incomes of unsalvageable poor could be supplemented somewhat, they could not all be raised to the poverty threshold.

It was not possible, from information available, to determine exactly how public development funds were used in the study area in 1970. Information was available, however, describing what funds were allocated to various general development activities in that year (U. S. Office of Economic Opportunity, 1970). Assumptions were made as to how these development activity funds were actually used.

It was assumed that public assistance funds totaling $1,567 annually were allocated to each unsalvageable poor person, age 65 and over. A grant of $1,506 was assumed allocated to each unsalvageable poor person, age 15 to 64. Thus, all unsalvageable poor received some welfare funds but, on the average, their incomes were not brought up to the poverty threshold. Up to $1,713,722 per year were allocated to education and training. It was assumed that first priority for these funds went to education to decrease the school dropout rate (less than $50,000 each year), with the remainder going to technical training as long as there

TABLE III

DEVELOPMENT STRATEGIES SIMULATED FOR THE STUDY AREA

Strategy	Programs Included	Assumed Industrialization Cost Effectiveness (Public Dollars per Direct Job Created)
1	programs in effect -- 1970	9,538
2	welfare, training, education, family planning, labor mobility, industrialization	9,538
3	welfare, training, education, family planning, industrialization	9,538
4	welfare, education, family planning, industrialization	9,538
5	welfare, education, industrialization	9,538
6	welfare, family planning, industrialization	9,538
7	welfare, labor mobility, industrialization	9,538
8	welfare, industrialization	9,538
9	welfare, labor mobility, industrialization	5,582
10	welfare, industrialization	5,582
11	welfare, labor mobility, industrialization	20,000
12	welfare, industrialization	20,000
13	welfare, training, education, family planning, labor mobility	no industrialization allocations

were untrained salvageable poor in the area. The 1970 allocation of industrial development funds ($3,402,764) was continued for each simulated year as long as there were salvageable poor in the area.[1]

The results of Strategy 1 (Table IV) show simulated poverty among salvageable poor in the study area to be alleviated in 14 years. However, insufficient funds were allocated each year to unsalvageable poor to bring their incomes up to the poverty threshold, and over 38 thousand poor people (17 percent of the total population) remained in the area at the end of the fifteenth simulated year. The results indicated that the continuation of existing development programs in the study area would yield positive economic returns to public costs, but would have only limited effectiveness in reducing the incidence of poverty.

Strategy 2

Strategy 2 provided for the annual allocation of up to $75 million to welfare, education, training, family planning, labor mobility and industrialization—all of the activities considered in this research (Table III). Sufficient funds were allocated to unsalvageable poor (both age categories) to bring the incomes of all unsalvageable poor persons to the poverty threshold. Annual public development expenditures on education and training were limited to 1970 allocations and were allocated as in Strategy 1. Sufficient funds were allocated to family planning

[1]The same cost effectiveness was assumed for actual 1970 allocations to education and training as was assumed for similar allocations simulated in other strategies. For 1970 industrial development allocations, the middle cost effectiveness estimate (9,538 public dollars per direct job created) was assumed. Actual cost effectiveness of 1970 allocations may have differed from these estimates, but no information was available describing actual cost effectiveness in the study area.

TABLE IV

SIMULATED RESULTS OF STRATEGY 1[a]

Year	Total Population	Total Poor	Annual Funds Allocated (dollars)	Efficiency Ratio 1[b]	Efficiency Ratio 2[c]	Person Poverty Years Accumulated
1	191,194	77,090	55,024,623	1.0957	1.0079	73,779
2	193,069	73,779	54,121,356	1.1349	1.0468	144,383
3	194,963	70,604	53,233,768	1.1728	1.0845	211,885
4	196,875	67,502	52,355,259	1.2100	1.1214	276,317
5	198,808	64,432	51,525,275	1.2466	1.1578	337,717
6	200,761	61,400	50,738,984	1.2829	1.1939	396,143
7	202,736	58,426	49,972,881	1.3188	1.2295	451,666
8	204,731	55,523	49,211,235	1.3543	1.2648	504,354
9	206,746	52,688	47,112,987	1.3901	1.3026	554,279
10	208,782	49,925	45,220,153	1.4256	1.3399	601,532
11	210,837	47,253	45,454,702	1.4607	1.3765	646,207
12	212,916	44,675	44,669,653	1.4954	1.4124	688,399
13	215,012	42,192	43,715,154	1.5287	1.4468	738,157
14[d]	217,134	39,758	40,355,255	1.5623	1.4811	777,184
15	219,144	39,027	39,425,218	1.5927	1.5122	815,666
16	221,036	38,482				

[a]Strategy 1—continuation of programs in effect in 1970 (middle estimate of industrialization cost effectiveness was assumed).

[b]Ratio of the present value of total regional income generated by development programs to the present value of total public costs of the programs.

[c]Ratio of the present value of income to the poor generated by development programs to the present value of total public costs of the programs.

[c]For Strategy 1, simulated poverty among salvageable poor in the study area was virtually eliminated in the fourteenth year, but simulated poverty was not eliminated among unsalvageable poor in the study area.

to reduce the poor birth rate to the level of the nonpoor birth rate. Remaining funds were allocated first to labor mobility until all salvageable poor had an opportunity to move to jobs outside the area, then were allocated to industrialization as long as there were salvageable poor in the area to take jobs. Many of the salvageable poor employed in jobs created by industrialization allocations were people who returned to the area after dropping out of labor mobility programs.

Other simulated strategies were more effective in eliminating poverty and more efficient in generating income than Strategy 2 (Table V). However, this strategy, including all of the development activities considered in the study, may be desirable. The program diversification reduces risk and fosters complementarity among development activities. Furthermore, society may choose to support a "second best" development strategy because of expected social or political benefits (real or imagined) not measured in this study. For example, residents might prefer to stress human resource improvement (education and training programs) and family planning rather than a more "efficient" approach emphasizing job creation if they place a high value on the social desirability of such people-oriented programs and feel an aversion to industrial development.

Strategy 3

Strategy 3 allocated funds as in Strategy 2 except no funds were allocated to labor mobility programs (Table III). By comparing the two above strategies, the effects of labor mobility programs can be viewed within the context of comprehensive area development plans (Table V and Table VI). Such comparisons are discussed later in this chapter.

TABLE V

SIMULATED RESULTS OF STRATEGY 2[a]

Year	Total Population	Total Poor	Annual Funds Allocated (dollars)	Efficiency Ratio 1[b]	Efficiency Ratio 2[c]	Person Poverty Years Accumulated
1	191,194	77,090	75,000,000	1.1452	1.0452	27,102
2	190,833	27,102	75,000,000	1.1936	1.0906	49,781
3	189,356	22,679	75,000,000	1.2457	1.1398	67,256
4	186,957	17,475	73,284,190	1.2794	1.1737	83,691
5	187,160	16,435	70,942,886	1.2827	1.1788	103,825
6	190,752	20,134	69,905,020	1.2772	1.1673	126,406
7	193,767	22,581	69,239,290	1.2677	1.1609	150,565
8	196,393	24,159	68,764,840	1.2572	1.1530	175,712
9	198,758	25,147	68,439,200	1.2470	1.1448	201,445
10	200,952	25,733	68,231,880	1.2374	1.1371	227,495
11	203,033	26,050	68,121,080	1.2288	1.1300	253,680
12	205,043	26,185	68,090,880	1.2211	1.1237	279,879
13	207,010	26,199	68,052,160	1.2143	1.1180	306,013
14[d]	208,954	26,135	67,953,120	1.2083	1.1130	332,033
15	210,887	26,020	67,800,360	1.2030	1.1085	357,906
16	212,722	25,873				

[a]Strategy 13—Annual allocation of up to $75 million to all development activities considered except industrialization programs.

[b]Ratio of the present value of total regional income generated by development programs to the present value of total public costs of the programs.

[c]Ratio of the present value of income to the poor generated by development programs to the present value of total public costs of the programs.

TABLE VI

SIMULATED RESULTS OF STRATEGY 3[a]

Year	Total Population	Total Poor	Annual Funds Allocated (dollars)	Efficiency Ratio 1[b]	Efficiency Ratio 2[c]	Person Poverty Years Accumulated
1	191,194	77.090	75,000,000	1.0793	0.9888	29,277
2	192,949	29,277	75,000,000	1.0925	1.0024	57,097
3	194,758	27,820	75,000,000	1.1073	1.0175	83,063
4	196,617	25,966	75,000,000	1.1244	1.0351	106,840
5	198,525	23,777	75,000,000	1.1435	1.0543	128,121
6	200,479	21,281	75,000,000	1.1645	1.0756	146,597
7	202,476	18,476	75,000,000	1.1873	1.0987	162,002
8	204,516	15,405	75,000,000	1.2115	1.1233	174,163
9	206,598	12,161	75,000,000	1.2370	1.1499	183,728
10	208,739	8,565	75,000,000	1.2647	1.1793	186,915
11[d]	210,976	4,187	75,000,000	1.2918	1.2081	187,717
12	213,175	802	67,445,720	1.3222	1.2393	188,511
13	215,138	794	67,064,903	1.3477	1.2657	189,303
14	217,120	792	66,843,770	1.3707	1.2893	190,113
15	219,120	810	66,669,560	1.3909	1.3100	190,932
16	221,012	819				

[a]Strategy 3—annual allocation of up to $75 million among all development activities considered except labor mobility programs (middle estimate of industrialization cost effectiveness was assumed).

[b]Ratio of the present value of total regional income generated by development programs to the present value of total public costs of the programs.

[c]Ratio of the present value of income to the poor generated by development programs to the present value of total costs of the programs.

[d]For Strategy 3, simulated poverty in the study area was virtually eliminated in the eleventh year.

Strategy 3 might be a desirable strategy for an underdeveloped area desiring to minimize outmigration. Community business leaders may view subsidized migration as undesirable, since it may reduce the local labor supply and raise wages. Also, communities frequently do not like to see young people leave.

Results of this strategy indicate that over time, poverty could be virtually eliminated in the study area without the use of labor mobility programs to subsidize outmigration of the poor. Such a strategy, however, would not eliminate poverty as rapidly or as efficiently (in terms of resultant income) as a strategy including labor mobility activities in the short run. Thus, the exclusion of labor mobility programs from development strategies is not without costs.

Strategy 4

Strategy 4 allocated funds as in Strategy 2 except no funds were allocated to technical training or labor mobility programs (Table III). Because Strategies 3 and 4 differ only by the exclusion of technical training programs, the results (Table VI and Table VII) can be compared to estimate the effects of technical training on area development. A later section of this chapter analyzes such comparisons.

Results of Strategy 4 indicate that if training programs are currently operating at adequate levels in the study area to provide enough trained workers to support job development, then economic development plans for the area can have significant effects toward poverty elimination and can yield net economic benefits without further investments in training activities. This result, however, would not likely hold for other depressed areas less endowed with formal and informal technical training programs.

TABLE VII

SIMULATED RESULTS OF STRATEGY 4[a]

Year	Total Population	Total Poor	Annual Funds Allocated (dollars)	Efficiency Ratio 1[b]	Efficiency Ratio 2[c]	Person Poverty Years Accumulated
1	191,194	77,090	75,000,000	1.0878	1.0201	28,243
2	193,034	28,243	75,000,000	1.1099	1.0351	54,248
3	194,757	26,005	75,000,000	1.1214	1.0419	77,286
4	196,699	23,038	75,000,000	1.1441	1.0701	97,013
5	198,694	19,727	75,000,000	1.1711	1.0932	113,154
6	200,735	16,141	75,000,000	1.1996	1.1323	125,405
7	202,827	12,251	75,000,000	1.2294	1.1626	133,495
8	204,967	8,090	75,000,000	1.2602	1.1940	137,234
9[d]	207,157	3,739	72,354,674	1.2920	1.2263	138,002
10	204,395	768	67,882,010	1.3263	1.2605	138,781
11	211,380	779	67,402,663	1.3551	1.2993	139,564
12	213,321	783	66,810,320	1.3809	1.3250	140,355
13	215,281	791	66,506,590	1.4123	1.3473	141,162
14	217,264	807	66,314,110	1.4328	1.3669	144,970
15	219,266	808	66,252,570	1.4501	1.3840	142,786
16	221,159	816				

[a]Strategy 4—annual allocation of up to $75 million among all development activities considered except labor mobility and technical training programs (middle estimate of industrialization cost effectiveness was assumed).

[b]Ratio of the present value of total regional income generated by development programs to the present value of total public costs of the programs.

[c]Ratio of the present value of income to the poor generated by development programs to the present value of total public costs of the programs.

[d]For Strategy 4, simulated poverty in the study area was virtually eliminated in the tenth year.

An assumption implicit in the simulator is that jobs can be generated with the same degree of cost effectiveness (number of jobs per dollar) regardless of the skill levels of the job recipients. For this model, potential earnings vary by skill levels, but job generating capabilities of industrialization and labor mobility programs do not. If, in fact, jobs can be generated more efficiently for trained people than for untrained people, then technical training programs may be a necessary ingredient in viable area development strategies, in which case the results of Strategy 4 may not be meaningful. On the other hand, if existing training programs (high school, post-high school and on-the-job) in the area can provide an adequate base of trained people and if job generating development activities can generate employment for unskilled area inhabitants, then Strategy 4 represents a valid public policy development plan for rural development policy decision makers.

Strategies 5 and 6

Strategy 5 differed from Strategy 4 only by the exclusion of family planning programs. Similarly, Strategy 6 differed from Strategy 4 only by the exclusion of education (school dropout prevention) programs (Table III). Thus the results of Strategies 5 and 6 (Tables VIII and IX), when compared with the results of Strategy 4, indicate the effects of family planning and education programs as components of development plans. Such programs were found to be relatively insignificant in funds requirements, shallow in effects and more nearly justifiable on social than on economic grounds. While they have a favorable economic payoff, they are less efficient than other major programs in reaching development targets in this study within the time frame considered. A longer

TABLE VIII

SIMULATED RESULTS OF STRATEGY 5[a]

Year	Total Population	Total Poor	Annual Funds Allocated (dollars)	Efficiency Ratio 1[b]	Efficiency Ratio 2[c]	Person Poverty Years Accumulated
1	191,194	77.090	75,000,000	1.0889	1.0290	27,876
2	193,062	27,876	75,000,000	1.1146	1.0550	52,909
3	194,934	25,033	75,000,000	1.1434	1.0841	76,716
4	196,953	23,807	75,000,000	1.1749	1.1159	92,963
5	198,980	16,247	75,000,000	1.2065	1.1477	107,316
6	201,058	14,353	75,000,000	1.2391	1.1805	117,486
7	203,188	10,170	75,000,000	1.2727	1.2144	123,289
8	205,368	5,803	75,000,000	1.3067	1.2485	124,488
9[d]	207,600	1,199	68,063,520	1.3444	1.2859	125,257
10	209,540	769	66,874,960	1.3764	1.3177	126,031
11	211,465	774	66,425,907	1.4034	1.3445	126,816
12	213,410	785	66,092,590	1.4265	1.3675	127,605
13	215,372	789	65,821,340	1.4465	1.3874	128,403
14	217,356	798	65,619,880	1.4641	1.4048	129,209
15	219,358	806	65,489,450	1.4797	1.4203	130,024
16	221,252	815				

[a]Strategy 5—annual allocation of up to $75 million among welfare, education and industrialization programs (middle estimate of industrialization cost effectiveness was assumed).

[b]Ratio of the present value of total regional income generated by development programs to the present value of total public costs of the programs.

[c]Ratio of the present value of income to the poor generated by development programs to the present value of total public costs of the programs.

[d]For Strategy 5, simulated poverty in the study area was virtually eliminated in the ninth year.

TABLE IX

SIMULATED RESULTS OF STRATEGY 6[a]

Year	Total Population	Total Poor	Annual Funds Allocated (dollars)	Efficiency Ratio 1[b]	Efficiency Ratio 2[c]	Person Poverty Years Accumulated
1	191,194	77.090	75,000,000	1.0880	1.0204	28,226
2	193,039	28,226	75,000,000	1.1102	1.0431	53,928
3	194,934	25,702	75,000,000	1.1358	1.0690	76,716
4	196,889	22,788	75,000,000	1.1642	1.0978	96,254
5	198,892	19,538	75,000,000	1.1936	1.1276	112,197
6	200,949	15,943	75,000,000	1.2238	1.1582	124,181
7	203,058	11,984	75,000,000	1.2553	1.1901	132,018
8	205,213	7,837	75,000,000	1.2879	1.2231	135,551
9[d]	207,420	3,533	72,067,320	1.3217	1.2571	136,365
10	209,534	814	67,364,300	1.3553	1.2905	137,171
11	211,463	806	66,904,498	1.3835	1.3186	137,985
12	213,410	814	66,550,270	1.4077	1.3427	138,807
13	215,373	822	66,273,520	1.4287	1.3636	139,637
14	217,357	830	66,075,360	1.4472	1.3819	140,476
15	219,361	839	65,942,590	1.4635	1.3982	141,324
16	221,279	848				

[a]Strategy 6—annual allocation of up to $75 million among welfare, family planning and industrialization programs (middle estimate of industrialization cost effectiveness was assumed).

[b]Ratio of the present value of total regional income generated by development programs to the present value of total public costs of the programs.

[c]Ratio of the present value of income to the poor generated by development programs to the present value of total public costs of the programs.

[d]For Strategy 6, simulated poverty in the study area was virtually eliminated in the ninth year.

time frame would improve the relative efficiency of these programs, but would not show them to have a massive impact on the outcomes measured herein.

Strategies 7 - 12

Results of Strategies 7 - 12 (Tables X-XV) indicate the effects on development goal attainment of varying cost effectiveness of industrialization. Strategies 7, 9 and 11 allocated funds to welfare grants, labor mobility and industrialization while Strategies 8, 10 and 12 allocated funds only to welfare grants and industrialization (Table III). For Strategies 7 and 8, the middle cost effectiveness estimate for industrialization was assumed. For Strategies 9 and 10 and Strategies 11 and 12, the upper and lower estimates of industrial development cost effectiveness were assumed, respectively. Simulated results indicate how the time required for full development of unused or underused labor resources varies with the cost effectiveness of industrial development programs. As would be expected, more cost effective industrial development programs simulated were found to alleviate study area poverty more rapidly and efficiently than less cost effective programs. However, even programs with very low industrialization cost effectiveness were successful in alleviating poverty in the later years of the time horizon simulated.

Strategy 13

Strategy 13 provided for the allocation of funds as in Strategy 2 except no funds were allocated to industrialization programs (Table III). The development activities included in Strategy 13 were welfare, education, training, family planning and labor mobility.

TABLE X

SIMULATED RESULTS OF STRATEGY 7[a]

Year	Total Population	Total Poor	Annual Funds Allocated (dollars)	Efficiency Ratio 1[b]	Efficiency Ratio 2[c]	Person Poverty Years Accumulated
1	191,194	77,090	75,000,000	1.2844	1.1938	20,875
2	186,266	20,875	75,000,000	1.3608	1.2686	33,816
3	181,882	12,941	75,000,000	1.3613	1.2797	48,438
4	186,275	14,622	75,000,000	1.3612	1.2668	62,648
5	189,958	14,210	75,000,000	1.3666	1.2788	74,894
6	193,169	12,246	75,000,000	1.3781	1.2948	84,355
7	196,066	9,461	75,000,000	1.3952	1.3151	90,214
8	198,763	5,859	75,000,000	1.4160	1.3384	91,719
9[d]	201,338	1,505	67,735,080	1.4442	1.3680	93,980
10	203,493	777	66,855,930	1.4684	1.3932	94,094
11	205,569	785	66,411,335	1.4905	1.4160	95,110
12	207,601	791	65,683,480	1.5088	1.4350	96,063
13	209,606	801	65,298,560	1.5249	1.4517	96,976
14	211,602	806	65,023,880	1.5393	1.4666	97,864
15	213,597	814	64,816,760	1.5522	1.4799	98,756
16	215,473	821				

[a]Strategy 7—annual allocation of up to $75 million among welfare, labor mobility and industrialization programs (middle estimate of industrialization cost effectiveness was assumed).

[b]Ratio of the present value of total regional income generated by development programs to the present value of total public costs of the programs.

[c]Ratio of the present value of income to the poor generated by development programs to the present value of total public costs of the programs.

[d]For Strategy 7, simulated poverty in the study area was virtually eliminated in the ninth year.

TABLE XI

SIMULATED RESULTS OF STRATEGY 8[a]

Year	Total Population	Total Poor	Annual Funds Allocated (dollars)	Efficiency Ratio 1[b]	Efficiency Ratio 2[c]	Person Poverty Years Accumulated
1	191,194	77,090	75,000,000	1.0891	1.0293	27,859
2	193,068	27,859	75,000,000	1.1157	1.0561	52,863
3	194,991	25,004	75,000,000	1.1453	1.0861	74,617
4	199,002	21,754	75,000,000	1.1774	1.1184	92,808
5	199,002	18,191	75,000,000	1.2096	1.1508	107,080
6	201,088	14,272	75,000,000	1.2427	1.1842	117,169
7	203,222	10,089	75,000,000	1.2770	1.2187	122,892
8	205,408	5,723	75,000,000	1.3115	1.2534	123,994
9[d]	207,644	1,102	67,826,110	1.3497	1.2914	124,794
10	209,576	800	66,845,310	1.3819	1.3233	125,600
11	211,505	806	66,398,621	1.4091	1.3503	126,416
12	213,450	816	66,061,000	1.4324	1.3734	127,237
13	215,416	821	65,783,210	1.4527	1.3935	128,066
14	217,402	829	65,590,380	1.4704	1.4112	128,904
15	219,405	838	65,461,165	1.4864	1.4270	129,749
16	221,289	845				

[a]Strategy 8—annual allocation of up to $75 million to welfare and industrialization programs (middle estimate of industrialization cost effectiveness was assumed).

[b]Ratio of the present value of total regional income generated by development programs to the present value of total public costs of the programs.

[c]Ratio of the present value of income to the poor generated by development programs to the present value of total public costs of the programs.

[d]For Strategy 8, simulated poverty in the study area was virtually eliminated in the ninth year.

TABLE XII

SIMULATED RESULTS OF STRATEGY 9[a]

Year	Total Population	Total Poor	Annual Funds Allocated (dollars)	Efficiency Ratio 1[b]	Efficiency Ratio 2[c]	Person Poverty Years Accumulated
1	191,194	77,090	75,000,000	1.2844	1.1938	20,875
2	186,266	20,875	75,000,000	1.3630	1.2708	33,623
3	181,897	12,748	75,000,000	1.3796	1.2981	45,714
4	186,477	12,091	75,000,000	1.4006	1.3245	55,246
5	190,376	9,532	75,000,000	1.4300	1.3573	60,248
6	193,831	5,002	71,601,710	1.4649	1.3941	62,563
7[d]	196,723	2,315	68,463,160	1.4980	1.4283	63,324
8	199,188	761	67,363,290	1.5256	1.4567	64,093
9	201,468	769	66,497,920	1.5491	1.4807	64,870
10	203,625	777	65,806,430	1.5692	1.5013	65,654
11	205,705	784	65,393,375	1.5866	1.5190	66,447
12	207,741	793	64,847,080	1.6020	1.5348	67,247
13	209,749	800	64,533,784	1.6157	1.5487	68,055
14	211,746	808	64,310,940	1.6279	1.4511	68,871
15	213,745	816	64,172,280	1.6389	1.5723	69,654

[a]Strategy 9—annual allocation of up to $75 million among welfare, labor mobility and industrialization programs (upper estimate of industrialization cost effectiveness was assumed).

[b]Ratio of the present value of total regional income generated by development programs to the present value of total public costs of the programs.

[c]Ratio of the present value of income to the poor generated by development programs to the present value of total public costs of the programs.

[d]For Strategy 9, simulated poverty in the study area was virtually eliminated in the seventh year.

TABLE XIII

SIMULATED RESULTS OF STRATEGY 10[a]

Year	Total Population	Total Poor	Annual Funds Allocated (dollars)	Efficiency Ratio 1[b]	Efficiency Ratio 2[c]	Person Poverty Years Accumulated
1	191,194	77,090	75,000,000	1.1269	1.0670	26,332
2	193,184	26,332	75,000,000	1.1757	1.1161	47,956
3	195,256	21,624	75,000,000	1.2268	1.1676	64,180
4	197,410	16,224	75,000,000	1.2794	1.2204	74,351
5	199,651	10,171	75,000,000	1.3347	1.2759	77,927
6[d]	201,975	3,576	70,858,400	1.3889	1.3300	78,716
7	204,040	789	67,624,000	1.4350	1.3757	79,495
8	205,916	779	66,951,630	1.4711	1.4116	80,281
9	207,810	786	66,379,870	1.5005	1.4407	81,075
10	209,721	794	65,898,250	1.5249	1.4650	81,877
11	211,651	802	65,492,017	1.5457	1.4857	82,694
12	213,599	817	65,196,620	1.5637	1.5035	83,511
13	215,566	817	64,948,030	1.5794	1.5192	84,337
14	217,552	826	64,785,260	1.5933	1.5330	85,172
15	219,559	835	64,688,750	1.6048	1.5444	85,316
16	221,457	844				

[a]Strategy 10—annual allocation of up to $75 million to welfare and industrialization programs (upper estimate of industrialization cost effectiveness was assumed).

[b]Ratio of the present value of total regional income generated by development programs to the present value of total public costs of the programs.

[c]Ratio of the present value of income to the poor generated by development programs to the present value of total public costs of the programs.

[d]For Strategy 10, simulated poverty in the study area was virtually eliminated in the sixth year.

TABLE XIV

SIMULATED RESULTS OF STRATEGY 11[a]

Year	Total Population	Total Poor	Annual Funds Allocated (dollars)	Efficiency Ratio 1[b]	Efficiency Ratio 2[c]	Person Poverty Years Accumulated
1	191,194	77,090	75,000,000	1.2844	1.1938	20,875
2	186,266	20,875	75,000,000	1.3567	1.2645	33,958
3	181,868	13,083	75,000,000	1.3429	1.2613	50,429
4	186,133	16,471	75,000,000	1.3259	1.2498	69,293
5	190,081	18,846	75,000,000	1.3133	1.2406	88,984
6	193,404	19,691	75,000,000	1.3061	1.2357	108,422
7	196,309	19,438	75,000,000	1.3039	1.2351	126,877
8	198,937	18,455	75,000,000	1.3061	1.2386	143,385
9	201,160	16,508	75,000,000	1.3122	1.2458	157,391
10	203,164	14,006	75,000,000	1.3210	1.2554	168,797
11	205,196	11,406	75,000,000	1.3318	1.2668	177,718
12	207,249	8,921	75,000,000	1.3440	1.2796	184,139
13	209,334	6,421	75,000,000	1.3572	1.2933	188,124
14	211,445	3,985	75,000,000	1.3710	1.3076	189,632
15[d]	213,584	1,508	68,991,320	1.3883	1.3251	190,474
16	215,484	842				

[a]Strategy 11—annual allocation of up to $75 million among welfare, labor mobility and industrialization programs (lower estimate of industrialization cost effectiveness was assumed).

[b]Ratio of the present value of total regional income generated by development programs to the present value of total public costs of the programs.

[c]Ratio of the present value of income to the poor generated by development programs to the present value of total public costs of the programs.

[d]For Strategy 11, simulated poverty among salvageable door was virtually eliminated in the fifteenth year.

TABLE XV

SIMULATED RESULTS OF STRATEGY 12[a]

Year	Total Population	Total Poor	Annual Funds Allocated (dollars)	Efficiency Ratio 1[b]	Efficiency Ratio 2[c]	Person Poverty Years Accumulated
1	191,194	77.090	75,000,000	1.0588	0.9895	28,983
2	192,979	28,983	75,000,000	1.0701	1.0106	56,454
3	194,797	27,471	75,000,000	1.0823	1.0230	82,231
4	196,649	25,777	75,000,000	1.0958	1.0367	106,192
5	198,531	23,961	75,000,000	1.1104	1.0515	128,221
6	200,444	22,029	75,000,000	1.1259	1.0673	148,211
7	202,389	19,990	75,000,000	1.1424	1.0840	166,104
8	204,363	17,893	75,000,000	1.1588	1.1005	181,813
9	206,367	15,709	75,000,000	1.1753	1.1172	195,242
10	208,401	13,429	75,000,000	1.1920	1.0341	206,321
11	210,460	11,079	75,000,000	1.2088	1.1510	215,180
12	212,543	8,859	75,000,000	1.2257	1.1680	221,798
13	214,655	6,618	75,000,000	1.2425	1.1850	226,223
14	216,797	4,425	75,000,000	1.2594	1.2020	228,422
15[d]	218,963	2,199	72,022,360	1.2772	1.2198	229,286
16	220,963	864				

[a]Strategy 12—annual allocation of up to $75 million to welfare and industrialization programs (lower estimate of industrialization cost effectiveness was assumed).

[b]Ratio of the present value of total regional income generated by development programs to the present value of total public costs of the programs.

[c]Ratio of the present value of income to the poor generated by development programs to the present value of total public costs of the programs.

[d]For Strategy 12, simulated poverty in the study was virtually eliminated in the fifteenth year.

An area development program package such as simulated by Strategy 13 is representative of a development plan which might be utilized in an area where industrial development is not feasible either because residents are opposed to industry or because the area lacks basic economic attributes required for firms to make a profit. An area could have such a paucity of developable resources that industry, even if publicly subsidized, could not develop such resources for a profit. This situation was indicated to be widespread based on a few early studies of micropolitan industrialization (Advisory Commission on Intergovernmental Relations, 1967; Stinson, 1968; Hansen, 1969). The comparison of the results of this strategy (Table XVI) with those of the other strategies simulated indicates the limitations to area development that such infeasibility of industrialization would impose. Without industrial development there appears to be little hope for attaining major development targets within a reasonable time period for tolerable cost in public funds.

Strategy Comparison and Evaluation

All but two of the development strategies simulated in this study virtually eliminated simulated poverty in the study area in 15 or fewer years (Table XVII). The two exceptions were Strategy 1, which did not provide sufficient welfare grants to raise the incomes of the area's unsalvageable poor to the poverty threshold, and Strategy 13, for which it was assumed that job creation by industrialization was infeasible. Other strategies were successful to different degrees. Some eliminated simulated poverty quicker than others. And they all yielded different ratios of present values of area income and income of the poor to present value of total public costs of development programs.

TABLE XVI

SIMULATED RESULTS OF STRATEGY 13[a]

Year	Total Population	Total Poor	Annual Funds Allocated (dollars)	Efficiency Ratio 1[b]	Efficiency Ratio 2[c]	Person Poverty Years Accumulated
1	191,194	77,090	75,000,000	1.1452	1.0452	27,102
2	190,833	27,102	75,000,000	1.1936	1.0906	49,781
3	189,356	22,679	75,000,000	1.2457	1.1398	67,256
4	186,957	17,275	75,000,000	1.2788	1.1736	85,868
5	187,244	18,612	75,000,000	1.2891	1.1871	105,595
6	191,037	19,727	75,000,000	1.2961	1.1963	124,823
7	194,285	19,228	75,000,000	1.3046	1.2064	142,388
8	197,172	17,565	75,000,000	1.3160	1.2191	157,455
9	199,827	15,067	75,000,000	1.3308	1.2357	169,122
10	202,357	11,667	75,000,000	1.3494	1.2565	176,550
11	204,839	7,428	75,000,000	1.3714	1.2805	179,758
12[d]	207,257	3,208	70,778,270	1.3966	1.3072	180,554
13	209,479	796	67,073,020	1.4218	1.3334	181,359
14	211,516	805	66,676,560	1.4439	1.3565	182,170
15	213,539	811	66,404,280	1.4635	1.3769	182,988
16	215,434	818				

[a]Strategy 2—annual allocation of up to $75 million among all development activities considered (middle estimate of industrialization cost effectiveness was assumed).

[b]Ratio of the present value of total regional income generated by development programs to the present value of total public costs of the programs.

[c]Ratio of the present value of income to the poor generated by development programs to the present value of total public costs of the programs.

[d]For Strategy 2, simulated poverty in the study area was virtually eliminated in the twelfth year.

TABLE XVII

SUMMARY OF SIMULATED FINAL RESULTS OF STRATEGIES CONSIDERED[a]

Strategy	Programs Included	Assumed Industrial-ization Cost Effectiveness[b]	Years Required to Substantially Eliminate Poverty	Person Poverty Years Accumulated	Present Value of Total Income Generated[c] (million dol.)	Efficiency Ratio 1[d]	Efficiency Ratio 2[e]
1	programs in effect-1970	M	poverty not eliminated	815,666	807	1.59	1.51
2	welfare, training, education, family planning, labor mobility, industrialization	M	12	182,988	1,169	1.46	1.38
3	welfare, training, education, family planning, industrialization	M	11	190,932	1,050	1.39	1.31
4	welfare, education, family planning, industrialization	M	9	142,786	1,085	1.45	1.38
5	welfare, education, industrialization	M	9	130,024	1,095	1.48	1.42
6	welfare, family planning, industrialization	M	9	141,324	1,086	1.46	1.40
7	welfare, labor mobility, industrialization	M	9	98,756	1,142	1.55	1.48

TABLE XVII (Continued)

Strategy	Programs Included	Assumed Industrialization Cost Effectiveness[b]	Years Required to Substantially Eliminate Poverty	Person Poverty Years Accumulated	Present Value of Total Income Generated[c]	Efficiency Ratio 1[d]	Efficiency Ratio 2[e]
8	welfare, industrialization	M	9	129,749	1,103	1.49	1.43
9	welfare, labor mobility, industrialization	U	7	69,654	1,186	1.64	1.57
10	welfare, industrialization	U	6	85,316	1,160	1.60	1.54
11	welfare, labor mobility, industrialization	L	15	190,474	1,140	1.39	1.33
12	welfare, industrialization	L	15	229,286	1,051	1.28	1.22
13	welfare training, education, family planning, labor mobility	no industrialization allocations	poverty not eliminated	357,906	888	1.20	1.11

[a]Results are for year 15--the final year simulated

[b]M--Middle estimate of cost effectiveness ($9,538 public dollars required per direct job created).
U--Upper estimate of cost effectiveness ($5,582 public dollars required per direct job created).
L--Lower estimate of cost effectiveness ($20,000 public dollars required per direct job created).

[c]Present value, over the planning horizon simulated, of total area income generated by development activities, including incomes of labor mobility relocates living outside the study area.

TABLE XVII (Continued)

[d]Ratio of the present value of total regional income generated by development programs to the present value of total public costs of the programs.

[e]Ratio of the present value of income to the poor generated by development programs to the present value of total public costs of the programs.

The simulated differences in final strategy results can be explained by the different development activities and industrialization cost effectiveness adsumed for various strategies. The following two subsections of this chapter list differences in strategy results, followed by a discussion of the implications of these differences in light of alternative goals and restrictions.

Strategy Comparison--Activity Combinations

Strategies 1 - 8 are those for which the most realistic industrialization cost effectiveness was assumed. Strategies 9 - 12 included some of the same activity combinations included in Strategies 1 - 8, but were simulated for different industrialization cost effectiveness assumptions, and Strategy 13 did not include industrialization as a development activity.

Comparisons of the final simulated results of Strategy 1 with those of Strategies 2 - 8 (Table XVII) indicate the effects of limiting expenditures on welfare grants. Strategy 1, with limited welfare expenditures, was ineffective in alleviation simulated poverty among unsalvageable poor in the area, and yielded a high number of person poverty years accumulated. However, both of the efficiency ratios of income generated to public costs were relatively high for Strategy 1, and the present value of total income generated for the strategy was relatively low. These comparative results can be explained by the fact that welfare allocations per recipient were limited in Strategy 1; thus a relatively greater portion of allocated funds went to job development than in other strategies simulated. Welfare programs providing only cash or in-kind assistance to the poor do not constitute an investment in jobs or human capital that generates a

future income stream. Thus decreasing welfare expenditures relative to other development activity expenditures causes efficiency ratios of incomes to costs to increase in all but the very short run. Moreover, for unsalvageable poor, welfare grants are the only effective means of eliminating poverty. So limiting welfare grants precludes poverty alleviation among unsalvageable poor and results in a high number of person poverty years accumulated.

Comparisons of the final simulated results of Strategies 2 and 3 and of Strategies 7 and 8 (Table XVII) indicate the effects of including labor mobility programs in development strategies. In both cases the strategy including labor mobility as a development activity (Strategy 2 and Strategy 7) was more efficient in eliminating poverty and in generating incomes both total area and poor incomes (as indicated by higher values of efficiency ratios and greater present values of income generated) than the strategy in which labor mobility was excluded.

The relative effects of including labor mobility in a development strategy appear to be less when comparing Strategies 2 and 3—person poverty years accumulated decreased from 190,932 to 182,988 (Table XVII)—than when comparing Strategies 7 and 8—person poverty years accumulated decreased from 129,749 to 98,756 (Table XVII). This was because, for Strategy 2, welfare, training, education and family planning had first priority for funds, with labor mobility and industrialization receiving the residual; while for Strategy 7 only welfare had priority for funds over labor mobility. So, for Strategy 7 labor mobility funds were utilized more intensively or in earlier years, keeping person poverty years from accumulating as rapidly as they did in Strategy 2.

Strategy 4 included all of the development activities of Strategy 3 except for technical training. The results shown in Table XVII indicate that the funds allocated to technical training programs were less efficient than funds allocated to other activities. Person poverty years accumulated were greater for Strategy 3, which included technical training, than for Strategy 4 which excluded such programs. Also, the income generation efficiency ratios were higher for Strategy 4.

These results are explainable by the fact that the role of technical training programs, as specified in the simulator utilized in this research, is passive. It was assumed that training does not directly create job opportunities for the poor, but rather increases their potential earnings when jobs become available. So, without bringing people to jobs or jobs to people, technical training programs have small payoffs. If, in fact, technical training programs complement job development programs, causing them to generate more jobs per dollar of public expenditure, then the simulated differences in Strategies 2 and 3 may be unrealistic. However, some strong high school and post-high school technical training programs are currently operating in the study area. So, it seems reasonable that training made available by these programs, supplemented with on-the-job training by new or expanding firms, might provide an adequate base of trained employees for most labor intensive industries.

Comparisons of the final simulated results of Strategies 4 and 6 and of Strategies 5 and 8 (Table XVII) indicate the effects of including school dropout prevention (education) programs in development strategies. For both cases the strategies which did not include education programs (Strategy 6 and Strategy 8) were slightly more effective in eliminating poverty (indicated by lower value of person poverty years accumulated) and more efficient in generating incomes (indicated by higher efficiency

ratios and greater present values of income generated). These results do not indicate that the education programs simulated were absolutely inefficient, but just that they were less efficient than the other programs in the strategies considered.

Comparisons of the final simulated results of Strategies 4 and 5 and of Strategies 6 and 8 (Table XVII) indicate the effects of including family planning programs in development strategies. In both cases the strategies which did not include family planning programs (Strategy 5 and Strategy 8) were more effective in eliminating poverty (fewer person poverty years accumulated) and more efficient in generating income (higher efficiency ratios and greater present values of income generated).

The comparative results of Strategies 4, 5, 6 and 8, as discussed above, indicate that family planning programs are slightly less efficient than education programs and that both activities, as simulated in this study, are shallow, requiring relatively few funds and yielding relatively minimal results. This shallowness is indicated by the small simulated differences in person poverty years accumulated, present values of income generated and efficiency ratios among these strategies; and by the fact that the simulated years required to substantially eliminate study area poverty did not vary at all among these strategies. These results do not necessarily mean that the programs are inefficient over a longer period than considered in this study, but they are no substitute for other major programs in accomplishing economic development objectives.

Strategy Comparison--Industrialization Efficiencies

Comparisons of Strategies 7, 9 and 11 and of Strategies 8, 10 and

12 indicate the effects of different industrialization cost effectiveness levels on the efficiency with which development strategies could eliminate poverty and create income in the study area (Table XVII). The simulated results of these strategies indicate, as would be expected, that greater industrialization cost effectiveness eliminates poverty more rapidly and generates income more efficiently.

Strategy 13, which contained no industrial development activity, was ineffective in eliminating study area poverty. Generating jobs locally appears to be basic to development of underdeveloped areas. The simulated results of Strategies 2 - 12 indicate that, given the assumptions of the model and given the feasibility of industrialization programs, poverty in the study area could be eliminated within a not too lengthy time horizon, and it could be eliminated efficiently—as indicated by economic returns in excess of public costs—even if actual industrialization cost effectiveness is very low. Alternatively simulated results of Strategy 13 indicate that without industrialization, an underdeveloped area makes economic progress slowly and with considerable public cost of programs. The principal reason for this conclusion is that even with strong programs to assist outmovement of labor, many workers return home and will be unemployed or underemployed without efforts to generate productive local employment. And the human resource development activities, as stated earlier, are ineffective unless accompanied by labor mobility or capital mobility programs.

Strategy Evaluation

The results of this research indicate that, given the assumptions of the model used, poverty could be eliminated in the study area in 15

or fewer years by annually allocating no more public funds to non-welfare development activities than were allocated in the area in 1970 (approximately $5 million) if sufficient funds were allocated to welfare grants to raise the incomes of the area's unsalvageable poor to the poverty threshold. Public assistance and job development programs were found to be necessary aspects of successful development strategies. However, alone, neither of these activities was found to be sufficient to alleviate poverty efficiently. Rather they must be utilized together, with possible supplementation by human resource development programs. It was found that a development strategy containing all of the development activities considered in the study (Strategy 2) could substantially eliminate poverty in the study area over the planning horizon considered (15 years) and could yield efficient income streams. Such a strategy would provide a wide range of program diversification, thus reducing risk and allowing for complementarity among development activities. This strategy was based on public assistance grants to provide minimum nonpoverty incomes for the unsalvageable poor and job development activities (labor mobility and industrialization) to provide employment and consequent incomes for the salvageable poor. Political restrictions might reduce or eliminate the use of labor mobility programs on grounds that they encourage outmigration of an area's youth, deplete a surplus labor pool or are inconsistent with programs to create jobs within the area.[2] The findings of this research indicate that a similar strategy

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[2]Arguments by an area's nonpoor (especially employers) that labor mobility programs encourate out-migration of an area's youth and deplete an area's surplus labor pool may be valid. However, the argument that such programs are inconsistent with programs to create jobs within the area seems less well founded. Labor mobility programs can have much more rapid effects in removing salvageable poor from poverty than can

to the one discussed above, but excluding labor mobility programs (Strategy 3) would be less effective but could still eliminate poverty and yield positive returns to public costs.

Simulated results of strategies including education (school dropout prevention) activities were not found to differ greatly from strategies excluding such activities. An implicit assumption included in the model is that when poor people take jobs and join the ranks of the nonpoor, the school dropout rate applicable to their children becomes the dropout rate of nonpoor children. This assumption may not be realistic in the short run. If the school dropout rate for the previously poor does not decline rapidly to the dropout rate for nonpoor as poverty is decreased in an area, then the effects of dropout prevention education programs may be greater than indicated in this study. In any case, education (dropout prevention) programs, as considered in this study, are quite shallow (affect only a few people and require minimal funding) so if they are considered socially desirable it does not appear that they should necessarily be avoided.

Family planning, like school dropout prevention, is a shallow activity, and its simulated effectiveness also may be underestimated because of an implicit assumption in the model. This assumption is that when poor people take jobs and join the ranks of the nonpoor the birth rate determining their fertility becomes the rate applicable to the

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industrialization programs. However, labor mobility programs typically have high attrition rates. Consequently, short run labor mobility programs may be consistent with long run area industrialization activities. Mobility programs generate income while industrial development is getting started, and provide a source of labor for local industry as workers return home. It is far more efficient from an economic, though not necessarily from a social standpoint, to hold the reserve labor supply awaiting local jobs in distant employment than in local underemployment.

previously nonpoor. In reality it may take some time for the previously poor to adopt the child bearing habits of their nonpoor peers. Also, the avoidance of unwanted births may be very socially desirable.

Strategies containing post-high school technical training programs were not found to be as effective in eliminating poverty or generating income for the study area as similar strategies with technical training excluded. An implicit assumption in the model is that on-the-job training programs with established and new industry along with existing high school and post-high school training programs operate at past levels in the area over the years simulated. With some realignment of programs, existing technical programs may provide an adequate base of trained personnel to support the development of labor intensive industry in the area. If, however, the strong existing technical training program eludes the poor and if jobs can be generated more efficiently with a major increase in trained people, then technical training programs for the disadvantaged may be a useful component of a viable area development strategy.

It was found that, for the study area, allocations to public assistance grants totaling almost $72 million per year in the early years of a development plan would be required to bring the income of all unsalvageable poor up to the poverty threshold. These funds constitute the bulk of "development" funding. Comparatively small annual allocations to other development activities (especially job development) of only two to four million dollars could appreciably reduce poverty among salvageable poor in the area. This suggests that, for underdeveloped areas where job development activities are currently not being actively pursued, the public may be overlooking a chance to use comparatively few economic

development funds to yield relatively large payoffs in terms of poverty amelioration and income generation.

Regardless of what programs are included in rural area development program packages or strategies, if poverty elimination is a major goal, efficient strategies must include public assistance grants and job development. While much poverty can be eliminated among salvageable poor by job development, poverty can be eliminated among the unsalvageable poor only by welfare grants. For a development strategy to be effective in eliminating poverty in a depressed area, such development activities must be continued for a sufficient period of time to allow a critical mass of self-sustaining economic activity to become entrenched in the area. Other development activities (primarily human resource development) may be supportive of job development activities and have other results which are socially or politically desirable. But, improvement of human, natural or public resources yields favorable returns only as these resources are gainfully employed.

CHAPTER VI

SUMMARY, LIMITATIONS AND FUTURE RESEARCH NEEDS

Many rural areas of the United States can be classified as underdeveloped, based on low returns to labor and high rates of underemployment relative to the rest of the nation. This phenomenon is explainable, according to neoclassical economic theory, by the existence of externalities not priced in the market (pollution, congestion and crime) and factor market imperfections, including minimum wage laws, union wage scales and commitment of people to specific areas or jobs as a way of life. The purpose of this study was to develop and utilize an exemplary model to simulate and evaluate the results of potential public policy strategies directed toward alleviating these problems of underdeveloped rural areas. This chapter summarizes the research presented in this thesis, notes limitations of the analysis and suggests future research needs.

Summary

During the 1960's underdeveloped areas became the objects of increasing public concern, and allocations of public funds to development programs greatly increased. Many of these programs of the 1960's were evaluated for cost effectiveness. However, the individual programs were generally viewed as separate entities rather than as integral parts of development packages or strategies. There was little or no recognition

of the need for coordination of programs in reaching a critical mass for rural development. Fragmented, inefficient and overlapping publicly funded development activities resulted.

It was assumed in this study that the allocation of public funds to development activities directed toward improving the performance of an imperfect market and fostering equity or efficiency "in the large" will continue. Given this assumption, the systems approach developed herein can assist decision makers in planning program packages to attain efficiency "in the small" by identifying least cost strategies required to reach certain development targets in a depressed area. Economic evaluation of the efficiencies of various programs, viewed in the context of systems planning, can help public policy decision makers decide which public programs to expand and which to contract, and what total level of funds is required to reach development targets. Systems planning can be used to devise an efficient rural development strategy that makes limited funds go as far as possible to reach development targets.

The systems approach, organized as a rural development game, can be used in the classroom to give students "experience" in devising a development strategy. It makes students aware of the inter-relationships which exist among demographic factors and policy activities within an area's economic system.

A rural development planning simulation model was developed in this study to simulate results over time of potential rural area development policy strategies. The model utilizes cost effectiveness estimates for different development programs to simulate the impacts of various program combinations on measures of the well-being of the people in a particular area. Well-being was measured indirectly by income, poverty and

employment. Each of the strategies simulated was evaluated on how effectively it eliminated study area poverty over time and how efficiently relative to public costs it generated income for the area's inhabitants. Such income, as simulated, came primarily from generating employment for salvageable poor and providing public assistance grants to unsalvageable poor. Coefficients in the simulator included estimates of unemployment and underemployment, and it was assumed that all job recipients received earnings comparable with those they could earn elsewhere based on their training and skills. These earnings were based on median earnings of Oklahoma workers by occupation groups and should be reasonably representative of market equilibrium wages. Thus, for the model utilized herein, elimination of all but structural poverty among salvageable poor through job development is tantamount to elimination of all but structural unemployment and underemployment.

For the simulator used in this research, the population of the area considered was cross-classified into 21 socio-demographic categories based on income, age, ability to work and levels of education and training. The poor were categorized according to their ability to work as salvageable or unsalvageable--those capable of supporting themselves by working being classified as salvageable. Salvageable poor were cross classified by age, attainment of high school education and possession of technical training. Nonpoor were categorized by age and income level.

It was assumed that a decision making authority responsible for dispersing development funds in an underdeveloped area could allocate these funds among public assistance grants for unsalvageable poor, education (school dropout prevention), technical training, family planning, industrialization and labor mobility subsidization. These

alternative activities, as considered in the study, represented special development activities which could be initiated over and above "typical" public investments in an area. It was assumed that roads, schools and other services and infrastructure initially were adequately funded in the area considered and that any improvements would be financed as desired by area residents from funds made available by the development process itself.

Public assistance grants were included to remove unsalvageable poor from poverty. Education allocations were assumed to decrease the school dropout rate among students in poverty. It was assumed that public funds allocated to technical training were used to train untrained poor, since sound vo-tech training is already available for "conventional" students in the study area. Family planning funds were assumed to decrease the birth rate by making family planning devices and information available to the poor.

All development activities were assumed to have direct as well as indirect effects on both the poor and the nonpoor in the area. Income resulting from jobs created by industrial development was assumed to continue through the time horizon simulated. Income resulting from jobs made available by labor mobility subsidization was also assumed to continue, as long as labor mobility program participants did not return to the home area. Income resulting from other development activities was of a temporary nature, continuing only as long as programs were continued.

Technical coefficients necessary to operate the model were estimated from primary and secondary sources. These coefficients included demographic coefficients, income coefficients, employment coefficients and development activity efficiency coefficients.

Demographic coefficients included birth rates, death rates and a population growth rate including migration for the area considered; and were estimated from U. S. Census data. Income coefficients included income thresholds for the poor and for low, medium and high income non-poor; potential earnings by skill levels for salvageable poor; a public funds-income multiplier; and the estimated proportion of this income from public funds going to the poor for the area considered. These coefficients were estimated from census data and from information reported in several input-output studies.

Employment coefficients included estimates of labor force participation rates and measures of incidence and degree of unemployment and of underemployment in the area. These coefficients were estimated primarily from U. S. Bureau of Census information.

Development activity efficiency coefficients, expressing the impacts of alternative development activities on various subpopulations of the area considered, were estimated primarily from information reported in individual project evaluation studies. Most development activity coefficients were stated in cost effectiveness terms.

Much of eastern Oklahoma is characterized by problems of underdevelopment. The study area includes seven eastern Oklahoma counties (Adair, Cherokee, McIntosh, Muskogee, Okmulgee, Sequoyah and Wagoner) for which the community of Muskogee (population 37,331) is the largest and most centrally located city. In 1970, approximately 40 percent of the area's population had family equivalent incomes less than $4,000 (calculated from U. S. Bureau of Census, 1971 and U. S. Bureau of Census, 1972a). Unemployment in the area averaged six percent in 1970, well above the average for Oklahoma and the nation which were four and five

percent respectively. Underemployment in the area is an even greater problem than unemployment. Kampe and LIndamood (1969) estimated 1960 rates of underemployment for males in the area ranging from 19 to 41 percent. They classified underemployment of over 20 percent as severe, and they found that all but one county (Muskogee) in the study area had severe underemployment.

The results of 13 development strategies simulated for this study area were reported herein. One of these strategies assumed continuation of programs in effect in 1970. These 1970 programs included limited welfare grants and allocations to education, training and industrialization activities.

The other 12 strategies simulated included sufficient annual allocations to welfare or public assistance to remove all unsalvageable poor from poverty; remaining funds, up to a total annual allocation limit of $75 million, went to various combinations of the other development activities considered. Preliminary work with the simulator indicated that in the early years of simulated development almost $72 million in welfare grants would be required to remove all unsalvageable poor from poverty. Almost $50 million were allocated to this purpose (welfare grants) in 1970.

Major conclusions of the study are summarized as follows:

1. Alleviation of poverty and all but structural unemployment and underemployment with positive returns to public development expenditures is possible in the study area within a reasonable time frame. These goals were found to be inseparable, since, for the model used herein, simulated poverty alleviation among salvageable (employable) poor was accomplished by providing them with jobs, the earnings from which were

comparable with what they could earn elsewhere based on their training and skills. Given the assumptions of the model, annual public allocations of no more than $75 million to development activities would achieve major development goals within 15 years. Approximately $55 million were allocated to such activities in 1970. Simulation of the continuation of these 1970 program levels, however, indicated that, unless the real dollars allocated to these programs are increased, 39 thousand people or 18 percent of the total study area population will still be in poverty in 1985.

2. The number of programs in an area development plan need not be large. In fact real advantages in administrative feasibility and avoidance of waste and program overlaps accrue from limiting the number of programs in a development strategy. The broadest strategy considered in this study (Strategy 2) should provide adequate diversification for risk reduction and program complementarity, but the number of activities it included was not nearly as great as the number now being used in the area.

3. Public assistance programs to provide income to unsalvageable (unemployable) poor would be the most massive program in a comprehensive development strategy for the study area. To avoid waste, administrative care is necessary to maintain work incentives among the employable poor and to reward those who work more than those on welfare.

4. Human resource development programs alone have low payoffs and, for efficiency, must be accompanied by programs to generate jobs locally or generate labor mobility to distant jobs. Education (school dropout prevention) and family planning activities were found to be quite shallow in effects, relatively inexpensive and more nearly justifiable on social than on economic grounds in the time frame considered herein.

5. Job development, through industrial incentives or other means, is essential to reach targets considered herein. Industrial development program effectiveness can be enhanced by tying industry subsidies directly to job creation and subsidizing firms according to labor rather than capital use, and by not first investing in area infrastructure and then "hoping" for job development.

6. Subsidized migration of salvageable poor is highly efficient in the use of development funds, but alone is inadequate to alleviate poverty in depressed areas because many people will not move at all and many return who do move. Labor mobility programs complement rather than compete with industrial development programs except, possibly, in the later years of development.

7. Regardless of what programs are included in area development strategies, if poverty elimination is a major goal, efficient strategies must include public assistance grants and job development. Much poverty can be eliminated among salvageable poor by job development, but, for unsalvageable poor, welfare grants are the only means to this end. Other development activities (primarily human resource development) may be supportive of job development activities and have other results which are socially or politically desirable. But resource improvement can yield returns only as these resources are gainfully employed. Industrialization program cost effectiveness was shown to be a major determinant of the rapidity with which results of poverty amelioration are achievable by development strategies. However, for the strategies simulated and the study area considered, results indicated that poverty could be eliminated efficiently—as indicated by economic returns in excess of

public costs—even if actual industrialization effectiveness was very low.

8. Strategies containing post-high school technical training programs in excess of such programs currently existing were not found to be as effective in eliminating poverty or generating income for the study area as similar strategies with technical training excluded. This result likely would not hold for other depressed areas less endowed with formal and informal technical training programs. And, even for the study area considered, if jobs can be generated more efficiently for trained people than for untrained people, then technical training programs may be a necessary aspect of viable area development strategies.

Limitations and Future Research Needs

One obvious limitation of this study is that the results specifically apply only to the study area. Some of the findings, such as the relative payoffs from various development activities in alternative program packages, should have general applications to development plans for other depressed areas. But specific results of alternative development strategies are dependent on the particular income, employment and socio-demographic situations of areas to which such strategies are applied. Thus levels of alternative development programs necessary to attain a critical mass of self sustaining economic activity vary among underdeveloped areas.

This study also was limited by lack of data describing the effects of alternative development activities. For some types of activities no information was available, so the activities were not included. For other activities some information was available, but lacked the precision desired.

Data are, for the most part, unavailable for estimating economic payoffs from state or federal subsidies to develop area infrastructure. No studies were available showing the portion of public investments in such infrastructure items as roads and water and sewer systems going to the poor in underdeveloped areas or the effectiveness of such investments in generating jobs. Also, no information was available on the effects of public processes (e.g. by the extension service) to initiate and maintain local planning activities and development organizations in underdeveloped areas. Cost effectiveness data on such activities would make it possible to include these activities in a systems model such as presented in this thesis.

Although the most complete information available was used, data describing the effects of education (school dropout prevention) programs and family planning programs was much less comprehensive than desired. Both of these activities affect only a small part of the population. Further research could provide information useful in more definitively assessing the potential contributions of these and other area development programs, and also could provide data on chance or random elements to include in a stochastic model of development.

Price decreases for the output of newly developed industries or increases in public costs of programs to generate jobs could result in diminishing returns to industrial development activities. Such diminishing returns are not directly accounted for in the model presented herein. However, this should not be a problem if development programs are focused on ohly a few depressed areas with potential for eventual self sustaining development given a critical mass of assistance. The study area appears to have such potential. Other areas lacking transportation

facilities, adequate population or a growth center may not have such development possibilities. It was assumed that the types of development activities considered would, at most, only be initiated in a few underdeveloped areas dispersed throughout the nation. It was further assumed that there is a sufficient number of expanding local firms or footloose outside industries willing, if subsidized, to locate in such areas so that cost effectiveness coefficients would not change appreciably as more jobs are brought into the area. If, in fact, diminishing returns to public development funds allocated to an area do exist, future research into the problem is needed. Traditional evaluations of development activities examine only one level of costs and returns. Typical studies also give little attention to the distribution of costs and benefits among economic and socio-demographic groups. These traditions will need to change if the concept of systems planning for area development is widely applied.

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APPENDIX

A USER'S GUIDE TO THE RURAL AREA DEVELOPMENT SIMULATOR

A computer listing of the simulator utilized in this research, as programmed for the 360-65 computer at Oklahoma State University, is presented in this appendix along with a brief guide to the use of the program. Required data cards and their formats are indicated in lines 1-120 of the program.

For an initial run (first simulated year) the number of strategies simulated per run must be entered as N (line 32), then the following data must be specified for each strategy according to the formats shown in the program:

CF—First year allocation to unsalvageable poor, age 65 and over (line 35)

CP—First year allocation to unsalvageable poor, age 15-64 (line 35)

CE—First year allocation to education (line 35)

CT—First year allocation to training (line 35)

CS—First year allocation to family planning (line 35)

CI—First year allocation to industrialization (line 35)

CL—First year allocation to labor mobility (line 35)

AL—Number of unsalvageable poor, age 15-64 (line 40)

XNDX—Strategy number (line 40)

B—Number of unsalvageable poor, age 65 and over (line 41)

OLDRCH—Number of nonpoor, age 65 and over (line 41)

E11—Number of salvageable poor with high school and training, age 20-39 (line 42)

F1—Number of high income nonpoor, age 20-39 (line 42)

E12—Number of salvageable poor with high school and training, age 40-64 (line 43)

F2—Number of high income nonpoor, age 40-64 (line 43)

E21—Number of salvageable poor with high school but no training, age 20-39 (line 44)

G1—Number of medium income nonpoor, age 20-39 (line 44)

E22—Number of salvageable poor with high school but no training, age 40-64 (line 45)

G2—Number of medium income nonpoor, age 40-64 (line 45)

E31—Number of salvageable poor with no high school but training, age 20-39 (line 46)

H1—Number of low income nonpoor, age 20-39 (line 46)

E32—Number of salvageable poor with no high school but training, age 40-64 (line 47)

H2—Number of low-income nonpoor, age 40-64 (line 47)

E41—Number of salvageable poor with no high school and no training, age 20-39 (line 48)

H3—Number of low income nonpoor, age 15-19 (line 48)

E42—Number of salvageable poor with no high school and no training, age 40-64 (line 49)

RCHKID—Number of nonpoor children and students less than age 19 (line 49)

E43—Number of salvageable poor with no high school and no training, age 15-19 (line 50)

TH—Number of poor children and students less than age 19 (line 51)

$NO—Number of jobs directly created per dollar of public expenditure on industrialization programs (line 19)

PVCAL—The year being simulated (enter 1 for initial year) (line 120)

All other data are entered as zeros or blanks for the initial run.

Output from the run includes 80 punched cards for each strategy simulated. To run the simulator for a second simulated year, enter the values of CF, CP, CE, CT, CS, CI and CL on one card (line 35) for each strategy, place the card before the 80 computer punchec cards, be sure that the data deck is preceded by the card on which the number of strategies (N) is punched (line 32), and make another run. This process can be continued until the desired number of years (up to 20) have been simulated.

Other variables included in the simulator are identified as follows:

$MBR—Annual birth rate per nonpoor adult, not in school, age 15-40 (line 216)

G—Annual birth rate per poor adult, not in school, age 15-40 (line 211)

DB—Annual death rate for persons, age 65 and over (line 209)

D2—Annual death rate for persons, age 46-64 (line 210)

DA—Annual death rate for unsalvageable poor, age 15-64 (line 208)

GRORT—Annual area population growth rate (line 162)

Q—Minimum annual family income for low income nonpoor (line 137)

GLOW—Minimum annual family income for medium income nonpoor (line 202)

FLOW—Minimum annual family income for high income nonpoor (line 203)

AH—Poverty threshold for unsalvageable poor age 65 and over (per person) (line 136)

$MULT—Area income resulting per dollar of public funds spent on development activities (line 189)

PERPR—Proportion of area income which goes to the poor (line 184)

AB—Number of adults removed from poverty per job created for the poor (line 132)

AE—Proportion of normal working age adults in labor force (line 135)

AC—Proportion of poor in the labor force who have jobs but are underemployed (line 1353)

AD—Percent underemployment of underemployed poor (line 134)

$M—Number of people moved to jobs per dollar of public expenditure on labor mobility programs

PERLM—Proportion of labor mobility allocation funds which goes to purposes other than relocation assistance allowances (administration, training, and counseling) (line 185)

$MXRET—Proportion of relocatees who eventually return to study area (limit to program attrition) (line 193)

A—Proportion of relocatees outside study area who do not return each year (until liminal attrition level is reached) (line 191)

X11—Average annual earnings for poor persons with high school training, age 20-39, employed in jobs made available by labor mobility activities (line 194)

X12—Average annual earnings for poor persons with high school and training, age 40-64, employed in jobs made available by labor mobility activities (line 195)

X21—Average annual earnings for poor persons with high school but no training, age 20-39, employed in jobs made available by labor mobility activities (line 196)

X22—Average annual earnings for poor persons with high school but no training, age 40-64, employed in jobs made available by labor mobility activities (line 197).

X31—Average annual earnings for poor persons with no high school but training, age 20-39, employed in jobs made available by labor mobility activities (line 198)

X32—Average annual earnings for poor persons with no high school but training, age 40-64, employed in jobs made available by labor mobility activities (line 199)

X41—Average annual earnings for poor persons with no high school or no training, age 20-39, employed in jobs made available by labor mobility activities (line 200)

X42—Average annual earnings for poor persons with no high school or no training, age 40-64, employed in jobs made available by labor mobility activities (line 201)

CM—Total area jobs resulting per direct job generated by industrialization (line 174)

PC—Proportion of jobs generated by industrialization which go to area's poor (line 173)

RCHIN—New jobs going to nonpoor within the area as a percentage of all new jobs going to people other than the area's poor (line 186)

RCHOVR—The proportion of jobs vacated by nonpoor workers which are refilled (line 187)

Z11—Average annual earnings for poor persons with high school and training, age 20-39, employed in jobs generated by industrialization activities (line 175)

Z12—Average annual earnings for poor persons with high school and training, age 40-64, employed in jobs generated by industrialization activities (line 176)

Z21—Average annual earnings for poor persons with high school, but no training, age 20-39 employed in jobs generated by industrialization activities (line 177)

Z22—Average annual earnings for poor persons with high school but no training, age 40-64, employed in jobs generated by industrialization activities (line 178)

Z31—Average annual earnings for poor persons with no high school but training, age 20-39, employed in jobs generated by industrialization activities (line 179)

Z32—Average annual earnings for poor persons with no high school but training, age 40-64, employed in jobs generated by industrialization activities (line 180)

Z41—Average annual earnings for poor persons with no high school and no training, age 20-39, employed in jobs generated by industrialization activities (line 181)

Z42—Average annual earnings for poor persons with no high school and no training, age 40-64, employed in jobs generated by industrialization activities (line 182)

Z43—Average annual earnings for poor persons with no high school and no training, age 15-19, employed in jobs generated by industrialization activities (line 183)

RTRD—Physically or mentally disabled students as an annual percentage of students, age 15-19 (line 218)

S—Annual school dropout rate for capable poor students, age 15-19 (line 212)

$MDP—Annual school dropout rate for capable nonpoor students, age 15-19 (line 217)

U—Number of potential dropouts kept in school per dollar of public expenditure on education programs (line 215)

DCR—Number of unplanned poor births avoided per dollar of public expenditure on family planning programs (line 213)

DSCNT—Discount rate (line 172)

80/80 LIST

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      00000000011111111112222222222333333333344444444445555555556666666666777777777 8
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
    1         DIMENSION XNDXA(100)
    2         DIMENSION TALA (100)
    3         DIMENSION TOPOPA(100)
    4         DIMENSION TOPRA(100)
    5         DIMENSION PPYA(100)
    6         DIMENSION BCPRA(100)
    7         DIMENSION BCTOTA(100)
    8         DIMENSION WLFYSA(100)
    9         DIMENSION WLFNOA(100)
   10         DIMENSION TOWLFA(100)
   11         DIMENSION WLFCPA(100)
   12         DIMENSION TOPOA1(100)
   13         DIMENSION TOPRA1(100)
   14         DIMENSION GRD(100)
   15         DO 9992 NDX=1,100
   16         XNDXA(NDX)=0.0
   17         TALA(NDX)=0.0
   18         TOPOPA(NDX)=0.0
   19         TOPRA(NDX)=0.0
   20         PPYA(NDX)=0.0
   21         BCPRA(NDX)=0.0
   22         BCTOTA(NDX)=0.0
   23         WLFYSA(NDX)=0.0
   24         WLFNOA(NDX)=0.0
   25         TOWLFA(NDX)=0.0
   26         WLFCPA(NDX)=0.0
   27         TOPOA1(NDX)=0.0
   28         TOPRA1(NDX)=0.0
   29         GRD(NDX)=0.0
   30    9992 CONTINUE
   31    9991 FORMAT(I10)
   32         READ(5,9991)N
   33    9999 FORMAT(F25.8)
   34    9997 FORMAT(7F10.0)
   35   99998 READ(5,9997,END=99999)CF,CP,CE,CT,CS,CI,CL
   36    9998 FORMAT(F25.8,2X,F10.0,39X,F4.0)
   37    9995 FORMAT(2F20.0)
   38    9993 FORMAT(F25.0,F25.8)
   39    9994 FORMAT(2F25.0)
   40         READ(5,9998)AL,PPY,XNDX
   41         READ(5,9995)B,OLDRCH
   42         READ(5,9995)E11,F1
   43         READ(5,9995)E12,F2
   44         READ(5,9995)E21,G1
   45         READ(5,9995)E22,G2
   46         READ(5,9995)E31,H1
   47         READ(5,9995)E32,H2
   48         READ(5,9995)E41,H3
   49         READ(5,9995)E42,RCHKID
   50         READ(5,9999)E43
   51         READ(5,9999)TH
   52         READ(5,9994)YI1,COST1
   53         READ(5,9994)YI2,COST2
   54         READ(5,9994)YI3,COST3
```

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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
   55         READ(5,9994)YI4,COST4
   56         READ(5,9994)YI5,COST5
   57         READ(5,9994)YI6,COST6
   58         READ(5,9994)YI7,COST7
   59         READ(5,9994)YI8,COST8
   60         READ(5,9994)YI9,COST9
   61         READ(5,9994)YI10,COST10
   62         READ(5,9994)YI11,COST11
   63         READ(5,9994)YI12,COST12
   64         READ(5,9994)YI13,COST13
   65         READ(5,9994)YI14,COST14
   66         READ(5,9994)YI15,COST15
   67         READ(5,9994)YI16,COST16
   68         READ(5,9994)YI17,COST17
   69         READ(5,9994)YI18,COST18
   70         READ(5,9994)YI19,COST19
   71         READ(5,9994)YL1,COST20
   72         READ(5,9993)YL2,HE11
   73         READ(5,9993)YL3,HE21
   74         READ(5,9993)YL4,HE31
   75         READ(5,9993)YL5,HE41
   76         READ(5,9993)YL6,HSTAY
   77         READ(5,9993)YL7,OLDGRO
   78         READ(5,9993)YL8,F1GRO
   79         READ(5,9993)YL9,F2GRO
   80         READ(5,9993)YL10,G1GRO
   81         READ(5,9993)YL11,G2GRO
   82         READ(5,9993)YL12,H1GRO
   83         READ(5,9993)YL13,H2GRO
   84         READ(5,9993)YL14,H3GRO
   85         READ(5,9993)YL15,RHKGRO
   86         READ (5,9993)YL16,$MBTOT
   87         READ (5,9993)YL17,RETTOT
   88         READ(5,9999)YL18
   89         READ(5,9999)YL19
   90         READ(5,9999)SM11
   91         READ(5,9999)SM12
   92         READ(5,9999)SM21
   93         READ(5,9999)SM22
   94         READ(5,9999)SM31
   95         READ(5,9999)SM32
   96         READ(5,9999)SM41
   97         READ(5,9994)SM42,RMB
   98 9996 FORMAT (3F25.0)
   99         READ(5,9996)Y1,YRCH1,YTOT1
  100         READ(5,9996)Y2,YRCH2,YTOT2
  101         READ(5,9996)Y3,YRCH3,YTOT3
  102         READ(5,9996)Y4,YRCH4,YTOT4
  103         READ(5,9996)Y5,YRCH5,YTOT5
  104         READ(5,9996)Y6,YRCH6,YTOT6
  105         READ(5,9996)Y7,YRCH7,YTOT7
  106         READ(5,9996)Y8,YRCH8,YTOT8
  107         READ(5,9996)Y9,YRCH9,YTOT9
  108         READ(5,9996)Y10,YRCH10,YTOT10
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      00000000011111111112222222223333333334444444444555555555566666666667777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
 109          READ(5,9996)Y11,YRCH11,YTOT11
 110          READ(5,9996)Y12,YRCH12,YTOT12
 111          READ(5,9996)Y13,YRCH13,YTOT13
 112          READ(5,9996)Y14,YRCH14,YTOT14
 113          READ(5,9996)Y15,YRCH15,YTOT15
 114          READ(5,9996)Y16,YRCH16,YTOT16
 115          READ(5,9996)Y17,YRCH17,YTOT17
 116          READ(5,9996)Y18,YRCH18,YTOT18
 117          READ(5,9996)Y19,YRCH19,YTOT19
 118          READ(5,9996)Y20,YRCH20,YTOT20
 119          READ(5,9999)$NO
 120          READ(5,9999)PVCAL
 121          OLDRHS=OLDRCH
 122          F1S=F1
 123          F2S=F2
 124          G1S=G1
 125          G2S=G2
 126          H1S=H1
 127          H2S=H2
 128          H3S=H3
 129          RCHKDS=RCHKID
 130          TOTRHS=OLDRHS+F1S+F2S+G1S+G2S+H1S+H2S+H3S+RCHKDS
 131          $OLDRH=5327
 132          AB=1.4406
 133          AC=0.7022
 134          AD=0.6667
 135          AE=0.7739
 136          AH=1704.
 137          Q=4000.0
 138          IF (PVCAL.GT.1.0) GO TO 6
 139          OLDGRO= OLDRHS/TOTRHS
 140          F1GRO=F1S/TOTRHS
 141          F2GRO=F2S/TOTRHS
 142          G1GRO=G1S/TOTRHS
 143          G2GRO=G2S/TOTRHS
 144          H1GRO=H1S/TOTRHS
 145          H2GRO=H2S/TOTRHS
 146          H3GRO=H3S/TOTRHS
 147          RHKGRO=RCHKDS/TOTRHS
 148        6 ALS=AL
 149          BS=B
 150          E11S=E11
 151          E12S=E12
 152          E21S=E21
 153          E22S=E22
 154          E31S=E31
 155          E32S=E32
 156          E41S=E41
 157          E42S=E42
 158          E43S=E43
 159          THS=TH
 160          QOLD=AH
 161          QDSBL=Q/AB
 162          GRORT=0.0085
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      0000000001111111111222222222233333333334444444444555555555566666666667777777778
      1234567890123456789012345678901234567890123456789012345678901234567890123456789
CARD
 163          E11=(E11/AB)*((1-AC)+AC*AD)
 164          E12=(E12/AB)*((1-AC)+AC*AD)
 165          E21=(E21/AB)*((1-AC)+AC*AD)
 166          E22=(E22/AB)*((1-AC)+AC*AD)
 167          E31=(E31/AB)*((1-AC)+AC*AD)
 168          E32=(E32/AB)*((1-AC)+AC*AD)
 169          E41=(E41/AB)*((1-AC)+AC*AD)
 170          E42=(E42/AB)*((1-AC)+AC*AD)
 171          E43=(E43/AB)*((1-AC)+AC*AD)
 172          DSCNT=0.06
 173          PC=0.33
 174          CM=2.3031
 175          Z11=9231.
 176          Z12=9231.
 177          Z21=6882.
 178          Z22=6882.
 179          Z31=6882.
 180          Z32=6882.
 181          Z41=5821.
 182          Z42=5821.
 183          Z43=4000.
 184          PERPR=0.1309
 185          PERLM=.66
 186          RCHIN=0.76
 187          RCHOVR=0.78
 188          PERCT=0.0
 189          $MULT=1.0720
 190          $M=0.00106952
 191          A=0.70
 192          AKEEP=A
 193          $MXRET=0.67
 194          X11=9231.
 195          X12=9231.
 196          X21=6882.
 197          X22=6882.
 198          X31=6882.
 199          X32=6882.
 200          X41=5821.
 201          X42=5821.
 202          GLOW=8000.
 203          FLOW=15000.0
 204          $F=0.0
 205          $G=0.0
 206          $H=0.0
 207          $H3=0.0
 208          DA=0.004137
 209          DB=0.064469
 210          D2=0.008075
 211          G=0.1048
 212          S=0.0123
 213          DCR=0.0010204
 214          V=0.000684
 215          U=0.0002520
 216          $MBR=0.0665
```

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      0000000001111111111222222222233333333334444444444555555555566666666667777777778
      1234567890123456789012345678901234567890123456789012345678901234567890123456789
CARD
 217        $MDP=0.0085
 218        RTRD=0.0178
 219        RCT1=0
 220        RCT2=0
 221        RCT3=0
 222        RCT4=0
 223        RCL=0
 224        RCI=0
 225        RCF=0
 226        RCP=0
 227        RCE=0
 228        RCS=0
 229        E11RCH=0
 230        E12RCH=0
 231        E21RCH=0
 232        E22RCH=0
 233        E31RCH=0
 234        E32RCH=0
 235        E41RCH=0
 236        E42RCH=0
 237        E43RCH=0
 238        AF=F1+F2+G1+G2+H1+H2+H3
 239        AG=AE*AF
 240        RICH=$NO*CM*(1-PC)
 241        RCHPR=RICH*RCHIN*RCHOVR
 242        $N=$NO*CM*PC+RCHPR
 243        IF ((CI*$N).GT.E11) GO TO 500
 244        YI=CI*$N*Z11
 245        IF ((CL*$M).GT.(E11-CI*$N)) GO TO 50
 246        YL=CL*$M*A*X11
 247        GET=0.0
 248      1 E11=E11*AB/((1-AC)+AC*AD)
 249        E12=E12*AB/((1-AC)+AC*AD)
 250        E21=E21*AB/((1-AC)+AC*AD)
 251        E22=E22*AB/((1-AC)+AC*AD)
 252        E31=E31*AB/((1-AC)+AC*AD)
 253        E32=E32*AB/((1-AC)+AC*AD)
 254        E41=E41*AB/((1-AC)+AC*AD)
 255        E42=E42*AB/((1-AC)+AC*AD)
 256        E43=E43*AB/((1-AC)+AC*AD)
 257        $M1=$M
 258        $N1=$N
 259        $M=$M*AB/((1-AC)+(AC*AD))
 260        $N=$N*AB/((1-AC)+(AC*AD))
 261        $MTEL=1.0/$M
 262        $NTEL=1.0/$N
 263        VTEL=1.0/V
 264        DIOUT=D2*(SM12+SM22+SM32+SM42)+DB*RMB
 265        RM11=SM11-(SM11/20.0)
 266        RM12=SM12-D2*SM12-((SM12-D2*SM12)/25.0)+SM11/20.0
 267        RM21=SM21-SM21/20.0
 268        RM22=SM22-D2*SM22-((SM22-D2*SM22)/25.0)+SM21/20.0
 269        RM31=SM31-SM31/20.0
 270        RM32=SM32-D2*SM32-((SM32-D2*SM32)/25.0)+SM31/20.0
```

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      00000000011111111112222222223333333334444444444555555555566666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
 271        RM41=SM41-SM41/20.0
 272        RM42=SM42-D2*SM42-((SM42-D2*SM42)/25.0)+SM41/20.0
 273        RMB=(SM12-D2*SM12+SM22-D2*SM22+SM32-D2*SM32+SM42-D2*SM42)/25+RMB-
 274       1RMB*DB
 275        RMTOT=RM11+RM12+RM21+RM22+RM31+RM32+RM41+RM42+RMB
 276        RET11=RM11*(1.0-A)
 277        RET12=RM12*(1.0-A)
 278        RET21=RM21*(1.0-A)
 279        RET22=RM22*(1.0-A)
 280        RET31=RM31*(1.0-A)
 281        RET32=RM32*(1.0-A)
 282        RET41=RM41*(1.0-A)
 283        RET42=RM42*(1.0-A)
 284        RETB=(1.0-A)*RMB
 285        RETOT1=RET11+RET12+RET21+RET22+RET31+RET32+RET41+RET42+RETB
 286        RETTOT=RETTOT+RETOT1
 287        IF (RETTOT.LE.$MXRET*$MBTOT) GO TO 21
 288        IF (RETTOT-RETOT1.GT.$MXRET*$MBTOT) GO TO 19
 289        A=(RMTOT-$MXRET*$MBTOT+(RETTOT-RETOT1))/RMTOT
 290        GO TO 20
 291     19 A=1.0
 292     20 RET11=RM11*(1.0-A)
 293        RET12=RM12*(1.0-A)
 294        RET21=RM21*(1.0-A)
 295        RET22=RM22*(1.0-A)
 296        RET31=RM31*(1.0-A)
 297        RET32=RM32*(1.0-A)
 298        RET41=RM41*(1.0-A)
 299        RET42=RM42*(1.0-A)
 300        RETB=RMB*(1.0-A)
 301        RETTOT=RETTOT-RETOT1
 302        RETOT1=RET11+RET12+RET21+RET22+RET31+RET32+RET41+RET42+RETB
 303        RETTOT=RETTOT+RETOT1
 304     21 YI20=YI19
 305        YI19=YI18
 306        YI18=YI17
 307        YI17=YI16
 308        YI16=YI15
 309        YI15=YI14
 310        YI14=YI13
 311        YI13=YI12
 312        YI12=YI11
 313        YI11=YI10
 314        YI10=YI9
 315        YI9=YI8
 316        YI8=YI7
 317        YI7=YI6
 318        YI6=YI5
 319        YI5=YI4
 320        YI4=YI3
 321        YI3=YI2
 322        YI2=YI1
 323        YI1=YI
 324        YL20=YL19*A
```

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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
  325         YL19=YL18*A
  326         YL18=YL17*A
  327         YL17=YL16*A
  328         YL16=YL15*A
  329         YL15=YL14*A
  330         YL14=YL13*A
  331         YL13=YL12*A
  332         YL12=YL11*A
  333         YL11=YL10*A
  334         YL10=YL9*A
  335         YL9=YL8*A
  336         YL8=YL7*A
  337         YL7=YL6*A
  338         YL6=YL5*A
  339         YL5=YL4*A
  340         YL4=YL3*A
  341         YL3=YL2*A
  342         YL2=YL1*A
  343         YL1=YL
  344         A=AKEEP
  345         RETR=(TH/4.0)*RTRD
  346         SMRT=(TH/4.0)-RETR
  347         IF ((U*CE).GT.((SMRT)*S)-(SMRT)*$MDP) GO TO 2
  348         S1=(SMRT*S-U*CE)/SMRT
  349         GO TO 3
  350       2 S1=$MDP
  351         RCE=(U*CE-((SMRT)*S-SMRT*$MDP))/U
  352       3 IF (((E11+E21+E31+E41+E43+AL/2)*G-DCR*CS).GT.($MBR*(E11+E21+E31+
  353        1E41+E43+AL/2)))GO TO 4
  354         THA=TH
  355         H=(SMRT/5.0)-(SMRT/5.0)*S1
  356         F=SMRT*S1
  357         THB=THA+(E11+E21+E31+E41+E43+AL/2)*$MBR-F-H-RETR
  358         RCS=($MBR*(E11+E21+E31+E41+E43+AL/2)-((E11+E21+E31+E41+E43+AL/2)
  359        1*G-DCR*CS))/DCR
  360         GO TO 5
  361       4 THA=TH
  362         H=(SMRT/5.0)-(SMRT/5.0)*S1
  363         F=SMRT*S1
  364         THB=THA+(E11+E21+E31+E41+E43+AL/2)*G-(DCR*CS)-F-H-RETR
  365       5 TH=THB
  366      10 IF (GET .EQ. 1.0) GO TO 51
  367         IF (GET .EQ. 2.0) GO TO 101
  368         IF (GET .EQ. 3.0) GO TO 151
  369         IF (GET .EQ. 4.0) GO TO 201
  370         IF (GET .EQ. 5.0) GO TO 251
  371         IF (GET .EQ. 6.0) GO TO 301
  372         IF (GET .EQ. 7.0) GO TO 351
  373         IF (GET .EQ. 8.0) GO TO 401
  374         IF (GET .EQ. 9.0) GO TO 501
  375         IF (GET .EQ. 10.0) GO TO 551
  376         IF (GET .EQ. 11.0) GO TO 601
  377         IF (GET .EQ. 12.0) GO TO 651
  378         IF (GET .EQ. 13.0) GO TO 701
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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
  379       IF (GET .EQ. 14.0) GO TO 751
  380       IF (GET .EQ. 15.0) GO TO 801
  381       IF (GET .EQ. 16.0) GO TO 851
  382       IF (GET .EQ. 17.0) GO TO 1001
  383       IF (GET .EQ. 18.0) GO TO 1051
  384       IF (GET .EQ. 19.0) GO TO 1101
  385       IF (GET .EQ. 20.0) GO TO 1151
  386       IF (GET .EQ. 21.0) GO TO 1201
  387       IF (GET .EQ. 22.0) GO TO 1251
  388       IF (GET .EQ. 23.0) GO TO 1301
  389       IF (GET .EQ. 24.0) GO TO 1501
  390       IF (GET .EQ. 25.0) GO TO 1551
  391       IF (GET .EQ. 26.0) GO TO 1601
  392       IF (GET .EQ. 27.0) GO TO 1651
  393       IF (GET .EQ. 28.0) GO TO 1701
  394       IF (GET .EQ. 29.0) GO TO 1751
  395       IF (GET .EQ. 30.0) GO TO 2001
  396       IF (GET .EQ. 31.0) GO TO 2051
  397       IF (GET .EQ. 32.0) GO TO 2101
  398       IF (GET .EQ. 33.0) GO TO 2151
  399       IF (GET .EQ. 34.0) GO TO 2201
  400       IF (GET .EQ. 35.0) GO TO 2501
  401       IF (GET .EQ. 36.0) GO TO 2551
  402       IF (GET .EQ. 37.0) GO TO 2601
  403       IF (GET .EQ. 38.0) GO TO 2651
  404       IF (GET .EQ. 39.0) GO TO 3001
  405       IF (GET .EQ. 40.0) GO TO 3051
  406       IF (GET .EQ. 41.0) GO TO 3101
  407       IF (GET .EQ. 42.0) GO TO 3501
  408       IF (GET .EQ. 43.0) GO TO 3551
  409       IF (GET .EQ. 44.0) GO TO 4001
  410       IF (GET .EQ. 45.0) GO TO 4051
  411       SM11=RM11-RET11+CL*$M*A
  412       SM12=RM12-RET12
  413       SM21=RM21-RET21
  414       SM22=RM22-RET22
  415       SM31=RM31-RET31
  416       SM32=RM32-RET32
  417       SM41=RM41-RET41
  418       SM42=RM42-RET42
  419       DEN=E21+E22+E41+E42
  420       E11RCH=CI*$N
  421       IF ((V*CT)*(E21/DEN).GT.E21) GO TO 11
  422       R11=E11-CI*$N-CL*$M*A+V*CT*(E21/DEN)
  423       R21=E21-V*CT*(E21/DEN)
  424       GO TO 12
  425    11 R11=E11-CI*$N-CL*$M*A+E21
  426       R21=0
  427       RCT1=((V*CT)*(E21/DEN)-E21)/V
  428    12 IF ((V*CT)*(E41/DEN).GT.E41) GO TO 13
  429       R31=E31+V*CT*(E41/DEN)
  430       R41=E41-V*CT*(E41/DEN)
  431       GO TO 14
  432    13 R31=E31+E41
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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
 433        R41=0
 434        RCT2=((V*CT)*(E41/DEN)-E41)/V
 435     14 IF ((V*CT)*(E22/DEN).GT.E22) GO TO 15
 436        R12=E12+V*CT*(E22/DEN)-D2*(E12+V*CT*(E22/DEN))
 437        R22=E22-V*CT*(E22/DEN)-D2*(E22-V*CT*(E22/DEN))
 438        GO TO 16
 439     15 R12=E12+E22-D2*(E12+E22)
 440        R22=0
 441        RCT3=((V*CT)*(E22/DEN)-E22)/V
 442     16 IF ((V*CT*(E42/DEN)).GT.E42) GO TO 17
 443        R32=E32+V*CT*(E42/DEN)-D2*(E32+V*CT*(E42/DEN))
 444        R42=E42-V*CT*(E42/DEN)-D2*(E42-V*CT*(E42/DEN))
 445        GO TO 18
 446     17 R32=E32+E42-D2*(E32+E42)
 447        R42=0
 448        RCT4=((V*CT)*(E42/DEN)-E42)/V
 449     18 R43=E43+F
 450        GO TO 9000
 451     50 IF (CL*$M-(E11-CI*$N).GT.E12) GO TO 100
 452        YL=(E11-CI*$N)*A*X11+(CL*$M-(E11-CI*$N))*A*X12
 453        GET=1.0
 454        GO TO 1
 455     51 $NUM1=E11-CI*$N
 456        $NUM2=CL*$M-$NUM1
 457        DEN=E21+E22+E41+E42
 458        SM11=RM11-RET11+$NUM1*A
 459        SM12=RM12-RET12+$NUM2*A
 460        SM21=RM21-RET21
 461        SM22=RM22-RET22
 462        SM31=RM31-RET31
 463        SM32=RM32-RET32
 464        SM41=RM41-RET41
 465        SM42=RM42-RET42
 466        IF (V*CT*(E21/DEN).GT.E21) GO TO 52
 467        R11=$NUM1*(1.0-A)+V*CT*(E21/DEN)
 468        R21=E21-V*CT*(E21/DEN)
 469        GO TO 53
 470     52 R11=E21+$NUM1*(1.0-A)
 471        R21=0
 472        RCT1=((V*CT)*(E21/DEN)-E21)/V
 473     53 IF (V*CT*(E41/DEN).GT.E41) GO TO 54
 474        R31=E31+V*CT*(E41/DEN)
 475        R41=E41-V*CT*(E41/DEN)
 476        GO TO 55
 477     54 R31=E31+E41
 478        R41=0
 479        RCT2=((V*CT)*(E41/DEN)-E41)/V
 480     55 IF (V*CT*(E22/DEN).GT.E22)GO TO 56
 481        R12=E12-$NUM2*A+V*CT*(E22/DEN)-D2*(E12-$NUM2*A+V*CT*(E22/DEN))
 482        R22=E22-V*CT*(E22/DEN)-D2*(E22-V*CT*(E22/DEN))
 483        GO TO 57
 484     56 R12=E12-$NUM2*A+E22-D2*(E12-$NUM2*A+E22)
 485        R22=0
 486        RCT3=((V*CT)*(E22/DEN)-E22)/V
```

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      00000000011111111112222222223333333333444444444455555555556666666666777777777 8
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
 487     57 IF (V*CT*(E42/DEN).GT.E42) GO TO 58
 488        R32=E32+V*CT*(E42/DEN)-D2*(E32+V*CT*(E42/DEN))
 489        R42=E42-V*CT*(E42/DEN)-D2*(E42-V*CT*(E42/DEN))
 490        GO TO 59
 491     58 R32=E32+E42-D2*(E32+E42)
 492        R42=0
 493        RCT4=((V*CT)*(E42/DEN)-E42)/V
 494     59 R43=E43+F
 495        GO TO 9000
 496    100 IF (CL*$M-(E11-CI*$N)-E12.GT.E21)GO TO 150
 497        YL=(E11-CI*$N)*A*X11+E12*A*X12+(CL*$M-(E11-CI*$N)-E12)*A*X21
 498        GET=2.0
 499        GO TO 1
 500    101 $NUM=CL*$M-(E11-CI*$N)-E12
 501        DEN=E21-$NUM+E22+E41+E42
 502        SM11=RM11-RET11+(E11-CI*$N)*A
 503        SM12=RM12-RET12+E12*A
 504        SM21=RM21-RET21+$NUM*A
 505        SM22=RM22-RET22
 506        SM31=RM31-RET31
 507        SM32=RM32-RET32
 508        SM41=RM41-RET41
 509        SM42=RM42-RET42
 510        IF (V*CT*((E21-$NUM)/DEN).GT.E21-$NUM) GO TO 102
 511        R11=(E11-CI*$N)*(1.0-A)+V*CT*((E21-$NUM)/DEN)
 512        R21=E21-$NUM*A-V*CT*((E21-$NUM)/DEN)
 513        GO TO 103
 514    102 R11=E21-$NUM+(E11-CI*$N)*(1.0-A)
 515        R21=$NUM*(1.0-A)
 516        RCT1=((V*CT)*((E21-$NUM)/DEN)-(E21-$NUM))/V
 517    103 IF (V*CT*(E41/DEN).GT.E41) GO TO 104
 518        R31=E31+V*CT*(E41/DEN)
 519        R41=E41-V*CT*(E41/DEN)
 520        GO TO 105
 521    104 R31=E31+E41
 522        R41=0
 523        RCT2=((V*CT)*(E41/DEN)-E41)/V
 524    105 IF (V*CT*(E22/DEN).GT.E22) GO TO 106
 525        R12=E12*(1.0-A)+V*CT*(E22/DEN)-D2*(E12*(1.0-A)+V*CT*(E22/DEN))
 526        R22=E22-V*CT*(E22/DEN)-D2*(E22-V*CT*(E22/DEN))
 527        GO TO 107
 528    106 R12=E12*(1.0-A)+E22-D2*(E12*(1.0-A)+E22)
 529        R22=0
 530        RCT3=((V*CT)*(E22/DEN)-E22)/V
 531    107 IF (V*CT*(E42/DEN).GT.E42) GO TO 108
 532        R32=E32+V*CT*(E42/DEN)-D2*(E32+V*CT*(E42/DEN))
 533        R42=E42-V*CT*(E42/DEN)-D2*(E42-V*CT*(E42/DEN))
 534        GO TO 109
 535    108 R32=E32+E42-D2*(E32+E42)
 536        R42=0
 537        RCT4=((V*CT)*(E42/DEN)-E42)/V
 538    109 R43=E43+F
 539        GO TO 9000
 540    150 IF (CL*$M-(E11-CI*$N)-E12-E21.GT.E22)GO TO 200
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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
  541       YL=(E11-CI*$N)*A*X11+E12*A*X12+E21*A*X21+(CL*$M-(E11-CI*$N)-E12-
  542      1E21)*A*X22
  543       GET=3.0
  544       GO TO 1
  545   151 $NUM=CL*$M-(E11-CI*$N)-E12-E21
  546       DEN=E22-$NUM+E41+E42
  547       SM11=RM11-RET11+(E11-CI*$N)*A
  548       SM12=RM12-RET12+E12*A
  549       SM21=RM21-RET21+E21*A
  550       SM22=RM22-RET22+$NUM*A
  551       SM31=RM31-RET31
  552       SM32=RM32-RET32
  553       SM41=RM41-RET41
  554       SM42=RM42-RET42
  555       R11=(E11-CI*$N)*(1.0-A)
  556       R21=E21*(1.0-A)
  557       IF(V*CT*(E41/DEN).GT.E41)GO TO 152
  558       R31=E31+V*CT*(E41/DEN)
  559       R41=E41-V*CT*(E41/DEN)
  560       GO TO 153
  561   152 R31=E31+E41
  562       R41=0
  563       RCT2=((V*CT)*(E41/DEN)-E41)/V
  564   153 IF(V*CT*((E22-$NUM)/DEN).GT.E22-$NUM) GO TO 154
  565       R12=E12*(1.0-A)+V*CT*((E22-$NUM)/DEN)-D2*(E12*(1.0-A)+V*CT*(E22-
  566      1$NUM)/DEN)
  567       R22=E22-$NUM*A-V*CT*((E22-$NUM)/DEN)-D2*(E22-$NUM*A-V*CT*(E22-
  568      1$NUM)/DEN)
  569       GO TO 155
  570   154 R12=E12*(1.0-A)+E22-$NUM-D2*(E12*(1.0-A)+E22-$NUM)
  571       R22=$NUM*(1.0-A)-D2*($NUM*(1.0-A))
  572       RCT3=(V*CT*((E22-$NUM)/DEN)-(E22-$NUM))/V
  573   155 IF(V*CT*(E42/DEN).GT.E42) GO TO 156
  574       R32=E32+V*CT*(E42/DEN)-D2*(E32+V*CT*(E42/DEN))
  575       R42=E42-V*CT*(E42/DEN)-D2*(E42-V*CT*(E42/DEN))
  576       GO TO 157
  577   156 R32=E32+E42-D2*(E32+E42)
  578       R42=0
  579       RCT4=((V*CT)*(E42/DEN)-E42)/V
  580   157 R43=E43+F
  581       GO TO 9000
  582   200 IF (CL*$M-(E11-CI*$N)-E12-E21-E22.GT.E31) GO TO 250
  583       YL=(E11-CI*$N)*A*X11+E12*A*X12+E21*A*X21+E22*A*X22+(CL*$M-(E11-CI*
  584      1$N)-E12-E21-E22)*A*X31
  585       GET=4.0
  586       GO TO 1
  587   201 $NUM=CL*$M-(E11-CI*$N)-E12-E21-E22
  588       DEN=E31-$NUM+E41+E42
  589       SM11=RM11-RET11+(E11-CI*$N)*A
  590       SM12=RM12-RET12+E12*A
  591       SM21=RM21-RET21+E21*A
  592       SM22=RM22-RET22+E22*A
  593       SM31=RM31-RET31+$NUM*A
  594       SM42=RM42-RET42
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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
 595        SM32=RM32-RET32
 596        SM41=RM41-RET41
 597        R11=(E11-CI*$N)*(1.0-A)
 598        R21=(E21)*(1.0-A)
 599        IF (V*CT*(E41/DEN).GT.E41) GO TO 202
 600        R31=E31-$NUM*A+V*CT*(E41/DEN)
 601        R41=E41-V*CT*(E41/DEN)
 602        GO TO 203
 603    202 R31=E31-$NUM*A+E41
 604        R41=0
 605        RCT2=((V*CT)*(E41/DEN)-E41)/V
 606    203 R12=E12*(1.0-A)-D2*(E12*(1.0-A))
 607        R22=E22*(1.0-A)-D2*(E22*(1.0-A))
 608        IF (V*CT*(E42/DEN).GT.E42) GO TO 204
 609        R32=E32+V*CT*(E42/DEN)-D2*(E32+V*CT*(E42/DEN))
 610        R42=E42-V*CT*(E42/DEN)-D2*(E42-V*CT*(E42/DEN))
 611        GO TO 205
 612    204 R32=E32+E42-D2*(E32+E42)
 613        R42=0
 614        RCT4=((V*CT)*(E42/DEN)-E42)/V
 615    205 R43=E43+F
 616        GO TO 9000
 617    250 IF((CL*$M-(E11-CI*$N)-E12-E21-E22-E31).GT.E32) GO TO 300
 618        YL=(E11-CI*$N)*A*X11+E12*A*X12+E21*A*X21+E22*A*X22+E31*A*X31+
 619       1(CL*$M-(E11-CI*$N)-E12-E21-E22-E31)*A*X32
 620        GET=5.0
 621        GO TO 1
 622    251 $NUM=CL*$M-(E11-CI*$N)-E12-E21-E22-E31
 623        DEN=E41+E42
 624        SM11=RM11-RET11+(E11-CI*$N)*A
 625        SM12=RM12-RET12+E12*A
 626        SM21=RM21-RET21+E21*A
 627        SM22=RM22-RET22+E22*A
 628        SM31=RM31-RET31+E31*A
 629        SM32=RM32-RET32+$NUM*A
 630        SM41=RM41-RET41
 631        SM42=RM42-RET42
 632        R11=(E11-CI*$N)*(1.0-A)
 633        R21=E21*(1.0-A)
 634        IF (V*CT*(E41/DEN).GT.E41) GO TO 252
 635        R31=E31*(1.0-A)+V*CT*(E41/DEN)
 636        R41=E41-V*CT*(E41/DEN)
 637        GO TO 253
 638    252 R31=E31*(1.0-A)+E41
 639        R41=0
 640        RCT2=((V*CT)*(E41/DEN)-E41)/V
 641    253 R12=E12*(1.0-A)-D2*(E12*(1.0-A))
 642        R22=E22*(1.0-A)-D2*(E22*(1.0-A))
 643        IF (V*CT*(E42/DEN).GT.E42) GO TO 254
 644        R32=E32-$NUM*A+V*CT*(E42/DEN)-D2*(E32-$NUM*A+V*CT*(E42/DEN))
 645        R42=E42-V*CT*(E42/DEN)-D2*(E42-V*CT*(E42/DEN))
 646        GO TO 255
 647    254 R32=E32-$NUM*A+E42-D2*(E32-$NUM*A+E42)
 648        R42=0
```

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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
 649        RCT4=((V*CT)*(E42/DEN)-E42)/V
 650     255 R43=E43+F
 651        GO TO 9000
 652     300 IF((CL*$M-(E11-CI*$N)-E12-E21-E22-E31-E32).GT.E41)GO TO 350
 653        YL=(E11-CI*$N)*A*X11+E12*A*X12+E21*A *X21+E22*A*X22+E31*A*X31+E32*
 654       1A*X32+ (CL*$M-(E11-CI*$N)-E12-E21-E22-E31-E32)*A*X41
 655        GET=6.0
 656        GO TO 1
 657     301 $NUM=CL*$M-(E11-CI*$N)-E12-E21-E22-E31-E32
 658        DEN=E41-$NUM+E42
 659        SM11=RM11-RET11+(E11-CI*$N)*A
 660        SM12=RM12-RET12+E12*A
 661        SM21=RM21-RET21+E21*A
 662        SM22=RM22-RET22+E22*A
 663        SM31=RM31-RET31+E31*A
 664        SM32=RM32-RET32+E32*A
 665        SM41=RM41-RET41+$NUM*A
 666        SM42=RM42-RET42
 667        R11=(E11-CI*$N)*(1.0-A)
 668        R21=(E21*(1.0-A))
 669        IF(V*CT*((E41-$NUM)/DEN).GT.E41-$NUM) GO TO 302
 670        R31=E31*(1.0-A)+V*CT*((E41-$NUM)/DEN)
 671        R41=E41-V*CT*((E41-$NUM)/DEN)-$NUM*A
 672        GO TO 303
 673     302 R31=E31*(1.0-A)+E41-$NUM
 674        R41=$NUM*(1.0-A)
 675        RCT2=((V*CT*(E41-$NUM)/DEN)-(E41-$NUM))/V
 676     303 R12=E12*(1.0-A)-D2*(E22*(1.0-A))
 677        R22=E22*(1.0-A)-D2*(E22*(1.0-A))
 678        IF(V*CT*E42/DEN.GT.E42)GO TO 304
 679        R32=E32*(1.0-A)+V*CT*E42/DEN-D2*(E32*(1.0-A)+V*CT*E42/DEN)
 680        R42=E42-V*CT*E42/DEN-D2*(E42-V*CT*E42/DEN)
 681        GO TO 305
 682     304 R32=E32*(1.0-A)+E42-D2*(E32*(1.0-A)+E42)
 683        R42=0
 684        RCT4=((V*CT)*(E42/DEN)-E42)/V
 685     305 R43=E43+F
 686        GO TO 9000
 687     350 IF(CL*$M-(E11-CI*$N)-E12-E21-E22-E31-E32-E41.GT.E42)GO TO 400
 688        YL=(E11-CI*$N)*A*X11+E12*A+E21*A*X21+E22*A*X22+E31*A*X31+E32*A*X32
 689       1+E41*A*X41+(CL*$M-(E11-CI*$N)-E12-E21-E22-E31-E32-E41)*A*X42
 690        GET=7.0
 691        GO TO 1
 692     351 $NUM=(CL*$M-(E11-CI*$N))-E12-E21-E22-E31-E32-E41
 693        SM11=RM11-RET11+(E11-CI*$N)*A
 694        SM12=RM12-RET12+E12*A
 695        SM21=RM21-RET21+E21*A
 696        SM22=RM22-RET22+E22*A
 697        SM31=RM31-RET31+E31*A
 698        SM32=RM32-RET32+E32*A
 699        SM41=RM41-RET41+E41*A
 700        SM42=RM42-RET42+$NUM*A
 701        R11=(E11-CI*$N)*(1.0-A)
 702        R21=E21*(1.0-A)
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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
 703          R41=E41*(1.0-A)
 704          R31=E31*(1.0-A)
 705          R12=E12*(1.0-A)-D2*(E12*(1.0-A))
 706          R22=E22*(1.0-A)-D2*(E22*(1.0-A))
 707          IF(V*CT.GT.E42-$NUM)GO TO 352
 708          R32=E32*(1.0-A)+V*CT-D2*(E32*(1.0-A)+V*CT)
 709          R42=E42-$NUM*A-V*CT-D2*(E42-$NUM*A-V*CT)
 710          GO TO 353
 711      352 R32=E32*(1.0-A)+E42-$NUM-D2*(E32*(1.0-A)+E42-$NUM)
 712          R42=$NUM*(1.0-A)
 713          RCT4=(V*CT-(E42-$NUM))/V
 714      353 R43=E43+F
 715          GO TO 9000
 716      400 YL=(E11-CI*$N) *A*X11+E12*A*X12+E21*X21*A+E22*A*X22+E31*A*X31+E3
 717         12*A*X32+E41*A*X41+E42*A*X42
 718          RCL=(CL*$M-(E11-CI*$N)-E12-E21-E22-E31-E32-E41-E42)/$M
 719          GET=8.0
 720          GO TO 1
 721      401 SM11=RM11-RET11+(E11-CI*$N)*A
 722          SM12=RM12-RET12+E12*A
 723          SM21=RM21-RET21+E21*A
 724          SM22=RM22-RET22+E22*A
 725          SM31=RM31-RET31+E31*A
 726          SM32=RM32-RET32+E32*A
 727          SM41=RM41-RET41+E41*A
 728          SM42=RM42-RET42+E42*A
 729          R11=(E11-CI*$N)*(1.0-A)
 730          R21=E21*(1.0-A)
 731          R41=E41*(1.0-A)
 732          R31=E31*(1.0-A)
 733          R12=E12*(1.0-A)-D2*(E12*(1.0-A))
 734          R22=E22*(1.0-A)-D2*(E22*(1.0-A))
 735          R32=E32*(1.0-A)-D2*(E32*(1.0-A))
 736          R42=E42*(1.0-A)-D2*(E42*(1.0-A))
 737          R43=E43+F
 738          RCT4=CT
 739          GO TO 9000
 740      500 IF (CI*$N-E11.GT.E12) GO TO 1000
 741          YI=E11*Z11+(CI*$N-E11)*Z12
 742          IF ((CL*$M).GT.(E12-(CI*$N-E11))) GO TO 550
 743          YL=CL*$M*A*X12
 744          GET=9.0
 745          GO TO 1
 746      501 DEN=E21+E22+E41+E42
 747          SM11=RM11-RET11
 748          SM12=RM12-RET12+CL*$M*A
 749          SM21=RM21-RET21
 750          SM22=RM22-RET22
 751          SM31=RM31-RET31
 752          SM32=RM32-RET32
 753          SM41=RM41-RET41
 754          SM42=RM42-RET42
 755          E11RCH=E11
 756          E12RCH=CI*$N-E11
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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
 757        IF(((V*CT)*(E21/DEN)).GT.E21)GO TO 502
 758        R11=V*CT*(E21/DEN)
 759        R21=E21-V*CT*(E21/DEN)
 760        GO TO 503
 761     502 R11=E21
 762        R21=0
 763        RCT1=((V*CT)*(E21/DEN)-E21)/V
 764     503 IF(((V*CT)*(E41/DEN)).GT.E41)GO TO 504
 765        R31=E31+V*CT*(E41/DEN)
 766        R41=E41-V*CT*(E41/DEN)
 767        GO TO 505
 768     504 R31=E31+E41
 769        R41=0
 770        RCT3=((V*CT)*(E22/DEN)-E22)/V
 771     505 IF((V*CT*(E22/DEN)).GT.E22)GO TO 506
 772        R12=E12-CL*$M*A+V*CT*(E22/DEN)-(CI*$N-E11)-D2*(E12-CL*$M*A+V*CT*(
 773       CE22/DEN)-(CI*$N-E11))
 774        R22=E22-V*CT*(E22/DEN)-D2*(E22-V*CT*(E22/DEN))
 775        GO TO 507
 776     506 R12=E12-CL*$M*A+E22-(CI*$N-E11)-D2*(E12-CL*$M*A+E22-(CI*$N-E11))
 777        R22=0
 778        SM11=RM11-RET11
 779     507 IF(V*CT*(E42/DEN).GT.E42)GO TO 508
 780        R32=E32+V*CT*(E42/DEN)-D2*(E32+V*CT*(E42/DEN))
 781        R42=E42-V*CT*(E42/DEN)-D2*(E42-V*CT*(E42/DEN))
 782        GO TO 509
 783     508 R32=E32+E42-D2*(E32-E42)
 784        R42=0
 785        RCT4=((V*CT)*(E42/DEN)-E42)/V
 786     509 R43=E43+F
 787        GO TO 9000
 788     550 IF(CL*$M-(E12-(CI*$N-E11)).GT.E21)GO TO 600
 789        YL=(E12-(CI*$N-E11))*A*X12+(CL* $M-(E12-(CI*$N-E11)))*A*X21
 790        GET=10.0
 791        GO TO 1
 792     551 $NUM=(E12-(CI*$N-E11))
 793        IF(V*CT*(E21-(CL*$M-$NUM))/DEN.GT.E21-(CL*$M-$NUM))GO TO 552
 794        DEN=E21-(CL*$M-$NUM)+E22+E41+E42
 795        SM12=RM12-RET12+$NUM*A
 796        SM21=RM21-RET21+(CL*$M-$NUM)*A
 797        SM22=RM22-RET22
 798        SM31=RM31-RET31
 799        SM32=RM32-RET32
 800        SM41=RM41-RET41
 801        SM42=RM42-RET42
 802        R11=V*CT*(E21-(CL*$M-$NUM))/DEN
 803        R21=E21-(CL*$M-$NUM)*A-V*CT*(E21-(CL*$M-$NUM))/DEN
 804        GO TO 553
 805     552 R11=E21-(CL*$M-$NUM)
 806        R21=(CL*$M-$NUM)*(1.0-A)
 807        RCT1=(V*CT*((E21-(CL*$M-$NUM))/DEN)-(E21-(CL*$M-$NUM)))/V
 808     553 IF(V*CT*(E41/DEN).GT.E41) GO TO 554
 809        R31=E31+V*CT*(E41/DEN)
 810        R41=E41-V*CT*(E41/DEN)
```

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      00000000011111111112222222223333333333444444444455555555556666666666777777777 8
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
 811        GO TO 555
 812     554 R31=E31+E41
 813        R41=0
 814        RCT2=((V*CT)*(E41/DEN)-E41)/V
 815     555 IF(V*CT*(E22/DEN).GT.E22) GO TO 556
 816        R12=$NUM*(1.0-A)+V*CT*(E22/DEN)-D2*($NUM*(1.0-A)+V*CT*(E22/DEN))
 817        R22=E22-V*CT*(E22/DEN)-D2*(E22-V*CT*(E22/DEN))
 818        GO TO 557
 819     556 R12=$NUM*(1.0-A)+E22-D2*($NUM*(1.0-A)+E22)
 820        R22=0
 821        RCT3=((V*CT)*(E22/DEN)-E22)/V
 822     557 IF(V*CT*(E42/DEN).GT.E42) GO TO 558
 823        R32=E32+V*CT*(E42/DEN)-D2*(E32+V*CT*(E42/DEN))
 824        R42=E42-V*CT*(E42/DEN)-D2*(E42-V*CT*(E42/DEN))
 825        GO TO 559
 826     558 R32=E32+E42-D2*(E32+E42)
 827        R42=0
 828        RCT4=((V*CT)*(E42/DEN)-E42)/V
 829     559 R43=E43+F
 830        GO TO 9000
 831     600 IF((CL)*$M-(E12-(CI*$N-E11))-E21.GT.E22)GO TO 650
 832        YL=(E12-(CI*$N-E11))*A*X12+E21*A*X21+(CL*$M-(E12-(CI*$N-E11))-E11)
 833       1*A*X22
 834        GET=11.0
 835        GO TO 1
 836     601 $NUM=E12-(CI*$N-E11)
 837        DEN=E22-(CL*$M-$NUM-E21)+E41+E42
 838        SM11=RM11-RET11
 839        SM12=RM12-RET12+$NUM*A
 840        SM21=RM21-RET21+E21*A
 841        SM22=RM22-RET22+(CL*$M-$NUM-E21)*A
 842        SM31=RM31-RET31
 843        SM32=RM32-RET32
 844        SM41=RM41-RET41
 845        SM42=RM42-RET42
 846        R11=0
 847        R21=E21*(1.0-A)
 848        IF(V*CT*(E41/DEN).GT.E41) GO TO 602
 849        R31=E31+V*CT*(E41/DEN)
 850        R41=E41-V*CT*(E41/DEN)
 851        GO TO 603
 852     602 R31=E31+E41
 853        R41=0
 854        RCT2=((V*CT)*(E41/DEN)-E41)/V
 855     603 IF(V*CT*(E22-(CL*$M-$NUM-E21))/DEN .GT.E22-(CL*$M-$NUM-E21)) GO TO
 856       2604
 857        R12=$NUM*(1.0-A)+V*CT*(E22-(CL*$M-$NUM-E21))/DEN-D2*($NUM*(1.0-A)+
 858       3V*CT*(E22-(CL*$M-$NUM-E21))/DEN)
 859        R22=E22-(CL*$M-$NUM-E21)*A-V*CT*((CL*$M-$NUM-E21)/DEN)-D2*(E22-(CL
 860       4*$M-$NUM-E21)*A-V*CT*(CL*$M-$NUM-E21)/DEN)
 861        GO TO 605
 862     604 R12=$NUM*(1.0-A)+E22-(CL*$M-$NUM-E21)-D2*($NUM*(1.0-A)+E22-(CL*$M-
 863       5$NUM-E21))
 864        R22=(CL*$M-$NUM-E21)*(1.0-A)
```

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      00000000011111111112222222222333333333344444444455555555556666666666777777777 8
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
 865        RCT3=((V*CT*(E22-(CL*$M-$NUM-E21))/DEN)-(E22-(CL*$M-$NUM-E21)))/V
 866     605 IF(V*CT*(E42/DEN).GT.E42) GO TO 606
 867        R32=E32+V*CT*(E42/DEN)-D2*(E32+V*CT*(E42/DEN))
 868        R42=E42-V*CT*(E42/DEN)-D2*(E42-V*CT*(E42/DEN))
 869        GO TO 607
 870     606 R32=E32+E42-D2*(E32+E42)
 871        R42=0
 872        RCT4=((V*CT)*(E42/DEN)-E42)/V
 873     607 R43=E43+F
 874        GO TO 9000
 875     650 IF(CL*$M-(E12-(CI*$N-E11))-E21-E22.GT.E31)GO TO 700
 876        YL=(E12-(CI*$N-E11))*A*X12+E21*A*X21+E22*A*X22+(CL*$M-(E12-(CI*$N
 877       2-E11))-E21-E22)*A*X31
 878        GET=12.0
 879        GO TO 1
 880     651 $NUM1=E12-(CI*$N-E11)
 881        $NUM2=CL*$M-$NUM1-E21-E22
 882        DEN=E41+E42
 883        SM11=RM11-RET11
 884        SM12=RM12-RET12+$NUM1*A
 885        SM21=RM21-RET21+E21*A
 886        SM22=RM22-RET22+E22*A
 887        SM31=RM31-RET31+$NUM2*A
 888        SM32=RM32-RET32
 889        SM41=RM41-RET41
 890        SM42=RM42-RET42
 891        R11=0
 892        R21=E21*(1.0-A)
 893        IF(V*CT*(E41/DEN).GT.E41) GO TO 652
 894        R31=E31-$NUM2*A+V*CT*(E41/DEN)
 895        R41=E41-V*CT*(E41/DEN)
 896        GO TO 653
 897     652 R31=E31-$NUM2*A+E41
 898        R41=0
 899        RCT2=((V*CT)*(E41/DEN)-E41)/V
 900     653 R12=$NUM1*(1.0-A)-D2*($NUM*(1.0-A))
 901        R22=E22*(1.0-A)-D2*(E22*(1.0-A))
 902        IF(V*CT*(E42/DEN).GT.E42)  GO TO 654
 903        R32=E32+V*CT*(E42/DEN)-D2*(E32-V*CT*(E42/DEN))
 904        R42=E42-V*CT*(E42/DEN)-D2*(E42-V*CT*(E42/DEN))
 905        GO TO 655
 906     654 R32=E32+E42-D2*(E32+E42)
 907        R42=0
 908        RCT4=((V*CT)*(E42/DEN)-E42)/V
 909     655 R43=E43+F
 910        GO TO 9000
 911     700 IF(CL*$M-(E12-(CI*$N-E11))-E21-E22-E31.GT.E32)GO TO 750
 912        YL=(E12-(CI*$N-E11))*A*X12+E21*A*X21+E22*A*X22+E31*A*X31+(CL*$M-(E
 913       112-(CI*$N-E11))-E21-E22-E31)*A*X32
 914        GET=13.0
 915        GO TO 1
 916     701 $NUM1=E12-(CI*$N-E11)
 917        $NUM2=CL*$M-$NUM1-E21-E22-E31
 918        DEN=E41+E42
```

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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
 919        SM11=RM11-RET11
 920        SM12=RM12-RET12+$NUM1*A
 921        SM21=RM21-RET21+E21*A
 922        SM22=RM22-RET22+E22*A
 923        SM31=RM31-RET31+E31*A
 924        SM32=RM32-RET32+$NUM2*A
 925        SM41=RM41-RET41
 926        SM42=RM42-RET42
 927        R11=0
 928        R21=E21*(1.0-A)
 929        IF(V*CT*(E41/DEN).GT.E41)GO TO 702
 930        R31=E31*(1.0-A)+V*CT*(E41/DEN)
 931        R41=E41-V*CT*(E41/DEN)
 932        GO TO 703
 933    702 R31=E31*(1.0-A)+E41
 934        R41=0
 935        RCT2=((V*CT)*(E41/DEN)-E41)/V
 936    703 R12=$NUM1*(1.0-A)-D2*($NUM1*(1.0-A))
 937        R22=E22*(1.0-A)-D2*(E22*(1.0-A))
 938        IF(V*CT*(E42/DEN).GT.E42) GO TO 704
 939        R32=E32-$NUM2*A+V*CT*(E42/DEN)-D2*(E32-$NUM2*A+V*CT*(E42/DEN))
 940        R42=E42-V*CT*(E42/DEN)-D2*(E42-V*CT*(E42/DEN))
 941        GO TO 705
 942    704 R32=E32-$NUM2*A+E42-D2*(E32-$NUM2*A+E42)
 943        R42=0
 944        RCT4=((V*CT)*(E42/DEN)-E42)/V
 945    705 R43=E43+F
 946        GO TO 9000
 947    750 IF(CL*$M-(E12-(CI*$N-E11))-E21-E22-E31-E32.GT.E41)GO TO 800
 948        YL=(E12-(CI*$N-E11))*A*X12+E21*A*X21+E22*A*X22+E31*A*X31+E32*A*X32
 949       1+(CL*$M-(E12-(CI*$N-E11))-E21-E22-E32-E41)*A*X41
 950        GET=14.0
 951        GO TO 1
 952    751 $NUM1=E12-(CI*$N-E11)
 953        $NUM2=CL*$M-$NUM1-E21-E22-E31-E32
 954        DEN=E41-$NUM2+E42
 955        SM11=RM11-RET11
 956        SM12=RM12-RET12+$NUM1*A
 957        SM21=RM21-RET21+E21*A
 958        SM22=RM22-RET22+E22*A
 959        SM31=RM31-RET31+E31*A
 960        SM32=RM32-RET32+E32*A
 961        SM41=RM41-RET41+$NUM2*A
 962        SM42=RM42-RET42
 963        RM11=0
 964        R21=E21*(1.0-A)
 965        IF(V*CT*(E41-$NUM2)/DEN.GT.E41-$NUM2)GO TO 752
 966        R31=E31*(1.0-A)+V*CT*(E41-$NUM2)/DEN
 967        R41=E41-$NUM2*A-V*CT*(E41-$NUM2)/DEN
 968        GO TO 753
 969    752 R31=E31*(1.0-A)+E41-$NUM2
 970        R41=$NUM2*(1.0-A)
 971        RCT2=((V*CT*(E41-$NUM2)/DEN)-(E41-$NUM2))/V
 972    753 R12=$NUM1*(1.0-A)-D2*($NUM1*(1.0-A))
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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
 973        R22=E22*(1.0-A)-D2*(E22*(1.0-A))
 974        IF(V*CT*(E42/DEN).GT.E42) GO TO 754
 975        R32=E32*(1.0-A)+V*CT*(E42/DEN)-D2*(E32*(1.0-A)+V*CT*(E42/DEN))
 976        R42=E42-V*CT*(E42/DEN)-D2*(E42-V*CT*E42/DEN)
 977        GO TO 755
 978    754 R32=E32*(1.0-A)+E42-D2*(E32*(1.0-A)+E42)
 979        R42=0
 980        RCT4=((V*CT)*(E42/DEN)-E42)/V
 981    755 R43=E43+F
 982        GO TO 9000
 983    800 IF(CL*$M-(E12-(CI*$N-E11))-E21-E22-E31-E32-E41.GT.E42)GO TO 850
 984        YL=(E12-(CI*$N-E11))*A*X12+E21*A*X21+E22*A*X22+E31*A*X31+E32*A*X32
 985       1+E41*A*X41+(CL*$M-(E12-(CI*$N-E11))-E21-E22-E31-E32-E41)*A*X42
 986        GET=15.0
 987        GO TO 1
 988    801 $NUM1=E12-(CI*$N-E11)
 989        $NUM2=CL*$M-(E12-(CI*$N-E11))-E21-E22-E31-E32-E41
 990        SM11=RM11-RET11
 991        SM12=RM12-RET12+$NUM1*A
 992        SM21=RM21-RET21+E21*A
 993        SM22=RM22-RET22+E22*A
 994        SM31=RM31-RET31+E22*A
 995        SM32=RM32-RET32+E32*A
 996        SM41=RM41-RET41+E41*A
 997        SM42=RM42-RET42+$NUM2*A
 998        R11=0
 999        R21=E21*(1.0-A)
1000        R31=E31*(1.0-A)
1001        R41=E41*(1.0-A)
1002        R12=$NUM1*(1.0-A)-D2*($NUM1*(1.0-A))
1003        R22=E22*(1.0-A)-D2*(E22  *(1.0-A))
1004        IF(V*CT.GT.E42-$NUM2)GO TO 802
1005        R32=E32*(1.0-A)+V*CT-D2*(E32*(1.0-A)+V*CT)
1006        R42=E42-$NUM2*A-V*CT-D2*(E42-$NUM2*A-V*CT)
1007        GO TO 803
1008    802 R32=E32*(1.0-A)+E42-$NUM2-D2*(E32*(1.0-A)+E42-$NUM2)
1009        R42=$NUM2*(1.0-A)
1010        RCT4=(V*CT-(E42-$NUM2))/V
1011    803 R43=E43+F
1012        GO TO 9000
1013    850 YL=(E12-(CI*$N-E11))*A*X12+E21*A*X21+E22*A*X22+E31*A*X31+E32*A*X32
1014       1+E41*A*X41+E42*A*X42
1015        RCL=(CL*$M-(E12-(CI*$N-E11))-E21-E22-E31-E32-E41-E42)/$M
1016        GET=16.0
1017        GO TO 1
1018    851 $NUM=E12-(CI*$N-E11)
1019        SM11=RM11-RET11
1020        SM12=RM12-RET12+$NUM*A
1021        SM21=RM21-RET21+E21*A
1022        SM22=RM22-RET22+E22*A
1023        SM31=RM31-RET31+E31*A
1024        SM32=RM32-RET32+E32*A
1025        SM41=RM41-RET41+E41*A
1026        SM42=RM42-RET42+E42*A
```

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      00000000011111111112222222222333333333344444444445555555556666666666777777777 8
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
1027        R11=0
1028        R21=E21*(1.0-A)
1029        R31=E31*(1.0-A)
1030        R41=E41*(1.0-A)
1031        R12=$NUM*(1.0-A)-D2*($NUM*(1.0-A))
1032        R22=E22*(1.0-A)-D2*(E22*(1.0-A))
1033        R32=E32*(1.0-A)-D2*(E32*(1.0-A))
1034        R42=E42*(1.0-A)-D2*(E42*(1.0-A))
1035        R43=E43+F
1036        RCT4=CT
1037        GO TO 9000
1038   1000 IF(CI*$N-E11-E12.GT.E21) GO TO 1500
1039        YI=E11*Z11+E12*Z12+(CI*$N-E11-E12)*Z21
1040        IF(CL*$M.GT.E21-(CI*$N-E11-E12)) GO TO 1050
1041        YL=CL*$M*A*X12
1042        GET=17.0
1043        GO TO 1
1044   1001 $NUM=CL*$M+(CI*$N-E11-E12)
1045        DEN=E21-$NUM+E22+E41+E42
1046        SM11=RM11-RET11
1047        SM12=RM12-RET12
1048        SM21=RM21-RET21
1049        SM22=RM22-RET22
1050        SM31=RM31-RET31
1051        SM32=RM32-RET32
1052        SM41=RM41-RET41
1053        SM42=RM42-RET42
1054        E11RCH=E11
1055        E12RCH=E12
1056        E21RCH=CI*$N-E11-E12
1057        IF(V*CT*((E21-$NUM)/DEN).GT.E21-$NUM) GO TO 1002
1058        R11=V*CT*((E21-$NUM)/DEN)
1059        R21=E21-(CI*$N-E11-E12)-CL*$M*A-V*CT*((E21-$NUM)/DEN)
1060        GO TO 1003
1061   1002 R11=E21-$NUM
1062        R21=CL*$M*(1.0-A)
1063        RCT1=((V*CT)*((E21-$NUM)/DEN)-(E21-$NUM))/V
1064   1003 IF(V*CT*E41/DEN.GT.E41) GO TO 1004
1065        R31=E31+V*CT*E41/DEN
1066        R41=E41-V*CT*E41/DEN
1067        GO TO 1005
1068   1004 R31=E31+E41
1069        R41=0
1070        RCT2=((V*CT)*(E41/DEN)-E41)/V
1071   1005 IF(V*CT*E22/DEN.GT.E22)GO TO 1006
1072        R12=V*CT*E22/DEN-D2*V*CT*E22/DEN
1073        R22=E22-V*CT*E22/DEN-D2*(E22-V*CT*E22/DEN)
1074        GO TO 1007
1075   1006 R12=E22-D2*E22
1076        R22=0
1077        RCT3=((V*CT)*(E22/DEN)-E22)/V
1078   1007 IF(V*CT*E42/DEN.GT.E42) GO TO 1008
1079        R32=E32+V*CT*E42/DEN-D2*(E32+V*CT*E42/DEN)
1080        R42=E42-V*CT*E42/DEN-D2*(E42-V*CT*E42/DEN)
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      00000000011111111112222222222333333333344444444455555555556666666666777777777 8
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
1081        GO TO 1009
1082    1008 R32=E32+E42-D2*(E32+E42)
1083        R42=0
1084        RCT4=((V*CT)*(E42/DEN)-E42)/V
1085    1009 R43=E43+F
1086        GO TO 9000
1087    1050 IF(CL*$M-(E21-(CI*$N-E11-E12)).GT.E22) GO TO 1100
1088        YL=(E21-(CI*$N-E11-E12))*A*X21+(CL*$M-(E21-(CI*$N-E11-E12)))*A*X22
1089        GET=18.0
1090        GO TO 1
1091    1051 $NUM=E21-(CI*$N-E11-E12)
1092        $NUM2=CL*$M-$NUM
1093        DEN=E22-$NUM2+E41+E42
1094        SM11=RM11-RET11
1095        SM12=RM12-RET12
1096        SM21=RM21-RET21+$NUM*A
1097        SM22=RM22-RET22+$NUM2*A
1098        SM31=RM31-RET31
1099        SM32=RM32-RET32
1100        SM41=RM41-RET41
1101        SM42=RM42-RET42
1102        R11=0
1103        R21=$NUM*(1.0-A)
1104        IF(V*CT*E41/DEN.GT.E41) GO TO 1052
1105        R31=E31+V*CT*E41/DEN
1106        R41=E41-V*CT*E41/DEN
1107        GO TO 1053
1108    1052 R31=E31+E41
1109        R41=0
1110        RCT2=((V*CT)*(E41/DEN)-E41)/V
1111    1053 IF(V*CT*((E22-$NUM2)/DEN).GT.E22-$NUM2)GO TO 1054
1112        R12=V*CT*((E22-$NUM2)/DEN)-D2*(V*CT*((E22-$NUM2)/DEN))
1113        R22=E22-$NUM2*A-V*CT*((E22-$NUM2)/DEN)-D2*(E22-$NUM2*A-V*CT*((E22-
1114       1$NUM2)/DEN))
1115        GO TO 1055
1116    1054 R12=E22-$NUM2-D2*(E22-$NUM2)
1117        R22=$NUM2*(1.0-A)
1118        RCT3=((V*CT*(E22-$NUM2)/DEN)-(E22-$NUM2))/V
1119    1055 IF(V*CT*E42/DEN.GT.E42) GO TO 1056
1120        R32=E32+V*CT*E42/DEN-D2*(E32+V*CT*E42/DEN)
1121        R42=E42-V*CT*E42/DEN-D2*(E42-V*CT*E42/DEN)
1122        GO TO 1057
1123    1056 R32=E32+E42-D2*(E32+E42)
1124        R42=0
1125        RCT4=((V*CT)*(E42/DEN)-E42)/V
1126    1057 R43=E43+F
1127        GO TO 9000
1128    1100 IF(CL*$M-(E21-(CI*$N-E12))-E22.GT.E31) GO TO 1150
1129        YL=(E21-(CI*$N-E11-E12))*A*X21+E22*A*X22+(CL*$M-(E21-(CI*$N-E11-E1
1130       12))-E22)*A*X31
1131        GET=19.0
1132        GO TO 1
1133    1101 $NUM1=E21-(CI*$N-E11-E12)
1134        $NUM2=CL*$M-$NUM1-E22
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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
1135         SM11=RM11-RET11
1136         SM12=RM12-RET12
1137         SM21=RM21-RET21+$NUM1*A
1138         SM22=RM22-RET22+E22*A
1139         SM31=RM31-RET31+$NUM2*A
1140         SM32=RM32-RET32
1141         SM41=RM41-RET41
1142         SM42=RM42-RET42
1143         R11=0
1144         R21=$NUM1*(1.0-A)
1145         IF(V*CT*E41/DEN.GT.E41) GO TO 1102
1146         R31=$NUM2*(1.0-A)+V*CT*E41/DEN
1147         R41=E41-V*CT*E41/DEN
1148         GO TO 1103
1149    1102 R31=$NUM2*(1.0-A)+E41
1150         R41=0
1151         RCT2=((V*CT)*(E41/DEN)-E41)/V
1152    1103 R12=0
1153         R22=E22*(1.0-A)-D2*(E22*(1.0-A))
1154         IF(V*CT*E42/DEN.GT.E42) GO TO 1104
1155         R32=E32+V*CT*E42/DEN-D2*(E32+V*CT*E42/DEN)
1156         R42=E42-V*CT*E42/DEN-D2*(E42-V*CT*E42/DEN)
1157         GO TO 1105
1158    1104 R32=E32+E42-D2*(E32+E42)
1159         R42=0
1160         RCT4=((V*CT)*(E42/DEN)-E42)/V
1161    1105 R43=E43+F
1162         GO TO 9000
1163    1150 IF(CL*$M-(E21-(CI*$N-E11-E12))-E22-E31.GT.E32) GO TO 1200
1164         YL=(E21-(CI*$N-E11-E12))*A*X21+E22*A*X22+E31*A*X31+(CL*$M-(E21-(CI
1165        1*$N-E11-E12))-E22-E31)*A*X32
1166         GET=20.0
1167         GO TO 1
1168    1151 $NUM1=E21-(CI*$N-E11-E12)
1169         $NUM2=CL*$M-$NUM1-E22-E31
1170         DEN=E41+E42
1171         SM11=RM11-RET11
1172         SM12=RM12-RET12
1173         SM21=RM21-RET21+$NUM1*A
1174         SM22=RM22-RET22+E22*A
1175         SM31=RM31-RET31+E31*A
1176         SM32=RM32-RET32+$NUM2*A
1177         SM41=RM41-RET41
1178         SM42=RM42-RET42
1179         R11=0
1180         R21=$NUM1*(1.0*A)
1181         IF(V*CT*E41/DEN.GT.E41) GO TO 1152
1182         R31=E31*(1.0-A)+V*CT*E41/DEN
1183         R41=E41-V*CT*E41/DEN
1184         GO TO 1153
1185    1152 R31=E31*(1.0-A)+E41
1186         R41=0
1187         RCT2=((V*CT)*(E41/DEN)-E41)/V
1188    1153 R12=0
```

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      0000000001111111111222222222233333333334444444444555555555566666666667777777778
      1234567890123456789012345678901234567890123456789012345678901234567890123456789
CARD
1189        R22=E22*(1.0-A)-D2*(E22*(1.0-A))
1190        IF(V*CT*E42/DEN.GT.E42) GO TO 1154
1191        R32=E32-$NUM2*A+V*CT*E42/DEN-D2*(E32-$NUM2*A+V*CT*E42/DEN)
1192        R42=E42-V*CT*E42/DEN-D2*(E42-V*CT*E42/DEN)
1193        GO TO 1155
1194   1154 R32=E32-$NUM2*A+E42-D2*(E32-$NUM2*A+E42)
1195        R42=0
1196        RCT4=((V*CT)*(E42/DEN)-E42)/V
1197   1155 R43=E43+F
1198        GO TO 9000
1199   1200 IF(CL*$M-(E21-(CI*$N-E11-E12))-E22-E31-E32.GT.E41) GO TO 1250
1200        YL=(E21-(CI*$N-E11-E12))*A*X21+E22*A*X22+E31*A*X31+E32*A*X31+(CL*$
1201       1M-(E21-(CI*$N-E11-E12))-E22-E31-E32)*A*X41
1202        GET=21.0
1203        GO TO 1
1204   1201 $NUM1=E21-(CI*$N-E11-E12)
1205        $NUM2=CL*$M-$NUM1-E22-E31-E32
1206        DEN=E41-$NUM2+E42
1207        SM11=RM11-RET11
1208        SM12=RM12-RET12
1209        SM21=RM21-RET21+$NUM1*A
1210        SM22=RM22-RET22+E22*A
1211        SM31=RM31-RET31+E31*A
1212        SM32=RM32-RET32+E32*A
1213        SM41=RM41-RET41+$NUM2*A
1214        SM42=RM42-RET42
1215        R11=0
1216        R21=$NUM1*(1.0-A)
1217        IF(V*CT*((E41-$NUM2)/DEN).GT.E41-$NUM2)GO TO 1202
1218        E31=E31*(1.0-A)+V*CT*((E41-$NUM2)/DEN)
1219        E41=E41-$NUM2*A-V*CT*((E41-$NUM2)/DEN)
1220        GO TO 1203
1221   1202 E31=E31*(1.0-A)+E41-$NUM2
1222        E41=$NUM2*(1.0-A)
1223        RCT2=((V*CT*(E41-$NUM2)/DEN)-(E41-$NUM2))/V
1224   1203 R12=0
1225        R22=E22*(1.0-A)-D2*(E22*(1.0-A))
1226        IF(V*CT*E42/DEN.GT.E42)GO TO 1204
1227        R32=E32*(1.0-A)+V*CT*E42/DEN-D2*(E32*(1.0-A)+V*CT*E42/DEN)
1228        R42=E42-V*CT*E42/DEN-D2*(E42-V*CT*E42/DEN)
1229        GO TO 1205
1230   1204 R32=E32*(1.0-A)+E42-D2*(E32*(1.0-A)+E42)
1231        E42=0
1232        RCT4=((V*CT)*(E42/DEN)-E42)/V
1233   1205 R43=E43+F
1234        GO TO 9000
1235   1250 IF(CL*$M-(E21-(CI*$N-E11-E12))-E22-E31-E32-E41.GT.E42)GO TO 1300
1236        YL=(E21-(CI*$N-E11-E12))*A*X21+E22*A*X22+E31*A*X31+E32*A*X32+E41*A
1237       1*X41+(CL*$M-(E21-(CI*$N-E11-E12))-E22-E31-E32-E41)*A*X42
1238        GET=22.0
1239        GO TO 1
1240   1251 $NUM1=E21-(CI*$N-E11-E12)
1241        $NUM2=CL*$M-$NUM1-E22-E31-E32-E41
1242        SM11=RM11-RET11
```

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      0000000001111111111222222222233333333334444444444555555555566666666667777777778
      1234567890123456789012345678901234567890123456789012345678901234567890123456789
CARD
1243        SM12=RM12-RET12
1244        SM21=RM21-RET21+$NUM1*A
1245        SM22=RM22-RET22+E22*A
1246        SM31=RM31-RET31+E31*A
1247        SM32=RM32-RET32+E32*A
1248        SM41=RM41-RET41+E41*A
1249        SM42=RM42-RET42+$NUM2*A
1250        R11=0
1251        R21=$NUM1*(1.0-A)
1252        R31=E31*(1.0-A)
1253        R41=E41*(1.0-A)
1254        R12=0
1255        R22=E22*(1.0-A)-D2*(E22*(1.0-A))
1256        IF(V*CT.GT.E42-$NUM2) GO TO 1252
1257        R32=E32*(1.0-A)+V*CT-D2*(E32*(1.0-A)+V*CT)
1258        R42=E42-$NUM2*A-V*CT-D2*(E42-$NUM2*A-V*CT)
1259        GO TO 1253
1260   1252 R32=E32*(1.0-A)+E42-$NUM2*A-D2*(E32*(1.0-A)+E42-$NUM2*A)
1261        R42=$NUM2*(1.0-A)-D2*($NUM2*(1.0-A))
1262        RCT4=(V*CT-(E42-$NUM2))/V
1263   1253 R43=E43+F
1264        GO TO 9000
1265   1300 YL=(E21-(CI*$N-E11-E12))*A*X21+E22*A*X22+E31*A*X31+E32*A*X32+E41*A
1266       2*X41+E42*A*X42
1267        RCL=(CL*$M-(E21-(CI*$N-E11-E12))-E22-E32-E41-E42)/$M
1268        GET=23.0
1269        GO TO 1
1270   1301 $NUM=E21-(CI*$N-E11-E12)
1271        SM11=RM11-RET11
1272        SM12=RM12-RET12
1273        SM21=RM21-RET21+$NUM*A
1274        SM22=RM22-RET22+E22*A
1275        SM31=RM31-RET31+E31*A
1276        SM32=RM32-RET32+E32*A
1277        SM41=RM41-RET41+E41*A
1278        SM42=RM42-RET42+E42*A
1279        R11=0
1280        R21=$NUM*(1.0-A)
1281        R31=E31*(1.0-A)
1282        R41=E41*(1.0-A)
1283        R12=0
1284        R22=E22*(1.0-A)-D2*(E22*(1.0-A))
1285        R32=E32*(1.0-A)-D2*(E22*(1.0-A))
1286        R42=E42*(1.0-A)-D2*(E22*(1.0-A))
1287        R43=E43+F
1288        RCT4=CT
1289        GO TO 9000
1290   1500 IF(CI*$N-E11-E12-E21.GT.E22)GO TO 2000
1291        YI =E11*Z11+E12*Z12+E21*Z21+(CI*$N-E11-E12-E21)*Z22
1292        IF(CL*$M.GT.E22-(CI*$N-E11-E12-E21))GO TO 1550
1293        YL=CL*$M*A*X22
1294        GET = 24.0
1295        GO TO 1
1296   1501 $NUM=CL*$M+(CI*$N-E11-E12-E21)
```

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      C000000001111111111222222222233333333334444444445555555555666666666677777777778
      1234567890123456789012345678901234567890123456789012345678901234567890123456789
CARD
1297        DEN=E22+$NUM+E41+E42
1298        SM11=RM11-RET11
1299        SM12=RM12-RET12
1300        SM22=RM22-RET22*CL*$M*A
1301        SM31=RM31-RET31
1302        SM32=RM32-RET32
1303        SM42=RM42-RET42
1304        R11=0
1305        R21=0
1306        E11RCH=E11
1307        E12RCH=E12
1308        E21RCH=E21
1309        E22RCH=CI*$N-E11-E12-E21
1310        IF(V*CT*E41/DEN.GT.E41)GO TO 1502
1311        R31=E31+V*CT*E41/DEN
1312        R41=E41-V*CT*E41/DEN
1313        GO TO 1503
1314   1502 R31=E31+E41
1315        R41=0
1316        RCT2=((V*CT)*(E41/DEN)-E41)/V
1317   1503 IF(V*CT*((E22-$NUM)/DEN).GT.E22-$NUM)GO TO 1504
1318        R12=V*CT*((E22-$NUM)/DEN)-D2*(V*CT*((E22-$NUM)/DEN))
1319        R22=E22-$NUM-V*CT*((E22-$NUM)/DEN)+CL*$M*(1.0-A)-D2*(E22-$NUM-V*CT
1320       C*((E22-$NUM)/DEN)+CL*$M*(1.0-A))
1321        GO TO 1505
1322   1504 R12=E22-$NUM-D2*(E22-$NUM)
1323        R22=CL*$M*(1.0-A)
1324        RCT3=(V*CT*((E22-$NUM)/DEN)-(E22-$NUM))/V
1325   1505 IF(V*CT*E42/DEN.GT.E42)GO TO 1506
1326        R32=E32+V*CT*E42/DEN-D2*(E32+V*CT*E42/DEN)
1327        R42=E42-V*CT*E42/DEN-D2*(E42-V*CT*E42/DEN)
1328        GO TO 1507
1329   1506 R32=E32+E42-D2*(E32+E42)
1330        R42=0
1331        RCT4=((V*CT)*(E42/DEN)-E42)/V
1332   1507 R43=E43+F
1333        GO TO 9000
1334   1550 IF(CL*$M-(E22-(CI*$N-E11-E12-E21)).GT.E31)GO TO 1600
1335        YL=(E22-(CI*$N-E11-E12-E21)*A*X22)+(CL*$M-(E22-(CI*$N-E11-E12-E21)
1336       1))*A*X31
1337        GET=25.0
1338        GO TO 1
1339   1551 $NUM1=E22-(CI*$N-E11-E12-E21)
1340        $NUM2=CL*$M-$NUM1
1341        DEN=E41+E42
1342        SM11=RM11-RET11
1343        SM12=RM12-RET12
1344        SM21=RM21-RET21
1345        SM22=RM22-RET22+$NUM1*A
1346        SM31=RM31-RET31+$NUM2*A
1347        SM32=RM32-RET32
1348        SM41=RM41-RET41
1349        SM42=RM42-RET42
1350        R11=0
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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
1351        R21=0
1352        IF(V*CT*E41/DEN.GT.E41)GO TO 1552
1353        R31=E31-$NUM2*A+V*CT*E41/DEN
1354        R41=E41-V*CT*E41/DEN
1355        GO TO 1553
1356     1552 R31=E31-$NUM2*A+E41
1357        R41=0
1358        RCT2=((V*CT)*(E41/DEN)-E41)/V
1359     1553 R12=0
1360        R22=$NUM1*(1.0-A)-D2*($NUM1*(1.0-A))
1361        IF(V*CT*E42/DEN.GT.E42)GO TO 1554
1362        R32=E32+V*CT*E42/DEN-D2*(E32+V*CT*E42/DEN)
1363        R42=E42-V*CT*E42/DEN-D2*(E42-V*CT*E42/DEN)
1364        GO TO 1555
1365     1554 R32=E32+E42-D2*(E32+E42)
1366        R42=0
1367        RCT4=((V*CT)*(E42/DEN)-E42)/V
1368     1555 R43=E43+F
1369        GO TO 9000
1370     1600 IF(CL*$M-(E22-(CI*$N-E11-E12-E21))-E31.GT.E32)GO TO 1650
1371        YL=(E22-(CI*$N-E11-E12-E21))*A*X22+E31*A*X31+(CL*$M-(E22-(CI*$N-E1
1372       11-E12-E21))-E31)*A*X32
1373        GET = 26.0
1374        GO TO 1
1375     1601 $NUM1=E22-(CI*$N-E11-E12-E21)
1376        $NUM2=CL*$M-$NUM1-E31
1377        DEN=E41+E42
1378        SM11=RM11-RET11
1379        SM12=RM12-RET12
1380        SM21=RM21-RET21
1381        SM22=RM22-RET22+$NUM1*A
1382        SM31=RM31-RET31+E31*A
1383        SM32=RM32-RET32+$NUM2*A
1384        SM41=RM41-RET41
1385        SM42=RM42-RET42
1386        R11=0
1387        R21=0
1388        IF(V*CT*E41/DEN.GT.E41)GO TO 1602
1389        R31=E31*(1.0-A)+V*CT*E41/DEN
1390        R41=E41-V*CT*E41/DEN
1391        GO TO 1603
1392     1602 R31=E31*(1.0-A)+E41
1393        R41=0
1394        RCT2=((V*CT)*(E41/DEN)-E41)/V
1395     1603 R12=0
1396        R22=$NUM1*(1.0-A)-D2*($NUM1*(1.0-A))
1397        IF(V*CT*E42/DEN.GT.E42)GO TO 1604
1398        R32=E32-$NUM2*A+V*CT*E42/DEN-D2*(E32-$NUM2*A+V*CT*E42/DEN)
1399        R42=E42-V*CT*E42/DEN-D2*(E42-V*CT*E42/DEN)
1400        GO TO 1605
1401     1604 R32=E32-$NUM2*A+E42-D2*(E32-$NUM2*A+E42)
1402        R42=0
1403        RCT4=((V*CT)*(E42/DEN)-E42)/V
1404     1605 R43=E43+F
```

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      00000000011111111112222222223333333333444444444455555555556666666666777777777 8
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
1405        GO TO 9000
1406   1650 IF(CL*$M-(E22-(CI*$N-E11-E12-E21))-E31-E32.GT.E41)GO TO 1700
1407        YL=(E22-(CI*$N-E11-E12-E21))*A*X22+E31*A*X31+E32*A*X32+(CL*$M-(E22
1408       1-(CI*$N-E11-E12-E21))-E31-E32)*A*X41
1409        GET=27.0
1410        GO TO 1
1411   1651 $NUM1=E22-(CI*$N-E11-E12-E21)
1412        $NUM2=CL*$M-$NUM1-E31-E32
1413        DEN=E41-$NUM2+E42
1414        SM11=RM11-RET11
1415        SM12=RM12-RET12
1416        SM21=RM21-RET21
1417        SM22=RM22-RET22+$NUM1*A
1418        SM31=RM31-RET31+E31*A
1419        SM32=RM32-RET32+E32*A
1420        SM41=RM41-RET41+$NUM2*A
1421        SM42=RM42-RET42
1422        R11=0
1423        R21=0
1424        IF(V*CT*((E41-$NUM2)/DEN).GT.E41-$NUM2)GO TO 1652
1425        R31=E31*(1.0-A)+V*CT*((E41-$NUM2)/DEN)
1426        R41=E41-$NUM2*A-V*CT*((E41-$NUM2)/DEN)
1427        GO TO 1653
1428   1652 R31=E31*(1.0-A)+E41-$NUM2
1429        R41=$NUM2*(1.0-A)
1430        RCT2=((V*CT*(E41-$NUM2)/DEN)-(E41-$NUM2))/V
1431   1653 R12=0
1432        R22=$NUM1*(1.0-A)-D2*($NUM1*(1.0-A))
1433        IF(V*CT*E42/DEN.GT.E42)GO TO 1654
1434        R32=E32*(1.0-A)+V*CT*E42/DEN-D2*(E32*(1.0-A)+V*CT*E42/DEN)
1435        R42=E42-V*CT*E42/DEN-D2*(E42-V*CT*E42/DEN)
1436        GO TO 1655
1437   1654 R32=E32*(1.0-A)+E42-D2*(E32*(1.0-A)+E42)
1438        R42=0
1439        RCT4=((V*CT)*(E42/DEN)-E42)/V
1440   1655 R43=E43+F
1441        GO TO 9000
1442   1700 IF(CL*$M-(E22-(CI*$N-E11-E12-E21))-E31-E32-E41.GT.E42)GO TO 1750
1443        YL=E22-(CI*$N-E11-E12-E21)*A*X22+E31*A*X31+E32*A*X32+E41*A*X41+(CL
1444       1*$M-(E22-(CI*$N-E11-E12-E21))-E31-E32-E41)*A*X42
1445        GET = 28.0
1446        GO TO 1
1447   1701 $NUM1=E22-(CI*$N-E11-E12-E21)
1448        $NUM2=CL*$M-$NUM1-E31-E32-E41
1449        SM11=RM11-RET11
1450        SM12=RM12-RET12
1451        SM21=RM21-RET21
1452        SM22=RM22-RET22+$NUM1*A
1453        SM31=RM31-RET31+E31*A
1454        SM32=RM32-RET32+E32*A
1455        SM41=RM41-RET41+E41*A
1456        SM42=RM42-RET42+E41*A
1457        R11=0
1458        R21=0
```

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      00000000011111111112222222222333333333344444444445555555556666666666777777777 8
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
1459        R31=E31*(1.0-A)
1460        R41=E41*(1.0-A)
1461        R12=0
1462        R22=$NUM*(1.0-A)-D2*($NUM1*(1.0-A))
1463        IF(V*CT.GT.E42-$NUM2)GO TO 1702
1464        R32=E32*(1.0-A)+V*CT-D2*(E32*(1.0-A)+V*CT)
1465        R42=E42-$NUM2*A-V*CT-D2*(E42-$NUM2*A-V*CT)
1466        GO TO 1703
1467   1702 R32=E32*(1.0-A)+E42-$NUM2-D2*(E32*(1.0-A)+E42-$NUM2)
1468        R42=$NUM2*(1.0-A)
1469        RCT4=(V*CT-(E42-$NUM2))/V
1470   1703 R43=E43+F
1471        GO TO 9000
1472   1750 YL=E22-(CI*$N-E11-E12-E21)*A*X22+E31*A*X31+E32*A*X32+E41*A*X41+E42
1473       2*A*X42
1474        RCL=(CL*$M-(E22-(CI*$N-E11-E12-E21))-E31-E32-E41-E42)/$M
1475        GET=29.0
1476        GO TO 1
1477   1751 $NUM=E22-(CI*$N-E11-E12-E21)
1478        SM11=RM11-RET11
1479        SM12=RM12-RET12
1480        SM21=RM21-RET21
1481        SM22=RM22-RET22+$NUM*A
1482        SM31=RM31-RET31+E31*A
1483        SM32=RM32-RET32+E32*A
1484        SM41=RM41-RET41+E41*A
1485        SM42=RM42-RET42+E42*A
1486        R11=0
1487        R21=0
1488        R31=E31*(1.0-A)
1489        R41=E41*(1.0-A)
1490        R12=0
1491        R22=$NUM*(1.0-A)-D2*($NUM*(1.0-A))
1492        R32=E32*(1.0-A)-D2*(E32*(1.0-A))
1493        R42=E42*(1.0-A)-D2*(E42*(1.0-A))
1494        R43=E43+F
1495        RCT4=CT
1496        GO TO 9000
1497   2000 IF(CI*$N-E11-E12-E21-E22.GT.E31)GO TO 2500
1498        YI=E11*Z11+E12*Z12+E21*Z21+E22*Z22+(CI*$N-E11-E12-E21-E22)*Z31
1499        IF(CL*$M.GT.E31-(CI*$N-E11-E12-E21-E22))GO TO 2050
1500        YL=CL*$M*A*X31
1501        GET=30.0
1502        GO TO 1
1503   2001 $NUM=CL*$M+(CI*$N-E11-E12-E21-E22)
1504        DEN=E41+E42
1505        SM11=RM11-RET11
1506        SM12=RM12-RET12
1507        SM21=RM21-RET21
1508        SM22=RM22-RET22
1509        SM31=RM31-RET31+CL*$M*A
1510        SM32=RM32-RET32
1511        SM41=RM41-RET41
1512        SM42=RM42-RET42
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      00000000011111111112222222222333333333344444444455555555556666666666777777777 8
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
1513        R11=0
1514        R21=0
1515        E11RCH=E11
1516        E12RCH=E12
1517        E21RCH=E21
1518        E22RCH=E22
1519        E31RCH=CI*$N-E11-E12-E21-E22
1520        IF(V*CT*E41/DEN.GT.E41)GO TO 2002
1521        R31=E31-$NUM+V*CT*(E41/DEN+CL*$M*(1.0-A))
1522        R41=E41-V*CT*E41/DEN
1523        GO TO 2003
1524   2002 R31=E31-$NUM+E41+CL*$M*(1.0-A)
1525        R41=0
1526        RCT2=((V*CT)*(E41/DEN)-E41)/V
1527   2003 R12=0
1528        R22=0
1529        IF(V*CT*E42/DEN.GT.E42)GO TO 2004
1530        R32=E32+V*CT*E42/DEN-D2*(E32+V*CT*E42/DEN)
1531        R42=E42-V*CT*E42/DEN-D2*(E42-V*CT*E42/DEN)
1532        GO TO 2005
1533   2004 R32=E32+E42-D2*(E32+E42)
1534        R42=0
1535        RCT4=((V*CT)*(E42/DEN)-E42)/V
1536   2005 R43=E43+F
1537        GO TO 9000
1538   2050 IF(CL*$M-(E31-(CI*$N-E11-E12-E21-E22)).GT.E32)GO TO 2100
1539        YL=(E31-(CI*$N-E11-E12-E21-E22))*A*X31+(CL*$M-(E31-(CI*$N-E11-E12-
1540       2E21-E22)))*A*X32
1541        GET=31.0
1542        GO TO 1
1543   2051 $NUM1=E31-(CI*$N-E11-E12-E21-E22)
1544        $NUM2=CL*$M-$NUM1
1545        DEN=E41+E42
1546        SM11=RM11-RET11
1547        SM12=RM12-RET12
1548        SM21=RM21-RET21
1549        SM22=RM22-RET22
1550        SM31=RM31-RET31+$NUM1*A
1551        SM32=RM32-RET32+$NUM2*A
1552        SM41=RM41-RET41
1553        SM42=RM42-RET42
1554        R11=0
1555        R21=0
1556        IF(V*CT*E41/DEN.GT.E41)GO TO 2052
1557        R31=$NUM1*(1.0-A)+V*CT*E41/DEN
1558        R41=E41-V*CT*E41/DEN
1559        GO TO 2053
1560   2052 R31=$NUM1*(1.0-A)+E41
1561        E41=0
1562        RCT2=((V*CT)*(E41/DEN)-E41)/V
1563   2053 R12=0
1564        R22=0
1565        IF(V*CT*E42/DEN.GT.E42)GO TO 2054
1566        R32=E32-$NUM2*A+V*CT*E42/DEN-D2*(E32-$NUM2*A+V*CT*E42/DEN)
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      0000000001111111111222222222233333333334444444444555555555566666666667777777778
      1234567890123456789012345678901234567890123456789012345678901234567890123456789
CARD
1567        R42=E42-V*CT*E42/DEN-D2*(E42-V*CT*E42/DEN)
1568        GO TO 2055
1569   2054 R32=E32-$NUM2*A+E42-D2*(E32-$NUM2*A+E42)
1570        R42=0
1571        RCT4=((V*CT)*(E42/DEN)-E42)/V
1572   2055 R43=E43+F
1573        GO TO 9000
1574   2100 IF(CL*$M-(E31-(CI*$N-E11-E12-E31-E22))-E32.GT.E41)GO TO 2150
1575        YL=(E31-(CI*$N-E11-E12-E21-E22))*A*X31+E32*A*X32+(CL*$M-(E31-(CI*$
1576       2N-E11-E12-E21-E22))-E32)*A*X41
1577        GET=32.0
1578        GO TO 1
1579   2101 $NUM1=E31-(CI*$N-E11-E12-E21-E22)
1580        $NUM2=CL*$M-$NUM1-E32
1581        DEN=E41-$NUM2+E42
1582        SM11=RM11-RET11
1583        SM12=RM12-RET12
1584        SM21=RM21-RET21
1585        SM22=RM22-RET22
1586        SM31=RM31-RET31+$NUM1*A
1587        SM32=RM32-RET32+E32*A
1588        SM41=RM41-RET41+$NUM2*A
1589        SM42=RM42-RET42
1590        R11=0
1591        R21=0
1592        IF(V*CT*((E41-$NUM2)/DEN).GT.E41-$NUM2)GO TO 2102
1593        R31=$NUM1*(1.0-A)+V*CT*((E41-$NUM2)/DEN)
1594        R41=E41-$NUM2*A-V*CT*((E41-$NUM2)/DEN)
1595        GO TO 2103
1596   2102 R31=$NUM1*(1.0-A)+E41-$NUM2
1597        R41=$NUM2*(1.0-A)
1598        RCT2=((V*CT*(E41-$NUM2)/DEN)-(E41-$NUM2))/V
1599   2103 R21=0
1600        R22=0
1601        IF(V*CT*E42/DEN.GT.E42)GO TO 2104
1602        R32=E32*(1.0-A)+V*CT*E42/DEN-D2*(E32*(1.0-A)+V*CT*E42/DEN)
1603        R42=E42-V*CT*E42/DEN-D2*(E42-V*CT*E42/DEN)
1604        GO TO 2105
1605   2104 R32=E32*(1.0-A)+E42-D2*(E32*(1.0-A)+E42)
1606        R42=0
1607        RCT4=((V*CT)*(E42/DEN)-E42)/V
1608   2105 R43=E43+F
1609        GO TO 9000
1610   2150 IF (CL*$M-(E31-(CI*$N-E11-E12-E21-E22))-E32-E41.GT.E42)GO TO 2200
1611        YL=(E31-(CI*$N-E11-E12-E21-E22))*A*X31+E32*A*X32+E41*A*X41+((CL*$M
1612       2-(CI*$N-E11-E12-E21-E22))-E32-E41)*A*X42
1613        GET=33.0
1614        GO TO 1
1615   2151 $NUM1=E31-(CI*$N-E11-E12-E21-E22)
1616        $NUM2=CL*$M-$NUM1-E32-E41
1617        SM11=RM11-RET11
1618        SM12=RM12-RET12
1619        SM21=RM21-RET21
1620        SM22=RM22-RET22
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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
1621        SM31=RM31-RET31+$NUM1*A
1622        SM32=RM32-RET32+E32*A
1623        SM41=RM41-RET41+E41*A
1624        SM42=RM42-RET42+$NUM2*A
1625        R11=0
1626        R21=0
1627        R31=$NUM1*(1.0-A)
1628        R41=E41*(1.0-A)
1629        R12=0
1630        R22=0
1631        IF(V*CT.GT.E42-$NUM2)GO TO 2152
1632        R32=E32*(1.0-A)+V*CT-D2*(E32*(1.0-A)+V*CT)
1633        R42=E42-$NUM2*A-V*CT-D2*(E42-$NUM2*A-V*CT)
1634        GO TO 2153
1635   2152 R32=E32*(1.0-A)+E42-$NUM2-D2*(E32*(1.0-A)+E42-$NUM2)
1636        R42=$NUM2*(1.0-A)-D2*($NUM2*(1.0-A))
1637        RCT4=(V*CT-(E42-$NUM2))/V
1638   2153 R43=E43+F
1639        GO TO 9000
1640   2200 YL=(E21-(CI*$N-E11-E12-E21-E22))*A*X31+E32*A*X32+E41*A*X41+E42*A*X
1641       242
1642        RCL=(CL*$M-(E31-(CI*$N-E11-E12-E21-E22))-E32-E41-E42)/$M
1643        GET=34.0
1644        GO TO 1
1645   2201 $NUM=E31-(CI*$N-E11-E12-E21-E22)
1646        SM11=RM11-RET11
1647        SM12=RM12-RET12
1648        SM21=RM21-RET21
1649        SM22=RM22-RET22
1650        SM31=RM31-RET31+$NUM*A
1651        SM32=RM32-RET32+E32*A
1652        SM41=RM41-RET41+E41*A
1653        SM42=RM42-RET42+E42*A
1654        R11=0
1655        R12=0
1656        R31=$NUM*(1.0-A)
1657        R41=E41*(1.0-A)
1658        R21=0
1659        R22=0
1660        R32=E32*(1.0-A)-D2*(E32*(1.0-A))
1661        R42=E42*(1.0-A)-D2*(E42*(1.0-A))
1662        R43=E43+F
1663        RCT4=CT
1664        GO TO 9000
1665   2500 IF(CI*$N-E11-E12-E21-E22-E31.GT.E32)GO TO 3000
1666        YI=E11*Z11+E12*Z12+E21*Z21+E22*Z22+E31*Z31+(CI*$N-E11-E12-E21-E22-
1667       2E31)*Z32
1668        IF(CL*$M.GT.E32-(CI*$N-E11-E12-E21-E22-E31)) GO TO 2550
1669        YL=CL*$M*A*X32
1670        GET=35.0
1671        GO TO 1
1672   2501 $NUM=CL*$M+(CI*$N-E11-E12-E21-E22-E31)
1673        DEN=E41+E42
1674        SM11=RM11-RET11
```

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      C000000001111111111222222222233333333334444444444555555555566666666667777777778
      1234567890123456789012345678901234567890123456789012345678901234567890123456789
CARD
1675        SM12=RM12-RET12
1676        SM21=RM21-RET21
1677        SM22=RM22-RET22
1678        SM31=RM31-RET31
1679        SM32=RM32-RET32+CL*$M*A
1680        SM41=RM41-RET41
1681        SM42=RM42-RET42
1682        R11=0
1683        R21=0
1684        E11RCH=E11
1685        E12RCH=E12
1686        E21RCH=E21
1687        E22RCH=E22
1688        E31RCH=E31
1689        E32RCH=CI*$N-E11-E12-E21-E22-E31
1690        IF(V*CT*E41/DEN.GT.E41)GO TO 2502
1691        R31=V*CT*E41/DEN
1692        R41=E41-V*CT*E41/DEN
1693        GO TO 2503
1694   2502 R31=E41
1695        R41=0
1696        RCT2=((V*CT)*(E41/DEN)-E41)/V
1697   2503 R12=0
1698        R22=0
1699        IF(V*CT*E42/DEN.GT.E42)GO TO 2504
1700        R32=E32-$NUM+V*CT*E42/DEN+CL*$M*(1.0-A)-D2*(E32-$NUM+V*CT*E42/DEN+
1701       3CL*$M*(1.0-A))
1702        R42=E42-V*CT*E42/DEN-D2*(E42-V*CT*E42/DEN)
1703        GO TO 2505
1704   2504 R32=E32-$NUM+E42+CL*$M*(1.0-A)-D2*(E32-$NUM+E42+CL*$M*(1.0-A))
1705        R42=0
1706        RCT4=((V*CT)*(E42/DEN)-E42)/V
1707   2505 R43=E43+F
1708        GO TO 9000
1709   2550 IF(CL*$M-(E32-(CI*$N-E11-E12-E21-E22-E31)).GT.E41)  GO TO 2600
1710        YL=(E32-(CI*$N-E11-E12-E21-E22-E31))*A*X32+(CL*$M-(E32-(CI*$N-E11-
1711       2E12-E21-E22-E31)))*A*X41
1712        GET=36.0
1713        GO TO 1
1714   2551 $NUM1=E32-(CI*$N-E11-E12-E21-E22-E31)
1715        $NUM2=CL*$M-$NUM1
1716        DEN=E41-$NUM2+E42
1717        SM11=RM11-RET11
1718        SM12=RM12-RET12
1719        SM21=RM21-RET21
1720        SM22=RM22-RET22
1721        SM31=RM31-RET31
1722        SM32=RM32-RET32+$NUM1*A
1723        SM41=RM41-RET41+$NUM2*A
1724        SM42=RM42-RET42
1725        R11=0
1726        R21=0
1727        IF(V*CT*((E41-$NUM2)/DEN).GT.E41-$NUM2)GO TO 2552
1728        R31=V*CT*((E41-$NUM2)/DEN)
```

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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
1729        R41=E41-$NUM2-V*CT*((E41-$NUM2)/DEN)+$NUM2*(1.0-A)
1730        GO TO 2553
1731   2552 R31=E41-$NUM2
1732        R41=$NUM2*(1.0-A)
1733        RCT2=((V*CT*(E41-$NUM2)/DEN)-(E41-$NUM2))/V
1734   2553 R12=0
1735        R22=0
1736        IF(V*CT*E42/DEN.GT.E42)GO TO 2554
1737        R32=$NUM1*(1.0-A)+V*CT*E42/DEN-D2*($NUM1*(1.0-A)+V*CT*E42/DEN)
1738        R42=E42-V*CT*E42/DEN-D2*(E42-V*CT*E42/DEN)
1739        GO TO 2555
1740   2554 R32=$NUM1*(1.0-A)+E42-D2*($NUM1*(1.0-A)+E42)
1741        R42=0
1742        RCT4=((V*CT)*(E42/DEN)-E42)/V
1743   2555 R43=E43+F
1744        GO TO 9000
1745   2600 IF((CL*$M-(E32-(CI*$N-E11-E12-E21-E22-E31))-E41).GT.E42)GO TO 2650
1746        YL=(E32-(CI*$N-E11-E12-E21-E22-E31))*A*X32+E41*A*X41+(CL*$M-(E32-(
1747       5CI*$N-E11-E12-E21-E22-E31))-E41)*A*X42
1748        GET=37.0
1749        GO TO 1
1750   2601 $NUM1=E32-(CI*$N-E11-E12-E21-E22-E31)
1751        $NUM2=CL*$M-$NUM1-E41
1752        SM11=RM11-RET11
1753        SM12=RM12-RET12
1754        SM21=RM21-RET21
1755        SM22=RM22-RET22
1756        SM31=RM31-RET31
1757        SM32=RM32-RET32+$NUM1*A
1758        SM41=RM41-RET41+E41*A
1759        SM42=RM42-RET42+$NUM2*A
1760        R11=0
1761        R21=0
1762        R31=0
1763        R41=E41*(1.0-A)
1764        R12=0
1765        R22=0
1766        IF(V*CT.GT.E42-$NUM2)GO TO 2602
1767        R32=$NUM1*(1.0-A)+V*CT-D2*($NUM1*(1.0-A)+V*CT)
1768        R42=E42-$NUM2-V*CT+$NUM2*(1.0-A)-D2*(E42-$NUM2-V*CT+$NUM2*(1.0-A))
1769        GO TO 2603
1770   2602 R32=$NUM1*(1.0-A)+E42-$NUM2-D2*($NUM1*(1.0-A)+E42-$NUM2)
1771        R42=$NUM2*(1.0-A)-D2*($NUM2*(1.0-A))
1772        RCT4=(V*CT-(E42-$NUM2))/V
1773   2603 R43=E43+F
1774        GO TO 9000
1775   2650 YL=(E32-(CI*$N-E11-E12-E21-E22-E31))*A*X32+E41*A*X41+E42*A*X42
1776        RCL=(CL*$M-(E32-(CI*$N-E11-E12-E21-E22-E31))-E41-E42)/$M
1777        GET=38.0
1778        GO TO 1
1779   2651 $NUM=E32-(CI*$N-E11-E12-E21-E22-E31)
1780        SM11=RM11-RET11
1781        SM12=RM12-RET12
1782        SM21=RM21-RET21
```

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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
1783        SM22=RM22-RET22
1784        SM31=RM31-RET31
1785        SM32=RM32-RET32+$NUM*A
1786        SM41=RM41-RET41+E41*A
1787        SM42=RM42-RET42+E42*A
1788        R11=0
1789        R21=0
1790        R31=0
1791        R41=E41*(1.0-A)
1792        R12=0
1793        R22=0
1794        R42=E42*(1.0-A)-D2*(E42*(1.0-A))
1795        R43=E43+F
1796        RCT4=CT
1797        GO TO 9000
1798   3000 IF(CI*$N-E11-E12-E21-E22-E31-E32.GT.E41)GO TO 3500
1799        YI=E11*Z11+E12*Z12+E21*Z21+E22*Z22+E31*Z31+E32*Z32+(CI*$N-E11-E12-
1800       6E21-E22-E31-E32)*Z41
1801        IF(CL*$M.GT.E41-(CI*$N-E11-E12-E21-E22-E31-E32))GO TO 3050
1802        YL=CL*$M*A*X41
1803        GET=39.0
1804        GO TO 1
1805   3001 $NUM=CL*$M+( CI*$N-E11-E12-E21-E22-E31-E32)
1806        DEN=E41-$NUM+E42
1807        SM11=RM11-RET11
1808        SM12=RM12-RET12
1809        SM21=RM21-RET21
1810        SM22=RM22-RET22
1811        SM31=RM31-RET31
1812        SM32=RM32-RET32
1813        SM41=RM41-RET41+CL*$M*A
1814        SM42=RM42-RET42
1815        R11=0
1816        R21=0
1817        E11RCH=E11
1818        E12RCH=E12
1819        E21RCH=E21
1820        E22RCH=E22
1821        E31RCH=E31
1822        E32RCH=E32
1823        E41RCH=CI*$N-E11-E12-E21-E22-E31-E32
1824        IF(V*CT*((E41-$NUM)/DEN).GT.E41-$NUM)GO TO 3002
1825        R31=V*CT*((E41-$NUM)/DEN)
1826        R41=E41-$NUM-V*CT*((E41-$NUM)/DEN)+CL*$M*(1.0-A)
1827        GO TO 3003
1828   3002 R31=E41-$NUM
1829        R41=CL*$M*(1.0-A)
1830        RCT2=((V*CT*(E41-$NUM)/DEN)-(E41-$NUM))/V
1831   3003 R12=0
1832        R22=0
1833        IF(V*CT*E42/DEN.GT.E42)GO TO 3004
1834        R32=V*CT*E42/DEN-D2*(V*CT*E42/DEN)
1835        R42=E42-V*CT*E42/DEN-D2*(E42-V*CT*E42/DEN)
1836        GO TO 3005
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      0000000001111111111122222222223333333333444444444455555555556666666666777777777 8
      1234567890123456789012345678901234567890123456789012345678901234567890123456789 0
CARD
1837   3004 R32=E42-D2*E42
1838        R42=0
1839        RCT4=((V*CT)*(E42/DEN)-E42)/V
1840   3005 R43=E43+F
1841        GO TO 9000
1842   3050 IF(CL*$M-(E41-(CI*$N-E11-E12-E21-E22-E31-E32)).GT.E42)GO TO 3100
1843        YL=(E41-(CI*$N-E11-E12-E21-E22-E31-E32))*A*X41+(CL*$M-(E41-(CI*$N-
1844       7E11-E12-E21-E22-E31-E32)))*A*X42
1845        GET=40.0
1846        GO TO 1
1847   3051 $NUM1=E41-(CI*$N-E11-E12-E21-E22-E31-E32)
1848        $NUM2=CL*$M-$NUM1
1849        SM11=RM11-RET11
1850        SM12=RM12-RET12
1851        SM21=RM21-RET21
1852        SM22=RM22-RET22
1853        SM31=RM31-RET31
1854        SM32=RM32-RET32
1855        SM41=RM41-RET41+$NUM1*A
1856        SM42=RM42-RET42+$NUM2*A
1857        R11=0
1858        R21=0
1859        R31=0
1860        R41=$NUM1*(1.0-A)
1861        R12=0
1862        R22=0
1863        IF(V*CT.GT.E42-$NUM2) GO TO 3052
1864        R32=V*CT-D2*(V*CT)
1865        R42=E42-$NUM2*A-V*CT-D2*(E42-$NUM2*A-V*CT)
1866        GO TO 3053
1867   3052 R32=E42-$NUM2-D2*(E42-$NUM2)
1868        R42=$NUM2*(1.0-A)
1869        RCT4=(V*CT-(E42-$NUM2))/V
1870   3053 R43=E43+F
1871        GO TO 9000
1872   3100 YL=(E41-(CI*$N-E11-E12-E21-E22-E31-E32))*A*X41+E42*A*X42
1873        RCL=(CL*$M-(E41-(CI*$N-E11-E12-E21-E22-E31-E32))-E42)/$M
1874        GET=41.0
1875        GO TO 1
1876   3101 $NUM=E41-(CI*$N-E11-E12-E21-E22-E31-E32)
1877        SM11=RM11-RET11
1878        SM12=RM12-RET12
1879        SM21=RM21-RET21
1880        SM22=RM22-RET22
1881        SM31=RM31-RET31
1882        SM32=RM32-RET32
1883        SM41=RM41-RET41+$NUM*A
1884        SM42=RM42-RET42+E42*A
1885        R11=0
1886        R21=0
1887        R31=0
1888        R41=$NUM*(1.0-A)
1889        R12=0
1890        R22=0
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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
1891        R32=0
1892        R42=E42*(1.0-A)-D2*(E42*(1.0-A))
1893        R43=E43+F
1894        RCT4=CT
1895        GO TO 9000
1896   3500 IF(CI*$N-E11-E12-E21-E22-E31-E32-E41.GT.E42)GO TO 4000
1897        YI=E11*Z11+E12*Z12+E21*Z21+E22*Z22+E31*Z31+E32*Z32+E41*Z41+(CI*$N-
1898       1E11-E12-E21-E22-E31-E32-E41)*Z42
1899        IF(CL*$M.GT.E42-(CI*$N-E11-E12-E21-E22-E31-E32-E41))GO TO 3550
1900        YL=CL*$M*A*X42
1901        GET=42.0
1902        GO TO 1
1903   3501 $NUM=CL*$M+(CI*$N-E11-E12-E21-E22-E31-E31-E32-E41)
1904        SM11=RM11-RET11
1905        SM12=RM12-RET12
1906        SM21=RM21-RET21
1907        SM22=RM22-RET22
1908        SM31=RM31-RET22
1909        SM32=RM32-RET32
1910        SM41=RM41-RET41
1911        SM42=RM42-RET42+CL*$M*A
1912        R11=0
1913        R21=0
1914        R31=0
1915        R41=0
1916        R12=0
1917        R22=0
1918        E11RCH=E11
1919        E12RCH=E12
1920        E21RCH=E21
1921        E22RCH=E22
1922        E31RCH=E31
1923        E32RCH=E32
1924        E41RCH=E41
1925        E42RCH=CI*$N-E11-E12-E21-E22-E31-E32-E41
1926        IF(V*CT.GT.E42-$NUM)GO TO 3502
1927        R32=V*CT-D2*V*CT
1928        R42=E42-$NUM-V*CT+CL*$M*(1.0-A)-D2*(E42-$NUM-V*CT+CL*$M*(1.0-A))
1929        GO TO 3503
1930   3502 R32=E42-$NUM-D2*(E42-$NUM)
1931        R42=CL*$M*(1.0-A)-D2*(CL*M*(1.0-A))
1932        RCT4=(V*CT-(E42-$NUM))/V
1933   3503 R43=E43+F
1934        GO TO 9000
1935   3550 YL=(E42-(CI*$N-E11-E12-E21-E22-E31-E32-E41))*A*X42
1936        RCL=(CL*$M-(E42-(CI*$N-E11-E12-E21-E22-E31-E32-E41)))/$M
1937        GET=43.0
1938        GO TO 1
1939   3551 $NUM=E42-(CI*$N-E11-E12-E21-E22-E31-E32-E41)
1940        SM11=RM11-RET11
1941        SM12=RM12-RET12
1942        SM21=RM12-RET21
1943        SM22=RM22-RET22
1944        SM31=RM31-RET31
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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
1945        SM32=RM32-RET32
1946        SM41=RM41-RET41
1947        SM42=RM42-RET42+$NUM*A
1948        R11=0
1949        R21=0
1950        R31=0
1951        R41=0
1952        R12=0
1953        R22=0
1954        R32=0
1955        R42=E42*(1.0-A)
1956        R43=E43+F
1957        RCT4=CT
1958        GO TO 9000
1959     4000 IF(CI*$N-E11-E12-E21-E22-E31-E32-E41-E42.GT.E43)GO TO 4050
1960        YI=E11*Z11+E12*Z12+E22*Z22+E31*Z31+E32*Z32+E41*Z41+E42*Z42+(CI*$N-
1961       2E11-E12-E21-E22-E31-E32-E41-E42)*Z43+E21*Z21
1962        YL=0.0
1963        RCL=CL
1964        GET=44.0
1965        GO TO 1
1966     4001 SM11=RM11-RET11
1967        SM12=RM12-RET12
1968        SM21=RM21-RET21
1969        SM22=RM22-RET22
1970        SM31=RM31-RET31
1971        SM32=RM32-RET32
1972        SM41=RM41-RET41
1973        SM42=RM42-RET42
1974        R11=0
1975        R21=0
1976        R31=0
1977        R41=0
1978        R12=0
1979        R22=0
1980        R32=0
1981        R42=0
1982        R43=E43-(CI*$N-E11-E12-E21-E22-E31-E32-E41-E42)+F
1983        E11RCH=E11
1984        E12RCH=E12
1985        E21RCH=E21
1986        E22RCH=E22
1987        E31RCH=E31
1988        E32RCH=E32
1989        E41RCH=E41
1990        E42RCH=E42
1991        E43RCH=CI*$N-E11-E12-E21-E22-E31-E32-E41-E42
1992        GO TO 9000
1993     4050 YI=E11*Z11+E12*Z12+E22*Z22+E31*Z31+E32*Z32+E41*Z41+E42*Z42+E43*Z43
1994       1+E21*Z21
1995        YL=0
1996        RCI=(CI*$N-E11-E12-E21-E22-E31-E32-E41-E42-E43)/$N
1997        RCL=CL
1998        GET=45.0
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      00000000011111111112222222222333333333344444444445555555556666666667777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
1999        GO TO 1
2000   4051 SM11=RM11-RET11
2001        SM12=RM12-RET12
2002        SM21=RM21-RET21
2003        SM22=RM22-RET22
2004        SM31=RM31-RET31
2005        SM32=RM32-RET32
2006        SM41=RM41-RET41
2007        SM42=RM42-RET42
2008        R11=0
2009        R21=0
2010        R31=0
2011        R41=0
2012        R12=0
2013        R22=0
2014        R32=0
2015        R42=0
2016        R43=F
2017        RCT4=CT
2018        E11RCH=E11
2019        E12RCH=E12
2020        E21RCH=E21
2021        E22RCH=E22
2022        E31RCH=E31
2023        E32RCH=E32
2024        E41RCH=E41
2025        E42RCH=E42
2026        E43RCH=E43
2027        GO TO 9000
2028   9000 IF(PVCAL.GT.1)GO TO 9011
2029        HE11=(E11/(E11+E21))
2030        HE21=(E21/(E11+E21))
2031        HE31=(E31/(E31+E41))
2032        HE41=(E41/(E31+E41))
2033        IF (H.GT.(E11+E21)/20.0) GO TO 9012
2034        HSTAY=1.0
2035        GO TO 9011
2036   9012 HSTAY=((E11+E21)/20.0)/H
2037   9011 E11=R11-(R11/20.0)+RET11+HE11*HSTAY*H
2038        E21=R21-(R21/20.0)+RET21+HE21*HSTAY*H
2039        E31=R31-(R31/20.0)+RET31+HE31*(R43/5.0)
2040        E41=R41-(R41/20.0)+RET41+HE41*(R43/5.0)
2041        E12=R12-(R12/25.0)+(R11/20.0)+RET12
2042        E22=R22-(R22/25.0)+(R21/20.0)+RET22
2043        E32=R32-(R32/25.0)+(R31/20.0)+RET32
2044        E42=R42-(R42/25.0)+(R41/20.0)+RET42
2045        E43=R43-(R43/5.0)
2046        $I=(R12+R22+R32+R42)/25
2047        $M=$M1
2048        $N=$N1
2049        $MBTOT=$MBTOT-DIOUT+(CL-RCL)/$MTEL
2050        SIMP1=((CF/QOLD)-B)*QOLD
2051        IF (CF/QOLD.GT.B) GO TO 9005
2052        WLFB=(CF/QOLD)-DB*(CF/QOLD)
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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
2053        B=B-(CF/QOLD)-CE*(B-(CF/QOLD))+$I+RETB
2054        IF (CP/QDSBL.GT.AL) GO TO 9010
2055        WLFAL=(CP/QDSBL)-DA*(CP/QDSBL)
2056        AL=AL-(CP/QDSBL)-DA*(AL-(CP/QDSBL))+RETR
2057        GO TO 9100
2058     9005 IF (CP/QDSBL.GT.AL) GO TO 9007
2059        IF((CP+SIMP1)/QDSBL.GT.AL)GO TO 9008
2060        WLFB=B-DB*B
2061        B=$I+RETB
2062        WLFAL=((CP+SIMP1)/QDSBL)-DA*((CP+SIMP1)/QDSBL)
2063        AL=AL-((CP+SIMPI)/QDSBL)-DA*(AL-((CP+SIMP1)/QDSBL))+RETR
2064        GO TO 9100
2065     9007 WLFB=B-DB*B
2066        B=$I+RETB
2067        WLFAL=AL-DA*AL
2068        AL=RETR
2069        RCF=((CF/QOLD)-BS)*QOLD
2070        RCP=((CP/QDSBL)-ALS)*QDSBL
2071        GO TO 9100
2072     9008 WLFB=B-DB*B
2073        B=$I+RETB
2074        WLFAL=AL-DA*AL
2075        AL=RETR
2076        RCF=(((CP+SIMP1)/QDSBL)-ALS)*QDSBL
2077        GO TO 9100
2078     9010 WLFAL=AL-DA*AL
2079        AL=RETR
2080        RCP=((CP/QDSBL)-ALS)*QDSBL
2081        GO TO 9100
2082     9100 RCT=RCT1+RCT2+RCT3+RCT4
2083        TP=ALS+BS+E11S+E12S+E21S+E22S+E31S+E32S+E41S+E42S+E43S+THS
2084        TAL=CF+CP+CE+CT+CS+CI+CL
2085        XYZ=CF-RCF+CP-RCP+CE-RCE+(CT-RCT)*PERCT+(CF-RCF+CP-RCP+CE-RCE+(CT-
2086       1RCT)*PERCT)*($MULT-1)*PERPR+((CT-RCT)*(1-PERCT)+(CL-RCL)*PERLM+CS-
2087       1RCS)*($MULT-1)*PERPR
2088        ZYX=(CF+CP+CE-RCF-RCP-RCE+CT-RCT+(CL-RCL)*PERLM+CS-RCS)*($MULT-1)*
2089       1(1-PERPR)+(CT-RCT)*(1-PERCT)+(CL-RCL)*PERLM+CS-RCS
2090        Y=YI1+YI2+YI3+YI4+YI5+YI6+YI7+YI8+YI9+YI10+YI11+YI12+YI13+
2091       1YI14+YI15+YI16+YI17+YI18+YI19+YI20+YL1+YL2+YL3+YL4+YL5+YL6+YL7+YL8
2092       1+YL9+YL10+YL11+YL12+YL13+YL14+YL15+YL16+YL17+YL18+YL19+YL20+XYZ
2093        YRICH=((F1/AF)*$F+(F2/AF)*$F+(G1/AF)*$G+(G2/AF)*$G+(H1/AF)*$H+(H2/
2094       1AF)*$H+(H3/AF)*$H3)*RICH*(CI-RCI)
2095        RICH1=RICH
2096        RICH=RICH/AE
2097        IF (RICH*RCHIN*(CI-RCI).LT.AF)GO TO 9101
2098        F1IN=(F1/AF)*RICH*(CI-RCI)-F1
2099        F2IN=(F2/AF)*RICH*(CI-RCI)-F2
2100        G1IN=(G1/AF)*RICH*(CI-RCI)-G1
2101        G2IN=(G2/AF)*RICH*(CI-RCI)-G2
2102        H1IN=(H1/AF)*RICH*(CI-RCI)-H1
2103        H2IN=(H2/AF)*RICH*(CI-RCI)-H2
2104        H3IN=(H3/AF)*RICH*(CI-RCI)-H3
2105        GO TO 9102
2106     9101 F1IN=RICH*(1-RCHIN)*(CI-RCI)*(F1/AF)
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      00000000011111111112222222223333333333444444444455555555556666666666777777777 8
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
2107        F2IN=RICH*(1-RCHIN)*(CI-RCI)*(F2/AF)
2108        G1IN=RICH*(1-RCHIN)*(CI-RCI)*(G1/AF)
2109        G2IN=RICH*(1-RCHIN)*(CI-RCI)*(G2/AF)
2110        H1IN=RICH*(1-RCHIN)*(CI-RCI)*(H1/AF)
2111        H2IN=RICH*(1-RCHIN)*(CI-RCI)*(H2/AF)
2112        H3IN=RICH*(1-RCHIN)*(CI-RCI)*(H3/AF)
2113     9102 RETRCH=(RCHKID/4.0)*RTRD
2114        SMTRCH=(RCHKID/4.0)-RETRCH
2115        HRCH=(SMTRCH/5.0)-(SMTRCH/5.0)*$MDP
2116        FRCH=SMTRCH*$MDP
2117        NOWRKD=RCHKID+(F1+G1+H1+H3)*$MBR-FRCH-HRCH-RETRCH
2118        $NTOT=F1IN+F2IN+G1IN+G2IN+H1IN+H2IN+H3IN
2119        F1=F1+F1IN+(G1/AF)*RICH*(CI-RCI)*$G/(FLOW-GLOW)
2120        F2=F2+F2IN+(G2/AF)*RICH*(CI-RCI)*$G/(FLOW-GLOW)
2121        G1=G1+F2IN+(H1/AF)*RICH*(CI-RCI)*$H/(GLOW-Q)-(G1/AF)*RICH*(CI-RCI)
2122       1*$G/(FLOW-GLOW)
2123        G2=G2+G2IN+(H2/AF)*RICH*(CI-RCI)*$H/(GLOW-Q)-(G2/AF)*RICH*(CI-RCI)
2124       1*$G/(FLOW-GLOW)
2125        H1=H1+H1IN+E11RCH+E21RCH+E31RCH+E41RCH-(H1/AF)*RICH*(CI-RCI)*$H/
2126       1(GLOW-Q)
2127        H2=H2+H2IN+E12RCH+E22RCH+E32RCH+E42RCH-(H2/AF)*RICH*(CI-RCI)*$H/
2128       1(GLOW-Q)
2129        H3=H3+H3IN+E43RCH
2130        GTLDF2=(F2-F2*D2)/25
2131        GTLDG2=(G2-G2*D2)/25
2132        GTLDH2=(H2-H2*D2)/25
2133        F1=F1-F1/20+F2*D2+GTLDF2
2134        F2=F2-F2*D2-GTLDF2
2135        G1=G1-G1/20+G2*D2+GTLDG2
2136        G2=G2-G2*D2-GTLDG2
2137        H1=H1-H/20+H2*D2+GTLDH2*H1/(H3+H1)
2138        H2=H2-H2*D2-GTLDH2
2139        H3=H3-H3/5+GTLDH2*H3/(H3+H1)
2140        RCHKID=(NOWRKD/AF)*(F1+F2+G1+G2+H1+H2+H3)
2141        OLDRCH=OLDRCH-CLDRCH*DB+GTLDF2+GTLDG2+GTLDH2
2142        AL=AL-(AL/50)+RETRCH
2143        B=B+(AL/50)
2144        WLFB=WLFB+WLFAL/50
2145        WLFAL=WLFAL-WLFAL/50
2146        $NEWB=B+WLFB
2147        $NEWAL=AL+WLFAL
2148        TH=(THS/(TP-THS-BS))*(E11+E12+E21+E22+E31+E32+E41+E42+E43+AL)
2149        WLFTH=(THS/(TP-THS-BS))*WLFAL
2150        $NEWTH=TH+WLFTH
2151        E43=E43+FRCH
2152        TRP=AL+B+E11+E12+E21+E22+E31+E32+E41+E42+E43+TH
2153        PPY=TRP+PPY
2154        TOTRCH=F1+F2+G1+G2+H1+H2+H3+OLDRCH+RCHKID
2155        RICH=RICH1
2156        YRICH=YRICH+ZYX
2157        GROSMP=((CL-RCL)/$MTEL)-RETOT1
2158        IF(TOTRCH+TRP+WLFB+WLFAL+WLFTH+GROSMP-$NTOT.GT.(TOTRHS+TP)*(1.0+
2159       CGRORT)) GO TO 9103
2160        GROW=(TOTRHS+TP)*(1.0+GRORT)-(TOTRCH+TRP+WLFB+WLFAL+WLFTH+GROSMP-
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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
2161        C$NTOT)
2162         F1=F1+GROW*F1GRO
2163         F2=F2+GROW*F2GRO
2164         G1=G1+GROW*G1GRO
2165         G2=G2+GROW*G2GRO
2166         H1=H1+GROW*H1GRO
2167         H2=H2+GROW*H2GRO
2168         H3=H3+GROW*H3GRO
2169         OLDRCH=OLDRCH+GROW*OLDGRO
2170         RCHKID=RCHKID+GROW*RHKGRO
2171         TOTRCH=F1+F2+G1+G2+H1+H2+H3+OLDRCH+RCHKID+WLFAL+WLFB+WLFTH
2172    9103 IF (PVCAL.EQ.1.0) GO TO 9301
2173         IF (PVCAL.EQ.2) GO TO 9302
2174         IF (PVCAL.EQ.3) GO TO 9303
2175         IF (PVCAL.EQ.4) GO TO 9304
2176         IF (PVCAL.EQ.5) GO TO 9305
2177         IF (PVCAL.EQ.6) GO TO 9306
2178         IF (PVCAL.EQ.7) GO TO 9307
2179         IF (PVCAL.EQ.8) GO TO 9308
2180         IF (PVCAL.EQ.9) GO TO 9309
2181         IF (PVCAL.EQ.10) GO TO 9310
2182         IF (PVCAL.EQ.11) GO TO 9311
2183         IF (PVCAL.EQ.12) GO TO 9312
2184         IF (PVCAL.EQ.13) GO TO 9313
2185         IF (PVCAL.EQ.14) GO TO 9314
2186         IF (PVCAL.EQ.15) GO TO 9315
2187         IF (PVCAL.EQ.16) GO TO 9316
2188         IF (PVCAL.EQ.17) GO TO 9317
2189         IF (PVCAL.EQ.18) GO TO 9318
2190         IF (PVCAL.EQ.19) GO TO 9319
2191         IF (PVCAL.EQ.20) GO TO 9320
2192    9301 Y1=Y
2193         COST1=TAL
2194         YRCH1=YRICH
2195         YTOT1=Y+YRCH1
2196         YTOT=YTOT1
2197         YRCH1=YRICH-ZYX
2198         GO TO 9329
2199    9302 Y2=Y
2200         COST2=TAL
2201         YRCH2=YRICH
2202         YTOT2=Y+YRCH1+YRCH2
2203         YTOT=YTOT2
2204         YRCH2=YRICH-ZYX
2205         GO TO 9329
2206    9303 Y3=Y
2207         COST3=TAL
2208         YRCH3=YRICH
2209         YTOT3=Y+YRCH1+YRCH2+YRCH3
2210         YTOT=YTOT3
2211         YRCH3=YRICH-ZYX
2212         GO TO 9329
2213    9304 Y4=Y
2214         COST4=TAL
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      00000000011111111112222222223333333333444444444455555555556666666666777777777 8
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
2215        YRCH4=YRICH
2216        YTOT4=Y+YRCH1+YRCH2+YRCH3+YRCH4
2217        YTOT=YTOT4
2218        YRCH4=YRICH-ZYX
2219        GO TO 9329
2220   9305 Y5=Y
2221        COST5=TAL
2222        YRCH5=YRICH
2223        YTOT5=Y+YRCH1+YRCH2+YRCH3+YRCH4+YRCH5
2224        YTOT=YTOT5
2225        YRCH5=YRICH-ZYX
2226        GO TO 9329
2227   9306 Y6=Y
2228        COST6=TAL
2229        YRCH6=YRICH
2230        YTOT6=Y+YRCH1+YRCH2+YRCH3+YRCH4+YRCH5+YRCH6
2231        YTOT=YTOT6
2232        YRCH6=YRICH-ZYX
2233        GO TO 9329
2234   9307 Y7=Y
2235        COST7=TAL
2236        YRCH7=YRICH
2237        YTOT7=Y+YRCH1+YRCH2+YRCH3+YRCH4+YRCH5+YRCH6+YRCH7
2238        YTOT=YTOT7
2239        YRCH7=YRICH-ZYX
2240        GO TO 9329
2241   9308 Y8=Y
2242        COST8=TAL
2243        YRCH8=YRICH
2244        YTOT8=Y+YRCH1+YRCH2+YRCH3+YRCH4+YRCH5+YRCH6+YRCH7+YRCH8
2245        YTOT=YTOT8
2246        YRCH8=YRICH-ZYX
2247        GO TO 9329
2248   9309 Y9=Y
2249        COST9=TAL
2250        YRCH9=YRICH
2251        YTOT9=Y+YRCH1+YRCH2+YRCH3+YRCH4+YRCH5+YRCH6+YRCH7+YRCH8+YRCH9
2252        YTOT=YTOT9
2253        YRCH9=YRICH-ZYX
2254        GO TO 9329
2255   9310 Y10=Y
2256        COST10=TAL
2257        YRCH10=YRICH
2258        YTOT10=Y+YRCH1+YRCH2+YRCH3+YRCH4+YRCH5+YRCH6+YRCH7+YRCH8+YRCH9+
2259       1YRCH10
2260        YTOT=YTOT10
2261        YRCH10=YRICH-ZYX
2262        GO TO 9329
2263   9311 Y11=Y
2264        COST11=TAL
2265        YRCH11=YRICH
2266        YTOT11=Y+YRCH1+YRCH2+YRCH3+YRCH4+YRCH5+YRCH6+YRCH7+YRCH8+YRCH9+
2267       1YRCH10+YRCH11
2268        YTOT=YTOT11
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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
2269        YRCH11=YRICH-ZYX
2270        GO TO 9329
2271   9312 Y12=Y
2272        COST12=TAL
2273        YRCH12=YRICH
2274        YTOT12=Y+YRCH1+YRCH2+YRCH3+YRCH4+YRCH5+YRCH6+YRCH7+YRCH8+YRCH9+
2275       1YRCH10+YRCH11+YRCH12
2276        YTOT=YTOT12
2277        YRCH12=YRICH-ZYX
2278        GO TO 9329
2279   9313 Y13=Y
2280        COST13=TAL
2281        YRCH13=YRICH
2282        YTOT13=Y+YRCH1+YRCH2+YRCH3+YRCH4+YRCH5+YRCH6+YRCH7+YRCH8+YRCH9+
2283       1YRCH10+YRCH11+YRCH12+YRCH13
2284        YTOT=YTOT13
2285        YRCH13=YRICH-ZYX
2286        GO TO 9329
2287   9314 Y14=Y
2288        COST14=TAL
2289        YRCH14=YRICH
2290        YTOT14=Y+YRCH1+YRCH2+YRCH3+YRCH4+YRCH5+YRCH6+YRCH7+YRCH8+YRCH9+
2291       1YRCH10+YRCH11+YRCH12+YRCH13+YRCH14
2292        YTOT=YTOT14
2293        YRCH14=YRICH-ZYX
2294        GO TO 9329
2295   9315 Y15=Y
2296        COST15=TAL
2297        YRCH15=YRICH
2298        YTOT15=Y+YRCH1+YRCH2+YRCH3+YRCH4+YRCH5+YRCH6+YRCH7+YRCH8+YRCH9+
2299       1YRCH10+YRCH11+YRCH12+YRCH13+YRCH14+YRCH15
2300        YTOT=YTOT15
2301        YRCH15=YRICH-ZYX
2302        GO TO 9329
2303   9316 Y16=Y
2304        COST16=TAL
2305        YRCH16=YRICH
2306        YTOT16=Y+YRCH1+YRCH2+YRCH3+YRCH4+YRCH5+YRCH6+YRCH7+YRCH8+YRCH9+
2307       1YRCH10+YRCH11+YRCH12+YRCH13+YRCH14+YRCH15+YRCH16
2308        YTOT=YTOT16
2309        YRCH16=YRICH-ZYX
2310        GO TO 9329
2311   9317 Y17=Y
2312        COST17=TAL
2313        YRCH17=YRICH
2314        YTOT17=Y+YRCH1+YRCH2+YRCH3+YRCH4+YRCH5+YRCH6+YRCH7+YRCH8+YRCH9+
2315       1YRCH10+YRCH11+YRCH12+YRCH13+YRCH14+YRCH15+YRCH16+YRCH17
2316        YTOT=YTOT17
2317        YRCH17=YRICH-ZYX
2318        GO TO 9329
2319   9318 Y18=Y
2320        COST18=TAL
2321        YRCH18=YRICH
2322        YTOT18=Y+YRCH1+YRCH2+YRCH3+YRCH4+YRCH5+YRCH6+YRCH7+YRCH8+YRCH9+
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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
2323       1YRCH10+YRCH11+YRCH12+YRCH13+YRCH14+YRCH15+YRCH16+YRCH17+YRCH18
2324        YTOT=YTOT18
2325        YRCH18=YRICH-ZYX
2326        GO TO 9329
2327    9319 Y19=Y
2328        COST19=TAL
2329        YRCH19=YRICH
2330        YTOT19=Y+YRCH1+YRCH2+YRCH3+YRCH4+YRCH5+YRCH6+YRCH7+YRCH8+YRCH9+
2331       1YRCH10+YRCH11+YRCH12+YRCH13+YRCH14+YRCH15+YRCH16+YRCH17+YRCH18+
2332       1YRCH19
2333        YTOT=YTOT19
2334        YRCH19=YRICH-ZYX
2335        GO TO 9329
2336    9320 Y20=Y
2337        COST20=TAL
2338        YRCH20=YRICH
2339        YTOT20=Y+YRCH1+YRCH2+YRCH3+YRCH4+YRCH5+YRCH6+YRCH7+YRCH8+YRCH9+
2340       1YRCH10+YRCH11+YRCH12+YRCH13+YRCH14+YRCH15+YRCH16+YRCH17+YRCH18+
2341       1YRCH19+YRCH20
2342        YTOT=YTOT20
2343        YRCH20=YRICH-ZYX
2344        GO TO 9329
2345    9329 PVY=Y1+(Y2/((1+DSCNT)**1))+(Y3/((1+DSCNT)**2))+(Y4/((1+DSCNT)**3)
2346       1)+(Y5/((1+DSCNT)**4))+(Y6/((1+DSCNT)**5))+(Y7/((1+DSCNT)**6))+
2347       1(Y8/((1+DSCNT)**7))+(Y9/((1+DSCNT)**8))+(Y11/((1+DSCNT)**10))+
2348       1(Y12/((1+DSCNT)**11))+(Y13/((1+DSCNT)**12))+(Y14/((1+DSCNT)**13))
2349       1+(Y15/((1+DSCNT)**14))+(Y16/((1+DSCNT)**15))+(Y17/((1+DSCNT)**16))
2350       1+(Y18/((1+DSCNT)**17))+(Y19/((1+DSCNT)**18))+(Y20/((1+DSCNT)**19))
2351       1+(Y10/((1+DSCNT)**9))
2352        D=1+DSCNT
2353        PVYTOT=YTOT1+(YTOT2/D)+(YTOT3/D**2)+(YTOT4/D**3)+(YTOT5/D**4)+
2354       1(YTOT6/D**5)+(YTOT7/D**6)+(YTOT8/D**7)+(YTOT9/D**8)+(YTOT10/D**9)+
2355       1(YTOT11/D**10)+(YTOT12/D**11)+(YTOT13/D**12)+(YTOT14/D**13)+
2356       1(YTOT15/D**14)+(YTOT16/D**15)+(YTOT17/D**16)+(YTOT18/D**17)+
2357       1(YTOT19/D**18)+(YTOT20/D**19)
2358        PVCOST=COST1+(COST2/D)+(COST3/D**2)+(COST4/D**3)+(COST5/D**4)+
2359       1(COST6/D**5)+(COST7/D**6)+(COST8/D**7)+(COST9/D**8)+(COST10/D**9)+
2360       1(COST11/D**10)+(COST12/D**11)+(COST13/D**12)+(COST14/D**13)+
2361       1(COST15/D**14)+(COST16/D**15)+(COST17/D**16)+(COST18/D**17)+
2362       1(COST19/D**18)+(COST20/D**19)
2363        IF(PVCOST.EQ.0.0)GO TO 9350
2364        BCPOOR=PVY/PVCOST
2365        BCTOT=PVYTOT/PVCOST
2366        GO TO 9351
2367    9350 BCPOOR=0.0
2368        BCTOT=0.0
2369    9351 CONTINUE
2370    9328 CSTEL=((SNEWAL/2+E11+E21+E31+E41+E43)*(G-$%BR))/DCR
2371        SMRT1=($NEWTH/4.0)-($NEWTH/4)*RTRD
2372        CETEL=(SMRT1*(S-$MDP))/U
2373    9353 YEAR=PVCAL
2374        PVCAL=PVCAL+1
2375        WLFCAP=(CF+CP)/(TOTRHS+TP)
2376        NDX=XNDX
```

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      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
2377        XNDXA(NDX)=XNDX
2378        TALA(NDX)=TAL
2379        TOPOPA(NDX)=TOTRHS+TP
2380        TOPRA(NDX)=TP
2381        PPYA(NDX)=PPY
2382        BCPRA(NDX)=BCPOOR
2383        BCTOTA(NDX)=BCTOT
2384        WLFYSA(NDX)=WLFAL+WLFB
2385        WLFNOA(NDX)=AL+B
2386        TOWLFA(NDX)=CF+CP
2387        WLFCPA(NDX)=WLFCAP
2388        TOPOA1(NDX)=TOTRCH+TRP
2389        TOPRA1(NDX)=TRP
2390    9500 WRITE(6,10042)XNDX
2391   10042 FORMAT('1                                                STRATEGY ',F4.0)
2392        WRITE(6,10043)YEAR
2393   10043 FORMAT('                                                YEAR ',F4.0)
2394        WRITE(6,9501)
2395    9501 FORMAT(' STARTING SITUATION:')
2396        WRITE(6,10039)
2397   10039 FORMAT(' ***************** ')
2398        WRITE(6,9523)TOTRHS
2399    9523 FORMAT('0',/,' TOTAL NONPOOR ',F25.0)
2400        WRITE(6,9524)OLDRHS
2401    9524 FORMAT('0',/,' NUMBER OF NONPOOR OVER AGE 65 ',F25.0)
2402        WRITE(6,9525)F1S
2403    9525 FORMAT(' NUMBER OF HIGH INCOME NONPOOR--AGE 20--39 ',F25.0)
2404        WRITE(6,9526)F2S
2405    9526 FORMAT(' NUMBER OF HIGH INCOME NONPOOR--AGE 40--64 ',F25.0)
2406        WRITE(6,9527)G1S
2407    9527 FORMAT(' NUMBER OF MEDIUM INCOME NONPOOR--AGE 20--39 ',F25.0)
2408        WRITE(6,9528)G2S
2409    9528 FORMAT(' NUMBER OF MEDIUM INCOME NONPOOR--AGE 40--64 ',F25.0)
2410        WRITE(6,9529)H1S
2411    9529 FORMAT(' NUMBER OF LOW INCOME NONPOOR--AGE 20--39 ',F25.0)
2412        WRITE(6,9530)H2S
2413    9530 FORMAT(' NUMBER OF LOW INCOME NONPOOR--AGE 40--64 ',F25.0)
2414        WRITE(6,9531)H3S
2415    9531 FORMAT(' NUMBER OF LOW INCOME NONPOOR--AGE 15--19 ',F25.0)
2416        WRITE(6,9532)RCHKDS
2417    9532 FORMAT(' NUMBER OF NONPOOR CHILDREN AND STUDENTS BELOW 19 ',F25.0)
2418        WRITE(6,9515)TP
2419    9515 FORMAT('0',/,' TOTAL POOR ',F25.0)
2420        WRITE(6,9502)ALS
2421    9502 FORMAT('0',/,' NUMBER OF UNSALVAGABLE POOR--AGE 15--64 ',F25.0)
2422        WRITE(6,9503)BS
2423    9503 FORMAT(' NUMBER OF UNSALVAGABLE POOR AGE 65 AND OVER ',F25.0)
2424        WRITE(6,9504)E11S
2425    9504 FORMAT(' NUMBER OF SALVAGABLE POOR WITH HIGH SCHOOL AND TRAINING--
2426       CAGE 20--39 ',F25.0)
2427        WRITE(6,9505)E12S
2428    9505 FORMAT(' NUMBER OF SALVAGABLE POOR WITH HIGH SCHOOL AND TRAINING--
2429       CAGE 40--64 ',F25.0)
2430        WRITE(6,9506)E21S
```

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      00000000011111111112222222222333333333344444444455555555556666666666777777777 8
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
2431   9506 FORMAT(' NUMBER OF SALVAGABLE POOR WITH HIGH SCHOOL BUT NO TRAININ
2432       CG--AGE 20--39 ',F25.0)
2433         WRITE(6,9507)E22S
2434   9507 FORMAT(' NUMBER OF SALVAGABLE POOR WITH HIGH SCHOOL BUT NO TRAININ
2435       CG--AGE 40--64 ',F25.0)
2436         WRITE(6,9508)E31S
2437   9508 FORMAT(' NUMBER OF SALVAGABLE POOR WITH NO HIGH SCHOOL BUT TRAININ
2438       CG--AGE 20--39 ',F25.0)
2439         WRITE(6,9509)E32S
2440   9509 FORMAT(' NUMBER OF SALVAGABLE POOR WITH NO HIGH SCHOOL BUT TRAININ
2441       CG--AGE 40--64 ',F25.0)
2442         WRITE(6,9510)E41S
2443   9510 FORMAT(' NUMBER OF SALVAGABLE POOR WITH NO HIGH SCHOOL AND NO TRAI
2444       CNING--AGE 20--39 ',F25.0)
2445         WRITE(6,9511)E42S
2446   9511 FORMAT(' NUMBER OF SALVAGABLE POOR WITH NO HIGH SCHOOL AND NO TRAI
2447       CNING--AGE 40--64 ',F25.0)
2448         WRITE(6,9512)E43S
2449   9512 FORMAT(' NUMBER OF SALVAGABLE POOR WITH NO HIGH SCHOOL AND NO TRAI
2450       CNING--AGE 15--19 ',F25.0)
2451         WRITE(6,9513)THS
2452   9513 FORMAT(' YOUNG CHILDREN AND STUDENTS LESS THAN AGE 19 ',F25.0)
2453         WRITE(6,9516)Y
2454   9516 FORMAT('0',/,' INCOME TO POOR FROM ALL PROJECTS THIS YEAR ',F25.0)
2455         WRITE(6,9517)YTOT
2456   9517 FORMAT('0',/,' TOTAL REGIONAL INCOME FROM ALL PROJECTS THIS YEAR '
2457       C,F25.0)
2458         WRITE(6,9514)PVY
2459   9514 FORMAT('0',/,' PRESENT VALUE OVER TIME OF INCOME TO POOR FROM ALL
2460       CPROJECTS ',F25.0)
2461         WRITE(6,9518)PVYTOT
2462   9518 FORMAT('0',/,' PRESENT VALUE OVER TIME OF TOTAL REGIONAL INCOME FR
2463       COM ALL PROJECTS ',F25.0)
2464         WRITE(6,9522)PPY
2465   9522 FORMAT('0',/,' PERSON POVERTY YEARS ACCUMULATED ',F25.0)
2466         WRITE(6,10000)CF
2467  10000 FORMAT('0',/,' ALLOCATION TO UNSALVAGABLE POOR OVER AGE 65 ',
2468       CF25.0)
2469         WRITE(6,10001)CP
2470  10001 FORMAT(' ALLOCATION TO UNSALVAGABLE POOR--AGE 15--64 ',F25.0)
2471         WRITE(6,10002)CE
2472  10002 FORMAT(' ALLOCATION TO EDUCATION ',F25.0)
2473         WRITE(6,10003)CT
2474  10003 FORMAT(' ALLOCATION TO TRAINING ',F25.0)
2475         WRITE(6,10004)CS
2476  10004 FORMAT(' ALLOCATION TO FAMILY PLANNING ',F25.0)
2477         WRITE(6,10005)CI
2478  10005 FORMAT(' ALLOCATION TO INDUSTRIALIZATION ',F25.0)
2479         WRITE(6,10006)CL
2480  10006 FORMAT(' ALLOCATION TO LABOR MOBILITY ',F25.0)
2481         WRITE(6,10022)TAL
2482  10022 FORMAT('0',/,' TOTAL ALLOCATION ',F25.0)
2483         WRITE (6,10047)WLFCAP
2484  10047 FORMAT ('0',/,' WELFARE EXPENDITURE PER CAPITA ',F25.0)
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     00000000011111111112222222223333333333444444444455555555556666666667777777778
     12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
2485        WRITE(6,10036)PVCOST
2486   10036 FORMAT('0',/,' PRESENT VALUE OF COSTS ',F25.0)
2487        WRITE(6,10037)BCPOOR
2488   10037 FORMAT('0',/,' B-C RATIO FOR INCOME TO POOR ',F25.15)
2489        WRITE(6,10038)BCTOT
2490   10038 FORMAT(' B-C RATIO FOR TOTAL REGIONAL INCOME ',F25.15)
2491        WRITE(6,10020)
2492   10020 FORMAT('0',/,' ENDING SITUATION: ')
2493        WRITE(6,10039)
2494        WRITE(6,10026)TOTRCH
2495   10026 FORMAT('0',/,' TOTAL NONPOOR ',F25.0)
2496        WRITE(6,10027)OLDRCH
2497   10027 FORMAT('0',/,' NUMBER OF NONPOOR OVER AGE 65 ',F25.0)
2498        WRITE(6,10028)F1
2499   10028 FORMAT(' NUMBER OF HIGH INCOME NONPOOR--AGE 20--39 ',F25.0)
2500        WRITE(6,10029)F2
2501   10029 FORMAT(' NUMBER OF HIGH INCOME NONPOOR--AGE 40--64 ',F25.0)
2502        WRITE(6,10030)G1
2503   10030 FORMAT(' NUMBER OF MEDIUM INCOME NONPOOR--AGE 20--39 ',F25.0)
2504        WRITE(6,10031)G2
2505   10031 FORMAT(' NUMBER OF MEDIUM INCOME NONPOOR--AGE 40--64 ',F25.0)
2506        WRITE(6,10032)H1
2507   10032 FORMAT(' NUMBER OF LOW INCOME NONPOOR--AGE 20--39 ',F25.0)
2508        WRITE(6,10033)H2
2509   10033 FORMAT(' NUMBER OF LOW INCOME NONPOOR--AGE 40--64 ',F25.0)
2510        WRITE(6,10034)H3
2511   10034 FORMAT(' NUMBER OF LOW INCOME NONPOOR--AGE 15--19 ',F25.0)
2512        WRITE(6,10035)RCHKID
2513   10035 FORMAT(' NUMBER OF NONPOOR CHILDREN AND STUDENTS BELOW 19 ',F25.0)
2514        WRITE(6,10023)
2515   10023 FORMAT('0',/,' NUMBER REMOVED FROM POVERTY BY WELFARE ')
2516        WRITE(6,10024)WLFAL
2517   10024 FORMAT('       UNSALVAGABLE POOR--AGE 15--64 ',F25.0)
2518        WRITE(6,10025)WLFB
2519   10025 FORMAT('       UNSALVAGABLE POOR AGE 65 AND OVER ',F25.0)
2520        WRITE(6,10040)WLFTH
2521   10040 FORMAT('       CHILDREN ',F25.0)
2522        WRITE(6,10021)TRP
2523   10021 FORMAT('0',/,' TOTAL REMAINING POOR ',F25.0)
2524        WRITE(6,10008)AL
2525   10008 FORMAT('0',/,' NUMBER OF UNSALVAGABLE POOR--AGE 15--64 ',F25.0)
2526        WRITE(6,10009)B
2527   10009 FORMAT(' NUMBER OF UNSALVAGABLE POOR AGE 65 AND OVER ',F25.0)
2528        WRITE(6,10010)E11
2529   10010 FORMAT(' NUMBER OF SALVAGABLE POOR WITH HIGH SCHOOL AND TRAINING--
2530       CAGE 20-39 ',F25.0)
2531        WRITE(6,10011)E12
2532   10011 FORMAT(' NUMBER OF SALVAGABLE POOR WITH HIGH SCHOOL AND TRAINING--
2533       CAGE 40--64 ',F25.0)
2534        WRITE(6,10012)E21
2535   10012 FORMAT(' NUMBER OF SALVAGABLE POOR WITH HIGH SCHOOL BUT NO TRAININ
2536       CG--AGE 20--39 ',F25.0)
2537        WRITE(6,10013)E22
2538   10013 FORMAT(' NUMBER OF SALVAGABLE POOR WITH HIGH SCHOOL BUT NO TRAININ
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      00000000011111111112222222223333333333444444444455555555556666666666777777777 8
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
2539       CG--AGE 40--64 ',F25.0)
2540        WRITE(6,10014)E31
2541  10014 FORMAT(' NUMBER OF SALVAGABLE POOR WITH NO HIGH SCHOOL BUT TRAININ
2542       CG--AGE 20--39 ',F25.0)
2543        WRITE(6,10015)E32
2544  10015 FORMAT(' NUMBER OF SALVAGABLE POOR WITH NO HIGH SCHOOL BUT TRAININ
2545       CG--AGE 40--64 ',F25.0)
2546        WRITE(6,10016)E41
2547  10016 FORMAT(' NUMBER OF SALVAGABLE POOR WITH NO HIGH SCHOOL AND NO TRAI
2548       CNING--AGE 20--39 ',F25.0)
2549        WRITE(6,10017)E42
2550  10017 FORMAT(' NUMBER OF SALVAGABLE POOR WITH NO HIGH SCHOOL AND NO TRAI
2551       CNING--AGE 40--64 ',F25.0)
2552        WRITE(6,10018)E43
2553  10018 FORMAT(' NUMBER OF SALVAGABLE POOR WITH NO HIGH SCHOOL AND NO TRAI
2554       CNING--AGE 15--19 ',F25.0)
2555        WRITE(6,10019)TH
2556  10019 FORMAT(' YOUNG CHILDREN AND STUDENTS LESS THAN AGE 19 ',F25.0)
2557  11000 FORMAT(F25.8,51X,F4.0)
2558  11002 FORMAT(3F25.0,1X,F4.0)
2559  11001 FORMAT(F25.8,2X,F10.0,39X,F4.0)
2560  11003 FORMAT(2F20.0,36X,F4.0)
2561  11004 FORMAT(2F25.0,26X,F4.0)
2562  11005 FORMAT(F25.0,F25.8,26X,F4.0)
2563        WRITE(7,11001)$NEWAL,PPY,XNDX
2564        WRITE(7,11003)$NEWB,OLDRCH,XNDX
2565        WRITE(7,11003)E11,F1,XNDX
2566        WRITE(7,11003)E12,F2,XNDX
2567        WRITE(7,11003)E21,G1,XNDX
2568        WRITE(7,11003)E22,G2,XNDX
2569        WRITE(7,11003)E31,H1,XNDX
2570        WRITE(7,11003)E32,H2,XNDX
2571        WRITE(7,11003)E41,H3,XNDX
2572        WRITE(7,11003)E42,RCHKID,XNDX
2573        WRITE(7,11003)E43,QOLD,XNDX
2574        WRITE(7,11003)$NEWTH,QDSBL,XNDX
2575        WRITE(7,11004)YI1,COST1,XNDX
2576        WRITE(7,11004)YI2,COST2,XNDX
2577        WRITE(7,11004)YI3,COST3,XNDX
2578        WRITE(7,11004)YI4,COST4,XNDX
2579        WRITE(7,11004)YI5,COST5,XNDX
2580        WRITE(7,11004)YI6,COST6,XNDX
2581        WRITE(7,11004)YI7,COST7,XNDX
2582        WRITE(7,11004)YI8,COST8,XNDX
2583        WRITE(7,11004)YI9,COST9,XNDX
2584        WRITE(7,11004)YI10,COST10,XNDX
2585        WRITE(7,11004)YI11,COST11,XNDX
2586        WRITE(7,11004)YI12,COST12,XNDX
2587        WRITE(7,11004)YI13,COST13,XNDX
2588        WRITE(7,11004)YI14,COST14,XNDX
2589        WRITE(7,11004)YI15,COST15,XNDX
2590        WRITE(7,11004)YI16,COST16,XNDX
2591        WRITE(7,11004)YI17,COST17,XNDX
2592        WRITE(7,11004)YI18,COST18,XNDX
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      00000000011111111112222222222333333333344444444445555555556666666666777777777 8
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
2593        WRITE(7,11004)YI19,COST19,XNDX
2594        WRITE(7,11004)YL1,COST20,XNDX
2595        WRITE(7,11005)YL2,HE11,XNDX
2596        WRITE(7,11005)YL3,HE21,XNDX
2597        WRITE(7,11005)YL4,HE31,XNDX
2598        WRITE(7,11005)YL5,HE41,XNDX
2599        WRITE(7,11005)YL6,HSTAY,XNDX
2600        WRITE(7,11005)YL7,OLDGRO,XNDX
2601        WRITE(7,11005)YL8,F1GRO,XNDX
2602        WRITE(7,11005)YL9,F2GRO,XNDX
2603        WRITE(7,11005)YL10,G1GRO,XNDX
2604        WRITE(7,11005)YL11,G2GRO,XNDX
2605        WRITE(7,11005)YL12,H1GRO,XNDX
2606        WRITE(7,11005)YL13,H2GRO,XNDX
2607        WRITE(7,11005)YL14,H3GRO,XNDX
2608        WRITE(7,11005)YL15,RHKGRO,XNDX
2609        WRITE(7,11005)YL16,$MBTOT,XNDX
2610        WRITE(7,11005)YL17,RETTOT,XNDX
2611        WRITE(7,11000)YL18,XNDX
2612        WRITE(7,11000)YL19,XNDX
2613        WRITE(7,11000)SM11,XNDX
2614        WRITE(7,11000)SM12,XNDX
2615        WRITE(7,11000)SM21,XNDX
2616        WRITE(7,11000)SM22,XNDX
2617        WRITE(7,11000)SM31,XNDX
2618        WRITE(7,11000)SM32,XNDX
2619        WRITE(7,11000)SM41,XNDX
2620        WRITE(7,11004)SM42,RMB,XNDX
2621        WRITE (7,11002)Y1,YRCH1,YTOT1,XNDX
2622        WRITE (7,11002)Y2,YRCH2,YTOT2,XNDX
2623        WRITE (7,11002)Y3,YRCH3,YTOT3,XNDX
2624        WRITE (7,11002)Y4,YRCH4,YTOT4,XNDX
2625        WRITE (7,11002)Y5,YRCH5,YTOT5,XNDX
2626        WRITE (7,11002)Y6,YRCH6,YTOT6,XNDX
2627        WRITE (7,11002)Y7,YRCH7,YTOT7,XNDX
2628        WRITE (7,11002)Y8,YRCH8,YTOT8,XNDX
2629        WRITE (7,11002)Y9,YRCH9,YTOT9,XNDX
2630        WRITE (7,11002)Y10,YRCH10,YTOT10,XNDX
2631        WRITE (7,11002)Y11,YRCH11,YTOT11,XNDX
2632        WRITE (7,11002)Y12,YRCH12,YTOT12,XNDX
2633        WRITE (7,11002)Y13,YRCH13,YTOT13,XNDX
2634        WRITE (7,11002)Y14,YRCH14,YTOT14,XNDX
2635        WRITE (7,11002)Y15,YRCH15,YTOT15,XNDX
2636        WRITE (7,11002)Y16,YRCH16,YTOT16,XNDX
2637        WRITE (7,11002)Y17,YRCH17,YTOT17,XNDX
2638        WRITE (7,11002)Y18,YRCH18,YTOT18,XNDX
2639        WRITE (7,11002)Y19,YRCH19,YTOT19,XNDX
2640        WRITE (7,11002)Y20,YRCH20,YTOT20,XNDX
2641        WRITE (7,11000)$NO,XNDX
2642        WRITE(7,11000)PVCAL,XNDX
2643        WRITE(6,12000)RCF
2644  12000 FORMAT('0',/,' FUNDS REMAINING--UNSALVAGABLE POOR OVER AGE 65 ',
2645       CF25.0)
2646        WRITE(6,12001)RCP
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80/80 LIST

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     00000000011111111112222222223333333333444444444455555555556666666666777777777 8
     12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
2647  12001 FORMAT(' FUNDS REMAINING--UNSALVAGABLE POOR--AGE 15--64 ',F25.0)
2648        WRITE(6,12002)RCE
2649  12002 FORMAT(' FUNDS REMAINING--EDUCATION ',F25.0)
2650        WRITE(6,12003)RCT
2651  12003 FORMAT(' FUNDS REMAINING--TRAINING ',F25.0)
2652        WRITE(6,12004)RCS
2653  12004 FORMAT(' FUNDS REMAINING--FAMILY PLANNING ',F25.0)
2654        WRITE(6,12005)RCI
2655  12005 FORMAT(' FUNDS REMAINING--INDUSTRIALIZATION ',F25.0)
2656        WRITE(6,12006)RCL
2657  12006 FORMAT(' FUNDS REMAINING--LABOR MOBILITY ',F25.0)
2658        GO TO 99998
2659  99999 WRITE(6,12011)
2660  12011 FORMAT('1')
2661        WRITE (6,10048)YEAR
2662  10048 FORMAT('0',/,' OUTPUT SUMMARY--YEAR ',F4.0)
2663        WRITE (6,10049)
2664  10049 FORMAT('                              START          PERSON
2665       C                  WELFARE              WELFARE          END       ')
2666        WRITE(6,10050)
2667  10050 FORMAT('                            *******          POVERTY
2668       C                ELIGIBLES    TOTAL      EXPEND          *******     ')
2669        WRITE(6,10051)
2670  10051 FORMAT('        FUNDS      TOTAL      TOTAL      YEARS       B/C
2671       CB/C      WELFARE     NOT ON    WELFARE      PER        TOTAL     TOTAL ')
2672        WRITE(6,10052)
2673  10052 FORMAT(' STRA ALLOCATED    POP        POOR      ACCUM      (POOR)    (T
2674       COTAL)     RECIPS    WELFARE     EXPEND     CAPITA      POP        POOR
2675       C GRD ')
2676        DO 12009 NDX=1,N
2677        WRITE(6,12010)XNDXA(NDX),TALA(NDX),TOPOPA(NDX),TOPRA(NDX),
2678       CPPYA(NDX),BCPRA(NDX),BCTOTA(NDX),WLFYSA(NDX),WLFNOA(NDX),
2679       CTOWLFA(NDX),WLFCPA(NDX),TOPOA1(NDX),TOPRA1(NDX),GRD(NDX)
2680  12010 FORMAT(F4.0,F10.0,2X,F8.0,2X,F8.0,2X,F8.0,2X,F8.0,2X,F8.5,2X,F8.5,2X,F8.0,
2681       C2X,F8.0,F10.0,2X,F8.0,2X,F8.0,2X,F8.0,2X,F4.0)
2682  12009 CONTINUE
2683        STOP
2684        END
2685  $ENTRY
2686  $IBSYS
```

VITA

James Ralph Nelson

Candidate for the Degree of

Doctor of Philosophy

Thesis: SYSTEMS SIMULATION OF PUBLIC POLICY STRATEGIES FOR MULTICOUNTY DISTRICT ECONOMIC DEVELOPMENT

Major Field: Agricultural Economics

Biographical:

Personal Data: Born in Lubbock, Texas, March 2, 1944, the son of Ralph and Elizabeth Nelson.

Education: Graduated from Littlefield High School, Littlefield, Texas, in 1962; received the Bachelor of Science degree in Agricultural Economics from Texas Tech University in 1966; received Master of Science in Agricultural Economics from Texas Tech University in 1968; completed requirements for the Doctor of Philosophy degree at Oklahoma State University in July, 1974.

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