AN ANALYSIS OF INVESTMENT STRATEGIES
FOR RETIRING FARMERS

By

LYLE CHRISTIAN SPENCE

Bachelor of Science

Purdue University

West Lafayette, Indiana

1974

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
MASTER OF SCIENCE
May, 1976

AN ANALYSIS OF INVESTMENT STRATEGIES

FOR RETIRING FARMERS

Thesis Approved:

Harry P. Mapp Jr.
Thesis Advisor

Paul D. Hummer

Ralph C. Johns

D. D. Durham
Dean of the Graduate College

ACKNOWLEDGMENTS

The author is deeply indebted to Dr. Harry P. Mapp, Jr. for his service as both thesis advisor and friend throughout the progress of the research reported here. I thank him for generously letting me wrongly believe (on several occasions) that I might have conceived an original thought. Thanks are also expressed to Drs. Paul Hummer and Raleigh Jobes for their cooperativeness as members of the advisory committee, and to Mr. Clint Roush for his counsel and assistance in parts of the research effort. To Sandra Graham and Linda Howard, I express my appreciation for their diligent efforts in typing various parts of this manuscript at various times in various forms.

As for my wife, Pat, my first thanks are for her uncomplaining help in typing early drafts of this volume, but my most heartfelt thanks are for the loving support she has given me throughout our marriage. Certainly no one who reads this thesis can be expected to fully understand the tribulations of a student's wife. Dear, I won't pretend to understand; I can offer only my Love and my Thanks.

TABLE OF CONTENTS

LIST OF TABLES

Table		Page

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The way in which a farm family earns its living income is somewhat unique in comparison to its nonfarm wage and salary earning counterpart, and as a result the way in which a farm family prepares financially for retirement must also be different. The distinction becomes clearer when we recognize that a 'business' exists when labor and management (people) are combined with capital (money, machinery, land, buildings, etc.) in a productive activity. Nonfarm workers generally offer their labor and management to be combined with someone else's capital. In return they receive a living wage, and the owner of the capital receives a return to his investment. When a nonfarm worker's current income exceeds his immediate needs, he saves for the future, and saving of this type is frequently used in financing retirement.

Farm families combine their labor and management with owned and borrowed capital in their own business enterprise. The living income which they receive is a combination of return to their investment and return to their labor. When earned income exceeds immediate consumption needs, the surplus is not always saved per se; the excess is most often invested in the farm business where it is again combined with the family's labor and management to produce more income (possible surplus income), and the cycle continues.

A growing farm business usually demands additional capital as fast as a family can generate it. In recent decades, the farming industry has combined larger and larger amounts of capital with a shrinking amount of labor, and continuous growth in capital investment has been needed to keep the farm family's labor and management efficiently employed. The high demand for capital reinvestment in the business enterprise can leave little opportunity for farm families to establish a saving program for their retirement years.

1.1 The Problem

In a mature family farming business, there comes a time when, either by choice or by the force of circumstances beyond their control, the elder family members substantially reduce or end their active engagement in farming. When such a large unit of labor and management is removed from the business, some or all of the capital previously combined with it in the farming operation becomes available to produce pure investment income in retirement. The retiring farmer then stands in the face of a perplexing problem. He needs to know how he can use his lifetime accumulation of capital to build a portfolio of investments which will generate a stable flow of income in amounts adequate to meet his changing needs over a period of time which, in all probability, will be at least as long as his life and his wife's. At the same time, he would like the strategy he selects to preserve or enlarge the size of his estate and facilitate the transfer of the family's wealth to the next generation.

The 1969 Census of Agriculture reports that at that time 27.6% of Oklahoma's 83,000 farm operators were between the ages of 55 and 64. One could infer that these individuals are now at an age when they are making decisions about their retirement from farming. In 1969, another 25.1% of Oklahoma's farmers were between the ages of 45 and 54. Over the next decade these men will face the same decisions as their predecessors: whether to continue operating their farm, to stop operating and rent out their land to a younger man, or to sell the land and invest off the farm.

1.2 Research Efforts

Much of the research which has been done in the exit or disinvestment stage of the farm firm growth cycle has dealt with the minimization of estate transfer costs in order to maximize the net value of the estate passed to the heirs. A great deal has been accomplished in interpreting and explaining the maze of tax laws relating to estate transfer, and as the tax structure inevitably changes, there is continued demand for this type of research. One of the serious shortcomings of most of these analyses is their failure to directly confront the issues of sound investment management and adequacy of retirement income for the older generation. Tax management in and of itself has seemingly taken a higher priority than business management.

Two previous studies (Lee and Brake, 1971) (Brucker, Baker and Erickson, 1975) have sought to analyze the investment problems and opportunities of retiring farmers. Lee's work included a survey of retirement age farmers in Michigan and a delineation of many of the relevant characteristics of the alternative investments, and has properly set the stage for a project of an analytical (versus descriptive) nature. Brucker has built a model which allocates investments among farm and nonfarm assets in a manner which maximizes the ending estate subject to an annual consumption requirement. However, he falls short of exercising the model on a credible data base to demonstrate its potential or to propose the profit maximizing strategies for retiring farmers. The analysis reported here proposes an alternative to Brucker's analytical technique and tests a range of investment strategies using the model developed in this research effort.

The purpose of the research reported here has been to concentrate on the selection of investment strategies which provide an adequate income for the retiring couple, facilitate the transfer of the estate at its maximum value to the next generation, and satisfy some of the nonmonetary goals and desires of retiring farm families. The problem is different from the selection of tax management strategies alone, and is more complex than the identification of profit maximizing strategies. The specific objectives undertaken in an attempt to fulfill this purpose have been (1) to ascertain the manner in which living expenses change as a family enters retirement, (2) to inventory the types and amounts of financial resources which are at the disposal of retiring farmers, (3) to enumerate the available methods of investing to provide retirement income while facilitating the growth and transfer of the family's wealth, and (4) to develop a model which will aid in the analysis of retirement investment strategies and serve as the basis for future individual retirement planning applications.

1.3 Review of Classical Literature

Any technique used to analyze retirement investment portfolios must consider (1) the expected value of the return from the portfolio in relation to the economic needs of the retiree, (2) the risk or variability of real return associated with the portfolio, and (3) the allocation of real returns and economic needs over the entire planning horizon or life expectancy of the couple. The following pages present existing theories and techniques of portfolio selection in light of their ability to effectively confront these issues.

Irving Fisher (1954) pioneered the theory of optimal allocations of investments among physical capital (business investments), market securities and cash in light of the individual's current and future needs and desires to consume his wealth (Baumol, 1970). Fisher's analysis centered on the rates of return to alternative investments as represented in the opportunity locus. Figure 1.1 presents an opportunity locus ACDB for an investor with wealth of A. The curve ACA' demonstrates the outcomes of various levels of investment in physical capital (for our purposes, the farm property). At point A, the investor consumes his entire wealth in time period 1 and invests nothing; at A', the investor consumes nothing in period 1, invests all his wealth in physical capital, and in time period 2 has A' available for consumption (A' = A + the return from investment in physical capital). The slope of ACA' at any point is equal to one plus the marginal rate of return, and ACA' is nonlinear as a result of the diminishing marginal return to investment in physical capital.[1/]

In addition to physical capital, the investor has the opportunity to place funds in market securities (for our purposes, a portfolio of

---

[1/] Figure 1.1 depicts a smooth curve, but in reality it might be a series of linear segments of decreasing absolute slope because of the lumpy nature of investment in physical capital.

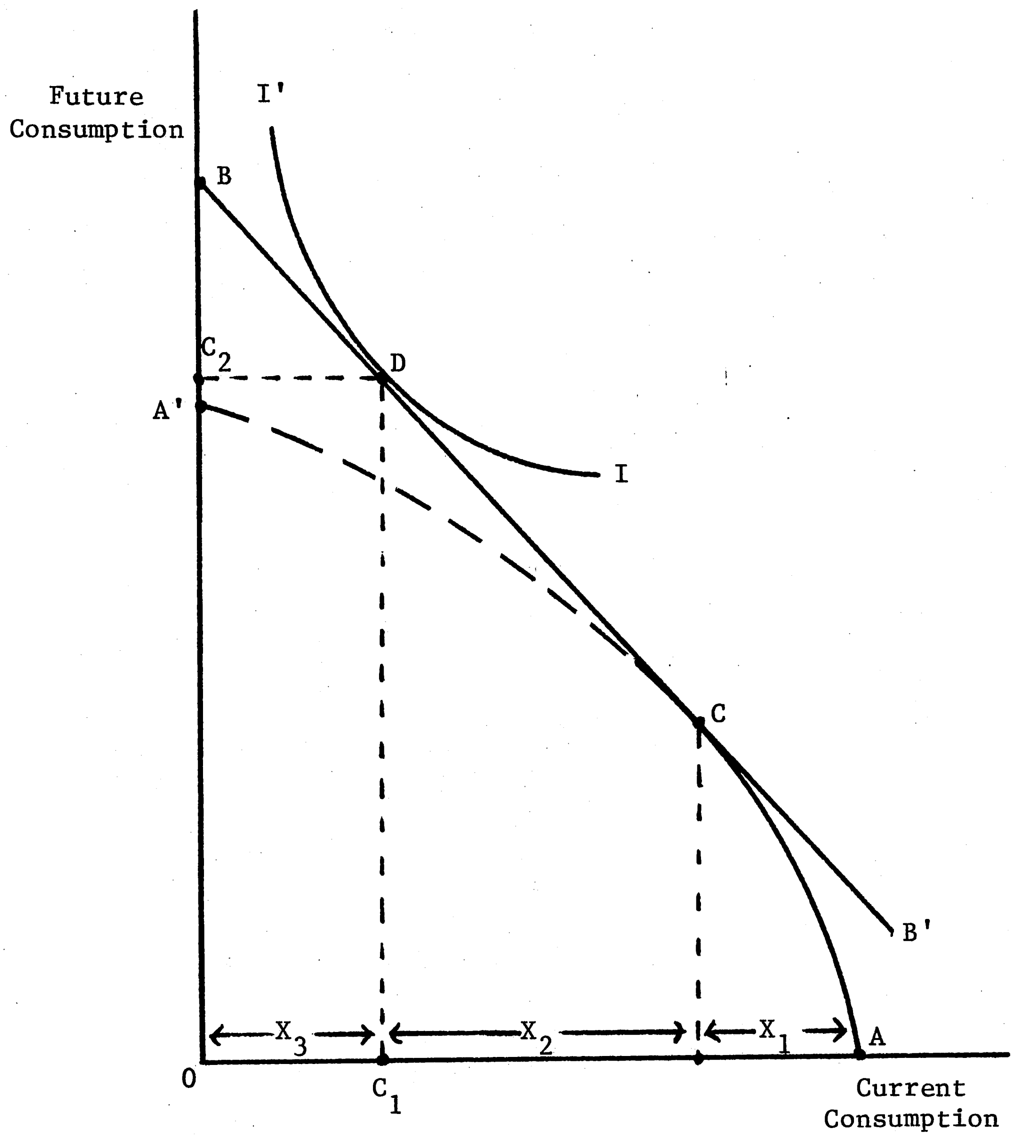

Figure 1.1 Fisher's Two Period Consumption-Investment Model

nonfarm investments). BB' represents the market securities opportunity locus, and since investment in these assets is not characterized by diminishing marginal return, BB' is linear with slope equal to one plus the average rate of return to nonfarm investment. In Figure 1.1 BB' has been located tangent to ACA' to demonstrate the behavior of a rational investor seeking the highest return to his investment. The broken segment CA' represents inefficient investment opportunities in physical capital since market securities yield higher returns.

A profit maximizing investor will place funds in physical capital until the marginal return from that investment falls below the return from his market securities opportunity (i.e. until the slope of ACA' becomes less than the slope of BB'). This occurs at tangency point C. Moving from A to C on the opportunity locus, our investor places X_1 amount of funds in physical capital. The remainder of his wealth must be allocated between market securities and cash for current consumption, and the distribution is defined by the individual's utility function reflected through indifference curve II'. Moving from C to D, he allocates X_2 amount of funds to market securities, and the remainder (X_3) of his wealth is held in cash for current consumption. At point D, the utility maximizing combination of current and future consumption is OC_1 dollars and OC_2 dollars respectively.

One drawback in using Fisher's approach to analyze investment strategies for retiring farmers is the difficulty in quantifying and measuring utility. A method of avoiding the measurement of utility is to force an arbitrary level of current consumption into the model, thereby locating a point in the neighborhood of D. The model could then be solved to find the allocation between market securities and physical capital (point C). In essence, this has been the approach taken by Brucker, Baker and Erickson (1975) in their analysis of farm and non-farm investment by retiring farmers. To locate C they used a linear programming technique.

This approach, however, is humbled by the assumption that utility (still unmeasured) is exclusively a function of current and future levels of consumable wealth, and ignores the potential utility derived from maintaining ownership of the family's farm property or from any other source. Nevertheless, the most serious criticism of the Fisher technique and of Brucker's modification is that the element of risk is totally ignored. These limitations render the model incapable of allowing a complete analysis of investment alternatives for retiring farmers.

Some other endeavors in the theory of portfolio selection have concentrated on the roles of risk and diversification. The Markowitz model (1959) defines the set of 'efficient' portfolios of market securities (those portfolios with the lowest level of risk or variability for each level of expected return). The decision as to which of the efficient portfolios is optimal is left to the investor and is determined by his risk preference function.

Markowitz's thesis is that the variability of return from a portfolio is determined by both the variability of return from the individual securities and the degree to which the variations in return from each security are correlated to one another. Figure 1.2 can be used to demonstrate that the overall variability of a portfolio can be reduced by adding to it a security with even greater variability if the variations in return to that asset are negatively correlated to the variations in return to the initial portfolio. Markowitz would term the initial

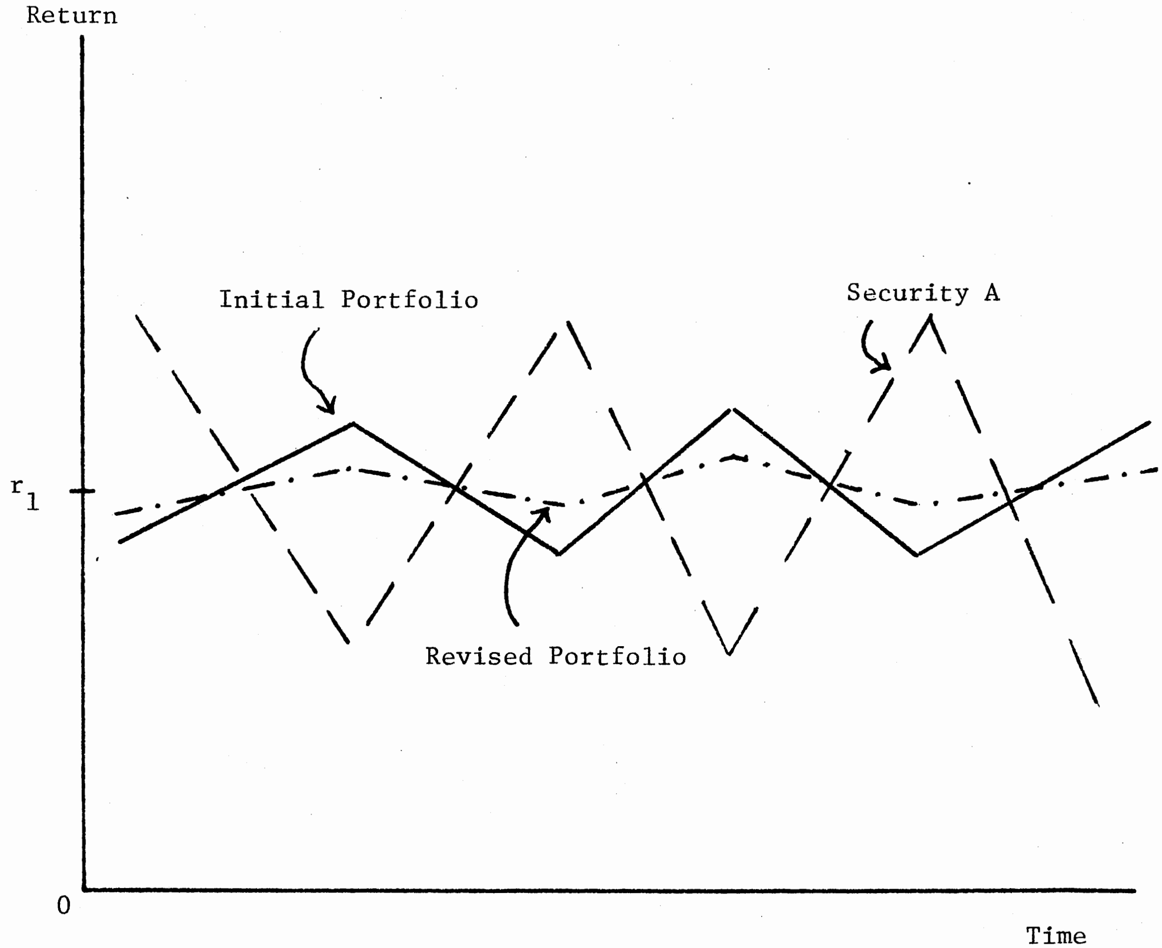

Figure 1.2 A Negative Correlation Between the Variability of Return to Security A and the Original Portfolio

portfolio inefficient since the investor could attain the same level of average return (r_1) with a smaller amount of variability by revising his portfolio to include some of security A. The analyst's job then becomes one of identifying the level of expected return from each security and the variance-covariance matrix describing the reaction of each security to a change in any other. Then, using a quadratic programming technique, the variance-covariance matrix can be minimized at each level of expected return, and the set of efficient portfolios will be defined. The investor need only select from the efficient set a portfolio with the risk-return combination which maximizes his utility. Figure 1.3 depicts an efficient frontier (EE') and indifference curve (II').[2/] Each point on the efficient frontier represents a portfolio or collection of securities which is among the efficient set, and the point or tangency (A) is the utility maximizing portfolio for the individual. All portfolios represented by points below and to the right of the efficient frontier are inefficient since higher return can be achieved without sacrificing risk (or vice-versa) by rearranging the composition of the portfolio.

Two of the serious drawbacks to the practical application of the Markowitz technique are the extraordinary computational costs and the voluminous nature of the data requirements (Baumol, 1970, pp. 26) (Cohen, et al., 1973, pp. 745). William Sharpe (1963), in an attempt to overcome those limitations, developed a simplified version of the basic

---

[2/] The figure depicts an indifference curve for a risk averter, since that example demonstrates the possibility of an optimum at any point along the frontier. A risk lover's indifference map would consist of curves convex to the origin, and the optimal portfolio would always be at the right most point of the frontier (Baumol, 1970, pp. 25).

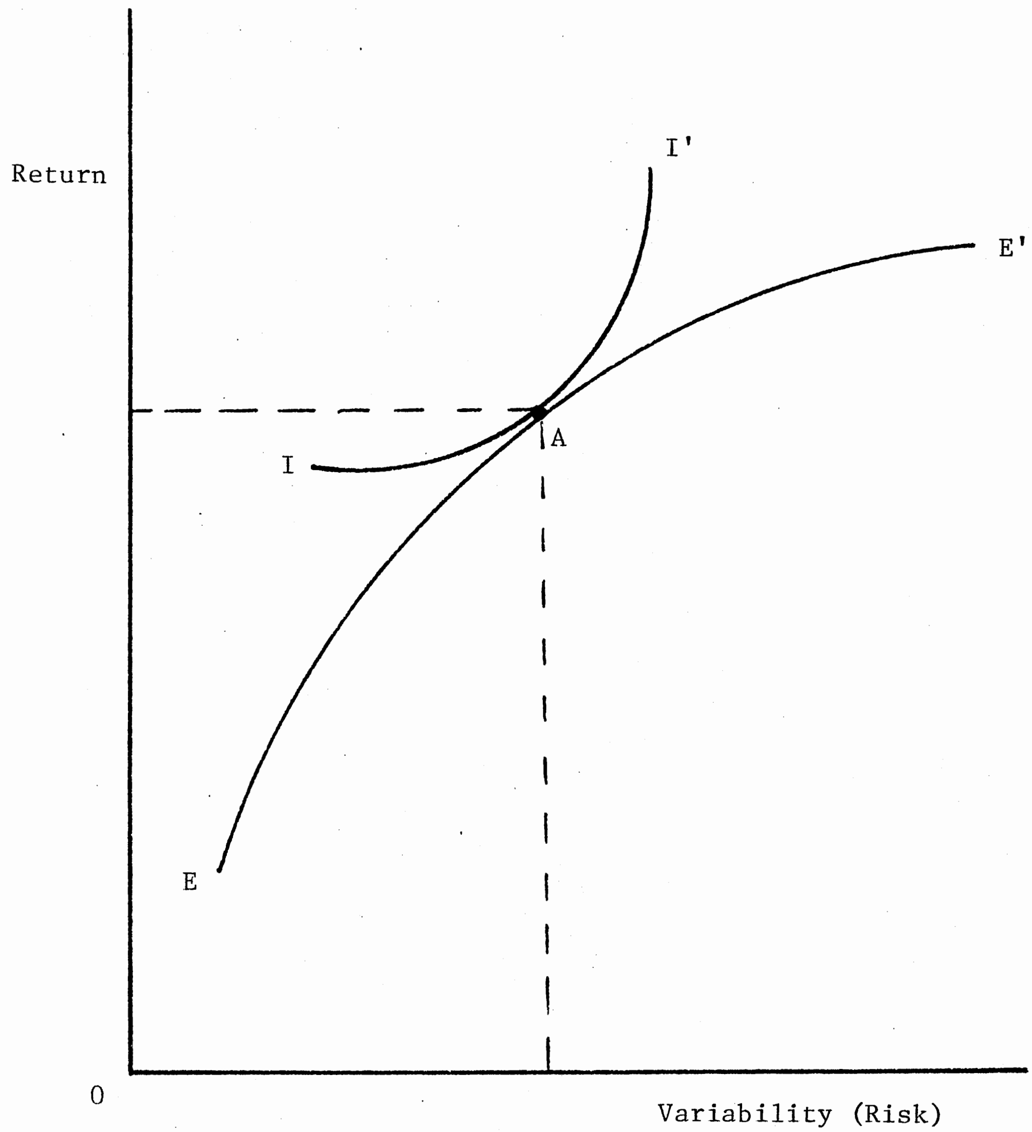

Figure 1.3 Markowitz's Efficient Frontier

Markowitz technique. Rather than relating each security to every other through a full variance-covariance matrix, Sharpe measured the reaction of each security to some common market indicator. This modification reduced the number of individual pieces of data required, and greatly simplified the calculations leading to the identification of efficient portfolios. Empirical studies by Cohen and Pogue (1967) have indicated that the Sharpe index model identified efficient portfolios nearly as well as the original Markowitz model using a full covariance matrix, and the cost economies associated with the Sharpe model have made possible the real-world application of the basic theories evolving from Markowitz's work (Cohen, et al., 1973, pp. 745).

In both analyses, the original measure of variability was the variance. Using the variance forces unusually high returns to be treated as evidence of risk (and therefore undesirable), while the real concern is the probability of unusually low returns. Markowitz (1959, pp. 188) suggests the semivariance as an alternative measure of risk concentrating only on the probability of low returns, but the complexity which this alternative measure of risk adds to the analysis has generally precluded its use.

1.4 Origins of Risk

Markowitz and Sharpe have couched their models in terms of the analysis of choice among individual market securities. The assumption that risk can be accurately represented by estimates of the variability of return does not severely restrict the application of their techniques to the management of portfolios containing relatively homogenous types of assets. However, this analysis must consider investments with widely differing characteristics and must account for risks coming from various origins. The following summary of risk origins helps to demonstrate the complexity of the risk issue.[3/]

Business Risk - The probability of a decline in the value of an equity asset due to a decline in the earnings of the business.

Market Risk - The probability of a decline in the trading value of an equity asset (such as a common stock or a mutual fund) due to the investors' expectations regarding that asset's earning power in the future.

Interest Rate Risk - The probability of an increase in the general level of interest rates which will cause the price of a fixed income asset (for example a bond) to decline until the overall yield is comparable with the elevated market rate.

Purchasing Power Risk - The probability of a decline in the real value of the income produced by a fixed income asset due to an increase in the general price level (inflation).

Longevity Risk - The probability of exhausting the income producing capital base before death.

When considering investments as diverse as real estate, corporate stocks, bonds, mutual funds, annuities, etc. it is not clear that one can lump risks from all origins into one measure of variability and estimate an optimal portfolio with the lowest 'risk' at the desired level of return. Perhaps the role of the Sharpe or Markowitz type of model in analyzing the alternatives of a retiring farmer is in identifying the efficient portfolios of nonfarm securities which can be compared with the desirability of retaining the investment in farm real estate. In the judgment of the researchers, these models are inadequate for a meaningful analysis of the full range of investment strategies for retiring farmers.

[3/] The first four risk types were adapted from Lee and Brake (1971, pp. 5).

1.5 Summary

Reviewing our discussion of the classical theories of portfolio analysis, we have found that none of them satisfy the three criteria established earlier in this chapter. All consider the expected return from the portfolio, but the early work by Fisher fails to account for risk. Markowitz and Sharpe, while concentrating on risk and the value of diversification, have tended to confront investment as an end in itself and not as a means of allocating the consumption of wealth over time (Herschleifer, 1958, pp. 329). In light of these shortcomings, the model selected for use in this research evolved to be something quite different from any of the classical models discussed here. The following pages trace the conception and development of the model.

The next chapter presents the general form of the model built and used in this analysis. Chapter III traces the development of the inputs required by the model, and Chapter IV reports the results from the analysis of a series of test case farms. The fifth and final chapter crystalizes the product of this research and hopefully challenges the reader to extend the interpretation of these results in light of both the shortcomings of this analysis and its contribution toward overcoming the inadequacies of existing theories and past research efforts.

CHAPTER II

MODEL DEVELOPMENT

Economic models are often intended to help researchers find optimal solutions to problems of resource allocation; indeed the models discussed in the preceding chapter have all sought to define the optimal allocation of financial resources among competing investment alternatives. In order to optimize, there must be an objective function, and the classical objective function is utility. However, in real world planning situations our inability to measure utility forces us to make some naive assumption about the nature of the individual's utility function. The most frequent assumption is that utility is a linear function of money income. Thus, maximizing income or net worth is tantamount to maximizing utility. In models of firm growth and allocation of resources among competing enterprises in commercial agriculture this assumption has served the profession quite well; yet in planning for the management of resources in retirement, the author argues that the assumption of profit maximizing behavior becomes increasingly unrealistic.

It is useful once again to refer to the recent report by Brucker, Baker and Erickson (1975) in discussing the form of the model developed in this research. Recall that their Fisher-type analysis was unable to account for differences in risk and variability of returns among alternative investments; moreover they based their approach on the assumption of profit maximizing behavior and, as they have acknowledged, were left unable to evaluate the economic consequences of strategies which were not profit maximizing. Realistically, retirement planning is complicated by a host of very important nonmonetary considerations including desires to live on the farm in retirement, reduce the responsibilities of business management, establish a child in the farming operation, make gifts to potential heirs, etc.

The assumptions that preclude these considerations from the analysis and the simplifications of risks certainly do not originate from mere oversight on the part of the researchers; rather they are a result of our inability to incorporate many of the important issues (most notably a complete measurement of utility and a treatment of risks from all origins) into a deterministic optimizing model. Perhaps a more accurate representation of the real world can be made in a model which steps away from the direct question, "What is the best (most profitable) way to manage resources in retirement?" and refocuses attention on evaluating the outcomes of selected investment and estate planning strategies.[1/]

In responding to this appeal, a stochastic simulation model has been built which is capable of analyzing investment strategies in a research setting, and which is flexible and economical enough to serve as forerunner to the basic element of an extension workshop program for individual investment planning. Rather than making a single analysis to define the optimal state, the procedure in using the simulation model

---

[1/] Boehlje (1973), in an excellent delineation of research priorities for the entry-growth exit process in agriculture, has implied this to be the appropriate methodology.

must be one of performing a series of experiments within the economic laboratory we have designed (Naylor, et al., 1968, pp. 1-22). Seeing the simulated outcomes of alternative courses of action, the individual can use his own multidimensional utility function to decide which strategy comes closest to satisfying his goals.

2.1 The Retirement Investment Simulator

The Retirement Investment Simulator (RIS) projects the performance of a chosen portfolio of farm and nonfarm investments over a time horizon determined by the life expectancy of the couple. Figure 2.1 presents a schematic diagram of the functions performed by the model. For each year in the planning horizon, the income needs of the couple are projected from input data indicating the living expenses, social security benefits and private pension benefits in the first year of retirement. Living expenses and social security benefits are increased by inflation rates supplied by the user, and private pension benefits can be increased with inflation or left constant throughout. A 'retirement income gap' (Newman, 1974, pp. 95) is calculated by subtracting social security and private pension benefits from projected living expenses, and represents the amount of funds which must be extracted from the portfolio in that year either by consuming income returns or by liquidating assets and consuming part of the capital base. The remainder of the model is designed to evaluate the abilities of a chosen collection of assets in meeting the annual income needs of the retired couple and to estimate the size of the estate left to the next generation.

The simulation model does not optimize the allocation of funds among alternative investments, but relies on the user to specify the

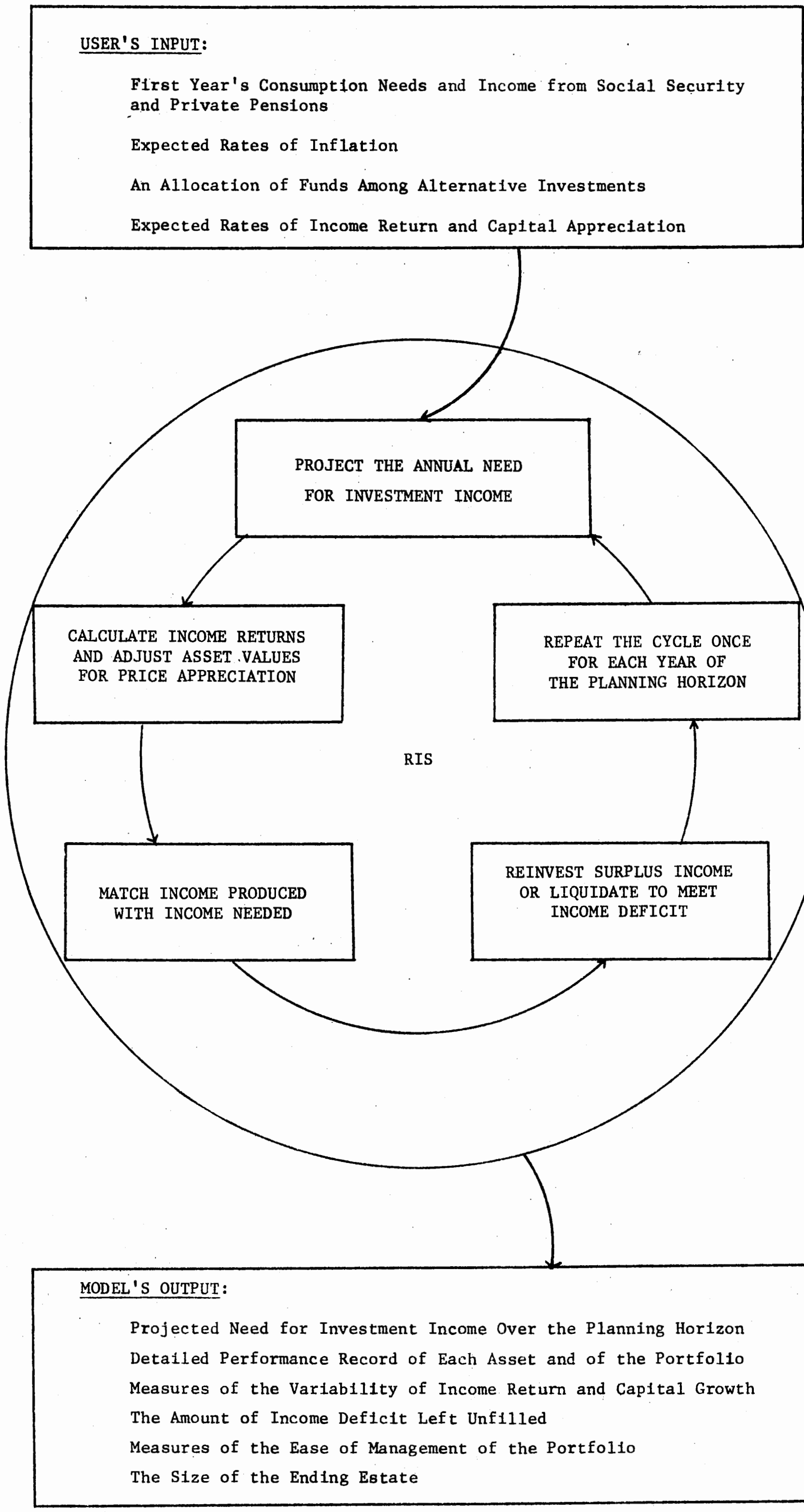

Figure 2.1 A Schematic Diagram of the Retirement Investment Simulator (RIS)

amount invested in each type of asset and the average rates of income return and capital appreciation expected from each.[2/] If the user chooses not to specify expected rates of return and capital appreciation, the model bases the simulation on fourteen years of historical data for income and price returns to the selected investment classes.

Variability of income and price return has been accounted for through the use of a procedure reported by Clements, Mapp and Eidman (1971). Given (1) the average rates of return supplied as input, (2) a matrix of coefficients derived from the historical matrix of variances and covariances of the returns from the selected investments, and (3) the assumption that annual rates of return will be normally distributed about the average rates, the simulator generates for each type of asset a random series of annual rates of income and price return which are normally distributed about the mean and appropriately correlated with the rates generated for all other types of assets in that year. Using the simulator therefore requires one to assume that the performance of each investment will react to changes in the performance of all other investments in the way that was observed during the period which provided data for the variance-covariance matrix.[3/] This feature is discussed further in light of the specific investments and the data series used in the current application of the model.

[2/] Income and price returns have been separated in this analysis to more accurately identify consumable returns and nonconsumable gains in the market value of an asset.

[3/] It is not necessary to assume that variations in performance will occur within the same general pattern of economic trends observed over the historical period.

The outcome of a selected investment strategy depends in part upon the set of randomly selected rates of return. To more accurately evaluate a strategy, the simulation may be replicated a number of times using a different set of randomly selected but appropriately correlated rates of return. Replicating the simulation of an investment strategy a number of times permits a discussion of the expected values and the variability of income returns, capital growth rates and the ending value of the estate.

In the analysis reported in Chapters III through V, each strategy was replicated fifteen times. In testing the correlation subroutine, it was found that the means and standard deviations of the historical data series could be reproduced by drawing one hundred sets of correlated rates. (The means and standard deviations of the one hundred rates were not significantly different from the historical observations; alpha = .01). By replicating a twenty year planning horizon fifteen times, three hundred sets of correlated rates are used, and we can place considerable confidence in the simulated outcomes.

Having projected both the income needs and the income provided by social security, private pensions and the chosen portfolio of farm and/or nonfarm investments in a given year, the model compares cash inflows and outflows. If there is surplus income, a part of the surplus is reinvested in an asset of the user's choice. If there is an income deficit, it is met by liquidating assets and allocating the proceeds to consumption. In each year of the planning horizon the model forces the consumption needs of the couple to be met, and the following year is entered with (1) a portfolio which has been adjusted to account for price appreciation and either reinvestment of excess funds or liquidation to meet consumption needs, and (2) a minimum consumption need which has been increased to account for inflation.

The output produced by the simulator consists of a schedule of the basic consumption needs of the couple as they change over time due to inflation and a report on the simulated performance of each asset showing both consumable income produced and changes in the value of the asset itself. Summary tables demonstrate the performance of the total portfolio in meeting income needs, provide measures of the variability of return and capital growth, and indicate the size of the ending estate.

The simulation model has been designed to meet the three criteria established earlier by considering (1) the amount of the return from a portfolio, (2) the allocation of returns over time in relation to the changing economic needs of the retired family and (3) the variability or risk associated with the portfolio. In its present form, the model can offer meaningful insight into the economic consequences of certain investment strategies for retiring farmers. While estate planning and tax management have received little attention, estate tax and transaction costs calculations could be included in the model and estate management strategies evaluated. The remainder of this chapter identifies the specific types of farm and nonfarm investments considered in this study, and outlines the methodology behind their incorporation into the model.

2.2 Specific Investments Embodied in the Simulation Model

Investments can generally be classified as equity assets or fixed income assets.[4/] The specific equity assets considered by the simulator are farm real estate, corporate stocks and mutual funds, and the fixed income assets are the installment land sale, bonds, bank deposits and purchased annuities. Recalling an earlier discussion of risk origins, equity assets are characterized by market risk and business risk, and returns to equity assets come in both price (nonconsumable) and income (consumable) forms. Fixed income assets possess interest rate risk, purchasing power risk and in some cases longevity risk. Price returns are minimal or nonexistent; virtually all returns to fixed income assets are income returns.

In selecting investments to be used in providing retirement income, farmers must choose assets which involve an acceptable (or least unacceptable) type of risk at a level which is commensurate with the expected return. Purchasing power risk poses perhaps the most serious threat to a retired couple in times of inflation. This would indicate an incentive to use equity assets. However, certain equity assets provide a large part of their returns in the form of price appreciation. This price return cannot be realized and utilized for retirement income unless and until the asset is liquidated. Thus, equity assets alone do not always constitute the retired investor's panacea. In cases where the capital base is extremely small, the investor might place some of his investments in assets producing high levels of current income.

The comments above apply to situations occurring in periods of economic prosperity and inflation. The existence of economic depression

---

[4/] The treatment of this subject has drawn heavily from the research report by Lee and Brake (1971).

and deflation would reverse the investors incentives in that fixed income assets would then protect him from purchasing power risk and equity assets would subject him to market risk and negative price returns. Shifting of the relative proportions of equity and fixed income assets in response to changing economic conditions would seem advisable when done with the aid of competent financial and economic counsel.

Four other characteristics which retirement investments should possess are liquidity, security of principal, income stability and ease of management. A retired couple's portfolio should contain an amount of very liquid assets which is likely to cover emergency cash needs. A large unexpected medical bill is unpleasant in itself, but if payment of the bill necessitates the liquidation of a large fixed asset (possibly at a capital loss), the situation could become even more unpleasant. Security of principal is generally a problem encountered with certain equity assets. Common stocks and mutual funds, if selected improperly, may carry a high risk of principal loss. This is associated with business risk. With increased dependence upon pure investment income in retirement, it is important for that investment income to be stable. Short run (seasonal) variability in income is not likely to be extremely difficult for a farm family to cope with, but severe cyclical fluctuations can cause hardship for a retired family with only a small amount of liquid assets in reserve. Finally, retirement investments should not be of a type that require frequent management or liquidation. A long range, self-sustaining plan implemented at the time of retirement, and altered only in response to changing economic conditions can reduce the amount of transaction costs, lighten the burden of decision making and lessen the risk of a large financial loss if poor health should leave one unable to manage his investments effectively.

Thus far, our discussion of investment alternatives has been centered on general characteristics of investments. On the next several pages we consider the relative merits of the specific investments which have been built into the simulator; first consider the three equity investments and then the four fixed income investments.

Farm Real Estate

By not selling the farmland he has operated in the past, a retiring farmer is in fact choosing to make farm real estate his retirement investment. Income returns come in the form of cash rent or crop share rent. When utilizing a crop share rental arrangement, working capital must be maintained to meet the landowner's share of variable costs, which must be accounted for when estimating the amount of funds available for other investments. Farm real estate has historically enjoyed steady and substantial price returns, providing landowners with an effective hedge against inflation. As long as income returns keep pace with the increasing value of real estate, the landowner has some protection against purchasing power risk. Business risk poses the most serious problem to landowners. Low incomes in the farm sector of the economy, bad weather, or a poor tenant in a crop share arrangement can all reduce both income and price returns to land ownership.

Farm real estate is an investment which is rather easily managed by a retired farmer. His experiences in working life prepare him well for the decisions faced by a non-operating landowner. In order to receive social security benefits, the landowner must not 'materially participate' in the management or actual production of crops and livestock.

This criterion provides incentive for, but does not require the use of professional farm manager to represent the landowner's interest in making operating decisions. The lumpy nature (lack of liquidity) of farm real estate investment makes it unsuitable as the sole component of the portfolio. If assets must be consumed over time to meet living expenses, farm real estate is not a viable alternative for investment because it is difficult to liquidate gradually.

Corporate Stocks

Corporate stocks provide both income (dividend) and price (capital gain) returns. The relative proportions of income and price returns vary widely among different stocks. To account for this type of variation in the distribution of income and price returns among different stocks, the simulator considers two types. A series of data on the performance of public utility companies was used to represent stocks yielding high income returns and relatively low capital growth rates.[5/] Similarly, industrial companies represent stocks yielding high capital growth rates and lower income returns. The primary risks associated with stocks are market risk and business risk. If stocks are gradually sold off to meet consumption needs, then longevity risk becomes a serious issue.

Corporate stocks are purchased from a broker, and there is a fee for performing stock transactions. This fee will effectively cause a reduction in the amount of the initial investment, and this must be

---

[5/] Standard and Poors Trade and Securities Statistics, Security Price Index Record, 1974 Edition.

accounted for when comparing stock purchase to the retention of the investment in farm real estate.

Mutual Funds

By purchasing shares of a mutual fund, the investor is effectively turning his money over to an investment company and asking that it be pooled with other peoples' money and invested in a variety of different securities. Mutual funds provide small investors with the opportunity to gain wider diversification in asset holdings than would be possible if they invested directly in corporate stocks. At the same time the investor acquires professional investment management, and several funds can probably be found with management philosophies and objectives in common with the investor's. As is the case with corporate stocks, the simulator accomodates two types of mutual funds: those which yield high current income and those which yield high capital growth rates.[6/]

Mutual funds are commonly sold through a marketing system, and the investor must pay a 'load' or transaction charge which once again reduces the real amount of investable funds. Certain 'no-load' funds are sold directly to the investor without using the marketing or distribution system. Research studies have generally been unable to show that 'load' funds perform better on the average than 'no-load' funds. The major difference is in the amount of effort which the investor must expend in making the transaction (Miller, 1970, b).

[6/] Investment Companies 1974, Mutual Funds and Other Types, Wiesenberger Services, Inc.

Installment Land Contract

When considering the sale of the farm, there can be considerable tax incentives for the use of an installment arrangement whereby the buyer makes regular principal and interest payments directly to the seller. By spreading the realization of capital gain over the term of an installment land contract, the seller is taxed at a lower overall rate and the after tax proceeds from the farm sale can be substantially greater than with a cash transaction and bank mortgage (Harl, 1974 and 1975) (Suter, 1971, a, b).

Depending on the value of the farm and the length and pattern of the principal and interest payments, the money received each year is likely to be more than adequate to meet consumption needs. However, if a plan is not implemented to reinvest part of each year's payment in some other asset, then longevity risk can make the installment land sale a very unattractive alternative.

Returns to an installment sale, when considering it as an investment, are pure income (interest) returns. After signing the contract, the seller is locked out of any price appreciation on the farm real estate. This limitation is offset somewhat by the opportunity to reinvest principal payments in an asset yielding some capital gain.

A schedule of payments can be designed to fit the needs of the buyer and the seller; the simulator has been built to accommodate three general types of payment plans as depicted in Figures 2.2, 2.3 and 2.4. All three allow for a down payment, a series of installment payments consisting of interest and principal, and a 'balloon' payment at the end. By accumulating equity over the life of the contract, the buyer is usually able to refinance the farm through a conventional loan to make the final balloon payment. The balloon payment therefore serves to liquidate the contract and remove both buyer and seller from the uncertainties involved in such an agreement.

Under the level payment plan (Figure 2.2), total contract payments are constant over the period. Each payment consists of a larger and larger amount of principal as interest obligations are reduced over time. Under the decreasing payment plan (Figure 2.3), total contract payments decrease over the period. Each payment consists of a constant amount of principal, and interest is paid on the remaining balance. The third payment schedule accommodated by the simulator is a delayed principal payment plan where no principal is paid in the early years of the contract (Figure 2.4). Principal payments begin in a year of the user's choice, and the annual principal payment is doubled halfway through the remainder of the contract period. Interest is calculated on the remaining balance throughout (Suter, 1971, a).

Bonds

Bonds are a tool which can provide the investor with a stable and relatively high rate of income return, and when held to maturity provide near perfect security of capital. However, when interest rates rise, the market lowers the trading value of a bond to the extent that the overall yield (interest plus price appreciation between the date of the transaction and the date of maturity) is comparable to the new higher market interest rate. The result is that the investor can expect to incur a capital loss if forced to liquidate bonds before they mature. This is a classic example of interest rate risk, but perhaps

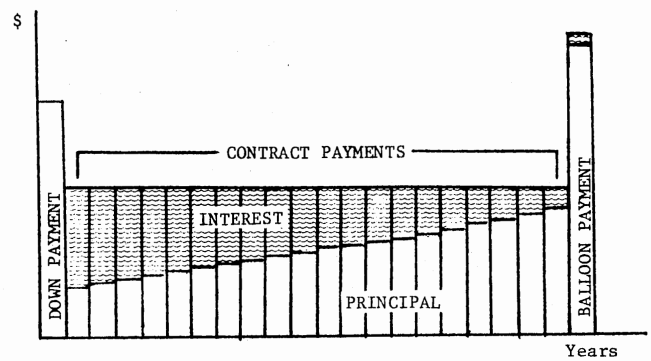

Figure 2.2 Level Contract Payments

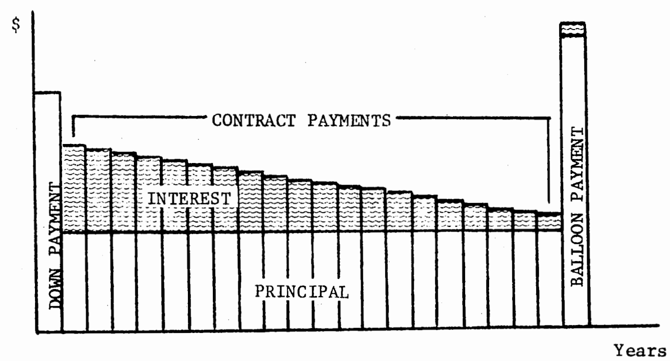

Figure 2.3 Decreasing Contract Payments

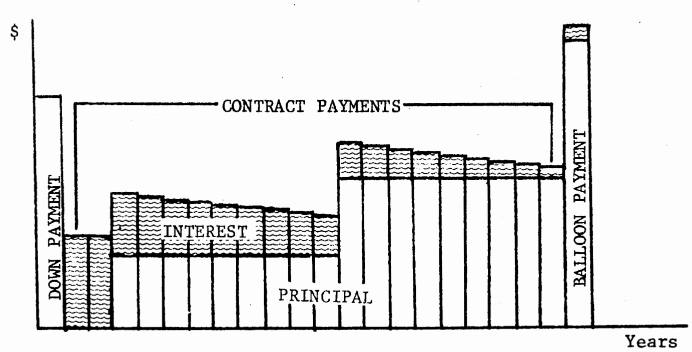

Figure 2.4 Delayed Principal Payments

a more serious problem in bond investment is purchasing power risk in times of high inflation rates.

Bonds can be purchased through an investment broker or a bank, and there will be the omnipresent transaction fee to reduce the capital base at the outset. As with stocks and mutual funds, the simulator accommodates two types of bonds. Long term bonds yield higher coupon rates (income returns) but are susceptible to greater price fluctuations (capital loss) than are short term bonds.[7/]

Bank Savings Deposits

Virtually every investment portfolio has need for some amount of bank savings deposits. While savings account interest rates are generally lower than can be obtained elsewhere and the depositor is susceptible to purchasing power risk, bank deposits are secure and constitute a liquid asset reserve for emergency cash needs. In the simulation model, the primary functions of the bank savings account are to act as a liquidity reserve and perform a holding function when funds are being transferred from one investment to another.

Purchased Annuities

For an initial investment, a couple may receive a periodic income check of a predetermined amount for as long as one or both lives, or for a specified guarantee period. An annuity represents the purest form of a fixed income asset, and generates only income returns. It provides a

---

[7/] Standard and Poors Trade and Securities Statistics, Security Price Index Record, 1974 Edition.

guaranteed level of income for life, but the annuitant is left vulnerable to purchasing power risk, particularly if he depends upon the annuity for a large portion of his retirement income and has little invested in equity assets for inflationary protection.

Various types of annuities are available from insurance companies. A straight life annuity provides income for one person as long as he lives. A joint and survivor annuity provides income for two persons as long as either lives. A life annuity with installments certain provides lifetime income for one person; if he should die within a specified guarantee period, his beneficiary would receive payments for the remainder of that period. An installment refund annuity provides lifetime income for one person; if the annuitant dies before receiving a specified amount of money, the balance is paid to his beneficiary in one sum or in regular installments.

Annuity costs per dollar of monthly income are based upon the type of annuity and the actuarial characteristics of the annuitant(s). Costs of a specific policy to a certain individual can be estimated by a life insurance agent, but Table 2.1 presents estimates of the costs of selected annuity plans. The simulator accommodates only straight life annuities and joint and survivor annuities. Other types may be considered by entering them as straight or joint annuities and adjusting the simulated outcomes to account for an installment refund or guarantee period.

Table 2.2 has been prepared in an attempt to summarize the discussion on the preceeding pages. The table admittedly embodies a great deal of subjective judgment and is included primarily for the purpose of provoking the reader to think about his own interpretation of the

Table 2.1 Costs of Selected Purchased Annuity Plans

Annuity Plan	Cost for each $10 of Monthly Lifetime Income
Life Income for One Person	
Husband Age 65	$1,390
Life Income for Two Persons	
Husband Age 65, Wife Age 65	$1,770
Husband Age 65, Wife Age 60	$1,900
Life Income for One Person, with a Ten-Year Guarantee Period	
Husband Age 65	$1,480
Life Income for One Person, with the Remainder of the Purchase Price Paid to the Beneficiary in Monthly Installments	
Husband Age 65	$1,600

Source: Maynard and Boehlje (1973, pp. 13).

Table 2.2 Types of Investments Often Used in Providing Retirement Income and Their General Characteristics

	Returns		Important Risks					Other Characteristics			
	Income Returns	Price Returns	Purchasing Power Risk	Business Risk	Market Risk	Interest Rate Risk	Longevity Risk	Liquidity	Security of Capital	Protected Against Inflation	Ease of Management[a]
Equities											
Farm Real Estate	*	*		*					*	*	*
Corporate Stocks[b]	*	*		*	*		*[c]	*[d]		*	
Mutual Funds[b]	*	*		*	*		*	*		*	
Fixed Income Investments											
Installment Land Contract	*		*				*		*		*
Bonds[b]	*	*	*			*		*[d]	*[d]		
Bank Deposits	*		*				*[c]	*	*		*
Annuities	*		*								*

[a]Easy to manage in light of a retiring farmer's investment management expertise.

[b]The Retirement Investment Simulator has been built to include two different types.

[c]Longevity risk is a problem only if the capital base itself is gradually liquidated and consumed.

[d]Forced liquidation on short notice can result in large capital loss if market conditions are unfavorable.

relevant characteristics of the selected investments.

Figure 2.5 presents a series of investment decisions faced by retiring farmers. The diagram sheds light on both the specific investments and the general strategies of capital allocation considered in this study. In Figure 2.5, the cells number 1 through 10 correspond to the investment types which have been built into the simulation model. It becomes evident from a study of the diagram that the pattern of this research project has been to identify the effects of alternative methods of handling the farm assets on the amount of funds available for off-farm investment (see the upper half of the diagram), and to evaluate the desirability of selected off-farm investments as compared with the retention of the farm real estate (see the lower half of the diagram).

2.3 Variability of Returns

For three of the ten investments embodied in the Retirement Investment Simulator the levels of both income and price returns are constant. For the installment land contract, the bank savings account and the purchased annuity, there is no need to account for variability of return in simulating their performance. For each year of the planning horizon, the returns from each of these investments are budgeted into the simulation directly from the input data.

However, the remaining investments (cells numbered 1 and 3 through 8 in Figure 2.5) exhibit year to year variations in the levels of income return and capital growth. In accounting for this variability, a procedure reported by Clements, Mapp and Eidman (1971) has been used to generate a series of randomly selected but appropriately correlated annual rates of income return and capital growth for each asset exhibiting

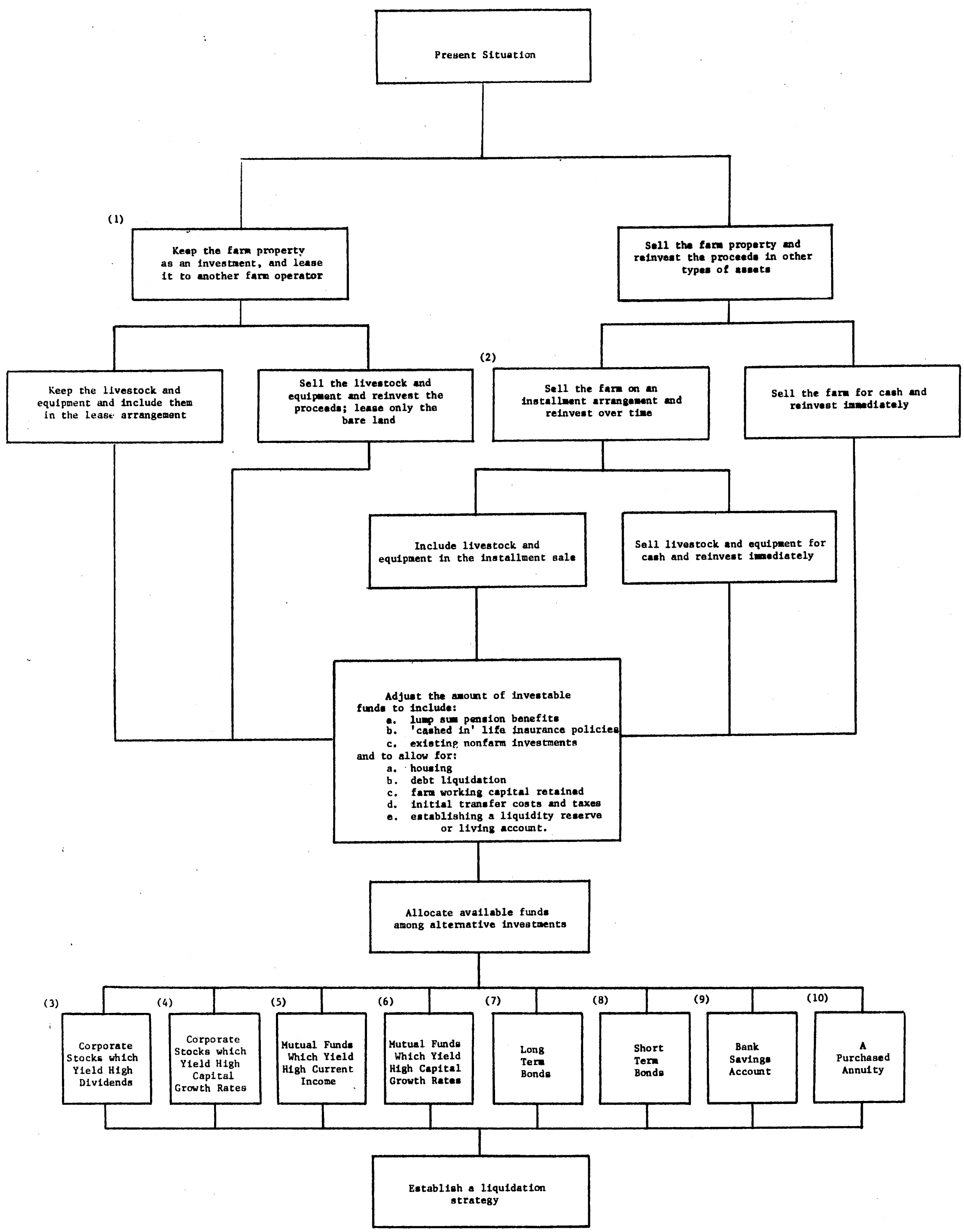

Figure 2.5 A Retiring Farmer's Investment Decision Tree

variability. In using this procedure, it was necessary to evaluate the historical performance of the selected investments.

Table 2.3 contains fourteen years of income and price return data for the relevant investment classes. The sources of all data are indicated in the footnotes to Table 2.3. Some assumption must be made about the form of the probability distribution of returns, and by inspecting the data it becomes evident that income returns are generally more well-behaved and exhibit more of the characteristics of normality (symmetry) than do price returns; moreover there appears no overriding evidence encouraging the assumption of any distribution other than the normal distribution. The literature has contained a great debate over the proper assumptions about the patterns of returns to investments (normal distribution vs. the random walk hypothesis). Admitting no new contributions to the understanding of this problem, we follow the precedent set by Markowitz, Sharpe and others in assuming a normal distribution of returns.

The correlation procedure requires that the covariance matrix for the events to be correlated be factored into upper and lower triangular matrixes.[8/] Then the upper triangular factor matrix must be multiplied by a matrix of random normal deviates to yield a matrix of correlated deviations about the mean or expected values of the events. Adding the correlated deviations to the vector of expected means gives the matrix of correlated rates of return.

[8/] The difficulty of this matrix conversion can be a major drawback to the use of the correlation procedure. As a part of this research, a generalized fortran program for factoring a covariance matrix has been written, and is presented in Appendix B.

Table 2.3 Income Returns and Price Returns (Percent) to Selected Investments

Year	Farm Real Estate[a] Income Returns	Farm Real Estate[a] Price Returns	Utility Stocks[b] Income Returns	Utility Stocks[b] Price Returns	Industrial Stocks[b] Income Returns	Industrial Stocks[b] Price Returns	Income Mutual Funds[c] Income Returns	Income Mutual Funds[c] Price Returns	Growth Mutual Funds[c] Income Returns	Growth Mutual Funds[c] Price Returns	Bonds (Price Returns)[b,d] Corporate	Bonds (Price Returns)[b,d] Municipal	Bonds (Price Returns)[b,d] Government Long Term	Bonds (Price Returns)[b,d] Government Short Term
1959	1.8	3.0	3.92	6.14	3.11	-3.29	4.4	4.34	1.4	19.19	-0.33	3.18	1.26	1.29
1960	2.9	1.5	3.89	28.47	3.36	17.77	4.8	-4.43	1.5	6.24	0.61	3.75	1.04	2.15
1961	4.0	5.7	3.24	-1.73	2.90	-6.36	4.2	12.53	1.1	26.81	0.99	3.99	-0.61	0.63
1962	4.2	5.5	3.46	9.85	3.32	11.98	4.8	-8.70	1.5	-18.7	0.62	-0.71	-0.83	-0.79
1963	4.0	6.5	3.29	7.57	3.12	17.44	4.1	10.97	1.4	19.14	-1.67	0.02	-1.66	-0.92
1964	3.3	4.9	3.27	8.83	2.96	8.46	3.9	9.72	1.3	11.47	-1.32	-0.81	-0.71	-4.48
1965	5.0	6.9	3.24	-10.3	2.94	-2.57	3.7	10.29	1.2	29.00	-8.33	-7.32	-5.17	0.97
1966	5.2	7.5	3.90	-0.16	3.32	8.89	4.3	-9.85	1.4	-3.07	-5.01	-1.95	-2.41	0.86
1967	3.6	7.0	4.19	-2.47	3.07	8.39	4.0	16.57	1.2	40.00	-6.53	-7.02	-4.85	-2.33
1968	3.4	5.6	4.50	-5.69	2.91	-0.28	3.7	10.84	1.1	9.46	-10.2	-15.4	-9.53	-3.19
1969	4.5	3.5	4.92	-13.0	3.07	-14.8	4.9	-20.5	1.6	15.66	-10.3	-15.4	-9.53	-2.46
1970	3.8	4.3	5.81	8.90	3.62	18.74	5.2	-0.32	2.1	-12.8	5.62	10.63	9.48	6.23
1971	3.7	8.2	5.45	-4.10	2.94	12.36	4.9	8.67	1.5	19.87	1.31	5.50	2.98	-1.66
1972	4.2	13.6	5.83	-6.03	2.61	-0.01	4.9	3.64	1.2	11.12	-3.05	1.15	-4.91	-3.36
Mean (1959-72)	3.83	5.98	4.21	1.88	3.09	5.48	4.41	3.13	1.39	12.39	-2.69	-1.46	-1.82	-0.50
Standard Deviation (1959-1972)	.8570	2.869	.9514	10.67	.2515	10.17	.4991	10.57	.2586	15.92	4.766	7.530	4.971	2.785

[a] Agricultural Finance Statistics, ERS, USDA.

[b] Standard and Poor's Trade And Securities Statistics, Security Price Index Record, 1974 Edition.

[c] Investment Companies 1974, Mutual Funds and Other Types, Wiesenberger Services, Inc.

[d] Corporate and Municipal Bond price returns are calculated by assuming a 4% coupon rate and a 20 year maturity; Government Bonds assuming a 3% coupon rate and a 15 and 3½ year maturity respectively.

Table 2.4 presents the covariance matrix for the historical data series. A matrix of correlation coefficients was calculated (Table 2.5) to identify asset types which were related to one another to such a degree that they might be combined into one investment classification thereby simplifying the model. Indeed very high and very significant correlations were noted among the three classifications of long term bonds (coefficients greater than .92 and observed significance levels less than .0001). In light of this not entirely surprising discovery, the data series for municipal bonds and government long term bonds were dropped from the analysis. The series for corporate bonds was retained to describe the variability in returns to all classifications of long term bonds. Eliminating the two bond classifications from the covariance matrix and performing the matrix factoring calculations yields the upper triangular factor matrix of the coefficients appearing in Table 2.6. This matrix is read as input in each simulation (as are the mean levels of expected return), and the remainder of the correlation procedure is accomplished endogenously. A series of randomly selected and appropriately correlated outcomes is generated for the income and price return to each of the seven assets exhibiting variability. For each year of the planning horizon one of the generated outcomes is used as the rate of return to the appropriate asset.

When using the simulator, one may create his own set of average rates of return based upon his unique expectations about the future. Historical means are assumed by the model as default values. The variability estimates, however are built into factor matrix along with measures of the reaction in performance of one investment to a change in the performance of other investments. Using the 'average' rates of

Table 2.4 Matrix of Covariances of Return from Selected Investments

	Farm Real Estate		Utility Stocks		Industrial Stocks		Income Mutual Funds		Growth Mutual Funds		Bonds (Price Returns)			
													Government	
	Income Returns	Price Returns	Income Returns	Price Returns	Income Returns	Price Returns	Income Returns	Price Returns	Income Returns	Price Returns	Corporate	Municipal	Long Term	Short Term
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
A	.73451	1.12758	-.00216	-4.52899	-.01005	-.97162	-.01352	-2.49512	-.00670	-1.60262	-1.40215	-1.77303	-1.29914	-.09518
B		8.23104	.97080	-15.65291	-.44171	-1.64131	-.01121	8.34530	-.27324	6.52865	-1.85496	.31562	-3.13949	-3.19556
C			.90519	-2.55472	-.00717	.22256	.31480	-2.08773	.11160	-3.03883	.48770	1.02889	.76108	.19966
D				113.85938	1.58231	76.30108	1.25881	-9.30778	.94944	-71.63551	32.59272	45.35857	31.12738	11.94315
E					.06327	1.45122	.04686	-1.17640	.05046	-2.39181	.51717	.64406	.72413	.51851
F						103.45934	1.08700	14.09809	1.14623	-66.24280	29.05209	43.80864	32.47697	9.56960
G							.24901	-3.17841	.09473	-4.14077	1.27323	1.85725	1.21135	.51376
H				a				111.75961	-1.42618	101.80270	3.36295	10.32701	3.23540	-5.42985
I									.06687	-2.45388	.64127	.86241	.84355	.45758
J										253.35297	-30.31785	-33.81824	-29.81057	-15.24804
K											22.71620	34.36619	22.21607	7.17706
L												56.70106	34.70529	12.02980
M													24.71428	9.59042
N														7.75841

[a] The remainder of the matrix is, of course, a mirror image of the portion presented.

Table 2.5 Matrix of Correlation Coefficients for Selected Investments

	Farm Real Estate		Utility Stocks		Industrial Stocks		Income Mutual Funds		Growth Mutual Funds		Bonds (Price Returns)			
													Government	
	Income Returns	Price Returns	Income Returns	Price Returns	Income Returns	Price Returns	Income Returns	Price Returns	Income Returns	Price Returns	Corporate	Municipal	Long Term	Short Term
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
A	1.00000	.45859 (.10)[b]	-.00266 (.99)	-.49524 (.07)	-.04664 (.87)	-.11146 (.70)	-.03161 (.91)	-.27539 (.34)	-.03025 (.92)	-.11748 (.69)	-.34327 (.23)	-.27474 (.34)	-.30492 (.29)	-.03987 (.89)
B		1.00000	.35566 (.21)	-.51131 (.06)	-.61209 (.02)	-.05624 (.85)	-.00783 (.98)	.27515 (.34)	-.36831 (.20)	.14297 (.63)	-.13566 (.64)	.01461 (.96)	-.22012 (.45)	-.39988 (.16)
C			1.00000	-.25165 (.39)	-.02997 (.92)	.02300 (.94)	.66307 (.01)	-.20757 (.48)	.45361 (.10)	-.20067 (.49)	.10755 (.71)	.14362 (.62)	.16091 (.58)	.07534 (.80)
D				1.00000	.58954 (.03)	.70301 (.005)	.23641 (.42)	-.08251 (.78)	.34409 (.23)	-.42178 (.13)	.64087 (.01)	.56452 (.04)	.58679 (.03)	.40184 (.15)
E					1.00000	.56722 (.03)	.37331 (.19)	-.44240 (.11)	.77573 (.001)	-.59741 (.02)	.43139 (.12)	.34005 (.23)	.57910 (.03)	.74008 (.003)
F						1.00000	.21416 (.46)	.13111 (.66)	.43579 (.12)	-.40916 (.15)	.59927 (.02)	.57198 (.03)	.64227 (.01)	.33777 (.24)
G							1.00000	-.60250 (.02)	.73409 (.003)	-.52133 (.06)	.53534 (.05)	.49427 (.07)	.48830 (.08)	.36963 (.19)
H				[a]				1.00000	-.52170 (.06)	.60500 (.02)	.06674 (.82)	.12973 (.66)	.06156 (.83)	-.18440 (.53)
I									1.00000	-.59619 (.02)	.52031 (.06)	.44290 (.11)	.65619 (.01)	.63529 (.01)
J										1.00000	-.39964 (.16)	-.28216 (.33)	-.37673 (.18)	-.34393 (.23)
K											1.00000	.95756 (.0001)	.93762 (.0001)	.54062 (.05)
L												1.00000	.92710 (.0001)	.57356 (.03)
M													1.00000	.69259 (.006)
N														1.00000

[a] The remainder of the matrix is, of course, a mirror image of the portion shown.

[b] The numbers in parenthesis are the observed levels of significance of the coefficients above them.

Table 2.6 The Upper Triangular Factor Matrix of Coefficients Used in Generating the Correlated Outcomes for the Simulation Model

	Farm Real Estate		Utility Stocks		Industrial Stocks		Income Mutual Funds		Growth Mutual Funds		Bonds[a] (Price Returns)	
	Income Returns	Price Returns	Income Returns	Price Returns	Income Returns	Price Returns	Income Returns	Price Returns	Income Returns	Price Returns	Long Term	Short Term
	A	B	C	D	E	F	G	H	I	J	K,L,M	N
A	0.35188	0.09179	-0.18102	-0.55755	-0.28810	0.10836	0.05926	-0.06737	-0.01993	-0.21648	-0.32774	-0.03417
B	0.00000	0.93251	0.13563	-1.30811	-1.08359	0.20578	1.58564	0.45672	-0.54040	0.09443	0.27463	-1.14726
C	0.00000	0.00000	0.30974	-0.01913	-0.07210	-0.10852	0.71764	0.10026	0.47909	-0.16269	0.07557	0.07168
D	0.00000	0.00000	0.00000	5.32614	1.51380	4.62101	-3.03249	-0.58957	-1.29243	-1.83734	5.37322	4.28778
E	0.00000	0.00000	0.00000	0.00000	0.07539	0.06552	-0.07641	0.00430	0.06394	-0.09278	0.00935	0.18615
F	0.00000	0.00000	0.00000	0.00000	0.00000	6.75398	-1.04630	3.92405	0.79310	-1.88101	5.03779	3.43564
G	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.23749	-0.20053	0.22942	-0.16168	0.19901	0.18445
H	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	6.62585	-3.43222	6.92122	2.09146	-1.94940
I	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.16829	-0.09276	0.05436	0.16428
J	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	14.38875	-4.04338	-5.47429
K,L,M	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	4.00960	2.57668
N	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	2.78539

[a]Due to the high correlations between price returns from Corporate, Municipal and Government Long Term Bonds, the three were combined into one class of investments and labeled simply "Long Term Bonds". The data series for Corporate Bonds was used to represent "Long Term Bonds" in creating this matrix.

return, the computer will randomly select a set of 'annual' rates of return as they might occur in the real world. The amount of variation that is created for each of the investments will be based upon actual performance data since 1959, and the variation in returns from one investment will be correlated to the variation in returns from all others in the manner that has been observed since 1959. Using the simulator in planning an investment strategy therefore requires the user to assume that the assets selected will react to each other in the same way that they have since 1959, but not necessarily in the same pattern of general economic trends or at the same levels of average return.

If an individual user or researcher is perceptive enough to estimate the variances of the selected investments in the future, then a new covariance matrix can be created based upon (1) the estimates of variance in the future and (2) the assumption that the historical correlation coefficients in Table 2.5 will hold into the future. In equation 2.1 below, γ_{ij} represents the coefficient of correlation between assets i and j, μ_{ij} is the covariance between assets i and j, σ_{ii}^2 is the variance of asset i and σ_{jj}^2 is the variance of asset j. Using estimates of the future values of σ_{ii}^2 and σ_{jj}^2 and assuming γ_{ij} to be constant at the historical value, equation 2.1 can be solved for μ_{ij} (equation 2.2) to calculate each member of the new covariance matrix. The new covariance matrix can then be factored using the computer routine in appendix B, and the new factor matrix can be used as input for the correlation subroutine of the simulation model.

$$(2.1) \qquad \gamma_{ij} = \frac{\mu_{ij}}{\sqrt{\sigma_{ii}^2 \sigma_{ij}^2}}$$

(2.2) $$\mu_{ij} = \gamma_{ij}\sqrt{\sigma_{ii}^{2}\sigma_{ij}^{2}}$$

In the simulations performed throughout the research reported here, the historical means appearing in Table 2.3 were used as the expected levels of returns, and the historical covariance matrix appearing in Table 2.4 was used to develop the factor matrix for the correlation subroutine.

CHAPTER III

DEVELOPING INPUTS AND SELECTING STRATEGIES FOR SIMULATION ANALYSIS

This chapter reports the development of the input data for the current application of the Retirement Investment Simulator. We begin with a discussion of the income needs of retired farm families, and then briefly outline the development of a set of case farms in an attempt to describe the types and amounts of financial resources controlled by older farmers. Chapter III concludes by enumerating the alternative strategies for farm and nonfarm investment which were analyzed in this study.

3.1 Income Needs of Retired Couples

The amount of investment income demanded by a couple in retirement is affected by (1) the living expenses they expect to encounter, (2) the offsetting social security and private pension benefits, and (3) the number of years over which retirement income must be provided. The Bureau of Labor Statistics maintains sample budgets for representative four-member working families (Brackett, 1973) and retired couples (Gedney, 1972). Careful study of these budgets lends a great deal of insight into methods of estimating retirement income needs.

The budgets present three arbitrary levels of living and are published with indexes that facilitate their adjustment to represent various areas of the United States. Adjusting each budget item to nonmetropolitan areas in the South and updating each item to January, 1974 using a detailed breakdown of the Consumer Price Index, we find total budget values of $3,303, $4,525, and $6,572 at the low, medium and high standards of living for retired couples. The first column of Table 3.1 presents a breakdown of the higher budget. This higher budget served as a benchmark or minimum level of consumption needs through the remainder of this study and was thought to be representative of a moderate commercial farm family.

Fixed budgets of this type can limit the flexibility of assumptions about living expense needs as they vary among families and over time in the face of inflation. The level of consumption expenditures which a family has actually lived with in the past is likely to be a good measure of their consumption expenditures in the future; certainly it is a much better measure than an average budget at an arbitrary living standard. The Bureau of Labor Statistics budgets can be used to hypothesize a fundamental set of relationships between consumption patterns earlier in life and consumption patterns in retirement.

The budget for a retired couple can be compared with the budget for a four-member working family by forming a coefficient $(\frac{br_i}{bw_i})$ for each budget item, where br_i is the i^{th} item in the retired couple's budget and bw_i is the i^{th} item in the working family's budget. Each coefficient represents a ratio of change in that budget item as a family moves from working life into retirement at constant price levels. The second column of Table 3.1 presents the series of ratios derived from the budgets for higher standards of living.

Table 3.1 Living Expenses in Retirement, A Sample Budget and A Predictive Model

	Sample Budget for a Retired Couple 1974[a/]	Ratios of Retired Family Budget Items to Four-Member Working Family Budget Items[b/]
Total Budget	6572	.45
Total Consumption	6074	.53
Food	1892	.52
Housing	1902	.57
Transportation	795	.62
Clothing	413	.32
Personal Care	221	.63
Medical Care	446	.67
Other Consumption	405	.42

[a/] Updated from Monthly Labor Review, U. S. Department of Labor, Bureau of Labor Statistics, Washington, D. C., Vol. 96, No. 10, October, 1973, pp. 45-50.

[b/] Prepared from the 1972 sample budgets and verified using comparable 1967 sample budgets.

If a family knows what its living expenses were when they were age 40 to 50 with children living at home, these ratios can be used to estimate their living expenses in retirement by forming the product of each ratio and its respective budget value and then adjusting that product for inflation over the fifteen to twenty-five year period between the observed budget and the date of retirement. Using this method implies that the family maintains the same style of living before and during retirement. If the living style changes, the ratios can be adjusted. For example, if a couple sells their farm and moves to town upon retirement, they can expect to spend more in their total budget on food and housing because of the loss of farm perquisits, but less on transportation because of their proximity to shopping and other needed services. These changes can be reflected in the budget projections by adjusting the ratios for food and housing upward and by lowering the ratio for transportation. Other changes can be reflected by similar adjustments. Adjustments for inflation can be made by multiplying the ratios by the factor $(1 + \frac{i}{100})$ where i is the total amount of price inflation since the budget was observed.

In summary, the study of sample budgets has indicated that, if we ignore price inflation, consumption expenditures in retirement can be expected to be about half what they were in working life with children at home. This conclusion is in agreement with the discoveries of Thurow (1969) and Motley and Morley (1970). In the case study approach used in this analysis of investment strategies, the sample budget in Table 3.1 has been used as the minimum level of consumption expenditures. When assumptions about the working life living expenditures of a couple has yielded a projected budget in retirement which was greater than

$6,500, the higher value has been used. Consumption expenditures have been inflated at a 6% annual rate in all simulations.

Publications by the U. S. Department of Health, Education and Welfare (1974) are available at local offices of the Social Security Administration to help estimate retirement benefits. The level of social security benefits in retirement is determined by the family's historical pattern of taxable income, and this makes it possible to link our assumptions about living expenses to the levels of social security benefits. It is therefore possible to estimate quite accurately the residual income needs which a retired farm family must derive from its investments, even though our assumptions about the absolute level of consumption expenditures before and during retirement are somewhat arbitrary.

Finally, the length of the planning horizon must be determined by some measure of the life expectancy of the couple. The simulation model automatically projects the performance of an investment plan over two different planning horizons to help evaluate its ability to produce income and maintain value over an indefinite number of years. In deciding on the lengths of the planning horizons for this analysis, Table 3.2 was prepared from data presented by Lee and Brake (1971). In all test case simulations, it was assumed that the couples retired at age 65, and the appropriate values in Table 3.2 were used for the short and long planning horizons.

3.2 Financial Resources of Retiring Farmers

To demonstrate the types of asset situations faced by retiring farmers and to provide input data for a simulation analysis of

Table 3.2 Expected Years of Remaining Life

The Individual's Present Age	Assuming the Individual Lives as Long as One-Third of All Americans		Assuming the Individual Lives as Long as One-Tenth of All Americans	
	Husband	Wife	Husband	Wife
	Years			
55	25	29	33	36
60	21	25	28	31
65	17	20	24	27
70	13	16	20	22

alternative investment strategies, three case farms were developed from farm record data.[1/] Individual records from the 1973 Costfinder project were grouped and studied by size and major enterprise.[2/] The case farms are not actual records pulled from the files; it was deemed important to maintain the privacy of the individuals cooperating in the Costfinder project. The case farms were not created by averaging the characteristics of the farms in each sample; such a procedure is not likely to yield a set of characteristics which could realistically represent a real world situation. The approach taken was to observe the general level of asset values and the percentage distribution of total capital among different asset types. In this way, it was possible to piece together a set of hypothetical case farms which could realistically exist in Oklahoma.

As the cases were developed, adjustments were made to reflect the characteristics of an older farmer. In two of the three cases, the operators were assumed to own a large portion of the land they farmed (Johnson, 1974), and to be relatively free from long term debt encumbering land ownership. The case farms also reflect a cash rich situation and a somewhat depreciated condition of field machinery and equipment. Tables 3.3, 3.4 and 3.5 present financial data for the case farms.

[1/] Initially, seven case farms were created. The results from preliminary simulations indicated that most of the relevant problems and opportunities facing retiring farmers could be demonstrated by the three case farms discussed here. The others were dropped from the analysis to simplify and economize.

[2/] Costfinder is Oklahoma State University's computerized farm record system.

Table 3.3 Case Farm One: A Small Tenant Operator or Renter, 40 Crop Acres Owned, 320 Crop Acres Rented

FARM ASSETS:			
Cash & Other Liquid Assets	$ 8,400		
Stored Grain, Forage, Feed, Crops	$21,000		
Livestock	$ 2,800		
Machinery	$17,500		
Total Nonreal Estate Farm Capital		$49,700	
Land & Buildings		$20,300	
Total Farm Assets			$70,000
FARM-RELATED DEBT:			
Current Debt		$ 7,000	
Long Term Debt		$ 0	
Total Debt			$ 7,000
FARM EQUITY CAPITAL			$63,000
NONFARM ASSETS:			
Personal Savings, Cooperative Stocks, Other Stocks, Bonds, Mutual Funds			$ 5,000
Retained Life Insurance Coverage			$22,000
TAX CONSIDERATIONS:			
Tax Basis for Farm Real Estate			$ 4,200
Capital Gain Tax if the Farm is Sold Immediately			$ 1,610
Capital Gain Tax if the Farm is Sold on a 15 Year Installment Arrangement			$ 1,369
INCOME NEEDS IN YEAR ONE:			
Budget of Consumption Expenditures			$ 6,500
Joint Social Security Benefits			$ 4,776

Table 3.4 Case Farm Two: A Small Crop Farmer, 200 Crop Acres Owned, 200 Crop Acres Rented, 20 Beef Cows

FARM ASSETS:			
Cash & Other Liquid Assets	$16,000		
Stored Grain, Forage, Feed, Crops	14,400		
Livestock	6,400		
Machinery	22,400		
Total Nonreal Estate Farm Capital		$ 59,200	
Land & Buildings		100,800	
Total Farm Assets			$160,000
FARM-RELATED DEBT:			
Current Debt		$ 16,000	
Long Term Debt		3,200	
Total Debt			$ 19,200
FARM EQUITY CAPITAL			$140,800
NONFARM ASSETS:			
Personal Savings, Cooperative Stocks, Other Stocks, Bonds, Mutual Funds			$ 5,000
Retained Life Insurance Coverage			16,000
TAX CONSIDERATIONS:			
Tax Basis for Farm Real Estate			$ 20,740
Capital Gain Tax if the Farm is Sold Immediately			12,800
Capital Gain Tax if the Farm is Sold on a 15 Year Installment Arrangement			7,205
INCOME NEEDS IN YEAR ONE:			
Budget of Consumption Expenditures			$ 6,500
Joint Social Secruity Benefits			4,776

Table 3.5 Case Farm Three: A Large Crop Farmer, 300 Crop Acres Owned, 600 Crop Acres Rented, 60 Beef Cows

FARM ASSETS:			
Cash & Other Liquid Assets	$25,000		
Stored Grain, Forage, Feed, Crops	20,000		
Livestock	20,000		
Machinery	35,000		
Total Nonreal Estate Farm Capital		$100,000	
Land & Buildings		150,000	
Total Farm Assets			$250,000
FARM-RELATED DEBT:			
Current Debt		$ 25,000	
Long Term Debt		12,500	
Total Debt			$ 37,500
FARM EQUITY CAPITAL			$212,500
NONFARM ASSETS:			
Personal Savings, Cooperative Stocks, Other Stocks, Bonds, Mutual Funds			$ 5,000
Retained Life Insurance Coverage			22,000
TAX CONSIDERATIONS:			
Tax Basis for Farm Real Estate			$ 31,000
Capital Gain Tax if the Farm is Sold Immediately			22,600
Capital Gain Tax if the Farm is Sold on a 15 Year Installment Arrangement			11,900
INCOME NEEDS IN YEAR ONE:			
Budget of Consumption Expenditures			$ 8,000
Joint Social Security Benefits			6,036

3.3 The Specific Strategies Selected for Simulation

In preparing the final input data sets for the alternative investment strategies, several adjustments must be made. First the fate of the farm real estate must be determined. For each of the case farms, three real estate strategies have been analyzed: (1) keep the farm real estate as an investment, (2) sell the farm for cash and reinvest off the farm immediately, and (3) sell the farm on an installment arrangement to reduce capital gain tax, and reinvest the proceeds over the length of the sale contract. If the farm is to be sold, then the amount of funds available for off-farm investment is assumed to be the market value of the farm less the appropriate capital gain tax.[3/] Regardless of the way in which real estate is handled, the farm chattels or personal property are assumed to be sold at their stated value, and the proceeds made available for off-farm investment. Investable funds are increased by the amount of existing nonfarm assets, and are decreased by the amount of debt to be liquidated and by the establishment of a cash reserve equal to one year's consumption need. Where the farm is retained as an investment, a cash rental arrangement is assumed, eliminating the need for retaining the working capital required in a crop share rental arrangement. Where the farm is sold, the capital base is reduced by an additional $10,000 to allow for the establishment

---

[3/] If the farm is sold for cash, the tax reduces the amount of investable funds immediately. If an installment contract is used, the tax is withdrawn from each year's payment by the model.

of new housing.[4/] For each real estate strategy, these adjustments yield estimates of (1) the amount of the investment retained in the farm property (zero if sold), (2) the amount of funds available for immediate off-farm investment, and (3) the amount of funds to become available for off-farm investment over the term of the installment land contract.

For each of the three real estate strategies, three alternatives for off-farm investment have been analyzed: (1) a portfolio of assets which produces high income returns and low capital growth rates, (2) a balanced portfolio in which investable funds are distributed evenly among the investments considered by the model, and (3) a portfolio concentrating on assets with high capital growth rates. Chapter IV presents the simulated outcomes of each of the strategies first from the standpoint of pure investment performance and then in light of inheritance taxes and selected methods of estate transfer.

[4/] New housing is therefore implicitly priced at $10,000 plus the market value of the farm dwelling.

CHAPTER IV

SIMULATED PERFORMANCE OF ALTERNATIVE STRATEGIES

Earlier writings addressing the investment problems and opportunities of retiring farmers (Brake and Lee, 1971; Smith, 1971; Brucker, Baker and Erickson, 1975) have jointly indicated that income maximizing or profit maximizing individuals should sell the farm property and invest in a portfolio of market securities which yields substantial income returns. The theme of this research project has been that in fact the analysis of retirement investment strategies for farmers cannot realistically be performed under the assumption of strict profit maximization. Moreover, the results of this simulation analysis demonstrate that if profit maximization were the motive, in most cases the preferred strategy would be to retain the farm property as an investment and place a large part of any additional capital in nonfarm investments yielding low income returns and high capital growth rates. This chapter reports the performance of a series of strategies applied to the three case farms using the Retirement Investment Simulator. We begin by evaluating the pure performance characteristics of the portfolios, and conclude with adjustments for inheritance taxes and the effects of certain estate planning schemes.

The simulation model, as mentioned previously, evaluates a portfolio over a short and a long planning horizon. In each of three case farms, it was not necessary to erode the capital base in retirement, so the longer planning horizon showed little of interest. To reduce the volume of data presented, results are reported for the short horizon only. In the short horizon, the husband has a life expectancy of seventeen years, and the wife twenty.

Discussion of the simulated performance of the strategies is couched in terms of mean levels and variability estimates for monetary returns to the portfolio. Perhaps this is the only type of absolute interpretation that can be made by a detached researcher without knowledge of the individual's utility function as regards the ownership of various assets. However, the tabulated results can indicate to the reader the pecuniary sacrifices which must be made if a plan is selected by some criterion other than profit maximization. In the author's opinion, this is a key feature of the model and a valuable contribution of this analysis to the understanding of retirement investment alternatives for farmers.

4.1 Small Farm Operators with Limited Land Holdings

Table 4.1 presents performance data for three real estate strategies assuming all investments made off the farm are in assets producing high income returns and low capital growth rates. Specifically, these investments are corporate stocks yielding high dividends, mutual funds yielding high current incomes and both short and long term bonds. The body of Table 4.1 reports for each replication of the experiment (1) the level and the year to year variability of income to the portfolio expressed as a percentage of the portfolio value and (2) the estimated value of the portfolio at the death of the last surviving spouse

Table 4.1 Simulated Performance of Selected Real Estate Strategies, Small Renter, Income Portfolio of Nonfarm Investments

	Keep Farm Real Estate as an Investment			Sell the Farm for Cash and Reinvest			Sell the Farm on an Installment Arrangement		
	Income Return		Ending Net Worth Before Estate Settlement	Income Return		Ending Net Worth Before Estate Settlement	Income Return		Ending Net Worth Before Estate Settlement
	Mean	Standard Deviation		Mean	Standard Deviation		Mean	Standard Deviation	
Replication 1	4.851	0.323	129941.	5.352	0.412	73776.	5.644	0.494	75101.
2	4.756	0.445	124011.	5.256	0.466	63753.	5.561	0.611	65565.
3	4.970	0.429	179564.	5.398	0.466	86702.	5.661	0.624	92404.
4	4.840	0.445	128444.	5.268	0.340	72687.	5.576	0.530	73477.
5	4.954	0.406	152839.	5.361	0.529	68246.	5.585	0.717	79237.
6	4.932	0.443	132191.	5.311	0.351	41540.	5.607	0.444	49441.
7	4.800	0.547	150692.	5.250	0.515	91364.	5.563	0.654	94232.
8	4.852	0.457	137122.	5.411	0.391	59163.	5.685	0.444	64700.
9	4.781	0.496	169007.	5.450	0.332	97706.	5.684	0.493	108723.
10	4.909	0.405	155752.	5.377	0.577	110794.	5.639	0.656	106390.
11	4.839	0.394	129382.	5.352	0.399	72087.	5.693	0.492	67145.
12	4.972	0.438	129949.	5.558	0.312	41610.	5.772	0.553	53523.
13	4.913	0.608	160646.	5.399	0.474	90465.	5.687	0.604	83773.
14	4.732	0.451	176196.	5.289	0.531	114727.	5.571	0.655	129938.
15	4.821	0.649	150618.	5.245	0.591	92128.	5.628	0.609	86648.
Mean	4.861	0.462	147090.	5.352	0.446	78450.	5.637	0.572	82020.
Coefficient of Variability[b]	.095		.126	.083		.281	.101		.266
Highest Value	4.972	0.649	179564.	5.558	0.591	114727.	5.772	0.717	129938.
Lowest Value	4.732	0.323	124011.	5.245	0.312	41540.	5.561	0.444	49441.
Average No. of liquidations to meet consumption expenditures			0			1			0

[a]An income portfolio consists of long term and short term bonds and corporate stocks and mutual funds producing high current incomes and low capital growth rates. Income surpluses are reinvested in income type mutual funds.

[b]The coefficients of variability for income return measure variability from one year to the next for the average of all replications; for ending net worth they measure variability across replications.

without considering estate settlement costs and inheritance taxes associated with either of the two death events. Each replication is carried out with a different set of randomly selected but appropriately correlated rates of return, and the results for each replication are shown to emphasize the stochastic nature of the simulation model and the differing amounts of variability associated with alternative portfolios. The bottom portion of the table reports means and variability estimates for the overall performance of the portfolio, and indicates the number of occasions on which part of the capital base had to be liquidated to meet consumption expenditures. With the exception of farm real estate, the model does not consider transaction costs at the time of asset liquidation. A large number of liquidations in any given strategy would indicate that a strategy is undesirable from an ease of management point of view, and that the ending net worth is overstated due to the failure to consider transaction costs.[1/]

Tables 4.2 and 4.3 report comparable performance characteristics of alternative real estate strategies assuming nonfarm investments are made in a balanced portfolio (Table 4.2) or in a portfolio concentrating on assets yielding high capital growth rates (Table 4.3). The balanced portfolio is formed by distributing initial investments equally among the six market securities and reinvesting surplus income in growth mutual funds; the growth portfolio consists of industrial stocks and mutual funds exhibiting high capital growth rates.

In analyzing the balanced portfolio of nonfarm investments (Table 4.2), it was not possible to make the installment land sale option

---

[1/] There are a number of practical books on investment management that indicate costs of off-farm investment. Cohen et al. (1973), Newman (1973) and Engel (1962) are examples.

Table 4.2 Simulated Performance of Selected Real Estate Strategies, Small Renter, Balanced Portfolio of Nonfarm Investments

	Keep Farm Real Estate as an Investment			Sell the Farm for Cash and Reinvest		
	Income Return		Ending Net	Income Return		Ending Net
	Mean	Standard Deviation	Worth Before Estate Settlement	Mean	Standard Deviation	Worth Before Estate Settlement
Replication 1	3.792	0.425	206313.	3.774	0.602	152335.
2	3.667	0.534	184428.	3.557	0.699	123245.
3	3.878	0.572	266954.	3.913	0.716	169096.
4	3.653	0.662	262945.	3.641	0.766	199451.
5	3.972	0.427	185235.	3.923	0.694	110998.
6	3.730	0.638	207577.	3.321	0.875	112422.
7	3.638	0.559	273812.	3.626	0.588	221647.
8	3.696	0.552	178667.	3.529	0.737	102254.
9	3.932	0.528	176523.	4.200	0.422	111257.
10	3.886	0.417	177189.	4.164	0.542	137310.
11	3.669	0.518	222015.	3.637	0.696	166996.
12	3.969	0.422	183630.	3.628	0.776	91799.
13	3.901	0.579	196519.	4.115	0.522	123650.
14	3.712	0.550	269949.	3.913	0.658	209861.
15	3.783	0.589	212380.	3.756	0.491	148346.
Mean	3.792	0.531	213609.	3.780	0.652	145377.
Coefficient of Variability[b/]	.140		.173	.172		.280
Highest Value	3.972	0.662	273812.	4.200	0.875	221647.
Lowest Value	3.638	0.417	176523.	3.321	0.422	91799.
Average No. of liquidations to meet consumption expenditures			0			3

[a/] A balanced portfolio is formed by distributing investments equally among the six types of market securities embodied in the simulation model. Income surpluses are reinvested in growth type mutual funds.

[b/] See footnote following Table 4.1.

Table 4.3[a] Simulated Performance of Selected Real Estate Strategies, Small Renter, Growth Portfolio of Nonfarm Investments

	Keep Farm Real Estate as an Investment			Sell the Farm for Cash and Reinvest			Sell the Farm on an Installment Arrangement		
	Income Return		Ending Net Worth Before Estate Settlement	Income Return		Ending Net Worth Before Estate Settlement	Income Return		Ending Net Worth Before Estate Settlement
	Mean	Standard Deviation		Mean	Standard Deviation		Mean	Standard Deviation	
Replication 1	3.532	0.341	155627.	2.810	0.271	146638.	3.820	0.525	101347.
2	3.501	0.364	133928.	2.670	0.289	113000.	3.851	0.572	73698.
3	3.500	0.389	247252.	2.849	0.427	186820.	3.631	0.788	152865.
4	3.514	0.345	140480.	2.659	0.366	184881.	3.586	0.751	112105.
5	3.588	0.309	203251.	2.940	0.325	140394.	3.843	0.683	122735.
6	3.631	0.300	176287.	2.607	0.376	128342.	3.628	0.600	89651.
7	3.506	0.444	195092.	2.722	0.286	228120.	3.859	0.694	135090.
8	3.578	0.371	151522.	2.681	0.233	105417.	3.861	0.474	77158.
9	3.478	0.397	225860.	3.150	0.338	155297.	3.831	0.599	159704.
10	3.388	0.342	228648.	3.039	0.332	200476.	3.657	0.718	175204.
11	3.519	0.331	146742.	2.661	0.327	149564.	3.880	0.548	85478.
12	3.672	0.316	142637.	2.757	0.281	72285.	3.764	0.623	63847.
13	3.458	0.402	263655.	3.000	0.286	202594.	3.685	0.668	178732.
14	3.413	0.410	184448.	2.863	0.424	186247.	3.713	0.734	148478.
15	3.580	0.508	235770.	2.841	0.252	197146.	3.856	0.576	161614.
Mean	3.524	0.371	188746.	2.817	0.321	159814.	3.764	0.637	122513.
Coefficient of Variability[b]	.105		.230	.114		.270	.169		.320
Highest Value	3.672	0.508	263655.	3.150	0.427	228120.	3.880	0.788	178732.
Lowest Value	3.388	0.300	133928.	2.607	0.233	72285.	3.586	0.474	63847.
Average No. of liquidations to meet consumption expenditures			0			10			0

a/ A growth portfolio consists of corporate stocks and mutual funds which yield high capital growth rates. Income surpluses are reinvested in growth type mutual funds.

b/ See footnote following Table 4.1.

strictly comparable with the other real estate strategies. The use of an installment land contract implies that capital will be reinvested in nonfarm assets as it is received in the annual contract principal payments. The current version of the model is only capable of making reinvestments in one asset. Therefore it was impossible to gradually build a balanced portfolio with the proceeds of the contract sale. The performance of the contract sale in the specialized portfolios can generally infer its desirability in a balanced portfolio strategy.

Upon studying the results presented in Tables 4.1, 4.2 and 4.3, it becomes evident that there is financial incentive to keep the farm real estate as an investment rather than sell it and invest entirely in any of the three nonfarm portfolios. In every case the farm investment meets all income needs and yields a higher ending net worth without sacrificing stability of income return or capital growth. Using Markowitz's terminology, the portfolios containing farm real estate are more efficient than those without it. The opportunity cost of a decision to sell the farm is apparent in the magnitudes of the differences in ending estates. A part of each of these differences is due to the initial reduction in the capital base when the farm is sold and capital gain tax is paid. However, in most cases more than half of the difference in ending estate values is accounted for purely through the superior performance of farm real estate as an investment.

If the farm is sold, then the economically efficient method of selling (cash or installment contract) appears to be determined by the nonfarm investments chosen. If the nonfarm investments are producers of high current incomes, then there is a slight pecuniary advantage in the use of an installment sale to reduce the total capital gain tax associated with the sale. If the nonfarm investments are growth assets, then the higher capital gain tax at the outset is more than offset by the benefit from a speedy transfer of funds to investments which grow rapidly. In a balanced portfolio situation, which we were unable to evaluate with the installment sale option, there might be a slight advantage to a cash sale over the installment method because surplus income and recaptured capital are reinvested in growth mutual funds under the balanced portfolio strategy.

The estimates of variability of income return to strategies involving installment land sales are overstated in every case, and particularly in the growth portfolio situations. Over the life of the sale contract, capital is transferred from an investment yielding high income returns and no capital growth to an asset yielding substantially lower income returns and some amount of price appreciation.[2/] This gradual shift in the rate of income return exaggerates the standard deviation above a value reflective of the year to year random flucuations which we are attempting to measure. The random fluctuations can reasonably be expected to be slightly less for the installment sale than for the cash sale alternative, and comparisons of the variability of return should consider the sources of bias in the variability estimates. The coefficient of variability for the average ending net worth is unaffected by the situation described above.

Evaluating each strategy in light of its monetary rewards, clearly the poorest alternative for this hypothetical limited resource farmer

---

[2/] Throughout this study, a 15 year installment land contract at 7.25% interest was assumed.

is to sell the farm and invest in assets producing high current incomes. Ironically, this is precisely the strategy that conventional wisdom has advocated.[3/] The best strategy (the one generating the greatest monetary returns) is to hold the farm real estate as an investment and place all remaining funds and surplus income in a balanced portfolio of nonfarm investments. If the investor desires to sell the farm for nonmonetary reasons of if his farm cannot be adapted to a rental situation, then the profit maximizing portfolio could be either balanced or specialized in growth assets. The verdict as to which is superior is not evident in the results, as the growth portfolio brings the highest ending value but yields an income return so low that assets are liquidated on ten occasions to meet consumption needs.

4.2 Family Farming Operations with Moderate Land Holdings

Tables 4.4, 4.5 and 4.6 display results from the simulation analysis of the various strategies on the second case farm. Under every strategy, the income return from the larger portfolio is adequate to meet consumption expenditures without having to liquidate assets. It can be argued, then, that the financial merits of the alternative courses of action can be evaluated based entirely upon the ending estate values and variability estimates.

It is once again clear that there are strong financial incentives to retain ownership of the farm real estate in retirement. Doing so can

---

[3/] Chapter V offers some possible explanations for this departure from generally accepted axioms.

Table 4.4 Simulated Performance of Selected Real Estate Strategies, Small Crop Farm, Income Portfolio of Nonfarm Investments

	Keep Farm Real Estate as an Investment			Sell the Farm for Cash and Reinvest			Sell the Farm on an Installment Arrangement		
	Income Return		Ending Net	Income Return		Ending Net	Income Return		Ending Net
	Mean	Standard Deviation	Worth Before Estate Settlement	Mean	Standard Deviation	Worth Before Estate Settlement	Mean	Standard Deviation	Worth Before Estate Settlement
Replication 1	4.326	0.424	491032.	4.944	0.513	283308.	5.561	0.690	322133.
2	4.303	0.532	470810.	4.819	0.557	211535.	5.456	0.857	251216.
3	4.541	0.545	729890.	5.010	0.545	382893.	5.596	0.838	443061.
4	4.369	0.633	498808.	4.838	0.414	299641.	5.498	0.768	326013.
5	4.486	0.513	586852.	4.991	0.587	235186.	5.557	0.900	316315.
6	4.673	0.566	584268.	4.812	0.489	179176.	5.512	0.702	225647.
7	4.297	0.676	547919.	4.893	0.542	333926.	5.549	0.819	376392.
8	4.382	0.631	575732.	4.946	0.461	238813.	5.595	0.684	317209.
9	4.213	0.625	594238.	5.024	0.408	327511.	5.631	0.729	435047.
10	4.229	0.603	443436.	5.029	0.704	269501.	5.622	0.869	287977.
11	4.329	0.586	524875.	4.931	0.536	334429.	5.544	0.751	341621.
12	4.554	0.490	563698.	4.973	0.484	152598.	5.620	0.833	217872.
13	4.354	0.778	596184.	5.003	0.559	307415.	5.580	0.805	310858.
14	4.159	0.512	715136.	4.953	0.661	612820.	5.549	0.823	720899.
15	4.365	0.835	566556.	4.813	0.685	343238.	5.540	0.828	326223.
Mean	4.372	0.597	565962.	4.932	0.543	300799.	5.561	0.793	347898.
Coefficient of Variability[b]	.137		.140	.110		.359	.143		.349
Highest Value	4.673	0.835	729890.	5.029	0.704	612820.	5.631	0.900	720899.
Lowest Value	4.159	0.424	443436.	4.812	0.408	152598.	5.456	0.684	217872.
Average No. of liquidations to meet consumption expenditures			0			0			0

[a], [b] See footnotes following Table 4.1.

Table 4.5 Simulated Performance of Selected Real Estate Strategies, Small Crop Farm, Balanced Portfolio of Nonfarm Investments

	Keep Farm Real Estate as an Investment			Sell the Farm for Cash and Reinvest		
	Income Return		Ending Net Worth Before Estate Settlement	Income Return		Ending Net Worth Before Estate Settlement
	Mean	Standard Deviation		Mean	Standard Deviation	
Replication 1	3.527	0.460	664959.	3.524	0.720	519124.
2	3.478	0.634	603983.	3.376	0.745	404276.
3	3.618	0.663	964931.	3.585	0.865	638205.
4	3.442	0.792	862136.	3.369	0.875	733987.
5	3.686	0.469	641263.	3.640	0.778	364581.
6	3.706	0.776	763736.	3.204	0.863	392461.
7	3.431	0.664	798296.	3.399	0.671	721743.
8	3.533	0.670	599006.	3.376	0.759	333088.
9	3.555	0.746	545423.	3.953	0.462	348160.
10	3.505	0.530	475990.	3.816	0.694	414100.
11	3.435	0.616	699759.	3.392	0.812	554166.
12	3.802	0.540	727397.	3.550	0.691	329722.
13	3.626	0.768	609980.	3.766	0.696	365357.
14	3.345	0.614	857874.	3.607	0.784	764563.
15	3.642	0.817	637317.	3.522	0.566	455008.
Mean	3.555	0.649	696803.	3.539	0.732	489236.
Coefficient of Variability[b/]	.183		.197	.207		.319
Highest Value	3.802	0.817	964931.	3.953	0.875	764563.
Lowest Value	3.345	0.460	475990.	3.204	0.462	329722.
Average No. of liquidations to meet consumption expenditures			0			0

[a/] See footnote following Table 4.2.

[b/] See footnote following Table 4.1.

Table 4.6 Simulated Performance of Selected Real Estate Strategies, Small Crop Farm, Growth Portfolio of Nonfarm Investments

	Keep Farm Real Estate as an Investment			Sell the Farm for Cash and Reinvest			Sell the Farm on an Installment Arrangement		
	Income Return		Ending Net Worth Before Estate Settlement	Income Return		Ending Net Worth Before Estate Settlement	Income Return		Ending Net Worth Before Estate Settlement
	Mean	Standard Deviation		Mean	Standard Deviation		Mean	Standard Deviation	
Replication 1	3.427	0.436	656214.	2.336	0.336	705368.	3.515	1.166	665678.
2	3.390	0.549	597013.	2.180	0.338	550340.	3.411	1.256	493259.
3	3.489	0.572	1001514.	2.414	0.446	810580.	3.483	1.367	918479.
4	3.345	0.719	813125.	2.263	0.428	998064.	3.393	1.365	939083.
5	3.573	0.439	692268.	2.404	0.331	490391.	3.565	1.296	505124.
6	3.626	0.653	788934.	2.170	0.413	589792.	3.332	1.327	555498.
7	3.404	0.624	749229.	2.224	0.283	1071985.	3.569	1.261	821288.
8	3.449	0.600	616805.	2.150	0.311	451197.	3.433	1.281	402884.
9	3.405	0.681	628124.	2.707	0.282	426838.	3.790	1.138	480156.
10	3.303	0.521	553496.	2.663	0.351	529288.	3.629	1.179	496671.
11	3.351	0.569	673334.	2.186	0.382	764545.	3.392	1.289	667490.
12	3.697	0.470	736534.	2.280	0.318	445538.	3.540	1.226	478621.
13	3.465	0.687	712277.	2.612	0.311	514480.	3.600	1.188	489002.
14	3.213	0.552	833949.	2.391	0.409	938061.	3.533	1.265	1000214.
15	3.572	0.795	695157.	2.331	0.220	645675.	3.672	1.119	547602.
Mean	3.447	0.591	716531.	2.354	0.344	662142.	3.524	1.248	630736.
Coefficient of Variability[b]	.171		.157	.146		.319	.354		.310
Highest Value	3.697	0.795	1001514.	2.707	0.446	1071985.	3.790	1.367	1000214.
Lowest Value	3.213	0.436	553496	2.150	0.220	426838.	3.332	1.119	402884.
Average No. of liquidations to meet consumption expenditures			0			0			0

[a] See footnote following Table 4.3.

[b] See footnote following Table 4.1.

yield a higher ending estate and a lower variability estimate while providing a generous stream of income. If it is necessary or desirable to sell the farm property, then the profit maximizing portfolio is one specializing in growth assets. If the farm is to be sold, the fastest growth can be accomplished by selling the farm for cash and moving the capital into growth assets quickly.

4.3 Commercial Family Farms with Sizable Land Holdings

In this largest class of farms analyzed, it appears that the issues of income adequacy have become trite at best. In fact, the results in Tables 4.7, 4.8 and 4.9 are somewhat confused by the fact that too much income is being produced and reinvested. When an asset grows in value, the increase remains in that asset unless and until it is liquidated. However, when an asset produces surplus income the surplus is pooled with all other surpluses and reinvested in one specific asset. The result is a net shift in the distribution of investments from assets producing surplus income to the asset performing the reinvestment function.

In both the balanced and growth portfolios (Tables 4.8 and 4.9) the reinvestment asset is growth mutual funds. The balanced portfolio is producing large amounts of surplus income (ranging from $200,000 to $357,000 over the length of the planning horizon for the 'keep the farm' strategy) and channelling it into growth mutual funds thereby creating a portfolio which concentrates more heavily in the fastest growing investment than even the growth portfolio (Table 4.9). The superior performance of the balanced portfolio option is explained by the fact

Table 4.7 Simulated Performance of Selected Real Estate Strategies, Large Crop Farm, Income Portfolio of Nonfarm Investments

	Keep Farm Real Estate as an Investment			Sell the Farm for Cash and Reinvest			Sell the Farm on an Installment Arrangement		
	Income Return		Ending Net	Income Return		Ending Net	Income Return		Ending Net
	Mean	Standard Deviation	Worth Before Estate Settlement	Mean	Standard Deviation	Worth Before Estate Settlement	Mean	Standard Deviation	Worth Before Estate Settlement
Replication 1	4.358	0.412	722803.	4.884	0.538	476369.	5.569	0.675	496714.
2	4.330	0.523	682665.	4.759	0.578	347489.	5.471	0.839	382940.
3	4.567	0.541	1069105.	4.959	0.556	643731.	5.611	0.826	668766.
4	4.396	0.613	729476.	4.782	0.426	496535.	5.508	0.750	498494.
5	4.511	0.503	851322.	4.932	0.589	377955.	5.570	0.892	478371.
6	4.684	0.552	839032.	4.756	0.527	301735.	5.526	0.682	345438.
7	4.328	0.663	803953.	4.841	0.560	556833.	4.558	0.807	576002.
8	4.409	0.621	836933.	4.884	0.481	402705.	5.611	0.664	477756.
9	4.254	0.612	875806.	4.963	0.432	532423.	5.649	0.712	662184.
10	4.272	0.592	644573.	4.972	0.733	419144.	5.633	0.856	449324.
11	4.363	0.571	775387.	4.876	0.557	572541.	5.556	0.738	524592.
12	4.572	0.476	806435.	4.899	0.518	252882.	5.647	0.817	332076.
13	4.391	0.747	868663.	4.944	0.579	506508.	5.595	0.793	476250.
14	4.198	0.502	1073749.	4.900	0.683	1029552.	5.564	0.813	1089267.
15	4.391	0.820	829625.	4.757	0.704	566595.	5.549	0.812	506075.
Mean	4.402	0.583	827301.	4.874	0.564	498866.	5.574	0.778	530950.
Coefficient of Variability[b]	.132		.145	.116		.367	.140		.343
Highest Value	4.684	0.820	1073749.	4.972	0.733	1029552.	5.649	0.892	1089267.
Lowest Value	4.198	0.412	644573.	4.756	0.426	252882.	5.471	0.664	332076.
Average No. of liquidations to meet consumption expenditures			0			0			0

[a], [b] See footnote following Table 4.1.

Table 4.8 Simulated Performance of Selected Real Estate Strategies, Large Crop Farm, Balanced Portfolio of Nonfarm Investments

	Keep Farm Real Estate as an Investment			Sell the Farm for Cash and Reinvest		
	Income Return			Income Return		
	Mean	Standard Deviation	Ending Net Worth Before Estate Settlement	Mean	Standard Deviation	Ending Net Worth Before Estate Settlement
Replication 1	3.427	0.469	1099253.	3.359	0.756	913968.
2	3.377	0.652	985470.	3.206	0.777	708055.
3	3.531	0.691	1576308.	3.444	0.870	1097044.
4	3.339	0.797	1454635.	3.224	0.886	1308797.
5	3.602	0.472	1011005.	3.473	0.787	613398.
6	3.612	0.777	1216637.	3.050	0.883	699174.
7	3.352	0.632	1298915.	3.244	0.669	1238529.
8	3.451	0.673	942575.	3.220	0.782	563537.
9	3.500	0.737	854762.	3.818	0.475	557241.
10	3.431	0.531	753563.	3.696	0.698	662940.
11	3.333	0.622	1151663.	3.222	0.835	980908.
12	3.737	0.539	1144691.	3.383	0.725	577199.
13	3.560	0.752	947322.	3.626	0.710	588303.
14	3.285	0.618	1401403.	3.456	0.794	1317733.
15	3.563	0.797	1006757.	3.400	0.565	734949.
Mean	3.473	0.650	1122996.	3.388	0.748	837451.
Coefficient of Variability[b]	.187		.206	.221		.337
Highest Value	3.737	0.797	1576308.	3.818	0.886	1317733.
Lowest Value	3.285	0.469	753563.	3.050	0.475	557241.
Average No. of liquidations to meet consumption expenditures			0			0

[a] See footnote following Table 4.2.

[b] See footnote following Table 4.1.

Table 4.9 Simulated Performance of Selected Real Estate Strategies, Large Crop Farm, Growth Portfolio of Nonfarm Investments

	Keep Farm Real Estate as an Investment			Sell the Farm for Cash and Reinvest			Sell the Farm on an Installment Arrangement		
	Income Return		Ending Net Worth Before Estate Settlement	Income Return		Ending Net Worth Before Estate Settlement	Income Return		Ending Net Worth Before Estate Settlement
	Mean	Standard Deviation		Mean	Standard Deviation		Mean	Standard Deviation	
Replication 1	3.338	0.424	1007942.	2.239	0.356	1221953.	3.463	1.086	1023596.
2	3.305	0.546	901868.	2.089	0.348	946273.	3.358	1.177	757269.
3	3.420	0.578	1504978.	2.315	0.429	1373077.	3.446	1.293	1370871.
4	3.262	0.711	1259806.	2.175	0.429	1761058.	3.341	1.293	1427723.
5	3.481	0.421	1029933.	2.282	0.335	808957.	3.517	1.220	778026.
6	3.523	0.646	1178647.	2.086	0.411	1007929.	3.283	1.256	844104.
7	3.290	0.604	1185590.	2.130	0.280	1815717.	3.521	1.188	1260485.
8	3.364	0.589	908052.	2.055	0.325	758308.	3.378	1.204	619728.
9	3.356	0.658	925927.	2.587	0.272	668626.	3.752	1.061	741787.
10	3.242	0.516	827839.	2.560	0.353	826082.	3.598	1.120	770495.
11	3.256	0.555	1031473.	2.093	0.392	1335293.	3.336	1.216	1023152.
12	3.622	0.452	1083730.	2.185	0.332	779403.	3.487	1.158	731190.
13	3.411	0.659	1038723	2.500	0.320	795342.	3.565	1.117	766504.
14	3.148	0.546	1299267.	2.285	0.401	1603539.	3.490	1.193	1509130.
15	3.490	0.760	1039056.	2.228	0.233	1032847.	3.628	1.031	851207.
Mean	3.367	0.578	1081521.	2.254	0.348	1115626.	3.478	1.174	965017.
Coefficient of Variability[b/]	.172		.165	.154		.342	.338		.300
Highest Value	3.622	0.760	1504978.	2.587	0.429	1815717.	3.752	1.293	1509130.
Lowest Value	3.148	0.421	827839.	2.055	0.233	668626.	3.283	1.031	619728.
Average No. of liquidations to meet consumption expenditures			0			0			0

a/ See footnote following Table 4.3.

b/ See footnote following Table 4.1.

that through the production and reinvestment of surplus income, the balanced portfolio is transformed into a super-growth portfolio.

Furthermore, only part of each year's surplus income is reinvested. In this study, eighty percent is reinvested and the remaining twenty percent disappears as nonessential consumption expenditures when incomes are high. In comparing the real estate strategies in Table 4.9, keep in mind that the 'keep the farm' strategy yields more surplus income and therefore loses part of its growth potential in contributing to a higher standard of living than the 'sell the farm' strategy. Comparing these two portfolios also gives an individual an opportunity to reveal the nature of his risk preference function, as the nonfarm growth portfolio generates a slightly higher but less certain ending estate value.

Regardless of the real estate strategy selected, it is clear that (1) profit maximizing large farmers should concentrate their nonfarm investments in growth assets and (2) profit maximization depends nearly as much on managing surplus income as it does on managing the initial allocation of investments. The discussion of tax and estate management implications will shed a great deal of light on the desirability of alternative real estate strategies in large farm situations. In the last two case farms discussed, we have seen that moderate and large size operators can accumulate a very sizable estate to be taxed and transferred to the next generation. As estates grow larger, it becomes more and more important to evaluate means of reducing the inheritance tax to maximize the net value of the assets passed to the heirs. Certain investment strategies offer more flexibility in estate planning and tax management, and these issues are treated below.

4.4 Adjusting the Ending Estate Values to Account for Estate Settlement Costs

The Retirement Investment Simulator does not estimate estate settlement costs. To estimate after tax estates exogenously, preliminary simulations were made to ascertain the values of the portfolios at the time of the death events. Estate settlement costs were estimated for both husband and wife, and were then forced into the model in the appropriate years. In secondary simulations, the model liquidated assets to meet estate settlement costs for the husband, continued the simulation with the after tax portfolio until the death of the wife, then liquidated again to meet her estate settlement costs. All taxes were calculated based on the assumption that assets are owned by the husband and passed to the wife at his death in year seventeen, and then to the children at her death in year twenty. Different will strategies could be used to reduce taxes in the situations with large estates (Roush, 1975; Boehlje, 1972), but the assumed will strategy was held constant for simplicity and ease of comparison.

The process of calculating estate settlement costs was very time consuming, and the computing costs of the secondary simulations considerable. In the interests of economy and expediency, a functional relationship was estimated between ending net worth before estate settlement and ending net worth after estate settlement in order that after tax estate values could be estimated with smaller amounts of hand calculations and lower computing costs. For twenty-one estates ranging in value from $100,000 to $1,300,000, portfolio values after estate settlement costs were hand calculated using the will strategy and timing of death events described above.

Various functional forms were estimated to the data, and the two which are of greatest interest are the linear function (equation 4.1) and the power function (equation 4.2). The numbers in parentheses are the standard errors of the coefficients above them. In both equations, A represents the ending net worth after estate settlement costs and B the ending net worth before estate settlement costs. The linear function is reported because it allows the reader to easily visualize the relationship, but in making the actual estimates, the power function was used because it reflects an increasing marginal rate of taxation.

$$(4.1)\quad A = \underset{(4804)}{46583} + \underset{(.0083)}{.601}(B) \qquad \text{R Square} = .996$$

$$(4.2)\quad A = \underset{(1.104)}{5.069} \times B^{\underset{(.0077)}{.85041}} \qquad \text{R Square} = .998$$

Table 4.10 summarizes the mean levels of ending estates in the eight strategies applied to case farm one. The first row of the table is taken directly from Tables 4.1, 4.2 and 4.3, and the second row presents estimates of the ending estate values after paying state and federal inheritance taxes, legal or administrative fees and funeral expenses for both death events. In studying Table 4.10, we see the amount of the reduction in portfolio values that can be expected when considering estate settlement costs. No new relationships are seen in Table 4.10; to gain much insight into the effects of estate taxes, we must consider ways of reducing them.

4.5 The Effects of Gift-Making on the Value of Assets Passed to Heirs

When the capital base is larger than it needs to be to produce an adequate income for the retired couple, there can be tax incentives for

Table 4.10 Success of Selected Strategies in Passing Assets to the Next Generation, Small Crop Farm

	Income Portfolio of Nonfarm Investments[a]			Balanced Portfolio of Nonfarm Investments[a]		Growth Portfolio of Nonfarm Investments[a]		
	Keep the Farm Real Estate	Sell the Farm for Cash	Sell the Farm on an Installment Arrangement	Keep the Farm Real Estate	Sell the Farm for Cash	Keep the Farm Real Estate	Sell the Farm for Cash	Sell the Farm on an Installment Arrangement
Ending Net Worth Before Estate Settlement	147090	78450	82020	213609	145377	188746	159814	122513
Ending Net Worth After Estate Settlement = Assets Successfully passed to heirs	125692[b]	73326	76511	172985[b]	124237	155642[b]	135085	108013

[a] For a description of the composition of the nonfarm portfolios, see footnotes following Tables 4.1, 4.2 and 4.3.

[b] Of this amount, approximately $60,000 is accounted for by the value of farm real estate.

making gifts to the heirs in retirement. By making gifts, the size of the retirees' portfolio is reduced and so is the tax burden when the estate is settled. Substantial amounts can be given away in lump sums and in smaller annual amounts without incurring any gift tax. In addition, gifts made above the tax free levels are taxed at a lower rate than assets passed through an estate. Harl (1974) and Maynard (1975) analyze gift and estate tax implications and opportunities in detail. Tax laws themselves will not be explained here, but the economic implications of making gifts at their tax free limits have been studied for the two larger case farms.

In the smallest case farm, the capital base is near the lower boundary of the range that is adequate to produce retirement income at the assumed level. Recall that when investments were made in assets with low income returns, several liquidations were necessary to meet consumption needs. For this reason, no gift-making strategies were tested on the limited resource case farm.

The second and third case farms were found to have portfolios large enough to produce substantial amounts of surplus income. The surplus income was accumulated in the portfolio and contributed to sizable tax bills at the death of each individual. For these farms, certain gift strategies were adopted for each real estate strategy, simulations were made forcing assets out of the portfolio as gifts, and the after tax ending estates were reestimated. The value of assets received by the heirs under the gift strategies is the sum of (1) the compounded value of gifts made and (2) the ending net worth after estate settlement. This sum can be compared with the ending net worth after estate settlement under the strategies not using gifts as an estate planning tool. The results of this analysis point out previously unmentioned advantages to selling the farm real estate when portfolio values are large.

Before elaborating on those results, however, the methods used to make gifts and to measure the value of gifts received merit discussion. Constraints on the amounts of gifts that can be made come from two origins: (1) the legal tax free limits,[3/] and (2) the amount of liquid (non real estate) assets in the portfolio. In strategies involving retention of the farm real estate, the second constraint is usually the limiting one. With a large part of the capital base tied up in land, little is available for gift-making; in each 'keep the farm' strategy, all nonfarm assets are given away in lump sum (an amount below the tax free limit) at the beginning of the planning horizon. Over the horizon, surplus income is retained and reinvested to eventually pay inheritance taxes. In each 'sell the farm for cash' strategy, gifts are made at the tax free limits until the portfolio is reduced to a size that has been deemed capable of producing an adequate but not excessive income. Under each 'sell the farm by installment' strategy, the amounts of the annual gifts are equal to the installment contract payment received less the capital gain tax due on that payment. This, in effect, is a method of giving the value of the farm to the heirs on a gradual basis to avoid gift taxes, and could be an arrangement used to pass the farm property itself as a gift from father to son. Under such a plan, the farm property can be kept in the family, gift taxes avoided and estate taxes

---

[3/] This is an arbitrary constraint imposed in this analysis. Boehlje (1972) has demonstrated that under certain circumstances it can be advisable to make gifts even above the tax free limits.

greatly reduced when compared to passing the property to the son through the estate. Passing the farm through the estate does have the desirable effect of adjusting the tax basis to present market value without paying capital gain tax (Harl, 1974). However, the simulation analysis demonstrates that, in the two case farms studied, this was more than offset by reduced estate taxes in the 'installment contract - farm gift ' strategy.

The value of the gifts received was implicitly compounded foreward to the date of final estate settlement by assuming that the gifts were made in the form of the assets themselves (not the proceeds from the sale of the assets) and that the children held those assets in the given form over the length of the planning horizon. The compounded value of the gifts in this even is the difference between the ending estate under the gift strategy and the ending estate under the no-gift strategy, both measured before estate settlement costs. This approach avoids the difficulty of choosing a compounding rate.

Tables 4.11 and 4.12 report the results of the analysis of gift strategies for the two largest case farms. Note that in both case farms, under the income portfolio and balanced portfolio options, making gifts raised the net value of assets successfully passed to the next generation. However, it did not change the relative financial desirability of keeping or selling the farm real estate.

Recall that we have previously established the growth portfolio to be the profit maximizing strategy in the two large farm situations. Using a growth portfolio and no gifts, it is unclear which real estate strategy is superior without knowledge of the individual's risk preference function. When making gifts, however, a clear disadvantage is

Table 4.11 Success of Selected Strategies in Passing Assets to the Next Generation, Large Crop Farm

	Income Portfolio of Nonfarm Investments[a]			Balanced Portfolio of Nonfarm Investments[a]		Growth Portfolio of Nonfarm Investments[a]		
	Keep the Farm Real Estate	Sell the Farm for Cash	Sell the Farm on an Installment Arrangement	Keep the Farm Real Estate	Sell the Farm for Cash	Keep the Farm Real Estate	Sell the Farm for Cash	Sell the Farm on an Installment Arrangement
Part I: Without Making Gifts								
Ending Net Worth Before Estate Settlement	565962	300799	347898	696803	489236	716531	662142	630736
Ending Net Worth After Estate Settlement = Assets Successfully passed to heirs	395572	231206	261569	472191	349316	483689	451949	433887
Part II: Making Gifts								
A. Ending Net Worth Before Estate Settlement	462111	95900	91180	496536	181591	520402	144871	135690
B. Ending Net Worth After Estate Settlement	332844	87487	83597	354170	150726	368061	124237	117648
C. Compounded Value of Tax Free Gifts to Heirs	103851	204899	256718	200267	307645	196129	517271	495046
Total of B and C = Assets Successfully Passed to heirs	436695[b]	292386	340315	554437[b]	458371	564190[b]	641508	612694

[a] For a description of the composition of the nonfarm portfolios, see footnotes following Tables 4.1, 4.2, and 4.3

[b] Of this amount, approximately $298,000 is accounted for by the value of the farm real estate.

Table 4.12 Success of Selected Strategies in Passing Assets to the Next Generation, Large Crop Farm

	Income Portfolio of Nonfarm Investments[a]			Balanced Portfolio of Nonfarm Investments[a]		Growth Portfolio of Nonfarm Investments[a]		
	Keep the Farm Real Estate	Sell the Farm for Cash	Sell the Farm on an Installment Arrangement	Keep the Farm Real Estate	Sell the Farm for Cash	Keep the Farm Real Estate	Sell the Farm for Cash	Sell the Farm on an Installment Arrangement
<u>Part I: Making No Gifts</u>								
Ending Net Worth Before Estate Settlement	827301	498866	530950	1122996	837451	1081521	1115626	965017
Ending Net Worth After Estate Settlement = Assets Successfully passed to heirs	546110	355382	374672	708399	551720	686344	704642	622696
<u>Part II: Making Gifts</u>								
A. Ending Net Worth Before Estate Settlement	663056	121254	215968	792964	235205	762374	178124	335925
B. Ending Net Worth After Estate Settlement	452530	106518	174359	526957	187319	509386	147904	253879
C. Compounded Value of Tax Free Gifts to Heirs	164245	377612	314982	330032	602246	319138	937502	629092
Total of B and C = Assets Successfully Passed to heirs	616775[b]	484130	489341	856989[b]	789565	828524[b]	1085406	882971

[a] For a description of the nonfarm portfolios, see footnotes following Tables 4.1, 4.2 and 4.3.

[b] Of this amount, approximately $443,000 is accounted for by the value of farm real estate.

seen in retaining the farm real estate, because the large farm investment is not easily passed by gift. If the motivations for keeping the farm real estate are to pass it to the next generation, then a good strategy is to sell the farm to the heir on an installment basis and then make gifts of the installment contract payments.

This analysis has centered on the values of ending estates in inflated dollars. Deflating or discounting ending estate values helps us to see what happens to the real purchasing power of a family's wealth under different strategies. Table 4.13 displays the values of assets successfully passed to heirs discounted over the twenty year horizon at the assumed six percent inflation rate. Note that every strategy simulated for the small renter resulted in an erosion of the real value of the family's wealth. In the small crop farm and large crop farm situations, the real value of the family's wealth could be increased only by using some combination of farm real estate, growth nonfarm investments and an estate management strategy involving gifts to the heirs.

In summary, it has been demonstrated that in most cases farm real estate has the potential of performing better as an investment than any other portfolio considered in this analysis. When the total capital base is large enough to produce an adequate income, the greatest financial rewards can be obtained by concentrating any nonfarm investments in a growth portfolio. In the smallest case farm studied, some investment in income producing nonfarm assets is desirable to avoid frequent asset liquidations and to maximize ending net worth. In all but the limited resource situation, there are economic benefits from making gifts to the heirs in retirement, and the retention of farm real estate

Table 4.13 Discounted Values of Assets Successfully Passed to the Next Generation

	Income Portfolio of Nonfarm Investments[b]			Balanced Portfolio of Nonfarm Investments[b]		Growth Portfolio of Nonfarm Investments[b]		
	Keep the Farm Real Estate	Sell the Farm for Cash	Sell the Farm on an Installment Arrangement	Keep the Farm Real Estate	Sell the Farm for Cash	Keep the Farm Real Estate	Sell the Farm for Cash	Sell the Farm on an Installment Arrangement
Small Renter (initial equity capital = $68,000)								
Without Making Gifts	39191	22863	23857	53938	38738	48530	42120	33679
Small Crop Farm (initial equity capital = $145,800)								
Without Making Gifts	123341	72091	81559	147240	108919	150820	140920	135288
Making Gifts	136164	91167	106112	172876	142906	175917	200026	191041
Large Crop Farm (initial equity capital = $217,500)								
Without Making Gifts	170280	110810	116825	220883	172029	214006	219711	194160
Making Gifts	192314	150954	152579	267214	246191	258338	338435	275315

[a] The assumed discount rate is the same as the inflation rate used in the simulation analysis: 6%.

[b] For a description of the composition of the nonfarm portfolios, see footnotes following Tables 4.1, 4.2 and 4.3.

as an investment carries the disadvantage of limiting the ability to make gifts and to thereby reduce estate tax burdens.

CHAPTER V

SUMMARY, CONCLUSIONS AND IMPLICATIONS FOR FUTURE RESEARCH

5.1 Summary of the Research Effort

The research reported in this volume has dealt with the investment problems and opportunities of farm operators at the time of their retirement. Previous studies in this same problem area have described the needs and characteristics of older farmers and the alternative investments available to them (Lee and Brake, 1971), and have proposed a model which ascertains the profit maximizing combination of farm and nonfarm investments for retiring farmers (Brucker, Baker and Erickson, 1975). The contributions of this research to a more complete understanding of the problem are in two areas. First, we have initiated the development of a stochastic simulation model which is potentially capable of evaluating the economic consequences of adopting any chosen retirement investment and estate management strategy. The simulation model is currently in a stage of development which allows an analysis of the performance of investment strategies in producing income for the retired couple and in preserving or enlarging the value of the before tax estate. The second contribution of this research comes from an application of the simulation model in evaluating the performance of a range of alternative investment strategies in three case farm situations.

For each of the three case farms, three methods of handling the farm real estate have been analyzed: (1) keep the farm real estate as an investment and rent it to a younger operator, (2) sell the farm for cash and invest the proceeds in nonfarm assets immediately, and (3) sell the farm on an installment land contract and gradually invest the proceeds in nonfarm assets. For each real estate strategy, three types of nonfarm asset portfolios have been considered: (1) a nonfarm portfolio consisting of assets producing high current income returns and low capital growth rates, (2) a balanced nonfarm portfolio in which investments are distributed evenly among the six classes of market securities embodied in the simulation model, and (3) a portfolio of nonfarm investments consisting of assets producing low current income returns and high capital growth rates. For the two largest case farms, strategies which use gifts to potential heirs as a means of reducing inheritance tax burdens have been tested.

In concentrating on nontax issues, there has admittedly been extensive oversimplification and even neglect of important tax issues. Indeed the critical observer will note that in every instance taxes have been treated as an externality in the model used in this analysis. Sound economic interpretation and continued development and use of the simulation model can do a great deal to link the product of this research with the vast and growing body of knowledge regarding the intricacies of tax management.

It has not been the objective of this research to analyze the merits of tax sheltered or tax deferred retirement saving plans for the self-employed. There has been a failure to consistently report more than very low levels of participation in these plans by farmers (Levi, 1974). A very timely piece of work by Wright and Acker (1975) has demonstrated that in fact these types of plans are of value to farmers only under very atypical conditions. In most cases farm families can earn greater after tax returns by investing surplus funds in the farm business than by establishing a tax sheltered or tax deferred saving plan. This study has been designed to aid the farm family which has accumulated virtually all its capital in the farm business and is ready to consider alternative investment strategies for their iminent retirement.

The outcomes of the selected investment strategies imply that the most profitable course of action for a retired farmer is determined by the size of his capital base in relation to his income need, and by his desire or ability to participate in estate management schemes which pass assets to his potential heirs before he and his wife die. Moreover, retirement planning presents an interesting multiple goals situation in which the individual's multidimensional utility function may dictate that the strategy deemed most desirable by the decision maker be something other than the profit maximizing strategy. The results of this simulation analysis allow the reader to estimate the monetary opportunity cost associated with the adoption of a strategy which is not profit maximizing.

5.2 Implications Drawn from the Simulation Analysis

Conventional wisdom has been that retiring farmers are better off to sell their farm assets and invest the proceeds conservatively, usually in assets which produce a high level of income return and a low rate of capital growth (Smith, 1971) (Lee and Brake, 1971). Using the rates of return and variability estimates observed over the fourteen year period from 1959 to 1972, this simulation analysis has demonstrated that in many cases this is the least profitable strategy that a retiring farmer could adopt. In every instance, the most profitable strategy involved a portfolio containing farm real estate and/or a set of nonfarm investments which contained a substantial amount of assets which returned high capital growth rates and low levels of current income. In the smallest case farm (initial net worth of $68,000) there is a clear advantage in keeping the farm real estate regardless of the nonfarm investments considered, and some amount of investment in income-producing nonfarm assets is more profitable than complete concentration in growth assets. In the moderately sized case farm (initial net worth of $145,800), the most profitable strategies are to keep the farm real estate and concentrate nonfarm investments in growth assets. In the largest case farm (initial net worth of $217,500), the economic performance of the strategy involving farm sale and investment in growth assets is apparently equivalent to that of the strategy involving keeping the farm and investing surplus capital in growth assets. However, when considering estate management (gift) schemes, the added flexibility which characterizes the farm sale alternatives makes them more attractive than maintaining the large fixed investment in real estate.

In evaluating the results of this study, it becomes clear that certain strategies are more suited to the achievement of specific goals. The discussion to this point has centered on monetary rewards for certain courses of action; we now consider alternative goals. A retiring farm couple may desire to leave the farm and move to live in a warmer climate or to be nearer to children who have left the homestead. This desire can of course be filled while retaining the farm investment; it might require that some professional management service be employed to oversee the tenant operated farm property in the absence of the landowner. The management fee would reduce the financial return to land ownership, but if the farm is small (under $150,000) owning land may still be the best strategy from an economic standpoint. Should the small farmer wish to sell the farm when he moves away, the best portfolio for him could be one which has enough income producing assets to meet his annual needs and which places all remaining capital and surplus income in growth assets. Concentrating only in income type assets can lock him out of a very profitable opportunity in growth investments. If the capital base is large, there are financial incentives to sell the farm and invest in growth type assets, particularly if gifts can be made to potential heirs in order to reduce estate tax burdens. With a large capital base, even a portfolio of growth type assets can provide an adequate income given the level of social security benefits assumed in this analysis.

If the retiring couple has a strong desire to live on the farm in retirement, the results of this analysis demonstrate that they can do so and usually profit from it. Under none of the simulated strategies was a nonfarm portfolio able to clearly outperform a portfolio containing farm real estate. When the farm investment is large, however, it should be recognized that keeping it can lead to inflexibility in estate planning and substantial tax losses due to state and federal estate tax structures which limit the size of the estate which can be passed to the next generation free of tax.

Establishing a younger family member in farming is another nonmonetary goal frequently perceived to be held by retiring farmers. If land holdings are small, the retiring couple is not in a position to be overly generous in giving ownership of the farm real estate to the heir before their death. Perhaps the best strategy for providing both income security and tax minimization is to rent the land to the heir and pass the farm through the estate at the time of death. In this way, some estate tax will be incurred, but the tax basis will be adjusted at the time of the transfer without paying capital gain tax. If land holdings are in excess of $100,000 then estate tax management can become a problem and the strategy which is least damaged by taxation can be one involving gifts to the heirs.

Selling the farm to the younger family member on an installment arrangement and then making gifts of the installment payments can serve the dual purpose of reducing estate taxes and transferring control of the farm property to the younger generation on very quick and easy terms. It is interesting to note that this appears to be the only efficient use (from the seller's standpoint) to which the installment land contract can be put. When the farm is small, the retiring couple cannot afford to sell it because of the reduction in size of the income producing capital base resulting from capital gain tax. When the farm is large enough for the family to consider selling it, then the best strategy is to sell for cash and reinvest in growth type assets. The benefits derived from a speedy transfer of capital to growth assets outweigh the potential benefits from the lower tax rates incurred in an installment sale. The installment land contract simply provides a method of making easy credit terms for a younger family member desiring to take over the family farming operation.

The findings of this research are quite radical in view of the types of strategies which have been advocated by the authors of previous reports (Smith, 1971) (Lee and Brake, 1971). The reasons for this divergence are rooted primarily in the changing economic setting which we find ourselves in. Lee and Brake based their description of asset performance on historical data for the period 1955 to 1968. The data base for this analysis was the period from 1959 through 1972. Since 1968, when Brake and Lee's data base ended, the performance of farm real estate as an investment has improved, particularly with respect to price appreciation. In addition, the recent performance of market securities has been considerably less desirable than in the period of economic growth experienced in the 1960's (see Table 2.3). The addition of the last several years to the data base has been largely responsible for the difference in the conclusions drawn from this research and those drawn by Lee and Brake.

The result of our simulation analysis can be used to ascertain the best strategy for a farmer who retired in the 1950's. Applying the same recommendations to farmers retiring in 1975 necessitates the assumption that the mean levels and the variabilities in performance of the selected assets over the next two decades remain as they were over the last two decades. Our findings should be interpreted in light of the reader's perceptions about future economic conditions as compared to our assumptions about them. The mean levels of returns and the variability estimates used in this research are derived from historical data series of general market performance of the investment classes. It should be recognized that individual investors cannot achieve a degree of diversification which would yield the mean levels of return and variability characteristics exhibited by the market averages. Individual market securities are likely to exhibit greater variability of return than market averages; locally severe weather or crop disease can cause returns to individual tracts of farm land to be more variable than aggregate data indicate.

Without doubt, a much better method of incorporating an individual's own perceptions into the recommendation of a course of action is to make it possible for him to perform his own analysis with the degree of sophistication afforded by computer technology. Extending the capabilities of the Retirement Investment Simulator to allow the analysis of tax management and estate planning strategies, and making an improved version available to the public in an extension setting can accomplish this end.

5.3 Limitations and Suggestions for Further Research

The shortcomings of this analysis are easily and logically expressed in a discussion of the needs for future research efforts. The needed extensions and improvements on this analysis can be divided into two classifications: (1) modifications of the simulation model, and (2) extended economic analysis in suggesting model inputs for individual users.

Estate taxes are currently handled exogenous to the model, and their incorporation into the model should be an issue of the highest priority. The methods used in this study to estimate estate settlement costs (see Chapter IV) are extremely laborious and severely limit the assumptions regarding how the estate is handled. Adding estate tax calculation capabilities to the model can be accomplished by writing a set of subroutines to handle the appropriate tax issues. Roush (1976) is currently building an estate planning model which includes estate tax calculation subroutines, and these could indicate the general form of the subroutines needed in the simulation model. The programming problem nonetheless remains sizeable, and the methods used in this study to estimate taxes exogenously suggest a more efficient way of programming the tax estimation feature.

Using the Roush model, estate settlement costs can be calculated for a series of estates of various sizes under different strategies of estate management. For each will strategy, one general function can be statistically estimated to predict estate settlement costs. (Possibly two functions will be needed: one for the first death event and one for the second.) This series of equations, each representing a different will strategy, can be added to the model and used to reduce the portfolio value by the amount of the estimated estate settlement cost at each death event. This approach can accomplish the desired objective of incorporating estate settlement costs with a smaller initial programming input and in a computationally efficient manner.

The current version of the simulator does not consider all transaction costs at the time of asset liquidation. Transaction costs at the time of retirement can be considered exogenously by adjusting the initial investment levels, and reinvestment costs can be implicitly considered by adjusting the marginal propensity to invest out of surplus income. Capital gain tax can be included if the farm real estate is sold in mid-horizon, but liquidation costs for all other assets are ignored. Incorporating them would be a rather simple programming task. Considering transaction costs would make nonfarm portfolios in which there are several liquidations look less desirable, and this can be expected to occur when the capital base is small and large amounts of growth assets are used.

Three other minor programming changes could enhance the model and make the interpretation of performance easier. In this analysis, we were unable to evaluate the installment land contract under a balanced portfolio because reinvestment of surplus income or recaptured capital can only take place in one asset. A reinvestment subroutine could be written with the capability of spreading reinvestments among several assets.

In this analysis, relative variability was evaluated using coefficients of variability (the standard deviation divided by the mean), but these measures had to be calculated exogenously. This calculation could easily be incorporated into the model. In the same way, the value of the after tax ending estates could be discounted to present value based on the user's specified inflation rates. This would allow him to see what happens to the real purchasing power of his wealth over the planning horizon.

As previously mentioned, further economic analysis is required in order to allow the suggestion of appropriate model inputs for the individual user. The data base from which the mean levels of return and the covariance matrix are derived should be updated as new information becomes available. The matrix factoring program developed in this project and needed in the preparation of input for the correlation program should make this job unavoidably easy (see Appendix B).

A more sophisticated type of economic analysis currently being attempted by Shouse (1975) involves identifying the efficient portfolios of nonfarm investments to be compared with the retention of farm real estate investments. Exercising Markowitz's quadratic programming techniques on the data base developed and used in this research, Shouse intends to describe the efficient set of portfolios which minimize risk (variability) at each attainable level of return. This work is completely complimentary with the use of the simulation model. As the technique is mastered, the estimation of the efficient set can be performed each time the data base for the correlation program is updated.

As this phase of the development of the Retirement Investment Simulator comes to conclusion, research priorities should be directed toward making the model more complete and more applicable to use by individuals in an extension setting. The characteristics of individual planning situations are likely to be quite diverse, and only subtle changes in parameters are likely to be needed to change the recommendations made to the individual. The conclusions and recommendations drawn from the simulation analysis embodied in this research effort cannot be universally applied to all retiring farm families. The greatest value can accrue to the largest number of people by making the planning tool itself available to the individual retiring farmer.

REFERENCES

Baumol, William J. "Portfolio Theory: The Selection of Asset Combinations." Mimeographed. Morristown, N. Y.: General Learning Press, 1970.

Boehlje, Michael D. "The Entry-Growth-Exit Process in Agriculture." Southern Journal of Agricultural Economics, No. 1 (1973), pp. 23-36.

_______________. "Strategies for the Creation and Transfer of the Farm Estate." American Journal of Agricultural Economics. 54(1972): 461-472.

Brackett, J. C. "Urban Family Budgets Updated to Autumn 1972." Monthly Labor Review, No. 8 (1973), pp. 70-76.

Brucker, M. H., C. B. Baker and D. E. Erickson. Planning Retirement from Farming: A Computer-Assisted Method for Low-Income Farmers. University of Illinois, College of Agriculture, Special Publication 34, 1975.

Clements, Alvin M., Harry P. Mapp, Jr. and Vernon R. Eidman. A Procedure for Correlating Events in Farm Firm Simulation Models. Oklahoma Agricultural Experiment Station Technical Bulletin T-131, August, 1971.

Cohen, Jerome B., Edward Zinbarg and Arthur Zeikel. Investment Analysis and Portfolio Management. Homewood, Illinois: Dow Jones-Irwin, Inc., 1973.

Cohen, Kalman J. and Jerry A. Pogue. "An Empirical Evaluation of Alternative Portfolio Selection Models." Journal of Business. 40(1967):166-193.

Engel, Louis. How to Buy Stocks. New York: Bantam Books, 1962.

Fisher, Irvin. The Theory of Interest. New York: Kelley and Milliman, 1954.

Gedney, F. S. "Retired Couples' Budgets Updated to Autumn, 1972." Monthly Labor Review, No. 10 (1972), pp. 45-50.

Harl, Neil E. Farm Estate and Business Planning. Skokie, IL: Agri. Business Publications, 1974.

___________. "Retirement Strategy During Inflation." Agri. Finance, January-February, 1975, pp. 27-29.

Hirshleifer, J. "On the Theory of the Optimal Investment Decision." Journal of Political Economy. 66(1958):329-352.

Johnson, G. Farmland Tenure Patterns in the United States. USDA ERS Agri. Econ. Report 249, 1974.

Lee, Warren F. and John R. Brake. Conversion of Farm Assets for Retirement Purposes. Michigan Agri. Exp. Station Research Report 129, January, 1971.

Levi, Donald. Keogh Retirement Plan Participation and Investment Choices by Farmers. Texas Agri. Exp. Station Technical Article TA 11448, 1974.

Markowitz, Harry M. "Portfolio Selection." Journal of Finance. 3(1952):77-91.

________________. Portfolio Selection: Efficient Diversification of Investments. New York: Wiley and Sons, Inc., 1959.

Maynard, C. D. and M. D. Boehlje. Retirement Planning for Farmers. Dept. of Agri. Econ. Circular E-817, Oklahoma State University, 1973.

Maynard, Cecil D. and Glenn E. Laughlin. "The New Oklahoma Gift Tax Law and Its Implications." OSU Current Report, Oklahoma State University, No. 706, 1970.

Miller, Leonard F. "Investing the Family's Savings." OSU Extension Facts. Oklahoma State University. No. 705, 1970, a.

________________. "Mutual Funds." OSU Extension Facts. Oklahoma State University. No. 706, 1970, b.

Motley, B. and S. A. Morley. "The Optimum Lifetime Distribution of Consumption Expenditures: Comment." American Economic Review. 60(1970):738-743.

Newman, Joseph. Plan Your Retirement Now. Washington, D. C.: U. S. News and World Report, 1974.

______________. Stocks, Bonds and Mutual Funds. Washington, D. C.: U. S. News and World Report, 1973.

Roush, Clint E. Forthcoming Ph.D. Thesis (untitled), Oklahoma State University, 1976.

Sharpe, William F. "A Simplified Model for Portfolio Analysis." Management Science. 9(1963):277-293.

Shouse, James C. "Efficient Portfolios of Nonfarm Investments for Retiring Farmers." Dept. of Agri. Econ. Unpublished paper, Oklahoma State University, 1975.

Smith, Robert S. Farmers and Retirement. Dept. of Agri. Econ. Information Bulletin 5, Cornell University, 1971.

Suter, Robert C. "Alternative Payment Plans for Installment Land Contracts and Farm Mortgages." Economic and Marketing Information for Indiana Farmers. Purdue University, May, 1971, a.

_______________. "The Installment Land Contract: Legal Provisions and Economic Implications." Economic and Marketing Information for Indiana Farmers. Purdue University, June, 1971, b.

Thurow, L. C. "The Optimum Lifetime Distribution of Consumption Expenditures." American Economic Review. 59(1969):324-330.

Tobin, James. "The Theory of Portfolio Selection." The Theory of Interest Rates. ed. F. Hahn and F. Brechling, pp. 3-50. New York: McMillan, 1965.

U. S. Dept. of Health, Education and Welfare, Social Security Administration. Estimating Your Social Security Retirement Check. DHEW Publication No. (SSA) 74-10047, February, 1974.

Wright, Paul L. and Darrell L. Acker. "An Economic Analysis of Tax-Sheltered Retirement Plans." Dept. of Agri. Econ. Unpublished paper. Ohio State University, May, 1975.

APPENDIX A

SAMPLE INPUT AND SAMPLE OUTPUT FOR THE RETIREMENT INVESTMENT SIMULATOR

Pages 99 through 102 present a copy of the Decision Form for the Retirement Investment Simulator, and pages 103 through 110 display the types of output tables produced by the model. The first two output tables appear once in every run of the model. The output tables on pages 105, 109 and 110 appear once for the short horizon and once for the long horizon. Tables on pages 106, 107 and 108 appear once for every replication of the simulation and are repeated in the same general form to report the performance of the strategy assuming the longer planning horizon.

DECISION FORM
for the
RETIREMENT INVESTMENT SIMULATOR

Name ____
First   Last

____
Wife's first name

Address ____

____

A Description of this Strategy ______________________________

____

****

Part I

ESTIMATING THE NEED FOR INVESTMENT INCOME

1. Budget of consumption expenditures in year 1 $___________

	Husband	Wife
2. Annual income from private pensions	$ ______	$ ______
3. Will private pension benefits (1) be constant over the period, or (2) change to keep pace with inflation (circle one for both husband and wife)	1 2	1 2
4. Annual Social Security income	$ ______	$ ______
5. Do the wife's Social Security benefits (1) come as a result of her work outside the home, or (2) does she receive benefits as a dependent of the husband? (circle one)		1 2

	Husband	Wife
6. Costs of estate settlement (Excluding Taxes and Administrative Costs)	$ ______	$ ______
7. Life insurance coverage	$ ______	$ ______

	Husband	Wife
8. Length of the short planning horizon	______yrs.	______yrs.
9. Length of the long planning horizon	______yrs.	______yrs.

10. Percent reduction in consumption expenditures when one individual dies. __________%

11. Rates of inflation expected over the planning period.

yr 1 _____% yr 2______ yr 3______ yr 4______ yr 5 ______

yr 6-10 ______ yr 11-15 ______ yr 16-20 ______ yr 21-25 ______

yr 26-50______

Part II

ALTERNATIVE INVESTMENTS

1. Installment Land Contract
   a. Payment Plan (circle one)

      level payments... 1

      decreasing payments... 2

      delayed principal payments... 3

   b. Downpayment $________

   c. Principal to be paid in installments $________

   d. Balloon payment $________

   e. Rate of interest paid on outstanding principal ________%

   f. Term or number of years over which contract payments are made ________yrs

   g. If using payment plan 3 (above), number of years over which no principal payments are made ________yrs

2. Purchased Annuity
   a. Amount invested in an annuity $________

   b. Cost per $10 of monthly income $________

   c. Will the plan cover the lives of both husband and wife (circle one)

      yes 1

      no 2

3. Other Investments

	1	2	3	4	5	6	7	8
	Farm Real Estate	Corporate Stocks which feature high Dividends	Corporate Stocks which feature high Capital Growth Rates	Mutual Funds which feature high Current Income	Mutual Funds which feature high Capital Growth Rates	Long Term Bonds	Short Term Bonds	Bank Savings Account
Average annual income returns... rents, interest, dividents, etc... which will be available for consumption.	____% (3.83)	____% (4.21)	____% (3.09)	____% (4.41)	____% (1.39)	____% (8.00)	____% (6.00)	____% (4.00)
Average annual rate of capital growth... price appreciation, increased market value, etc... which can only be used for consumption expenditures if the asset is sold.	____% (5.98)	____% (1.88)	____% (5.48)	____% (3.13)	____% (12.39)	____% (-2.69)	____% (-0.50)	XXX
The amount to be invested in each asset.	$____	$____	$____	$____	$____	$____	$____	$____
The lowest level to which each asset can be liquidated.	$____	$____	$____	$____	$____	$____	$____	$____
The order in which the assets should be liquidated	____	____	____	____	____	____	____	XXX
The amount of each liquidation	$____	$____	$____	$____	$____	$____	$____	XXX

If current income exceeds consumption expenditures in any single year, ______% of the excess should be added to the Bank Savings Account. If the savings account ever exceeds $_______, then $_______ should be withdrawn and invested in asset number _______.

If it becomes necessary to sell the farm for cash sometime in the future, _______% of the value of the farm will be spent on taxes and transfer costs at the time of the sale.

4. Other income (+) or expense (-)

Year 1	$ ________	26	________
2	________	27	________
3	________	28	________
4	________	29	________
5	________	30	________
6	________	31	________
7	________	32	________
8	________	33	________
9	________	34	________
10	________	35	________
11	________	36	________
12	________	37	________
13	________	38	________
14	________	39	________
15	________	40	________
16	________	41	________
17	________	42	________
18	________	43	________
19	________	44	________
20	________	45	________
21	________	46	________
22	________	47	________
23	________	48	________
24	________	49	________
25	________	50	________

5. Number of replications desired ________

6. Do you request output tables which trace each asset's performance over the short horizon (circle one)
yes 1
no 2

7. Do you request output tables which trace each asset's performance over the long horizon (circle one)
yes 1
no 2

RETIREMENT INVESTMENT SIMULATOR

A RETIREMENT INVESTMENT PLAN FOR

JOHN AND JANE DOUGH

FARMLAND AND MUTUAL FUNDS

PREPARED BY

THE DEPARTMENT OF AGRICULTURAL ECONOMICS

OKLAHOMA STATE UNIVERSITY

ON THIS PAGE, THE COMPUTER HAS REPRODUCED THE INFORMATION WHICH YOU HAVE PROVIDED ON THE DECISION FORM. CHECK CLOSELY TO ENSURE THAT THERE HAVE BEEN NO ERRORS IN PROCESSING THE DATA.

PART 1: INCOME NEEDS

QUESTION NUMBER		YOUR INPUT								
1		8000.								
2		0.		0.						
3		1.		1.						
4		3000.		1500.						
5		2.								
6		3000.		3000.						
7		10000.		5000.						
8		17		20						
9		24		27						
10		40.								
11	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PART 2: ALTERNATIVE INVESTMENTS

QUESTION NUMBER	YOUR INPUT							
1	1.	0.	0.	0.	0.	0.	0	
2	0.	0.	1.					
3	3.83	4.21	3.09	4.41	1.39	8.00	6.00	4.00
	5.98	1.88	5.48	3.13	12.39	-2.69	-0.50	
	80000.	0.	0.	0.	15000.	0.	0.	5000.
	0.	0.	0.	0.	0.	0.	0.	1000.
	2.	3.	4.	5.	1.	6.	7.	0.
	999999.	1000.	1000.	1000.	1000.	1000.	1000.	0.
	80.	10000.	5000.	5				
	12.							
4	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.						
5	15.							
6	1.							
7	2.							

RETIREMENT INVESTMENT SIMULATOR

PROJECTING THE NEED FOR INVESTMENT INCOME

ASSUMING THE SHORTER PLANNING HORIZON

YEAR	CONSUMPTION EXPENDITURES	SOCIAL SECURITY BENEFITS	PRIVATE PENSION BENEFITS	RETIREMENT INCOME GAP
1	8000.	4500.	0.	3500.
2	8430.	4770.	0.	3710.
3	8989.	5056.	0.	3933.
4	9528.	5360.	0.	4169.
5	10100.	5681.	0.	4419.
6	10706.	6022.	0.	4684.
7	11348.	6383.	0.	4965.
8	12029.	6766.	0.	5263.
9	12751.	7172.	0.	5578.
10	13516.	7603.	0.	5913.
11	14327.	8059.	0.	6268.
12	15186.	8542.	0.	6644.
13	16097.	9055.	0.	7043.
14	17063.	9598.	0.	7465.
15	18087.	10174.	0.	7913.
16	19172.	10784.	0.	8388.
17	28401.	11431.	0.	16969.

IN YEAR 17 JOHN DIES. EXPENDITURES IN YEAR 17 INCLUDE THE ESTIMATED COST OF THE ESTATE SETTLEMENT.

BEGINNING IN YEAR 18 CONSUMPTION EXPENDITURES ARE REDUCED BY 40.% AND SOC.SEC. AND PRIVATE PENSIONS ARE ALSO REDUCED

18	12925.	8078.	0.	4847.
19	13701.	8563.	0.	5138.
20	24144.	9077.	0.	15067.

IN YEAR 20 JANE DIES. EXPENDITURES IN YEAR 20 INCLUDE THE ESTIMATED COST OF ESTATE SETTLEMENT.

INDIVIDUAL ASSET PERFORMANCE

SHORTER PLANNING HORIZON

	FARM REAL ESTATE		INCOME STOCKS		GROWTH STOCKS		INCOME MUTUAL FUNDS		GROWTH MUTUAL FUNDS	
YEAR	INCOME PRODUCED	VALUE	INCOME PRODUCED	VALUE	INCOME PRODUCED	VALUE	INCOME PRODUCED	VALUE	INCOME PRODUCED	VALUE
1	2572.	80000.	0.	0.	0.	0.	0.	0.	269.	15000.
2	2437.	82258.	0.	0.	0.	0.	0.	0.	224.	14040.
3	2680.	87213.	0.	0.	0.	0.	0.	0.	193.	18092.
4	3038.	89589.	0.	0.	0.	0.	0.	0.	316.	22485.
5	4127.	96071.	0.	0.	0.	0.	0.	0.	241.	22777.
6	3950.	102914.	0.	0.	0.	0.	0.	0.	515.	29232.
7	4029.	105299.	0.	0.	0.	0.	0.	0.	367.	31831.
8	4735.	113648.	0.	0.	0.	0.	0.	0.	296.	39864.
9	5377.	123051.	0.	0.	0.	0.	0.	0.	938.	49575.
10	6190.	126689.	0.	0.	0.	0.	0.	0.	678.	48478.
11	4190.	137028.	0.	0.	0.	0.	0.	0.	710.	59141.
12	6090.	141801.	0.	0.	0.	0.	0.	0.	1035.	66534.
13	4826.	150903.	0.	0.	0.	0.	0.	0.	877.	62579.
14	6242.	161420.	0.	0.	0.	0.	0.	0.	1079.	64937.
15	7272.	166586.	0.	0.	0.	0.	0.	0.	579.	54131.
16	5829.	177240.	0.	0.	0.	0.	0.	0.	1090.	71346.
17	8640.	182359.	0.	0.	0.	0.	0.	0.	1429.	87160.
18	7292.	189217.	0.	0.	0.	0.	0.	0.	1633.	97588.
19	5497.	195030.	0.	0.	0.	0.	0.	0.	1157.	104422.
20	8773.	202585.	0.	0.	0.	0.	0.	0.	2602.	148201.
AVERAGE RATE OF INCOME RETURN	3.792		0.0		0.0		0.0		1.421	
AVERAGE RATE OF CAPITAL GROWTH		5.012		0.0		0.0		0.0		13.790

INDIVIDUAL ASSET PERFORMANCE

SHORTER PLANNING HORIZON
(CONTINUED)

	LONG TERM BONDS		SHORT TERM BONDS		BANK SAVINGS ACCOUNT		PURCHASED ANNUITY	OTHER INCOME(+) OR EXPENSE(-)
YEAR	INCOME PRODUCED	VALUE	INCOME PRODUCED	VALUE	INCOME PRODUCED	VALUE	INCOME PRODUCED	
1	0.	0.	0.	0.	200.	4541.	0.	0.
2	0.	0.	0.	0.	182.	3673.	0.	0.
3	0.	0.	0.	0.	147.	2760.	0.	0.
4	0.	0.	0.	0.	110.	2055.	0.	0.
5	0.	0.	0.	0.	82.	2081.	0.	0.
6	0.	0.	0.	0.	83.	1945.	0.	0.
7	0.	0.	0.	0.	78.	1453.	0.	0.
8	0.	0.	0.	0.	58.	1280.	0.	0.
9	0.	0.	0.	0.	51.	1910.	0.	0.
10	0.	0.	0.	0.	76.	2735.	0.	0.
11	0.	0.	0.	0.	109.	1477.	0.	0.
12	0.	0.	0.	0.	59.	1909.	0.	0.
13	0.	0.	0.	0.	76.	1646.	0.	0.
14	0.	0.	0.	0.	66.	1567.	0.	0.
15	0.	0.	0.	0.	63.	1567.	0.	0.
16	0.	0.	0.	0.	63.	1161.	0.	0.
17	0.	0.	0.	0.	46.	3679.	0.	0.
18	0.	0.	0.	0.	147.	7060.	0.	0.
19	0.	0.	0.	0.	282.	8499.	0.	0.
20	0.	0.	0.	0.	340.	9817.	0.	0.
AVERAGE RATE OF INCOME RETURN	0.0		0.0					
AVERAGE RATE OF CAPITAL GROWTH		0.0		0.0				

PORTFOLIO PERFORMANCE

SHORTER PLANNING HORIZON

YEAR	RATE OF INCOME RETURN	RATE OF CAPITAL GROWTH	INCOME PRODUCED	TOTAL VALUE	RETIREMENT INCOME GAP	SURPLUS OR DEFICIT INCOME	INCOME DEFICIT NOT MET BY LIQUIDATION
	*********************	******PORTFOLIO TOTALS	**************************				
1	3.041	-0.459	3041.	100000.	3500.	-459.	0.
2	2.855	0.432	2842.	99541.	3710.	-868.	0.
3	3.020	8.096	3019.	99971.	3933.	-914.	0.
4	3.206	5.612	3464.	108065.	4169.	-704.	0.
5	3.900	5.958	4451.	114130.	4419.	32.	0.
6	3.761	10.884	4548.	120929.	4684.	-136.	0.
7	3.336	3.350	4473.	134091.	4965.	-492.	0.
8	3.672	11.696	5089.	138583.	5263.	-173.	0.
9	4.113	12.755	6367.	154792.	5578.	788.	0.
10	3.978	1.929	6944.	174536.	5913.	1031.	0.
11	2.816	11.097	5010.	177902.	6268.	-1258.	0.
12	3.635	6.374	7184.	197645.	6644.	540.	0.
13	2.749	2.324	5780.	210243.	7043.	-1263.	0.
14	3.434	5.948	7387.	215128.	7465.	-79.	0.
15	3.472	-2.475	7913.	227924.	7913.	0.	0.
16	3.141	12.355	6982.	222283.	8388.	-1406.	0.
17	4.051	9.390	10116.	249747.	16969.	3147.	0.
18	3.321	7.565	9073.	273198.	4847.	4226.	0.
19	2.361	4.793	6937.	293865.	5138.	1799.	0.
20	3.804	17.098	11715.	307950.	15067.	1648.	0.
AVERAGES	3.383	6.736					
TOTALS			122334.		131875.	5460.	0.
ENDING ESTATE				360603.			

SUMMARY OF PERFORMANCE

AND AIDS TO INTERPRETATION

SHORTER PLANNING HORIZON

	AVERAGE RATE OF INCOME RETURN	VARIABILITY OF INCOME RETURN (STANDARD DEVIATION)	AVERAGE RATE OF CAPITAL GROWTH	VARIABILITY OF CAPITAL GROWTH (STANDARD DEVIATION)
REPLICATION 1	3.383	0.473	6.736	4.911
REPLICATION 2	3.398	0.573	6.541	4.462
REPLICATION 3	3.704	0.536	8.339	5.650
REPLICATION 4	3.366	0.746	8.022	5.514
REPLICATION 5	3.711	0.553	6.618	3.799
REPLICATION 6	3.773	0.696	8.048	6.150
REPLICATION 7	3.223	0.636	8.085	5.165
REPLICATION 8	3.462	0.619	6.730	4.595
REPLICATION 9	3.464	0.737	4.919	3.167
REPLICATION 10	3.415	0.779	3.954	3.363
REPLICATION 11	3.262	0.608	7.418	4.780
REPLICATION 12	3.795	0.494	7.592	4.313
REPLICATION 13	3.587	0.985	6.271	4.300
REPLICATION 14	3.251	0.630	6.891	5.299
REPLICATION 15	3.478	0.826	6.610	3.568
AVERAGE	3.485	0.659	6.852	4.602

SUMMARY OF PERFORMANCE

AND AIDS TO INTERPRETATION

SHORTER PLANNING HORIZON

(CONTINUED)

	SUCCESS IN MEETING RETIREMENT INCOME NEEDS*		SIZE OF ENDING ESTATE	ESTIMATE OF REMAINING INCOME POTENTIAL**
	A	B		
REPLICATION 1	2.	0.	360603.	37. YEARS
REPLICATION 2	0.	0.	348947.	39. YEARS
REPLICATION 3	0.	0.	482843.	47. YEARS
REPLICATION 4	1.	0.	456321.	46. YEARS
REPLICATION 5	3.	0.	355785.	39. YEARS
REPLICATION 6	0.	0.	455348.	49. YEARS
REPLICATION 7	3.	0.	462846.	44. YEARS
REPLICATION 8	0.	0.	361054.	39. YEARS
REPLICATION 9	3.	0.	258885.	31. YEARS
REPLICATION 10	11.	0.	214901.	26. YEARS
REPLICATION 11	1.	0.	410112.	41. YEARS
REPLICATION 12	0.	0.	425180.	43. YEARS
REPLICATION 13	1.	0.	332046.	35. YEARS
REPLICATION 14	6.	0.	369943.	39. YEARS
REPLICATION 15	0.	0.	355684.	37. YEARS
AVERAGE	2.	0.	376699.	39. YEARS

* A = NUMBER OF OCCASIONS ON WHICH ASSETS WERE LIQUIDATED TO MEET CONSUMPTION EXPENDITURES.
B = TOTAL INCOME DEFICIT WHICH COULD NOT BE MET BY LIQUIDATION

** IF THE " ENDING ESTATE " WERE PLACED IN YOUR BANK SAVINGS ACCOUNT,IT WOULD PRODUCE ADEQUATE INCOME FOR THE SURVIVING SPOUSE FOR THE NUMBER OFYEARS SHOWN.

APPENDIX B

COMPUTER SOFTWARE DEVELOPED IN THIS RESEARCH

Page 112 displays a listing of the computer routine developed to factor the covariance matrix into an upper triangular and a lower triangular matrix of coefficients used in the correlation subroutine of the simulation model. Pages 113 through 126 present the version of the Retirement Investment Simulator and accompanying subroutines used in this research.

```
C     ***********************************************************************
C     A DIAGONALLY SYMMETRIC MATRIX OF COVARIANCES CAN BE FACTORED INTO AN
C     UPPER AND A LOWER TRIANGULAR MATRIX "A" AND"APRIME" WHERE APRIME IS THE
C     TRANSPOSE OF A.  THIS COMPUTER ROUTINE IS DESIGNED TO GENERATE THE A AND
C     APRIME MATRICES FOR A COVARIANCE  MATRIX OF ANY SIZE.  THE PROGRAM BELOW
C     WILL PERFORM THE CALCULATIONS ... THE USER MUST PROVIDE INPUT AND OUTPUT
C     COMMANDS COMPATIBLE WITH HIS USE OF THE PROGRAM, AND REMOVE
C     SOME OF THE INPUT AND OUTPUT COMMANDS APPEARING BELOW.
C
C     THE FOLLOWING MUST BE PROVIDED BY THE USER AS INPUT:
C
C         M=THE SIZE OF THE INPUT MATRIX (IN COL 1-5 OF THE FIRST DATA CARD)
C              ( DON'T FORGET THE DIMENSION STATEMENT)
C         SIG(M,M)=THE INPUT MATRIX (ACTUALLY, ONLY THE UPPER TRIANGLE IS
C                  NEEDED, NOT THE FULL MATRIX.)
C
C     THE FOLLOWING MUST BE TAKEN BY THE USER AS OUTPUT:
C
C         SIG(M,M)=THE INPUT MATRIX...FOR VERIFICATION
C         A(M,M)= THE UPPER TRIANGULAR "A" MATRIX
C         AP(M,M)=THE LOWER TRIANGULAR "APRIME" MATRIX
C
C     A SELF-CHECKING MECHANISM HAS BEEN BUILT INTO THE PROGRAM.  IF THE PROGRAM
C     EXECUTES COMPLETELY, IT WILL ATTEMPT TO REPRODUCE THE (1,1) ELEMENT OF THE
C     INPUT MATRIX AND WILL INDICATE TO YOU ITS SUCCESS. IF YOUR INPUT MATRIX IS
C     FREE FROM ERROR, YOU HAVE THE SOLUTION.  IF THE PROGRAM DOES NOT
C     REACH COMPLETION, IT WILL INDICATE TO YOU HOU FAR IT HAS GOTTEN AND WILL
C     OUTPUT SOME DIAGNOSTICS TO HELP YOU LOCATE THE PROBLEM.
C     GOOD LUCK
C-----------------------------------------------------------------------
C
C     DIMENSION STATEMENT PLEASE
C
      DIMENSION SIG(12,12), A(12,12), AP(12,12)
C
C     THANK YOU
C
      REAL*8 SIG,A,SUM,DSQRT,AP,CHEK11
      READ(5,1) M
      ICOL=M
      IROW=M
      ISTOP=M-1
      CHEK11=0.
      DO 10 I=1,M
      DO 10 J=1,M
      SIG(I,J)=0.
      A(I,J)=0.
      AP(I,J)=0.
   10 CONTINUE
C
C     YOUR INPUT MATRIX PLEASE...CHECK THE FORMAT...STMT.20
C
      DO 30 I=1,12
      READ(5,20)(SIG(I,J),J=1,6)
      READ(5,21)(SIG(I,J),J=7,11)
   30 READ(5,22) SIG(I,12)
C
C     THANK YOU
C
C     REPRODUCE INPUT FOR VERIFICATION... CHECK THE FORMAT...STMT.300
C
      WRITE(6,401)
      WRITE(6,300)((SIG(I,J),J=1,M),I=1,M)
C
C     CALCULATE THE M TH COLUMN
C
      A(M,M)=DSQRT(SIG(M,M))
      DO 50 I=1,ISTOP
   50 A(I,M)=SIG(I,M)/A(M,M)
C
C     NEXT DIAGONAL ELEMENT
C
      WRITE(6,350)
      WRITE(6,902)
   90 ICOL=ICOL-1
      IRCW=ICOL
      IRCWP1=IROW+1
      SUM=0.
      DO 100 K=IROWP1,M
      WRITE(6,901) SUM
  100 SUM=SUM+A(IROW,K)**2
      WRITE(6,900) SIG(IROW,ICOL),SUM, IROW,ICOL
      IF(SUM.GT.SIG(IROW,ICOL))WRITE(6,904)IROW,ICOL
      IF(SUM.GT.SIG(IROW,ICOL)) GO TO 220
      A(IROW,ICOL)=DSQRT(SIG(IROW,ICOL)-SUM)
      IF(ICOL.EQ.1)WRITE(6,903)
      IF(ICOL.EQ.1)GO TO 220
C
C     COMPLETE THE COLUMN
C
      ICOLP1=ICOL+1
      ISTOP=ISTOP-1
      DO 200 J=1,ISTOP
      IRCW=IROW-1
      IF(IROW.EQ.0)GO TO 210
      SUM=0.
      DO 150 K=ICOLP1,M
  150 SUM=SUM+A(IROW,K)*A(ICOL,K)
      A(IROW,ICOL)=(SIG(IROW,ICOL)-SUM)/A(ICOL,ICOL)
  200 CONTINUE
  210 GO TO 90
C
  220 CONTINUE
C
      DO 500 I=1,M
      DO 500 J=1,M
      AP(I,J)=A(J,I)
  500 CONTINUE
      DO 600 I=1,M
  600 CHEK11=CHEK11+A(1,I)*AP(I,1)
C
C     OUTPUT PLEASE...CHECK THE OUTPUT FORMAT...ST.300
C
      WRITE(6,250)
      WRITE(6,300)((A(I,J),J=1,M),I=1,M)
      WRITE(6,501)
      WRITE(6,300)((AP(I,J),J=1,M),I=1,M)
C
C     THANK YOU
C
      WRITE(6,650)CHEK11
      WRITE(6,350)
C
C     YOUR FORMAT STATEMENTS
C
    1 FORMAT(I5)
   20 FORMAT(6F13.0)
   21 FORMAT(5F13.0)
   22 FORMAT(13X,F13.0)
  300 FORMAT(2H0,12F10.5)
C
C     THANK YOU
C
C     DOCUMENTATION FORMAT STATEMENTS
C
  250 FORMAT('1 THE UPPER TRIANGULAR "A" MATRIX')
  350 FORMAT(1H1)
  401 FORMAT('1  YOUR INPUT MATRIX')
  501 FORMAT('1  THE LOWER TRIANGULAR "APRIME"MATRIX')
  650 FORMAT('1 MULTIPLYING THE FIRST ROW OF "A" BY THE FIRST COLUMN OF
     1"APRIME" YIELDS',F10.5//'  THIS SHOULD BE THE SAME AS ELEMENT (1,1
     2) OF YOUR INPUT MATRIX'//'  CHECK TO SEE   ')
  900 FORMAT(' SIG AND SUM:',2F12.4,2I5)
  901 FORMAT(' IN LOOP SUM',F12.4)
  902 FORMAT('  DIAGNOSTICS ON THE CALCULATION OF THE DIAGONAL ELEMENTS.
     1'/'  IF "SUM" EXCEEDS "SIG", THE PROGRAM ABORTS.'/'  IT HAS ATTEMP
     2TED TO TAKE THE SQUARE ROOT OF A NEGATIVE NUMBER.')
  903 FORMAT('0 TERMINATION REACHED')
  904 FORMAT('0 PREMATURE TERMINATION REACHED WHEN CALCULATING ELEMENT',
     1I3,',',I3)
      STOP
      END
```

```
C
C
C
C      ***********************************************************************
C
C
C                      THE RETIREMENT INVESTMENT SIMULATOR
C
C                                 DEVELOPED AT
C                          OKLAHOMA STATE UNIVERSITY
C                    DEPARTMENT OF AGRICULTURAL ECONOMICS
C
C                               SEPTEMBER 1975
C                                     BY
C                               LYLE C. SPENCE
C                             HARRY P. MAPP, JR.
C                              LARRY FALCONER
C
C
C      DEVELOPED TO AID IN THE ANALYSIS OF RETIREMENT INVESTMENT STRATEGIES FOR
C                                FARM FAMILIES.
C
C
C      ***********************************************************************
C
C
C
C      VARIABLE NAMES FOR THE RETIREMENT INVESTMENT SIMULATOR AND ITS SUBROUTINES
C                          (LISTED ALPHABETICALLY)
C
C         A(12,12)         = MATRIX OF COEFFICIENTS USED IN CORRELATION PROGRAM
C         AMEAN(12)        = MEAN LEVELS OF RETURNS TO ASSETS (INPUT VALUES)
C         AMLIQ(I)         = DOLLAR AMOUNT OF EACH LIQUIDATION OF ASSET I
C         AMPI             = MARGINAL PROPENSITY TO INVEST OUT OF SURPLUS INCOME
C         ANINC(J)         = STORAGE ARRAY - ANNUITY INCOME - YEAR J
C         ANINC2(J)        = STORAGE ARRAY - ANNUITY INCOME - LONG PLANNING HORIZON
C         ANNBOT           = DOLLARS INVESTED IN ANNUITY
C         ANNCST           = COST OF ANNUITY PER TEN DOLLARS OF MONTHLY INCOME
C         ANNINC           = ANNUAL ANNUITY INCOME
C         ARCG(I,J)        = RATE OF CAPITAL GROWTH, ASSET I, YEAR J (CALCULATED)
C         ARCG2(I,J)       = SAME FOR LONGER PLANNING HORIZON
C         ARIR(I,J)        = RATE OF INCOME RETURN ,ASSET I, YEARJ (CALCULATED)
C         ARIR2(I,J)       = SAME FOR LONGER PLANNING HORIZON
C         ASET(I,J)        = AMOUNT INVESTED IN (VALUE OF) ASSET I, YEAR J
C         ASET2(I,J)       = SAME FOR LONGER PLANNING HORIZON
C         ASET1 - ASET13= INPUT VALUES FOR INITIAL INVESTMENTS
C         ASTRP(K)         = AVERAGE OF SUMMARY INFORMATION IN STREP
C         ASTRP2(K)        = SAME FOR LONGER PLANNING HORIZON
C         AVRCG(I)         = AVERAGE RATE OF CAPITAL GROWTH, ASSET I (CALCULATED)
C         AVRCG2(I)        = SAME FOR LONGER PLANNING HORIZON
C         AVRIR(I)         = AVERAGE RATE OF INCOME RETURN TO ASSETI (CALCULATED)
C         AVRIR2(I)        = SAME FOR LONGER PLANNING HORIZON
C         BGT(J)           = BUDGET OF CONSUMPTION EXPENDITURES
C         BGT2(J)          = SAME FOR LONGER PLANNING HORIZON
C         CUPNLT           = COUPON RATE EARNED ON LONG TERM BONDS
C         CUPNST           = COUPON RATE EARNED ON SHORT TERM BONDS
C         DEATH(1)         = IDENTIFIES SOURCE OF WIFES SOCIAL SECURITY BENEFITS
C         DEATH(2)AND(3)= COST OF ESTATE SETTLEMENT, (HUSBAND) AND (WIFE)
C         DEATH(4)AND(5)= LIFE INSURANCE COVERAGE, (HUSBAND) AND (WIFE)
C         DEATH(6)         = CHANGE IN CONSUMPTION EXPENDITURES WHEN ONE PERSON
C                            DIES
C         DPSN(1)AND(2) = IDENTIFIES RESPONSE OF PRIVATE PENSION TO INFLATION
C                            FOR (HUSBAND) AND (WIFE)
C         FLOSS            = CAPITAL LOSS WHEN LIQUIDATING FARM - TAXES AND
C                            TRANSFER COSTS
C         INF(J)           = RATE OF INFLATION IN YEAR J
C         INVST            = ASSET IN WHICH WDRAW IS INVESTED
C         IPREM            = REMAINING INCOME POTENTIAL
C         IPREM2           = SAME FOR LONGER PLANNING HORIZON
C         IX               = SEED PASSED TO RANDOM NORMAL DEVIATE GENERATOR
C         LE1 AND LE2      = LIFE EXPECTANCIES FOR HUSBAND AND WIFE SHORT HORIZON
C         LE3 AND LE4      = LIFE EXPECTANCIES FOR HUSBAND AND WIFE LONG HORIZON
C         LES              = SMALLER OF LE1 AND LE2
C         LEL              = LARGER OF LE1 AND LE2
C         LES2             = SMALLER OF LE3 AND LE4
C         LEL2             = LARGER OF LE3 AND LE4
C         MLIQ(I)          = MINIMUM LEVEL TO WHICH ASSET I MAY BE LIQUIDATED
C         NAME1            = FIRST NAME OF USER
C         NAME2            = LAST NAME OF USER
C         NAME3            = WIFE'S FIRST NAME
C         NRID             = RUN IDENTIFICATION
C         OUTPUT(2)        = SPECIAL OUTPUT REQUESTS
C         OTHER(J)         = CATCHALL VECTOR OF INCOME AND EXPENSE
C         PNSN(1,J)+(2,J)= PRIVATE PENSION BENEFITS YEAR J FOR (HUSBAND) AND
C                            (WIFE)
C         PNSN2(1,J)+(2,J)= SAME FOR LONGER PLANNING HORIZON
C         PRCG(J)          = PORTFOLIO RATE OF CAPITAL GROWTH IN YEAR J
C         PRCG2(J)         = SAME FOR LONGER PLANNING HORIZON
C         PRIR(J)          = PORTFOLIO RATE OF INCOME RETURN IN YEAR J
C         PRIR2(J)         = SAME FOR LONGER PLANNING HORIZON
C         RANK(I)          = LIQUIDATION PRIORITY OF ASSET I
C         REPLIC           = NUMBER  OF REPLICATIONS
C         RETI(I,J)        = DOLLAR INCOME RETURN FROM ASSET I IN YEAR J
C         RETI2(I,J)       = SAME FOR LONGER PLANNING HORIZON
C         RGAP(J)          = INCOME NEEDED FROM INVESTMENTS, YEAR J
C         RGAP2(J)         = SAME FOR LONGER PLANNING HORIZON
C         SAVMAX           = MAXIMUM SIZE OF SAVINGS ACCOUNT
C         SAVRAT           = RATE OF INTEREST EARNED ON BANK SAVINGS ACCOUNT
C         SDCG             = STANDARD DEVIATION OF CAPITAL GROWTH RATE FOR THE PORT
C                          = FOLIO (CALCULATED)
C         SDCG2            = SAME FOR LONGER PLANNING HORIZON
C         SDIR             = STANDARD DEVIATION OF INCOME RETURN TO THE PORTFOLIO
C                            (CALCULATED)
C         SDIR2            = SAME FOR LONGER PLANNING HORIZON
C         SCSEC(1,J)+(2,J)= SOCIAL SECURITY BENEFITS YEAR J FOR (HUSBAND) AND
C                            (WIFE)
C         SOSEC2(1,J+(2,J)= SAME FOR LONGER PLANNING HORIZON
C         SRPLS(J)         = SURPLUS INCOME IN YEAR J
C         SRPLS2(J)        = SAME FOR LONGER PLANNING HORIZON
C         STREP(45,8)      = STORAGE ARRAY WHICH ALLOWS REPLICATION FEATURE
C         STREP2(45,8)     = SAME FOR LONGER PLANNING HORIZON
C         UFGAP(J)         = INCOME DEFICIT WHICH COULD NOT BE MET BY LIQUIDATION,
C                            YEAR J
C         UFGAP2(J)        = SAME FOR LONGER PLANNING HORIZON
C         WDRAW            = SIZE OF WITHDRAWAL FROM SAVINGS FOR REINVESTMENT
C
C                     INSTALLMENT LAND CONTRACT SUBROUTINE
C         BALDUE(J)        = OUTSTANDING CONTRACT PRINCIPAL YEAR J
C         BINT             = INTEREST ON BALLOON PAYMENT
C         BLN              = BALLOON PAYMENT
C         CINT(J)          = CONTRACT INTEREST PAYMENT YEAR J
C         CNTCT            = AMOUNT OF THE CONTRACT PRINCIPAL
C         CPRIN(J)         = CONTRACT PRINCIPAL PAYMENT YEAR J
C         DOWN             = DOWN PAYMENT
C         IONLY            = NUMBER OF YEARS OF PURE INTEREST PAYMENTS, PLAN 3
C         PLAN             = TYPE OF PAYMENT PLAN ... INCREASING,DECREASING,DELAYED
C         RBAL(J)          = REMAINING PRINCIPAL BALANCE YEAR J
C         RATE             = INTEREST RATE
C         TINT(J)          = TOTAL INTEREST PAYMENT YEAR J
C         TOTAL(J)         = TOTAL CONTRACT PAYMENT YEAR J
C         YEARS            = TERM OF CONTRACT
```

```
C
C     FOR VARIABLES SUBSCRIPTED "I" ABOVE, THE 15TH ELEMENT OF THE ARRAY
C     GENERALLY IS THE AVERAGE, THE SUM, ETC.
C
C
      REAL INF, MLIQ
      COMMON  AMLIQ(15),AMPI,ANINC(50),ANINC2(50),ANNBOT,ANNCST,ANNINC,
     2ASET(15,50),ASET2(15,50),ASET1,ASET3,ASET5,ASET7,ASET9,ASET11,
     3ASET12,ASET13,BGT(50),BGT2(50),DEATH(6),DPNSN(2),FLOSS,INF(50),
     4INVST,LE1,LE2,LE3,LE4,LE(4),LES,LES2,LEL,LEL2,MLIQ(15),NAME1(3),
     5            OTHER(50),PNSN(3,50),PNSN2(3,50),PRCG(50),PRIR(50),
     6PRCG2(50),PRIR2(50),RANK(15),RETI(15,50),RETI2(15,50),SAVMAX,
     7SOSEC(3,50),SOSEC2(3,50),SRPLS(50),SRPLS2(50),UFGAP(50),
     8UFGAP2(50),WDRAW, RGAP(50), RGAP2(50),DEATHI(6),NAME2(5),NAME3(3)
      COMMON LELM1,LEL2M1,
     9BALDUE(50),BINT,BLN,CINT(50),CNTCT,CPRIN(50),DOWN,IONLY,RBAL(50),
     1RATE,TINT(50),TOTAL(50),YEARS,TPRIN,TOTINT,TPAY,RBZERO,PLAN,
     2IX,KK,IRANK,IYEARS,LESM1,LES2M1,NLIK,IYR,SUCES,SUCES2,
     3 A(12,12),AMEAN(12),X(12,100),D1(12,12),AK(12,100),Y(12,100),
     4RED,BLNT,REDUCE,LESP1,LES2P1,NRID(8),ARIR(15,50),ARIR2(15,50),
     5ARCG(15,50),ARCG2(15,50),AVRIR(15),AVRIR2(15),AVRCG(15),AVRCG2(15)
     6,SDIR,SDIR2,SDCG,SDCG2,IPREM,IPREM2,STREP(45,8),STREP2(45,8),
     7REPLIC,ASTRP(8),ASTRP2(8),TRETI,TRETI2,TRGAP,TRGAP2,TSPLS,TSPLS2,
     8TUGAP,TUGAP2,IREP,OUTPUT(2),ANSTOP,CUPNST,CUPNLT,SAVRAT
      COMMON HRZN
C
C     READ "A" MATRIX
      READ(5,11)((A(I,J),J=1,12),I=1,12)
   11 FORMAT(6F10.0)
C
C     INITIALIZE ARRAYS TO ZERO
C
 9999 DO 1 I=1,50
      BGT(I)=0.
      BGT2(I)=0.
      INF(I)=0.
      RGAP(I)=0.
      RGAP2(I)=0.
      CINT(I)=0.
      CPRIN(I)=0.
      BALDUE(I)=0.
      RBAL(I)=0.
      TINT(I)=0.
      TOTAL(I)=0.
      DO 1 J=1,3
      PNSN(J,I)=0.
      PNSN2(J,I)=0.
      SOSEC(J,I)=0.
      SOSEC2(J,I)=0.
    1 CONTINUE
      DO 14 I=1,12
      AMEAN(I)=0.0
      DO 14 J=1,12
      D1(I,J)=0.0
   14 CONTINUE
      DO 15 I=1,12
      DO 15 J=1,100
      X(I,J)=0.0
      AK(I,J)=0.0
      Y(I,J)=0.0
   15 CONTINUE
      DO 7 I=1,15
      DO 6 J=1,50
      ASET(I,J)=0.
      ASET2(I,J)=0.
      ARIR(I,J)=0.
      ARIR2(I,J)=0.
      ARCG(I,J)=0.
      ARCG2(I,J)=0.
      RETI(I,J)=0.
    6 RETI2(I,J)=0.
      AMLIQ(I)=0.
      AVRIR(I)=0.
      AVRIR2(I)=0.
      AVRCG(I)=0.
      AVRCG2(I)=0.
      MLIQ(I)=0.
    7 RANK(I)=0.
      DO 8 J=1,50
      ANINC(J)=0.
      ANINC2(J)=0.
      OTHER(J)=0.
      PRCG(J)=0.
      PRCG2(J)=0.
      PRIR(J)=0.
      PRIR2(J)=0.
      SRPLS(J)=0.
      SRPLS2(J)=0.
      UFGAP(J)=0.
    8 UFGAP2(J)=0.
      DO 9 I=1,45
      DO 9 J=1,8
      STREP(I,J)=0.
    9 STREP2(I,J)=0.
      IX=999997
      IREP=1
      IYEARS=1
      CALL INPUT
      CALL TPAGE
      CALL INRITE
      LE1=LE(1)
      LE2=LE(2)
      LE3=LE(3)
      LE4=LE(4)
      REDUCE=DEATH(6)
      DEATH(6)=DEATH(6)/100.
      BGT2(1)=BGT(1)
      PNSN2(1,1)=PNSN(1,1)
      PNSN2(2,1)=PNSN(2,1)
      SOSEC2(1,1)=SOSEC(1,1)
      SOSEC2(2,1)=SOSEC(2,1)
      IF(LE1.GT.LE2)GO TO 2
      LES=LE1
      LEL=LE2
      GO TO 3
    2 LES=LE2
      LEL=LE1
    3 IF(LE3.GT.LE4)GO TO 4
      LES2=LE3
      LEL2=LE4
      GO TO 5
    4 LES2=LE4
      LEL2=LE3
    5 DO 10 I=1,4
      INF(6+I)=INF(6)
      INF(11+I)=INF(11)
      INF(16+I)=INF(16)
      INF(21+I)=INF(21)
   10 INF(26+I)=INF(26)
      DO 20 I=31,50
   20 INF(I)=INF(30)
      DO 30 I=1,50
```

```
   30 INF(I)=1.+INF(I) /100.
      IF(INVST.EQ.7) INVST=12
      IF(INVST.EQ.6) INVST=11
      IF(INVST.EQ.5) INVST=9
      IF(INVST.EQ.4) INVST=7
      IF(INVST.EQ.3) INVST=5
      IF(INVST.EQ.2) INVST=3
      LESM1=LES-1
      LELM1=LEL-1
      LES2M1=LES2-1
      LEL2M1=LEL2-1
      LEL2P1=LEL2+1
      LELP1=LEL+1
      CUPNST=CUPNST/100.
      CUPNLT=CUPNLT/100.
      SAVRAT=SAVRAT/100.
C
C     PROJECT THE BUDGET VECTOR FOR THE SHORTER LIFE EXPECTANCIES
      LELM1=LEL-1
      LESP1=LES+1
      DO 40 I=1,LES
   40 BGT(I+1)=BGT(I)*INF(I)
      IF(LES.EQ.LEL)GO TO 58
      BGT(LESP1)=BGT(LESP1)-(DEATH(6)*BGT(LESP1))
      IF(LESP1.GT.LELM1)GO TO 59
      IF(LESP1.EQ.LELM1)GO TO 57
      DO 50 I=LESP1,LELM1
   50 BGT(I+1)=BGT(I)*INF(I)
      GO TO 59
   57 BGT(LESP1+1)=BGT(LESP1)*INF(LESP1)
      GO TO 59
   58 BGT(LESP1)=0.
   59 DEATHI(2)=DEATH(2)
      DEATHI(3)=DEATH(3)
      DO 60 I=1,LE1
   60 DEATHI(2)=DEATHI(2)*INF(I)
      DO 70 I=1,LE2
   70 DEATHI(3)=DEATHI(3)*INF(I)
      BGT(LE1)=BGT(LE1)+DEATHI(2)
      BGT(LE2)=BGT(LE2)+DEATHI(3)
C
C     PROJECT THE BUDGET VECTOR FOR THE LONGER LIFE EXPECTANCIES
      LES2P1=LES2+1
      LEL2M1=LEL2-1
      DO 140 I=1,LES2
  140 BGT2(I+1)=BGT2(I)*INF(I)
      IF(LES2.EQ.LEL2)GO TO 158
      BGT2(LES2P1)=BGT2(LES2P1)-(DEATH(6)*BGT2(LES2P1))
      IF(LES2P1.GT.LEL2M1)GO TO 159
      IF(LES2P1.EQ.LEL2M1)GO TO 157
      DO 150 I=LES2P1,LEL2M1
  150 BGT2(I+1)=BGT2(I)*INF(I)
      GO TO 159
  157 BGT2(LES2P1+1)=BGT2(LES2P1)*INF(LES2P1)
      GO TO 159
  158 BGT2(LES2P1)=0.
  159 DEATHI(2)=DEATH(2)
      DEATHI(3)=DEATH(3)
      DO 160 I=1,LE3
  160 DEATHI(2)=DEATHI(2)*INF(I)
      DO 170 I=1,LE4
  170 DEATHI(3)=DEATHI(3)*INF(I)
      BGT2(LE3)=BGT2(LE3)+DEATHI(2)
      BGT2(LE4)=BGT2(LE4)+DEATHI(3)
C
C     PROJECT PRIVATE PENSION BENEFITS FOR THE SHORTER LIFE EXPECTANCIES
      LE1M1=LE1-1
      LE2M1=LE2-1
      IF(DPNSN(1).EQ.1.)GO TO 210
      DO 200 I=1,LE1M1
  200 PNSN(1,I+1)=PNSN(1,I)*INF(I)
      GO TO 230
  210 DO 220 I=1,LE1M1
  220 PNSN(1,I+1)=PNSN(1,I)
  230 IF(DPNSN(2).EQ.1.)GO TO 250
      DO 240 I=1,LE2M1
  240 PNSN(2,I+1)=PNSN(2,I)*INF(I)
      GO TO 270
  250 DO 260 I=1,LE2M1
  260 PNSN(2,I+1)=PNSN(2,I)
  270 DO 280 I=1,LEL
  280 PNSN(3,I)=PNSN(1,I)+PNSN(2,I)
C
C     PROJECT PRIVATE PENSION BENEFITS FOR THE LONGER LIFE EXPECTANCIES
      LE3M1=LE3-1
      LE4M1=LE4-1
      IF(DPNSN(1).EQ.1.)GO TO 310
      DO 300 I=1,LE3M1
  300 PNSN2(1,I+1)=PNSN2(1,I)*INF(I)
      GO TO 330
  310 DO 320 I=1,LE3M1
  320 PNSN2(1,I+1)=PNSN2(1,I)
  330 IF(DPNSN(2).EQ.1.)GO TO 350
      DO 340 I=1,LE4M1
  340 PNSN2(2,I+1)=PNSN2(2,I)*INF(I)
      GO TO 370
  350 DO 360 I=1,LE4M1
  360 PNSN2(2,I+1)=PNSN2(2,I)
  370 DO 380 I=1,LEL2
  380 PNSN2(3,I)=PNSN2(1,I)+PNSN2(2,I)
C
C     PROJECT SOCIAL SECURITY BENEFITS FOR THE SHORTER LIFE EXPECTANCIES
      LE1P1=LE1+1
      DO 400 I=1,LE1M1
  400 SOSEC(1,I+1)=SOSEC(1,I)*INF(I)
      IF(DEATH(1).EQ.1.)GO TO 430
      IF(LE1.GE.LE2)GO TO 430
      DO 410 I=1,LE1M1
  410 SOSEC(2,I+1)=SOSEC(2,I)*INF(I)
      SOSEC(2,LE1P1)=SOSEC(1,LE1)*INF(LE1)
      IF(LE1P1.GT.LE2M1)GO TO 450
      DO 420 I=LE1P1,LE2M1
  420 SOSEC(2,I+1)=SOSEC(2,I)*INF(I)
      GO TO 450
  430 DO 440 I=1,LE2M1
  440 SOSEC(2,I+1)=SOSEC(2,I)*INF(I)
  450 DO 460 I=1,LEL
  460 SOSEC(3,I)=SOSEC(1,I)+SOSEC(2,I)
C
C     PROJECT SOCIAL SECURITY BENEFITS FOR THE LONGER LIFE EXPECTANCIES
      LE3P1=LE3+1
      DO 500 I=1,LE3M1
  500 SOSEC2(1,I+1)=SOSEC2(1,I)*INF(I)
      IF(DEATH(1).EQ.1.)GO TO 530
      IF(LE3.GE.LE4)GO TO 530
      DO 510 I=1,LE3M1
  510 SOSEC2(2,I+1)=SOSEC2(2,I)*INF(I)
      SOSEC2(2,LE3P1)=SOSEC2(1,LE3)*INF(LE3)
      IF(LE3P1.GT.LE4M1)GO TO 550
      DO 520 I=LE3P1,LE4M1
  520 SOSEC2(2,I+1)=SOSEC2(2,I)*INF(I)
      GO TO 550
```

```
  530 DO 540 I=1,LE4M1
  540 SOSEC2(2,I+1)=SOSEC2(2,I)*INF(I)
  550 DO 560 I=1,LEL2
  560 SOSEC2(3,I)=SOSEC2(1,I)+SOSEC2(2,I)
C
C     GENERATE THE TWO VECTORS OF RETIREMENT INCOME GAP
      DO 600 I=1,LEL
  600 RGAP(I)=BGT(I)-PNSN(3,I)-SOSEC(3,I)
      DO 610 I=1,LEL2
  610 RGAP2(I)=BGT2(I)-PNSN2(3,I)-SOSEC2(3,I)
      CALL TABL1S
      CALL TABL1L
C     ***********************************************************************
C
C     PROJECTING THE PERFORMANCE OF AN INVESTMENT PORTFOLIO
C
C     CALCULATE INSTALLMENT LAND CONTRACT PAYMENT SCHEDULE
      IF(CNTCT.NE.0.) CALL CNTRAC
      RBAL(IYEARS)=0.
C
C     CALCULATE ANNUITY INCOME
      IF(ANNCST.EQ.0.) GO TO 9997
      ANNINC=(ANNBOT/ANNCST)*120
      I=1
      IF(ANSTOP.EQ.1.) I=LES
      IF(ANSTOP.EQ.2.) I=LEL
      DO 620 J=1,I
  620 ANINC(J)=ANNINC
      I=1
      IF(ANSTOP.EQ.1) I=LES2
      IF(ANSTOP.EQ.2) I=LEL2
      DO 630 J=1,I
  630 ANINC2(J)=ANNINC
C
C     GENERATE YIELDS
 9997 CALL CORLAT
C
C     SET INITIAL INVESTMENT LEVELS
      ASET(1,1)=ASET1
      ASET(3,1)=ASET3
      ASET(5,1)=ASET5
      ASET(7,1)=ASET7
      ASET(9,1)=ASET9
      ASET(11,1)=ASET11
      ASET(12,1)=ASET12
      ASET(13,1)=ASET13
C
C     SIMULATE FOREWARD, ONE YEAR AT A TIME
      ASET(13,1)=ASET(13,1)+(DOWN*((100.-FLOSS)/100.))
      SUCES=0.
      KK=2
      IRANK=1
      HRZN=1.
      DO 800 IYR=1,LEL
C
C     REINVEST EXCESS SAVINGS
      IF(INVST.EQ.0.OR.INVST.EQ.8) GO TO 702
      DO 701 I=1,1000
      IF( ASET(13,IYR).LT.SAVMAX) GO TO 702
      ASET(13,IYR)=ASET(13,IYR) - WDRAW
      ASET(INVST,IYR)= ASET(INVST,IYR) + WDRAW
  701 CONTINUE
  702 CONTINUE
C
C     CALCULATE INCOME RETURNS
      DO 710 I=1,9,2
  710 RETI(I,IYR)= ASET(I,IYR) * Y(I,IYR)
      RETI(12,IYR)= ASET(12,IYR) * CUPNST
      RETI(11,IYR)= ASET(11,IYR) * CUPNLT
      RETI(13,IYR)= ASET(13,IYR) * SAVRAT
      DO 705 I=1,13,2
  705 RETI(15,IYR)=RETI(15,IYR)+RETI(I,IYR)
      RETI(15,IYR)=RETI(15,IYR)+RETI(12,IYR)+TINT(IYR)
C
C     DETERMINE SURPLUS INCOME STATUS
      SRPLS(IYR)= RETI(15,IYR) - RGAP(IYR)+ANINC(IYR)+OTHER(IYR)
      IF(IYR.EQ.LE1) SRPLS(IYR) =SRPLS(IYR)+ DEATH(4)
      IF(IYR.EQ.LE2) SRPLS(IYR) =SRPLS(IYR)+ DEATH(5)
      ASET(13,IYR)=ASET(13,IYR) +(CPRIN(IYR)*((100.-FLOSS)/100.))
      IF(IYR.EQ.IYEARS)ASET(13,IYR)=ASET(13,IYR)+(BLN *((100.-FLOSS)/100
     1.))
      IF((ASET(13,IYR)+SRPLS(IYR)).GE.MLIQ(13)) GO TO 730
C
C     LIQUIDATE
      RANK(15)=0.
      DO 725 I=1,12
  725 RANK(15)=RANK(15)+RANK(I)
      IF(RANK(15).EQ.0.) CALL LICKA
      IF(RANK(15).GT.0.) CALL LICKB
      IF((ASET(13,IYR)+SRPLS(IYR)).GE.MLIQ(13))GO TO 730
      UFGAP(IYR)= SRPLS(IYR) +( ASET(13,IYR)-MLIQ(13))
      ASET(13,IYR)= MLIQ(13)
      GO TO 731
C
C     BALANCE SAVINGS AND CONSUMPTION
  730 IF(SRPLS(IYR).GT.0.)ASET(13,IYR)=ASET(13,IYR)+ SRPLS(IYR)*AMPI*.01
      IF(SRPLS(IYR).LE.0.)ASET(13,IYR)=ASET(13,IYR)+ SRPLS(IYR)
C
C     PORTFOLIO TOTALS
  731 DO 740 J=1,13
  740 ASET(15,IYR)=ASET(15,IYR)+ ASET(J,IYR)
      ASET(15,IYR)=ASET(15,IYR)+ RBAL(IYR)
      IF(IYR.GT.1) PRIR(IYR)=( RETI(15,IYR)/ASET(15,IYR-1))*100.
      IF(IYR.GT.1)PRCG(IYR)  =(ASET(15,IYR)/ASET(15,IYR-1))*100. -100.
C
C     ADJUST ASSET VALUES FOR PRICE APPRECIATION
      DO 720 I=1,9,2
  720 ASET(I,IYR+1)=ASET(I,IYR) * (1.0 + Y(I+1,IYR))
      ASET(11,IYR+1)=ASET(11,IYR) * (1.0 + Y(11,IYR))
      ASET(12,IYR+1)=ASET(12,IYR) * (1.0 + Y(12,IYR))
      ASET(13,IYR+1)=ASET(13,IYR)
C
  800 CONTINUE
C
      PRCG(1)= ( ASET(15,1)/(ASET1+ASET3+ASET5+ASET7+ASET9+ASET11+
     1ASET12+ASET13+DOWN+BLN+CNTCT))*100.-100.
      PRIR(1)=(  RETI(15,1)/(ASET1+ASET3+ASET5+ASET7+ASET9+ASET11+
     1ASET12+ASET13+DOWN+BLN+CNTCT))*100.
C
C     LONGER PLANNING HORIZON
C
C     SET INITIAL INVESTMENT LEVELS
      ASET2(1,1)=ASET1
      ASET2(3,1)=ASET3
      ASET2(5,1)=ASET5
      ASET2(7,1)=ASET7
      ASET2(9,1)=ASET9
      ASET2(11,1)=ASET11
      ASET2(12,1)=ASET12
      ASET2(13,1)=ASET13
C
C     SIMULATE FOREWARD OVER LONGER HORIZON
```

```
      ASET2(13,1)=ASET2(13,1)+(DOWN*((100.-FLOSS)/100.))
      SUCES2=0.
      KK=2
      IRANK=1
      HRZN=2.
      DO 1000 IYR=1,LEL2
C
C     REINVEST EXCESS SAVINGS
      IF(INVST.EQ.0.OR.INVST.EQ.8) GO TO 902
      DO 901 I=1,1000
      IF(ASET2(13,IYR).LT.SAVMAX) GO TO 902
      ASET2(13,IYR)=ASET2(13,IYR)- WDRAW
      ASET2(INVST,IYR)=ASET2(INVST,IYR) + WDRAW
  901 CONTINUE
  902 CONTINUE
C
C     CALCULATE INCOME RETURNS
      DO 910 I=1,9,2
  910 RETI2(I,IYR)=ASET2(I,IYR) * Y(I,IYR)
      RETI2(12,IYR)=ASET2(12,IYR) * CUPNST
      RETI2(11,IYR)=ASET2(11,IYR) * CUPNLT
      RETI2(13,IYR)=ASET2(13,IYR) * SAVRAT
      DO 905 I=1,13,2
  905 RETI2(15,IYR)=RETI2(15,IYR)+RETI2(I,IYR)
      RETI2(15,IYR)=RETI2(15,IYR)+RETI2(12,IYR)+TINT(IYR)
C
C     DETERMINE SURPLUS INCOME STATUS
      SRPLS2(IYR)= RETI2(15,IYR)-RGAP2(IYR)+ANINC2(IYR)+OTHER(IYR)
      IF(IYR.EQ.LE3) SRPLS2(IYR)=SRPLS2(IYR)+DEATH(4)
      IF(IYR.EQ.LE4) SRPLS2(IYR)=SRPLS2(IYR)+DEATH(5)
      ASET2(13,IYR)=ASET2(13,IYR)+(CPRIN(IYR)*((100.-FLOSS)/100.))
      IF(IYR.EQ.IYEARS)ASET2(13,IYR)=ASET2(13,IYR) +(BLN *((100.-FLOSS)/
     1100.))
      IF((ASET2(13,IYR)+SRPLS2(IYR)).GE.MLIQ(13)) GO TO 930
C
C     LIQUIDATE
      RANK(15)=0.
      DO 925 I=1,12
  925 RANK(15)=RANK(15)+RANK(I)
      IF(RANK(15).EQ.0.) CALL LICKA
      IF(RANK(15).GT.0.) CALL LICKB
      IF((ASET2(13,IYR)+SRPLS2(IYR)).GE.MLIQ(13)) GO TO 930
      UFGAP2(IYR)= SRPLS2(IYR) +(ASET2(13,IYR) - MLIQ(13))
      ASET2(13,IYR)= MLIQ(13)
      GO TO 931
C
C     BALANCE SAVINGS AND CONSUMPTION
  930 IF(SRPLS2(IYR).GT.0.)ASET2(13,IYR)=ASET2(13,IYR)+(SRPLS2(IYR)*AMPI
     1*.01)
      IF(SRPLS2(IYR).LE.0.)ASET2(13,IYR)=ASET2(13,IYR)+SRPLS2(IYR)
C
C     PORTFOLIO TOTALS
  931 DO 940 J=1,13
  940 ASET2(15,IYR)=ASET2(15,IYR)+ ASET2(J,IYR)
      ASET2(15,IYR)=ASET2(15,IYR)+ RBAL(IYR)
      IF(IYR.GT.1)PRIR2(IYR)=(RETI2(15,IYR)/ASET2(15,IYR-1))*100.
      IF(IYR.GT.1)PRCG2(IYR)  =(ASET2(15,IYR)/ASET2(15,IYR-1))*100.-100.
C
C     ADJUST ASSET VALUES FOR PRICE APPRECIATION
      DO 920 I=1,9,2
  920 ASET2(I,IYR+1)=ASET2(I,IYR) * (1.0 + Y(I+1,IYR))
      ASET2(11,IYR+1)=ASET2(11,IYR) * (1.0 + Y(11,IYR))
      ASET2(12,IYR+1)=ASET2(12,IYR) * (1.0 + Y(12,IYR))
      ASET2(13,IYR+1)=ASET2(13,IYR)
C
 1000 CONTINUE
```

```
C
      PRIR2(1)=(RETI2(15,1)/(ASET1+ASET3+ASET5+ASET7+ASET9+ASET11+
     1ASET12+ASET13+DOWN+BLN+CNTCT))*100.
      PRCG2(1)=(ASET2(15,1)/(ASET1+ASET3+ASET5+ASET7+ASET9+ASET11+
     1ASET12+ASET13+DOWN+BLN+CNTCT))*100.-100.
C
C     AVERAGE RATES OF RETURN AND CAPITAL GROWTH
      DO 1100 J=1,LEL
      ARIR(13,J)= SAVRAT*100.
      ARIR(12,J)= CUPNST*100.
      ARIR(11,J)= CUPNLT*100.
      DO 1100 I=1,9,2
      ARIR(I,J) =Y(I,J)*100.
 1100 CONTINUE
      DO 1110 J=1,LEL
      ARCG(12,J)=Y(12,J)*100.
      ARCG(11,J)=Y(11,J)*100.
      DO 1110 I=1,9,2
      ARCG(I,J)=Y(I+1,J)*100.
 1110 CONTINUE
      DO 1120 I=1,13
      SUM1=0.
      SUM2=0.
      DO 1115 J=1,LEL
      SUM1=SUM1+ ARIR(I,J)
 1115 SUM2=SUM2+ ARCG(I,J)
      AVRIR(I)=SUM1 /LEL
 1120 AVRCG(I)=SUM2 /(LEL)
      DO 1130 J=1,LEL2
      ARIR2(13,J)=SAVRAT*100.
      ARIR2(12,J)=CUPNST*100.
      ARIR2(11,J)=CUPNLT*100.
      DO 1130 I=1,9,2
      ARIR2(I,J)=Y(I,J)*100.
 1130 CONTINUE
      DO 1140 J=1,LEL2
      ARCG2(12,J)=Y(12,J)*100.
      ARCG2(11,J)=Y(11,J)*100.
      DO 1140 I=1,9,2
      ARCG2(I,J)=Y(I+1,J)*100.
 1140 CONTINUE
      DO 1150 I=1,13
      SUM1=0.
      SUM2=0.
      DO 1145 J=1,LEL2
      SUM1=SUM1+ ARIR2(I,J)
 1145 SUM2=SUM2+ ARCG2(I,J)
      AVRIR2(I)=SUM1 /LEL2
 1150 AVRCG2(I)=SUM2 /(LEL2)
C
C     PORTFOLIO TOTALS OVER THE ENTIRE HORIZON
      TRETI=0.
      TRGAP=0.
      TSPLS=0.
      TUGAP=0.
      DO 1160 I=1,LEL
      AVRIR(15)=AVRIR(15)+ PRIR(I)
      AVRCG(15)=AVRCG(15)+ PRCG(I)
      TRETI=TRETI+RETI(15,I)
      TRGAP=TRGAP+RGAP(I)
      TSPLS=TSPLS+SRPLS(I)
 1160 TUGAP=TUGAP+UFGAP(I)
      AVRIR(15)=AVRIR(15) / LEL
      AVRCG(15)=AVRCG(15) /(LEL)
      TRETI2=0.
      TRGAP2=0.
```

```
      TSPLS2=0.
      TUGAP2=0.
      DO 1170 I=1,LEL2
      AVRIR2(15)=AVRIR2(15)+ PRIR2(I)
      AVRCG2(15)=AVRCG2(15)+ PRCG2(I)
      TRETI2=TRETI2+ RETI2(15,I)
      TRGAP2=TRGAP2+ RGAP2(I)
      TSPLS2=TSPLS2+ SRPLS2(I)
 1170 TUGAP2=TUGAP2+ UFGAP2(I)
      AVRIR2(15)=AVRIR2(15)/LEL2
      AVRCG2(15)=AVRCG2(15)/LEL2
C
C     CALCULATE STANDARD DEVIATIONS OF RETURNS
      SDIR=0.
      DO 1180 I=1,LEL
 1180 SDIR = SDIR + ((PRIR(I)-AVRIR(15))**2)
      SDIR = SQRT( SDIR / LEL)
      LELM1=LEL-1
      SDCG=0.
      DO 1185 I=1,LEL
 1185 SDCG = SDCG + ((PRCG(I)-AVRCG(15))**2)
      SDCG = SQRT( SDCG/LEL)
      SDIR2=0.
      DO 1190 I=1,LEL2
 1190 SDIR2=SDIR2 + ((PRIR2(I)-AVRIR2(15))**2)
      SDIR2= SQRT( SDIR2/ LEL2)
      LEL2M1=LEL2-1
      SDCG2=0.
      DO 1195 I=1,LEL2
 1195 SDCG2=SDCG2 + ((PRCG2(I)-AVRCG2(15))**2)
      SDCG2= SQRT( SDCG2/LEL2)
C
C     ESTIMATE REMAINING INCOME POTENTIAL
      AINF=INF(50)
      ABGT=  RGAP(LELM1) * AINF
      BREAD=(ASET(15,LELM1) -(FLOSS * ASET(1,LELM1) /100.))*(SAVRAT+1.)
      IF(BREAD.LE.0.) GO TO 1201
      DO 1200 IPREM=1,50
      IF(BREAD.LE.0.) GO TO 1201
      ABGT=(ABGT* AINF)
      BREAD=(BREAD-ABGT)*(SAVRAT+1.)+ANINC(LELM1)
      IF(BREAD.LE.0.) GO TO 1201
 1200 CONTINUE
 1201 CONTINUE
      ABGT=  RGAP2(LEL2M1)*AINF
      BREAD=(ASET2(15,LEL2M1)-(FLOSS*ASET2(1,LEL2M1)/100.))*(SAVRAT+1.)
      IF(BREAD.LE.0) GO TO 1211
      DO 1210 IPREM2=1,50
      IF(BREAD.LE.0.) GO TO 1211
      ABGT=(ABGT* AINF)
      BREAD=(BREAD-ABGT)*(SAVRAT+1.)+ANINC2(LEL2M1)
      IF(BREAD.LE.0.) GO TO 1211
 1210 CONTINUE
 1211 CONTINUE
C
C     ADJUST PORTFOLIO VALUES FOR REPORTING PURPOSES
      DO 1161 I=1,49
      J=51-I
 1161 ASET(15,J)=ASET(15,J-1)
      ASET(15,1)=          (ASET1+ASET3+ASET5+ASET7+ASET9+ASET11+
     1ASET12+ASET13+DOWN+BLN+CNTCT)
      DO 1162 I=1,49
      J=51-I
 1162 ASET2(15,J)=ASET2(15,J-1)
      ASET2(15,1)=         (ASET1+ASET3+ASET5+ASET7+ASET9+ASET11+
     1ASET12+ASET13+DOWN+BLN+CNTCT)
      IF(ASET1 .EQ.0.AND.INVST.NE.1 ) AVRIR(1) =0.
      IF(ASET1 .EQ.0.AND.INVST.NE.1 ) AVRCG(1) =0.
      IF(ASET1 .EQ.0.AND.INVST.NE.1 )AVRIR2(1) =0.
      IF(ASET1 .EQ.0.AND.INVST.NE.1 )AVRCG2(1) =0.
      IF(ASET3 .EQ.0.AND.INVST.NE.3 ) AVRIR(3) =0.
      IF(ASET3 .EQ.0.AND.INVST.NE.3 ) AVRCG(3) =0.
      IF(ASET3 .EQ.0.AND.INVST.NE.3 )AVRIR2(3) =0.
      IF(ASET3 .EQ.0.AND.INVST.NE.3 )AVRCG2(3) =0.
      IF(ASET5 .EQ.0.AND.INVST.NE.5 ) AVRIR(5) =0.
      IF(ASET5 .EQ.0.AND.INVST.NE.5 ) AVRCG(5) =0.
      IF(ASET5 .EQ.0.AND.INVST.NE.5 )AVRIR2(5) =0.
      IF(ASET5 .EQ.0.AND.INVST.NE.5 )AVRCG2(5) =0.
      IF(ASET7 .EQ.0.AND.INVST.NE.7 ) AVRIR(7) =0.
      IF(ASET7 .EQ.0.AND.INVST.NE.7 ) AVRCG(7) =0.
      IF(ASET7 .EQ.0.AND.INVST.NE.7 )AVRIR2(7) =0.
      IF(ASET7 .EQ.0.AND.INVST.NE.7 )AVRCG2(7) =0.
      IF(ASET9 .EQ.0.AND.INVST.NE.9 ) AVRIR(9) =0.
      IF(ASET9 .EQ.0.AND.INVST.NE.9 ) AVRCG(9) =0.
      IF(ASET9 .EQ.0.AND.INVST.NE.9 )AVRIR2(9) =0.
      IF(ASET9 .EQ.0.AND.INVST.NE.9 )AVRCG2(9) =0.
      IF(ASET11.EQ.0.AND.INVST.NE.11) AVRIR(11)=0.
      IF(ASET11.EQ.0.AND.INVST.NE.11) AVRCG(11)=0.
      IF(ASET11.EQ.0.AND.INVST.NE.11)AVRIR2(11)=0.
      IF(ASET11.EQ.0.AND.INVST.NE.11)AVRCG2(11)=0.
      IF(ASET12.EQ.0.AND.INVST.NE.12) AVRIR(12)=0.
      IF(ASET12.EQ.0.AND.INVST.NE.12) AVRCG(12)=0.
      IF(ASET12.EQ.0.AND.INVST.NE.12)AVRIR2(12)=0.
      IF(ASET12.EQ.0.AND.INVST.NE.12)AVRCG2(12)=0.
C
C     STORE SUMMARY INFORMATION PRIOR TO REPLICATION
      STREP(IREP,1)= AVRIR(15)
      STREP(IREP,2)= SDIR
      STREP(IREP,3)= AVRCG(15)
      STREP(IREP,4)= SDCG
      STREP(IREP,5)= SUCES
      STREP(IREP,6)= TUGAP
      STREP(IREP,7)= ASET(15,LEL+1)
      STREP(IREP,8)= IPREM
      STREP2(IREP,1)= AVRIR2(15)
      STREP2(IREP,2)= SDIR2
      STREP2(IREP,3)= AVRCG2(15)
      STREP2(IREP,4)= SDCG2
      STREP2(IREP,5)= SUCES2
      STREP2(IREP,6)= TUGAP2
      STREP2(IREP,7)= ASET2(15,LEL2+1)
      STREP2(IREP,8)= IPREM2
      NTAB=2
      IF(OUTPUT(1).EQ.1) NTAB=NTAB+2
      IF(OUTPUT(2).EQ.1) NTAB=NTAB+2
      WRITE(6,1220) NTAB,IREP
 1220 FORMAT(1H1/////////,1H0,130('*'),////////,T51,'THE FOLLOWING ',
     1I1,' PAGES REPORT',////,T51,'THE OUTCOME OF REPLICATION',I4,
     2////////,1H0,130('*'))
      IF(OUTPUT(1).EQ.1) CALL TABL2S
      IF(OUTPUT(1).EQ.1.) CALL TABL3S
      IF(OUTPUT(2).EQ.1) CALL TABL2L
      IF(OUTPUT(2).EQ.1.) CALL TABL3L
      CALL TABL4S
      CALL TABL4L
C
C     REPLICATE
      IF(IREP.GE.REPLIC) GO TO 1300
      DO 1250 I=1,15
      AVRIR(I)=0.
      AVRIR2(I)=0.
      AVRCG(I)=0.
```

```
      AVRCG2(I)=0.
      DO 1245 J=1,50
      ASET(I,J)=0.
      ASET2(I,J)=0.
      ARIR(I,J)=0.
      ARIR2(I,J)=0.
      ARCG(I,J)=0.
      ARCG2(I,J)=0.
      RETI(I,J)=0.
 1245 RETI2(I,J)=0.
 1250 CONTINUE
      DO 1255 J=1,50
      PRCG(J)=0.
      PRCG2(J)=0.
      PRIR(J)=0.
      PRIR2(J)=0.
      SRPLS(J)=0.
      SRPLS2(J)=0.
      UFGAP(J)=0.
      UFGAP2(J)=0.
 1255 CONTINUE
      DO 1265 I=1,12
      DO 1260 J=1,12
 1260 D1(I,J)=0.
      DO 1265 J=1,100
      X(I,J)=0.
      AK(I,J)=0.
 1265 Y(I,J)=0.
      IX= 999997 -(IREP*22222)
      IREP=IREP+1
      GO TO  9997
C
C     AVERAGE THE SUMMARY INFORMATION
 1300 DO 1301 J=1,8
      ASTRP(J)=0.
 1301 ASTRP2(J)=0.
      DO 1450 I=1,8
      DO 1400 J=1,IREP
      ASTRP2(I)=ASTRP2(I)+STREP2(J,I)
 1400 ASTRP(I)=ASTRP(I) + STREP(J,I)
      ASTRP(I)=ASTRP(I) / IREP
 1450 ASTRP2(I)=ASTRP2(I) / IREP
      WRITE(6,1221)
 1221 FORMAT(1H1//////////,1H0,130('*'),////////,T51,'THE FOLLOWING 4 PA
     1GES SUMMARIZE'////,T51,'THE OUTCOMES OF ALL REPLICATIONS'////////,
     21H0,130('*'))
      CALL TABL5S
      CALL TABL6S
      CALL TABL5L
      CALL TABL6L
      WRITE(6,100)
  100 FORMAT(1H1)
      READ(5,90)N
   90 FORMAT(I3)
      IF(N.EQ.999)GO TO 9999
      STOP
      END
C
C     **************************************************************************
C
      SUBROUTINE INPUT
C
      REAL INF, MLIQ
C     //////////   COMMON STATEMENTS   //////////
C
      READ(5,10)NAME1,NAME2,NAME3
   10 FORMAT(3A4,8X,5A4,3A4)
      READ(5,11) NRIO
   11 FORMAT(8A4)
C
C     READ DATA FOR PROJECTING INCOME NEEDS
      READ(5,20) BGT(1),PNSN(1,1),PNSN(2,1),DPNSN(1),DPNSN(2),SOSEC(1,1)
     1,SOSEC(2,1),DEATH(1)
   20 FORMAT(8F10.0)
      READ(5,30)(DEATH(I),I=2,5),LE
   30 FORMAT(4F10.0,4I10)
      READ(5,40)DEATH(6),(INF(I),I=1,5)
   40 FORMAT(6F10.0)
      READ(5,45)(INF(I),I=6,26,5)
   45 FORMAT(5F10.0)
C
C     READ INSTALLMENT LAND CONTRACT DATA
      READ(5,50)PLAN,DOWN,CNTCT,BLN,RATE,YEARS,IONLY
   50 FORMAT(6F10.0,I10)
C
C     READ ANNUITY DATA
      READ(5,60) ANNBOT,ANNCST,ANSTOP
   60 FORMAT(3F10.0)
C
C     READ AVERAGE RETURNS
      READ(5,65)(AMEAN(I),I=1,9,2),CUPNLT,CUPNST,SAVRAT
      READ(5,70)(AMEAN(I),I=2,10,2),AMEAN(11),AMEAN(12)
   65 FORMAT(8F10.0)
   70 FORMAT(7F10.0)
C
C     READ INITIAL INVESTMENT LEVELS
      READ(5,65) ASET1,ASET3,ASET5,ASET7,ASET9,ASET11,ASET12,ASET13
C
C     READ LIQUIDATION DATA
      READ(5,65)(MLIQ(I),I=1,11,2),MLIQ(12),MLIQ(13)
      READ(5,65)(RANK(I),I=1,11,2),RANK(12),RANK(13)
      READ(5,65)(AMLIQ(I),I=1,11,2),AMLIQ(12),AMLIQ(13)
C
C     READ REINVESTMENT DATA
      READ(5,75)AMPI,SAVMAX,WDRAW,INVST,FLOSS
   75 FORMAT(3F10.0,I10,F10.0)
C
C     READ THE CATCHALL VECTOR
C     READ JOB CONTROL
      READ(5,80)(OTHER(I),I=1,48)
   80 FORMAT(8F10.0)
      READ(5,85)OTHER(49),OTHER(50),REPLIC,OUTPUT(1),OUTPUT(2)
   85 FORMAT(5F10.0)
      RETURN
      END
C
C     **************************************************************************
C
      SUBROUTINE TPAGE
C
C     TPAGE WRITES THE OUTPUT TITLE PAGE
C
      REAL INF, MLIQ
C     //////////   COMMON STATEMENTS   //////////
      WRITE(6,10)
   10 FORMAT(1H1//////////,T51,'RETIREMENT INVESTMENT SIMULATOR')
      WRITE(6,20)
   20 FORMAT(1H0,130('*'))
      WRITE(6,30)
   30 FORMAT(////////1H0,T50,'A RETIREMENT INVESTMENT PLAN FOR')
      WRITE(6,40)NAME1,NAME3,NAME2
   40 FORMAT(//1H-,T50,3A4,1X,'AND',1X,3A4,1X,5A4)
```

```
      WRITE(6,45)NRID
   45 FORMAT(//1H0,T48,8A4)
      WRITE(6,50)
   50 FORMAT(////////1H0,130('*'))
      WRITE(6,60)
   60 FORMAT(//1H-,T60,'PREPARED BY')
      WRITE(6,70)
   70 FORMAT(1H0,T47,'THE DEPARTMENT OF AGRICULTURAL ECONOMICS')
      WRITE(6,80)
   80 FORMAT(1H0,T54,'OKLAHOMA STATE UNIVERSITY')
      RETURN
      END
C
C     ****************************************************************************
      SUBROUTINE INRITE
C
C     INRITE REPRODUCES THE USERS INPUT FOR VERIFICATION
C
      REAL INF, MLIQ
C     //////////   COMMON STATEMENTS   //////////
      WRITE(6,1000)
 1000 FORMAT(1H1,T10,'ON THIS PAGE, THE COMPUTER HAS REPRODUCED THE INFO
     1RMATION'/T10,'WHICH YOU HAVE PROVIDED ON THE DECISION FORM. CHECK
     2CLOSELY'/T10,'TO ENSURE THAT THERE HAVE BEEN NO ERRORS IN PROCESSI
     3NG THE DATA.')
      WRITE(6,1010)
 1010 FORMAT(1H-,T20,'PART 1: INCOME NEEDS')
      WRITE(6,1020)
 1020 FORMAT(1H0,T20,'QUESTION NUMBER',T40,'YOUR INPUT')
      WRITE(6,1030)BGT(1)
 1030 FORMAT(1H ,T27,'1',T40,F10.0)
      WRITE(6,1040)PNSN(1,1),PNSN(2,1)
 1040 FORMAT(1H ,T27,'2',T40,2F10.0)
      WRITE(6,1050)DPNSN(1),DPNSN(2)
 1050 FORMAT(1H ,T27,'3',T40,2F10.0)
      WRITE(6,1060)SOSEC(1,1),SOSEC(2,1)
 1060 FORMAT(1H ,T27,'4',T40,2F10.0)
      WRITE(6,1070)DEATH(1)
 1070 FORMAT(1H ,T27,'5',T40,F10.0)
      WRITE(6,1080)DEATH(2),DEATH(3)
 1080 FORMAT(1H ,T27,'6',T40,2F10.0)
      WRITE(6,1090)DEATH(4),DEATH(5)
 1090 FORMAT(1H ,T27,'7',T40,2F10.0)
      WRITE(6,1100)LE(1),LE(2)
 1100 FORMAT(1H ,T27,'8',T40,2I10)
      WRITE(6,1110)LE(3),LE(4)
 1110 FORMAT(1H ,T27,'9',T40,2I10)
      WRITE(6,1120)DEATH(6)
 1120 FORMAT(1H ,T27,'10',T40,F10.0)
      WRITE(6,1130)(INF(I),I=1,6),INF(11),INF(16),INF(21),INF(26)
 1130 FORMAT(1H ,T27,'11',T40,10F5.0)
      WRITE(6,1140)
 1140 FORMAT(1H-,T20,'PART 2: ALTERNATIVE INVESTMENTS')
      WRITE(6,1150)
 1150 FORMAT(1H0,T20,'QUESTION NUMBER',T40,'YOUR INPUT')
      WRITE(6,1160)PLAN,DOWN,CNTCT,BLN,RATE,YEARS,IONLY
 1160 FORMAT(1H ,T27,'1',T40,6F10.0,I10)
      WRITE(6,1170)ANNBOT,ANNCST,ANSTOP
 1170 FORMAT(1H ,T27,'2',T40,3F10.0)
      WRITE(6,1200)(AMEAN(I),I=1,9,2),CUPNLT,CUPNST,SAVRAT
 1200 FORMAT(1H ,T27,'3',T40,8F10.2)
      WRITE(6,1210)(AMEAN(I),I=2,10,2),AMEAN(11),AMEAN(12)
 1210 FORMAT(1H ,T40,7F10.2)
      WRITE(6,1220)ASET1,ASET3,ASET5,ASET7,ASET9,ASET11,ASET12,ASET13
 1220 FORMAT(1H ,T40,8F10.0)
      WRITE(6,1230)(MLIQ(I),I=1,11,2),(MLIQ(I),I=12,13)
 1230 FORMAT(1H ,T40, 8F10.0)
      WRITE(6,1240)(RANK(I),I=1,11,2),(RANK(I),I=12,13)
 1240 FORMAT(1H ,T40,8F10.0)
      WRITE(6,1250)(AMLIQ(I),I=1,11,2),(AMLIQ(I),I=12,13)
 1250 FORMAT(1H ,T40,8F10.0)
      WRITE(6,1260)AMPI,SAVMAX,WDRAW,INVST
 1260 FORMAT(1H ,T40,3F10.0,I10)
      WRITE(6,1270)FLOSS
 1270 FORMAT(1H ,T40,F10.0)
      WRITE(6,1280)(OTHER(I),I=1,50)
 1280 FORMAT(1H ,T27,'4 ',6(T40,8F10.0,/),T40,2F10.0)
      WRITE(6,1290)REPLIC
 1290 FORMAT(1H ,T26,'5 ',T40,F10.0)
      WRITE(6,1300)OUTPUT(1)
 1300 FORMAT(1H ,T26,'6 ',T40,F10.0)
      WRITE(6,1310)OUTPUT(2)
 1310 FORMAT(1H ,T26,'7 ',T40,F10.0)
      RETURN
      END
C
C     ****************************************************************************
C
      SUBROUTINE CNTRAC
C
C     CNTRAC CALCULATES INSTALLMENT LAND CONTRACT PAYMENT SCHEDULES
C
      REAL INF, MLIQ
C     //////////   COMMON STATEMENTS   //////////
      RATE=RATE/100.
      IYEARS=YEARS
      BALDUE(1)=CNTCT
      BINT=BLN * RATE
      BLNT=BLN+ BINT
      IF(PLAN-2.)100,200,300
C
C     PLAN ONE
C
C     CALCULATE THE ANNUAL PAYMENT COEFFICIENT
  100 COEF=((1.+RATE)**YEARS)*RATE /(((1.+RATE)**YEARS)-1.)
      PYMT= CNTCT * COEF
C     ISOLATE EACH YEAR'S INTEREST AND PRINCIPAL
      DO 10 I=1,IYEARS
      CINT(I)= BALDUE(I)* RATE
      CPRIN(I)=  PYMT - CINT(I)
   10 BALDUE(I+1)= BALDUE(I) - CPRIN(I)
      GO TO 400
C
C     PAYMENT PLAN TWO
C
  200 DO 11 I=1,IYEARS
      CPRIN(I)= CNTCT / YEARS
      BALDUE(I+1)=BALDUE(I)-CPRIN(I)
   11 CINT(I)=BALDUE(I)* RATE
      GO TO 400
C
C     PAYMENT PLAN THREE
C
  300 LNGTH2=(IYEARS-IONLY)/2
      LNGTH3=(IYEARS-IONLY)-LNGTH2
      ALNGT2=LNGTH2
      ALNGT3=LNGTH3
      ICHANG=LNGTH2+IONLY
      SUM=0.0
      IONLY1=IONLY+1
      DO 21 I=IONLY1,ICHANG
      CPRIN(I)=(CNTCT / 3.)/ ALNGT2
```

```
   21 SUM=SUM+CPRIN(I)
      RCNTCT=CNTCT-SUM
      ICP1=ICHANG+1
      DO 31 I=ICP1,IYEARS
   31 CPRIN(I)=RCNTCT/ALNGT3
      DO 41 I=1,IYEARS
      BALDUE(I+1)=BALDUE(I)-CPRIN(I)
   41 CINT(I)=BALDUE(I)* RATE
C
C     COMPLETE
C
  400 TPRIN=DOWN+BLN
      TOTINT=0.
      TPAY=DOWN+BLNT
      DO 55 I=1,IYEARS
      TPRIN=TPRIN+CPRIN(I)
      TINT(I)= BINT+ CINT(I)
      TOTINT =TOTINT+TINT(I)
      TOTAL(I)=CPRIN(I)+TINT(I)
      TPAY=TPAY+TOTAL(I)
      RBAL(I)=BALDUE(I)+BLN
   55 CONTINUE
      RBZERO=CNTCT+BLN
      RBAL(1)=CNTCT+BLN-CPRIN(1)
      DO 56 I=2,IYEARS
   56 RBAL(I)=RBAL(I-1)-CPRIN(I)
      CALL INCON
      RETURN
      END
C
C     ****************************************************************************
C
      SUBROUTINE INCON
C
C     INCON WRITES THE REPORT FOR THE INSTALLMENT LAND CONTRACT SUBROUTINE
C
      REAL INF, MLIQ
C     //////////   COMMON STATEMENTS   //////////
      WRITE(6,10)
   10 FORMAT(1H1,////////,T50,'RETIREMENT INVESTMENT SIMULATOR')
      WRITE(6,20)
   20 FORMAT(1H0,T50,'INSTALLMENT LAND CONTRACT OPTION')
      IF(PLAN.EQ.1.0)WRITE(6,30)
      IF(PLAN.EQ.2.0)WRITE(6,31)
      IF(PLAN.EQ.3.0)WRITE(6,32)
   30 FORMAT(1H0,T56,'LEVEL PAYMENT PLAN')
   31 FORMAT(1H0,T53,'DECREASING PAYMENT PLAN')
   32 FORMAT(1H0,T55,'DELAYED PAYMENT PLAN')
      WRITE(6,40)
   40 FORMAT(1H-,T35,'TOTAL',T50,'PRINCIPAL',T65,'INTEREST',T78,'REMAINI
     1NG').
      WRITE(6,50)
   50 FORMAT(1H ,T18,'YEAR',T31,'ANNUAL PAYMENT',T51,'PAYMENT',T65,'PAYM
     1ENT',T78,'BALANCE')
      WRITE(6,60)
   60 FORMAT(1H ,T18,4('_'),T34,7('_'),T50,9('_'),T65,8('_'),T77,9('_'))
      WRITE(6,70)DOWN,DOWN,RBZERO
   70 FORMAT(1H0,T14,'DOWN PAYMENT',T30,F10.0,T46,F10.0,T75,F10.0)
      IYR=YEARS
      DO 1 I=1,IYR
   80 FORMAT(1H ,T19,I2,T30,F10.0,T46,F10.0,T60,F10.0,T75,F10.0)
      WRITE(6,80)I,TOTAL(I),CPRIN(I),TINT(I),RBAL(I)
    1 CONTINUE
      WRITE(6,90)BLNT,BLN,BINT
   90 FORMAT(1H0,T12,'BALLOON PAYMENT',T30,F10.0,T46,F10.0,T60,F10.0)
      WRITE(6,100)TPAY,TPRIN, TOTINT
  100 FORMAT(1H0,T12,'TOTAL PAYMENTS',T30,F10.0,T46,F10.0,T60,F10.0)
      WRITE(6,110)
  110 FORMAT(1H1)
      RETURN
      END
C
C     ****************************************************************************
      SUBROUTINE CORLAT
C
C     CORLAT GENERATES CORRELATED RATES OF RETURN FOR THE INVESTMENTS
C
      REAL INF, MLIQ
C     //////////   COMMON STATEMENTS   //////////
C
C     GENERATE RANDOM NORMAL DEVIATES
      DO 6 J=1,100
      DO 6 I=1,12
      CALL GAUSS (IX,1.0,0.0,X(I,J))
    6 CONTINUE
C
C     CALCULATE CORRELATED OUTCOMES
      DO 7 K=1,100
      DO 7 I=1,12
      DO 7 J=1,12
      D1(I,J)=A(I,J)*X(J,K)
      AK(I,K)=AK(I,K)+D1(I,J)
    7 CONTINUE
      DO 9 K=1,100
      DO 9 I=1,12
      Y(I,K)=AMEAN(I)+AK(I,K)
    9 CONTINUE
C
C     CONVERT YIELDS
      DO 100 J=1,100
      DO 100 I=1,12
  100 Y(I,J)=Y(I,J)/100.
      RETURN
      END
C
C     ****************************************************************************
C
      SUBROUTINE GAUSS(IX,S,AM,V)
C
C     GAUSS GENERATES RANDOM NORMAL DEVIATES
C
      A=0.0
      A=A+RANF(IX)
      IX=0
      DO 50 I=2,12
      A=A+RANF(IX)
   50 CONTINUE
      V=(A-6.0)*S+AM
      RETURN
      END
C
C     ****************************************************************************
C
      SUBROUTINE LICKA
C
C     LICKA LIQUIDATES ASSETS ON A ROTATIONAL BASIS TO MAINTAIN PORTFOLIO
C     BALANCE.  FARM REAL ESTATE IS LIQUIDATED ONLY AFTER ALL OTHER ASSETS
C
      REAL INF, MLIQ
C     //////////   COMMON STATEMENTS   //////////
      COMMON HRZN
      IF(HRZN.EQ.2.) GO TO 100
```

```
      SUCES=SUCES+1
      ISTART = KK + 1
    1 DO 10 KK=ISTART,12
      IF(ASET(KK,IYR).LE.0.) GO TO 9
      IF(ASET(KK,IYR).LE.MLIQ(KK)) GO TO 9
      IF( (ASET(KK,IYR)-MLIQ(KK)).LE.AMLIQ(KK) ) GO TO 5
      ASET(KK,IYR)=ASET(KK,IYR)-AMLIQ(KK)
      ASET(13,IYR)=ASET(13,IYR)+AMLIQ(KK)
      GO TO 6
    5 ASET(13,IYR)=ASET(13,IYR)+(ASET(KK,IYR)-MLIQ(KK))
      ASET(KK,IYR)=ASET(KK,IYR)-(ASET(KK,IYR)-MLIQ(KK))
    9 BROKE=1.
      IF(                           ASET(3,IYR).LE.MLIQ(3).AND.ASET(5,IY
     1R).LE.MLIQ(5).AND.ASET(7,IYR).LE.MLIQ(7).AND.ASET(9,IYR).LE.MLIQ(9
     2).AND.ASET(11,IYR).LE.MLIQ(11).AND.ASET(12,IYR).LE.MLIQ(12))BROKE=
     4 0.
      IF(BROKE.GT.0.) GO TO 6
      IF(ASET(1,IYR).LE.MLIQ(1)) RETURN
      IF((ASET(1,IYR)- MLIQ(1)).LE.AMLIQ(1)) GO TO 7
      ASET(1,IYR) =ASET(1,IYR) -AMLIQ(1)
      ASET(13,IYR) =ASET(13,IYR) +( AMLIQ(1) *(100.-FLOSS)/100.)
      GO TO 8
    7 ASET(13,IYR) =ASET(13,IYR)+((ASET(1,IYR)- MLIQ(1))*(100.-FLOSS)/10
     10.)
      ASET(1,IYR) =ASET(1,IYR) -(ASET(1,IYR) -MLIQ(1))
    8 CONTINUE
    6 IF((ASET(13,IYR)+SRPLS(IYR)).GE.MLIQ(13)) RETURN
   10 CONTINUE
      ISTART=3
      GO TO 1
C     LONGER PLANNING HORIZON
  100 SUCES2=SUCES2+1
      ISTART=KK+1
  101 DO 20 KK=ISTART,12
      IF(ASET2(KK,IYR).LE.0) GO TO 19
      IF(ASET2(KK,IYR).LE.MLIQ(KK))GO TO 19
      IF( (ASET2(KK,IYR)-MLIQ(KK)).LE.AMLIQ(KK))GO TO 15
      ASET2(KK,IYR)=ASET2(KK,IYR)-AMLIQ(KK)
      ASET2(13,IYR)=ASET2(13,IYR)+AMLIQ(KK)
      GO TO 16
   15 ASET2(13,IYR)=ASET2(13,IYR)+(ASET2(KK,IYR)-MLIQ(KK))
      ASET2(KK,IYR)=ASET2(KK,IYR)-(ASET2(KK,IYR)-MLIQ(KK))
   19 BROKE=1.
      IF(                           ASET2(3,IYR).LE.MLIQ(3).AND.ASET2(5
     1,IYR).LE.MLIQ(5).AND.ASET2(7,IYR).LE.MLIQ(7).AND.ASET2(9,IYR).LE.M
     2LIQ(9).AND.ASET2(11,IYR).LE.MLIQ(11).AND.ASET2(12,IYR).LE.MLIQ(12)
     3)BROKE=0.
      IF(BROKE.GT.0.) GO TO 16
      IF(ASET2(1,IYR).LE.MLIQ(1)) RETURN
      IF((ASET2(1,IYR) -MLIQ(1)).LE.AMLIQ(1)) GO TO 107
      ASET2(1,IYR) =ASET2(1,IYR) -AMLIQ(1)
      ASET2(13,IYR) =ASET2(13,IYR) + (AMLIQ(1) *(100.-FLOSS)/100.)
      GO TO 108
  107 ASET2(13,IYR) =ASET2(13,IYR)+((ASET2(1,IYR)-MLIQ(1))*(100.-FLOSS)/
     1100.)
      ASET2(1,IYR) =ASET2(1,IYR) -(ASET2(1,IYR)-MLIQ(1))
  108 CONTINUE
   16 IF((ASET2(13,IYR)+SRPLS2(IYR)).GE.MLIQ(13))RETURN
   20 CONTINUE
      ISTART=3
      GO TO 101
      END
C
C     ************************************************************************
C
      SUBROUTINE LICKB
C
C     LICKB LIQUIDATES ASSETS SEQUENTIALLY ACCORDING TO THE USERS SPECIFICATIONS
C
      REAL INF, MLIQ
C     //////////   COMMON STATEMENTS   //////////
      COMMON HRZN
      IF(HRZN.EQ.1.) SUCES=SUCES+1.
      IF(HRZN.EQ.2.) SUCES2=SUCES2+1.
      IRANK=1
    1 I=IRANK
      IF(RANK(1).EQ.I)GO TO 15
      IF(RANK(3).EQ.I)NLIK=3
      IF(RANK(5).EQ.I)NLIK=5
      IF(RANK(7).EQ.I)NLIK=7
      IF(RANK(9).EQ.I)NLIK=9
      IF(RANK(11).EQ.I)NLIK=11
      IF(RANK(12).EQ.I)NLIK=12
      RED=1.
      GO TO 2
   15 NLIK=1
      RED= (100.-FLOSS)/100.
    2 IF(HRZN.EQ.2.) GO TO 100
    3 DO 10 J=1,1000
      IF(ASET(NLIK,IYR).LE.0.) GO TO 9
      IF(ASET(NLIK,IYR).LE.MLIQ(NLIK))GO TO 9
      IF((ASET(NLIK,IYR)-MLIQ(NLIK)).LE.AMLIQ(NLIK))GO TO 5
      ASET(NLIK,IYR)=ASET(NLIK,IYR) - AMLIQ(NLIK)
      ASET(13,IYR)  =ASET(13,IYR)  + AMLIQ(NLIK) * RED
      IF((ASET(13,IYR)+SRPLS(IYR)).GE.MLIQ(13))RETURN
      GO TO 10
    5 ASET(13,IYR)  =ASET(13,IYR)   + (ASET(NLIK,IYR) -  MLIQ(NLIK))*RED
      ASET(NLIK,IYR)=ASET(NLIK,IYR) - (ASET(NLIK,IYR) -  MLIQ(NLIK))
    9 IF((ASET(13,IYR)+SRPLS(IYR)).GE.MLIQ(13))RETURN
      IF(ASET(1,IYR).LE.MLIQ(1).AND.ASET(3,IYR).LE.MLIQ(3).AND.ASET(5,IY
     1R).LE.MLIQ(5).AND.ASET(7,IYR).LE.MLIQ(7).AND.ASET(9,IYR).LE.MLIQ(9
     2).AND.ASET(11,IYR).LE.MLIQ(11).AND.ASET(12,IYR).LE.MLIQ(12))RETURN
      IRANK=IRANK+1
      IF(IRANK.GT.7) IRANK=1
      GO TO 1
   10 CONTINUE
      GO TO 3
  100 DO 110 J=1,1000
      IF(ASET2(NLIK,IYR).LE.0.) GO TO 109
      IF(ASET2(NLIK,IYR).LE.MLIQ(NLIK))GO TO 109
      IF((ASET2(NLIK,IYR)-MLIQ(NLIK)).LE.AMLIQ(NLIK))GO TO 105
      ASET2(NLIK,IYR)=ASET2(NLIK,IYR) - AMLIQ(NLIK)
      ASET2(13,IYR)  =ASET2(13,IYR)   + AMLIQ(NLIK) * RED
      IF((ASET2(13,IYR)+SRPLS2(IYR)).GE.MLIQ(13)) RETURN
      GO TO 110
  105 ASET2(13,IYR)  =ASET2(13,IYR)  +(ASET2(NLIK,IYR)-MLIQ(NLIK))*RED
      ASET2(NLIK,IYR)=ASET2(NLIK,IYR)-(ASET2(NLIK,IYR)-MLIQ(NLIK))
  109 IF((ASET2(13,IYR)+SRPLS2(IYR)).GE. MLIQ(13))RETURN
      IF(ASET2(1,IYR).LE.MLIQ(1).AND.ASET2(3,IYR).LE.MLIQ(3).AND.ASET2(5
     1,IYR).LE.MLIQ(5).AND.ASET2(7,IYR).LE.MLIQ(7).AND.ASET2(9,IYR).LE.M
     2LIQ(9).AND.ASET2(11,IYR).LE.MLIQ(11).AND.ASET2(12,IYR).LE.MLIQ(12)
     3) RETURN
      IRANK=IRANK+1
      IF(IRANK.GT.7) IRANK=1
      GO TO 1
  110 CONTINUE
      GO TO 100
      END
C
C     ************************************************************************
C
      SUBROUTINE TABLIS
```

```
C
C     TABL1S WRITES THE DERIVATION OF RETIREMENT INCOME NEEDS, SHORT HORIZON
C
      INTEGER CROAK(3),ALIVE(3)
      REAL INF, MLIQ
C     //////////   COMMON STATEMENTS   //////////
      IF(LE1.EQ.LES)GO TO 11
      DO 14 I=1,3
      CROAK(I)=NAME3(I)
   14 CONTINUE
      GO TO 2
   11 DO 16 I=1,3
      CROAK(I)=NAME1(I)
   16 CONTINUE
    2 CONTINUE
      IF(LE2.EQ.LEL)GO TO 3
      DO 22 I=1,3
      ALIVE(I)=NAME1(I)
   22 CONTINUE
      GO TO 4
    3 DO 23 I=1,3
      ALIVE(I)=NAME3(I)
   23 CONTINUE
    4 CONTINUE
      WRITE(6,10)
   10 FORMAT(1H1,T50,'RETIREMENT INVESTMENT SIMULATOR')
      WRITE(6,20)
   20 FORMAT(1H-,//,T45,'PROJECTING THE NEED FOR INVESTMENT INCOME')
      WRITE(6,30)
   30 FORMAT(1H-,T47,'ASSUMING THE SHORTER PLANNING HORIZON')
      WRITE(6,40)
   40 FORMAT(1H-,//,T31,'CONSUMPTION',T56,'SOCIAL SECURITY',T81,'PRIVATE
     1 PENSION',T105,'RETIREMENT INCOME')
      WRITE(6,50)
   50 FORMAT(1H ,T11,'YEAR',T31,'EXPENDITURES',T58,'BENEFITS',T83,'BENEF
     1ITS',T111,'GAP')
      WRITE(6,60)
   60 FORMAT(1H+,T11,4('_'),T31,12('_'),T56,15('_'),T81,15('_'),T105,18(
     1'_')/ )
      DO 1 I=1,LEL
      WRITE(6,70)I,BGT(I),SCSEC(3,I),PNSN(3,I),RGAP(I)
   70 FORMAT(1H ,T12,I2,T32,F10.0,T57,F10.0,T83,F10.0,T107,F10.0)
      IF(I.EQ.LES)WRITE(6,80)LES,CROAK,LES
   80 FORMAT(1H-,10X,'IN YEAR ',I2,2X,3A4,1X,'DIES. EXPENDITURES IN YEAR
     1',1X,I2,1X,'INCLUDE THE ESTIMATED COST OF THE ESTATE SETTLEMENT.'/
     2 )
      IF(LES.EQ.LEL)GO TO 1
      IF(I.EQ.LES)WRITE(6,81)LESP1,REDUCE
   81 FORMAT(1H ,10X,'BEGINNING IN YEAR ',I2,' CONSUMPTION EXPENDITURES
     1ARE REDUCED BY ',F5.0,'% AND SOC.SEC. AND PRIVATE PENSIONS ARE ALS
     2O REDUCED')
    1 CONTINUE
      WRITE(6,90)LEL,ALIVE,LEL
   90 FORMAT(1H-,//,10X,'IN YEAR ',I2,1X,3A4,' DIES. EXPENDITURES IN YEA
     1R ',I2,' INCLUDE THE ESTIMATED COST OF ESTATE SETTLEMENT.')
      RETURN
      END
C
C     ***********************************************************************
C
      SUBROUTINE TABL1L
C
C     TABL1L WRITES THE DERIVATION OF RETIREMENT INCOME NEEDS, LONGER HORIZON
C
      INTEGER CROAK(3),ALIVE(3)
      REAL INF, MLIQ
C     //////////   COMMON STATEMENTS   //////////
      IF(LE3.EQ.LES2)GO TO 11
      DO 14 I=1,3
      CROAK(I)=NAME3(I)
   14 CONTINUE
      GO TO 2
   11 DO 16 I=1,3
      CROAK(I)=NAME1(I)
   16 CONTINUE
    2 CONTINUE
      IF(LE4.EQ.LEL2)GO TO 3
      DO 22 I=1,3
      ALIVE(I)=NAME1(I)
   22 CONTINUE
      GO TO 4
    3 DO 23 I=1,3
      ALIVE(I)=NAME3(I)
   23 CONTINUE
    4 CONTINUE
      WRITE(6,10)
   10 FORMAT(1H1,T50,'RETIREMENT INVESTMENT SIMULATOR')
      WRITE(6,20)
   20 FORMAT(1H-,//,T45,'PROJECTING THE NEED FOR INVESTMENT INCOME')
      WRITE(6,30)
   30 FORMAT(1H-,T47,'ASSUMING THE LONGER PLANNING HORIZON')
      WRITE(6,40)
   40 FORMAT(1H-,//,T31,'CONSUMPTION',T56,'SOCIAL SECURITY',T81,'PRIVATE
     1 PENSION',T105,'RETIREMENT INCOME')
      WRITE(6,50)
   50 FORMAT(1H ,T11,'YEAR',T31,'EXPENDITURES',T58,'BENEFITS',T83,'BENEF
     1ITS',T111,'GAP')
      WRITE(6,60)
   60 FORMAT(1H+,T11,4('_'),T31,12('_'),T56,15('_'),T81,15('_'),T105,18(
     1'_')/ )
      DO 1 I=1,LEL2
      WRITE(6,70)I,BGT2(I),SCSEC2(3,I),PNSN2(3,I),RGAP2(I)
   70 FORMAT(1H ,T12,I2,T32,F10.0,T57,F10.0,T83,F10.0,T107,F10.0)
      IF(I.EQ.LES2)WRITE(6,80)LES2,CROAK,LES2
   80 FORMAT(1H-,10X,'IN YEAR ',I2,2X,3A4,1X,'DIES. EXPENDITURES IN YEAR
     1',1X,I2,1X,'INCLUDE THE ESTIMATED COST OF THE ESTATE SETTLEMENT.'/
     2 )
      IF(LES2.EQ.LEL2)GO TO 1
      IF(I.EQ.LES2)WRITE(6,81)LES2P1,REDUCE
   81 FORMAT(1H ,10X,'BEGINNING IN YEAR ',I2,' CONSUMPTION EXPENDITURES
     1ARE REDUCED BY ',F5.0,'% AND SOC.SEC. AND PRIVATE PENSIONS ARE ALS
     2O REDUCED')
    1 CONTINUE
      WRITE(6,90)LEL2,ALIVE,LEL2
   90 FORMAT(1H-,//,10X,'IN YEAR ',I2,1X,3A4,' DIES. EXPENDITURES IN YEA
     1R ',I2,' INCLUDE THE ESTIMATED COST OF ESTATE SETTLEMENT.')
      RETURN
      END
C     ***********************************************************************
C
      SUBROUTINE TABL2S
C
C     TABL2S WRITES INDIVIDUAL ASSET PERFORMANCE, SHORT HORIZON, PART 1
C
      REAL INF, MLIQ
C     //////////   COMMON STATEMENTS   //////////
      WRITE(6,10)
   10 FORMAT(1H1,T53,'INDIVIDUAL ASSET PERFORMANCE')
      WRITE(6,20)
   20 FORMAT(///,T55,'SHORTER PLANNING HORIZON')
      WRITE(6,30)
   30 FORMAT(////,T12,'FARM REAL ESTATE',T38,'INCOME STOCKS',T63,'GROWTH
```

```
   1 STOCKS',T84,'INCOME MUTUAL FUNDS',T108,'GROWTH MUTUAL FUNDS')
      WRITE(6,40)
   40 FORMAT(1H0,T11,'INCOME',T36,'INCOME',T61,'INCOME',T85,'INCOME',T10
    19,'INCOME')
      WRITE(6,50)
   50 FORMAT(1H , 1X,'YEAR',4X,'PRODUCED',5X,'VALUE',7X,'PRODUCED',5X,'V
    1ALUE',7X,'PRODUCED',5X,'VALUE',7X,'PRODUCED',5X,'VALUE',7X,'PRODUC
    2ED',5X,'VALUE')
      WRITE(6,60)
   60 FORMAT(1H+,1X,4('_'),4X,8('_'),5X,5('_'),7X,8('_'),5X,5('_'),7X,8(
    1'_'),5X,5('_'),7X,8('_'),5X,5('_'),7X,8('_'),5X,5('_'))
      WRITE(6,70)
   70 FORMAT(//)
      DO 200 I=1,LEL
      WRITE(6,80)I,RETI(1,I),ASET(1,I),RETI(3,I),ASET(3,I),RETI(5,I),
     1ASET(5,I),RETI(7,I),ASET(7,I),RETI(9,I),ASET(9,I)
   80 FORMAT(1H ,2X,I2,4X,F10.0,1X,F10.0,4X,F10.0,1X,F10.0,4X,F10.0,1X,F
    110.0,4X,F10.0,1X,F10.0,4X,F10.0,1X,F10.0)
  200 CONTINUE
      WRITE(6,90)
   90 FORMAT(1H+,8X,10('_'),1X,10('_'),4X,10('_'),1X,10('_'),4X,10('_'),
    11X,10('_'),4X,10('_'),1X,10('_'),4X,10('_'),1X,10('_'))
      WRITE(6,100)
  100 FORMAT(//,' AVERAGE RATE',/,' OF INCOME',/,'  RETURN')
      WRITE(6,110)AVRIR(1),AVRIR(3),AVRIR(5),AVRIR(7),AVRIR(9)
  110 FORMAT(//,8X,F10.3,15X,F10.3,15X,F10.3,15X,F10.3,15X,F10.3)
      WRITE(6,120)
  120 FORMAT(//,' AVERAGE RATE',/,' OF CAPITAL',/,'  GROWTH')
      WRITE(6,130)AVRCG(1),AVRCG(3),AVRCG(5),AVRCG(7),AVRCG(9)
  130 FORMAT(//,19X,F10.3,15X,F10.3,15X,F10.3,15X,F10.3,15X,F10.3)
      RETURN
      END
C     **********************************************************************
C
      SUBROUTINE TABL2L
C
C     TABL2L WRITES INDIVIDUAL ASSET PERFORMANCE, LONG HORIZON, PART 1
C
      REAL INF, MLIQ
C     //////////   COMMON STATEMENTS   //////////
      WRITE(6,10)
   10 FORMAT(1H1,T53,'INDIVIDUAL ASSET PERFORMANCE')
      WRITE(6,20)
   20 FORMAT(///,T54,'LONGER PLANNING HORIZON')
      WRITE(6,30)
   30 FORMAT(////,T12,'FARM REAL ESTATE',T38,'INCOME STOCKS',T63,'GROWTH
   1 STOCKS',T84,'INCOME MUTUAL FUNDS',T108,'GROWTH MUTUAL FUNDS')
      WRITE(6,40)
   40 FORMAT(1H0,T11,'INCOME',T36,'INCOME',T61,'INCOME',T85,'INCOME',T10
    19,'INCOME')
      WRITE(6,50)
   50 FORMAT(1H , 1X,'YEAR',4X,'PRODUCED',5X,'VALUE',7X,'PRODUCED',5X,'V
    1ALUE',7X,'PRODUCED',5X,'VALUE',7X,'PRODUCED',5X,'VALUE',7X,'PRODUC
    2ED',5X,'VALUE')
      WRITE(6,60)
   60 FORMAT(1H+,1X,4('_'),4X,8('_'),5X,5('_'),7X,8('_'),5X,5('_'),7X,8(
    1'_'),5X,5('_'),7X,8('_'),5X,5('_'),7X,8('_'),5X,5('_'))
      WRITE(6,70)
   70 FORMAT(//)
      DO 200 I=1,LEL2
      WRITE(6,80)I,RETI2(1,I),ASET2(1,I),RETI2(3,I),ASET2(3,I),RETI2(5,I
    1),ASET2(5,I),RETI2(7,I),ASET2(7,I),RETI2(9,I),ASET2(9,I)
   80 FORMAT(1H ,2X,I2,4X,F10.0,1X,F10.0,4X,F10.0,1X,F10.0,4X,F10.0,1X,F
    110.0,4X,F10.0,1X,F10.0,4X,F10.0,1X,F10.0)
  200 CONTINUE
      WRITE(6,90)
   90 FORMAT(1H+,8X,10('_'),1X,10('_'),4X,10('_'),1X,10('_'),4X,10('_'),
    11X,10('_'),4X,10('_'),1X,10('_'),4X,10('_'),1X,10('_'))
      WRITE(6,100)
  100 FORMAT(//,' AVERAGE RATE',/,' OF INCOME',/,'  RETURN')
      WRITE(6,110)AVRIR2(1),AVRIR2(3),AVRIR2(5),AVRIR2(7),AVRIR2(9)
  110 FORMAT(//,8X,F10.3,15X,F10.3,15X,F10.3,15X,F10.3,15X,F10.3)
      WRITE(6,120)
  120 FORMAT(//,' AVERAGE RATE',/,' OF CAPITAL',/,'  GROWTH')
      WRITE(6,130)AVRCG2(1),AVRCG2(3),AVRCG2(5),AVRCG2(7),AVRCG2(9)
  130 FORMAT(//,19X,F10.3,15X,F10.3,15X,F10.3,15X,F10.3,15X,F10.3)
      RETURN
      END
C     **********************************************************************
C
      SUBROUTINE TABL3S
C
C     TABL3S WRITES INDIVIDUAL ASSET PERFORMANCE,SHORT HORIZON, PART2
C
      REAL INF, MLIQ
C     //////////   COMMON STATEMENTS   //////////
      KW = 6
      WRITE(KW,1)
    1 FORMAT(1H1, T52,'INDIVIDUAL ASSET PERFORMANCE' // T54,'SHORTER PLA
     *NNING HORIZON' / T61, '(CONTINUED)')
      WRITE(KW,2)
    2 FORMAT(/// T19,'LONG TERM',T48,'SHORT TERM',T83,'BANK SAVINGS',
     * T105,'PURCHASED',T121,'OTHER',/T21,'BONDS',T51,'BONDS',T86,
     * 'ACCOUNT',T106,'ANNUITY',T120,'INCOME(+)', / T12,'INCOME',T42,
     * 'INCOME',T78,'INCOME',T106,'INCOME',T122,'OR',/ T5,'YEAR',T11,
     * 'PRODUCED',T28,'VALUE',T41,'PRODUCED',T58,'VALUE',T77,'PRODUCED',
     *T93, 'VALUE',T105,'PRODUCED',T120,'EXPENSE(-)',/1H+,T5,'____',T11,
     * '________',T28,'_____',T41,'________',T58,'_____',T77,'________',
     * T93,'_____',T105,'________',T120,'_______')
      DO 10 I=1,LEL
      WRITE(KW,3)I,RETI(11,I),ASET(11,I),RETI(12,I),ASET(12,I),RETI(13,I
     *),ASET(13,I),ANINC(I),OTHER(I)
    3 FORMAT( T5,I2,2X,F10.0,5X,F10.0,5X,F10.0,5X,F10.0,11X,F10.0,5X,F10
     *.0,5X,F10.0,5X,F10.0)
   10 CONTINUE
      WRITE(KW,4)
    4 FORMAT(// T5,'___' ,T11,'______',T28,'_____',T41,'________',T58,
     * '_____',T77,'________',T93,'_____')
      WRITE(KW,5)(AVRIR(I),I=11,12)
    5 FORMAT(//  ' AVERAGE RATE',/ ' OF INCOME',/ '  RETURN', T13,F10.3,
     * T40,F10.3)
      WRITE(KW,6)(AVRCG(I),I=11,12)
    6 FORMAT(//  ' AVERAGE RATE',/ ' OF CAPITAL',/'  GROWTH', T25,F10.3,
     * T55,F10.3)
      RETURN
      END
C     **********************************************************************
C
      SUBROUTINE TABL3L
C
C     TABL3L WRITES INDIVIDUAL ASSET PERFORMANCE, LONG HORIZON, PART 2
C
      REAL INF, MLIQ
C     //////////   COMMON STATEMENTS   //////////
      KW = 6
      WRITE(KW,1)
    1 FORMAT(1H1,  T52,'INDIVIDUAL ASSET PREFORMANCE',// T54,'LONGER PLA
     *NNING HORIZON',/ T61, '(CONTINUED)')
      WRITE(KW,2)
    2 FORMAT(/// T19,'LONG TERM',T48,'SHORT TERM',T83,'BANK SAVINGS',
     * T105,'PURCHASED',T121,'OTHER',/T21,'BONDS',T51,'BONDS',T86,
     * 'ACCOUNT',T106,'ANNUITY',T120,'INCOME(+)', / T12,'INCOME',T42,
```

```
     * 'INCOME',T78,'INCOME',T106,'INCOME',T122,'OR',/ T5,'YEAR',T11,
     * 'PRODUCED',T28,'VALUE',T41,'PRODUCED',T58,'VALUE',T77,'PRODUCED',
     *T93,'VALUE',T105,'PRODUCED',T120,'EXPENSE(-)',/1H+,T5,'____',T11,
     * '________',T28,'_____',T41,'________',T58,'_____',T77,'________',
     * T93,'_____',T105,'________',T120,'_______')
      DO 10 I=1,LEL2
          WRITE(KW,3) I,RETI2(11,I),ASET2(11,I),RETI2(12,I),ASET2(12,I),
     * RETI2(13,I),ASET2(13,I),ANINC2(I),OTHER(I)
    3 FORMAT( T5,I2,2X,F10.0,5X,F10.0,5X,F10.0,5X,F10.0,11X,F10.0,5X,F10
     *.0,5X,F10.0,5X,F10.0)
   10 CONTINUE
      WRITE(KW,4)
    4 FORMAT(// T5,'___' ,T11,'______',T28,'_____',T41,'________',T58,
     * '_____',T77,'________',T93,'_____')
      WRITE(KW,5)(AVRIR2(I),I=11,12)
    5 FORMAT(//  ' AVERAGE RATE',/ ' OF INCOME',/ '  RETURN', T13,F10.3,
     * T40,F10.3)
      WRITE(KW,6)(AVRCG2(I),I=11,12)
    6 FORMAT(//  ' AVERAGE RATE',/ ' OF CAPITAL',/'  GROWTH', T25,F10.3,
     * T55,F10.3)
      RETURN
      END
C     **********************************************************************
C
      SUBROUTINE TABL4S
C
C     TABL4S WRITES PORTFOLIO PERFORMANCE, SHORT HORIZON
C
      INTEGER CROAK(3),ALIVE(3)
      REAL INF, MLIQ
C     //////////   COMMON STATEMENTS   //////////
      IF(LE1.EQ.LES)GO TO 11
      DO 14 I=1,3
      CROAK(I)=NAME3(I)
   14 CONTINUE
      GO TO 2
   11 DO 16 I=1,3
      CROAK(I)=NAME1(I)
   16 CONTINUE
    2 CONTINUE
      IF(LE2.EQ.LEL)GO TO 3
      DO 22 I=1,3
      ALIVE(I)=NAME1(I)
   22 CONTINUE
      GO TO 4
    3 DO 23 I=1,3
      ALIVE(I)=NAME3(I)
   23 CONTINUE
    4 CONTINUE
      WRITE(6,10)
   10 FORMAT(1H1,/////,T55,'PCRTFOLIO PERFORMANCE')
      WRITE(6,15)
   15 FORMAT(1H-,T53,'SHORTER PLANNING HORIZON')
      WRITE(6,20)
   20 FORMAT(1H-,T6,26('*'),'PORTFOLIO TOTALS',27('*'),T81,'RETIREMENT',
     1T100,'SURPLUS',T114,'INCOME DEFICIT')
      WRITE(6,25)
   25 FORMAT(1H ,T11,'RATE OF',T29,'RATE OF',T48,'INCOME',T66,'TOTAL',T8
     11,'INCOME GAP',T98;'OR DEFICIT',T118,'NOT MET BY')
      WRITE(6,30)
   30 FORMAT(1H ,1X,'YEAR',T8,'INCOME RETURN',T26,'CAPITAL GROWTH',T47,'
     1PRODUCED',T66,'VALUE',T101,'INCOME',T116,'LIQUIDATION')
      WRITE(6,35)
   35 FORMAT(1H+,T2,4('_'),T8,13('_'),T26,14('_'),T47,8('_'),T66,5('_'),
     1T81,10('_'),T98,10('_'),T116,12('_'))
      DO 1000 I=1,LEL
      WRITE(6,40)I,PRIR(I),PRCG(I),RETI(15,I),ASET(15,I),RGAP(I),SRPLS(I
     1),UFGAP(I)
   40 FORMAT(1H ,T3,I2,T8,F10.3,T30,F10.3,T46,F10.0,T64,F10.0,T81,F10.0,
     1T98,F10.0,T118,F10.0)
 1000 CONTINUE
      WRITE(6,55)
   55 FORMAT(1H ,130('_'))
      WRITE(6,60)AVRIR(15),AVRCG(15)
   60 FORMAT(1H0,1X,'AVERAGES',1X,F10.3,T30,F10.3)
      WRITE(6,65)TRETI,TRGAP,TSPLS,TUGAP
   65 FORMAT(1H0,1X,'TOTALS',T46,F10.0,T81,F10.0,T98,F10.0,T118,F10.0)
      WRITE(6,70)ASET(15,LEL+1)
   70 FORMAT(1H0,1X,'ENDING ESTATE',T64,F10.0)
      RETURN
      END
C     **********************************************************************
C
      SUBROUTINE TABL4L
C
C     TABL4L WRITES PORTFOLIO PERFORMANCE, LONG  HORIZON
C
      INTEGER CROAK(3),ALIVE(3)
      REAL INF, MLIQ
C     //////////   COMMON STATEMENTS   //////////
      IF(LE3.EQ.LES)GO TO 11
      DO 14 I=1,3
      CROAK(I)=NAME3(I)
   14 CONTINUE
      GO TO 2
   11 DO 16 I=1,3
      CROAK(I)=NAME1(I)
   16 CONTINUE
    2 CONTINUE
      IF(LE4.EQ.LEL)GO TO 3
      DO 22 I=1,3
      ALIVE(I)=NAME1(I)
   22 CONTINUE
      GO TO 4
    3 DO 23 I=1,3
      ALIVE(I)=NAME3(I)
   23 CONTINUE
    4 CONTINUE
      WRITE(6,10)
   10 FORMAT(1H1,/////,T55,'PORTFOLIO PERFORMANCE')
      WRITE(6,15)
   15 FORMAT(1H-,T54,'LONGER PLANNING HORIZON')
      WRITE(6,20)
   20 FORMAT(1H-,T6,26('*'),'PORTFOLIO TOTALS',27('*'),T81,'RETIREMENT',
     1T100,'SURPLUS',T114,'INCOME DEFICIT')
      WRITE(6,25)
   25 FORMAT(1H ,T11,'RATE OF',T29,'RATE OF',T48,'INCOME',T66,'TOTAL',T8
     11,'INCOME GAP',T98,'OR DEFICIT',T118,'NOT MET BY')
      WRITE(6,30)
   30 FORMAT(1H ,1X,'YEAR',T8,'INCOME RETURN',T26,'CAPITAL GROWTH',T47,'
     1PRODUCED',T66,'VALUE',T101,'INCOME',T116,'LIQUIDATION')
      WRITE(6,35)
   35 FORMAT(1H+,T2,4('_'),T8,13('_'),T26,14('_'),T47,8('_'),T66,5('_'),
     1T81,10('_'),T98,10('_'),T116,12('_'))
      DO 1000 I=1,LEL2
      WRITE(6,40)I,PRIR2(I),PRCG2(I),RETI2(15,I),ASET2(15,I),RGAP2(I),SR
     1PLS2(I),UFGAP2(I)
   40 FORMAT(1H ,T3,I2,T8,F10.3,T30,F10.3,T46,F10.0,T64,F10.0,T81,F10.0,
     1T98,F10.0,T118,F10.0)
 1000 CONTINUE
      WRITE(6,55)
   55 FORMAT(1H ,130('_'))
```

```
      WRITE(6,60)AVRIR2(15),AVRCG2(15)
   60 FORMAT(1H0,1X,'AVERAGES',1X,F10.3,T30,F10.3)
      WRITE(6,65)TRETI2,TRGAP2,TSPLS2,TUGAP2
   65 FORMAT(1H0,1X,'TOTALS',T46,F10.0,T81,F10.0,T98,F10.0,T118,F10.0)
      WRITE(6,70)ASET2(15,LEL2+1)
   70 FORMAT(1H0,1X,'ENDING ESTATE',T64,F10.0)
      RETURN
      END
C     ************************************************************************
C
      SUBROUTINE TABL5S
C
C     TABL5S WRITES SUMMARY OF PERFORMANCE, SHORT HORIZON, PART 1
C
      REAL INF, MLIQ
C     //////////    COMMON STATEMENTS    //////////
      WRITE(6,100)
  100 FORMAT('1',55X,'SUMMARY OF PERFORMANCE',//,54X,'AND AIDS TO INTERP
     ARETATION',//,55X,'SHORTER PLANNING HORIZON',//,55X,'VARIABILITY',
     A48X,'VARIABILITY',/,26X,'AVERAGE RATE',14X,'OF INCOME RETURN',15X,
     A'AVERAGE RATE',16X,'OF CAPITAL GROWTH',/,24X,'OF INCOME RETURN',
     A11X,'(STANDARD DEVIATION)',11X,'OF CAPITAL GROWTH',11X,'(STANDARD
     ADEVIATION)')
      WRITE(6,250)
      DO 1 I=1,IREP
    1 WRITE(6,200)I,(STREP(I,K),K=1,4)
  200 FORMAT('0REPLICATION  ',I3,T28,F10.3,T57,F10.3,T85,F10.3,T115,
     AF10.3)
      WRITE(6,250)
  250 FORMAT(24X,16('_'),11X,20('_'),11X,17('_'),11X,20('_'))
      WRITE(6,300)(ASTRP(N),N=1,4)
  300 FORMAT(T3,' AVERAGE',T28,F10.3,T57,F10.3,T85,F10.3,T115,F10.3)
      RETURN
      END
C     ************************************************************************
C
      SUBROUTINE TABL5L
C
C     TABL5L WRITES SUMMARY OF PERFORMANCE, LONG HORIZON, PART 1
C
      REAL INF, MLIQ
C     //////////    COMMON STATEMENTS    //////////
      WRITE(6,100)
  100 FORMAT('1',55X,'SUMMARY OF PERFORMANCE',//,54X,'AND AIDS TO INTERP
     ARETATION',//,55X,' LONGER PLANNING HORIZON',//,55X,'VARIABILITY',
     A48X,'VARIABILITY',/,26X,'AVERAGE RATE',14X,'OF INCOME RETURN',15X,
     A'AVERAGE RATE',16X,'OF CAPITAL GROWTH',/,24X,'OF INCOME RETURN',
     A11X,'(STANDARD DEVIATION)',11X,'OF CAPITAL GROWTH',11X,'(STANDARD
     ADEVIATION)')
      WRITE(6,250)
      DO 1 I=1,IREP
    1 WRITE(6,200)I,(STREP2(I,K),K=1,4)
  200 FORMAT('0REPLICATION  ',I3,T28,F10.3,T57,F10.3,T85,F10.3,T115,
     AF10.3)
      WRITE(6,250)
  250 FORMAT(24X,16('_'),11X,20('_'),11X,17('_'),11X,20('_'))
      WRITE(6,300)(ASTRP2(N),N=1,4)
  300 FORMAT(T3,' AVERAGE',T28,F10.3,T57,F10.3,T85,F10.3,T115,F10.3)
      RETURN
      END
C     ************************************************************************
C
      SUBROUTINE TABL6S
C
C     TABL6S WRITES SUMMARY OF PERFORMANCE, SHORT HORIZON, PART2
C
      REAL INF, MLIQ
C     //////////    COMMON STATEMENTS    //////////
      WRITE(6,1)
    1 FORMAT(1H1,T54,'SUMMARY OF PERFORMANCE'//T52,'AND AIDS TO INTERPRE
     1TATION'//T54,'SHORTER PLANNING HORIZON'//T60,'(CONTINUED)')
      WRITE(6,10)
   10 FORMAT(T115,'ESTIMATE OF',/T87,'SIZE OF',T112,'REMAINING INCOME'/
     1T26,'SUCCESS IN MEETING RETIREMENT INCOME NEEDS*',T84,'ENDING ESTA
     2TE',T115,'POTENTIAL**')
      WRITE(6,20)
   20 FORMAT(T26,42('_'),T84,13('_'),T112,16('_')/'0',T36,'A',T65,'B')
      DO 9 I=1,IREP
         WRITE(6,30)I,(STREP(I,K),K=5,8)
   30 FORMAT('0','REPLICATION',I3,T28,F10.0,T57,F10.0,T85,F10.0,T115,F10
     1.0,' YEARS')
    9 CONTINUE
      WRITE(6,21)
   21 FORMAT(T26,42('_'),T84,13('_'),T112,16('_'))
      WRITE(6,50)ASTRP(5),ASTRP(6),ASTRP(7),ASTRP(8)
   50 FORMAT('0   AVERAGE',T28,F10.0,T57,F10.0,T85,F10.0,T115,F10.0,' YEA
     1RS')
      WRITE(6,5)
    5 FORMAT('0*   A = NUMBER OF OCCASIONS ON WHICH ASSETS WERE LIQUIDATE
     >D TO MEET CONSUMPTION EXPENDITURES.',/,'     B = TOTAL INCOME DEFIC
     >IT WHICH COULD NOT BE MET BY LIQUIDATION',/,'0** IF THE " ENDING E
     >STATE " WERE PLACED IN YOUR BANK SAVINGS ACCOUNT,IT WOULD PRODUCE'
     >,/,'     ADEQUATE INCOME FOR THE SURVIVING SPOUSE FOR THE NUMBER OF
     >YEARS SHOWN.')
      IF(ASTRP(8).EQ.50) WRITE(6,60)
   60 FORMAT(T90,'ACTUALLY THE REMAINING INCOME POTENTIAL'/
     1T90,'IS GREATER THAN 50 YEARS.  THE EXACT'/
     2T90,'VALUE IS IRRELEVANT, BUT THE POINT HAS'/
     3T90,'BEEN MADE THAT THERE IS LITTLE CHANCE'/
     4T90,'OF OUTLIVING YOUR ASSETS.')
      RETURN
      END
C     ************************************************************************
C
      SUBROUTINE TABL6L
C
C     TABL6L WRITES SUMMARY OF PERFORMANCE, LONG  HORIZON, PART2
C
      REAL INF, MLIQ
C     //////////    COMMON STATEMENTS    //////////
      WRITE(6,1)
    1 FORMAT(1H1,T54,'SUMMARY OF PERFORMANCE'//T52,'AND AIDS TO INTERPRE
     1TATION'//T54,'LONGER PLANNING HORIZON'//T60,'(CONTINUED)')
      WRITE(6,10)
   10 FORMAT(T115,'ESTIMATE OF',/T87,'SIZE OF',T112,'REMAINING INCOME'/
     1T26,'SUCCESS IN MEETING RETIREMENT INCOME NEEDS*',T84,'ENDING ESTA
     2TE',T115,'POTENTIAL**')
      WRITE(6,20)
   20 FORMAT(T26,42('_'),T84,13('_'),T112,16('_')/'0',T36,'A',T65,'B')
      DO 9 I=1,IREP
         WRITE(6,30)I,(STREP2(I,K),K=5,8)
   30 FORMAT('0','REPLICATION',I3,T28,F10.0,T57,F10.0,T85,F10.0,T115,F10
     1.0,' YEARS')
    9 CONTINUE
      WRITE(6,21)
   21 FORMAT(T26,42('_'),T84,13('_'),T112,16('_'))
      WRITE(6,50)ASTRP2(5),ASTRP2(6),ASTRP2(7),ASTRP2(8)
   50 FORMAT('0   AVERAGE',T28,F10.0,T57,F10.0,T85,F10.0,T115,F10.0,' YEA
     1RS')
      WRITE(6,5)
    5 FORMAT('0*   A = NUMBER OF OCCASIONS ON WHICH ASSETS WERE LIQUIDATE
     >D TO MEET CONSUMPTION EXPENDITURES.',/,'     B = TOTAL INCOME DEFIC
     >IT WHICH COULD NOT BE MET BY LIQUIDATION',/,'0** IF THE " ENDING E
     >STATE " WERE PLACED IN YOUR BANK SAVINGS ACCOUNT,IT WOULD PRODUCE'
     >,/,'     ADEQUATE INCOME FOR THE SURVIVING SPOUSE FOR THE NUMBER OF
     >YEARS SHOWN.')
      IF(ASTRP2(8).EQ.50) WRITE(6,60)
   60 FORMAT(T90,'ACTUALLY THE REMAINING INCOME POTENTIAL'/
     1T90,'IS GREATER THAN 50 YEARS.  THE EXACT'/
     2T90,'VALUE IS IRRELEVANT, BUT THE POINT HAS'/
     3T90,'BEEN MADE THAT THERE IS LITTLE CHANCE'/
     4T90,'OF OUTLIVING YOUR ASSETS.')
      RETURN
      END
```

VITA

Lyle Christian Spence

Candidate for the Degree of

Master of Science

Thesis: AN ANALYSIS OF INVESTMENT STRATEGIES FOR RETIRING FARMERS

Major Field: Agricultural Economics

Biographical:

Personal Data: Born in Penn Yan, New York, February 12, 1952, the son of Mr. and Mrs. Theodore Spence.

Education: Graduated from Penn Yan Academy, Penn Yan, New York, June, 1970; received Bachelor of Science degree in Agricultural Economics from Purdue University, West Lafayette, Indiana, May, 1974; completed requirements for the Master of Science degree in May, 1976 at Oklahoma State University, Stillwater, Oklahoma.

Professional Experience: Undergraduate Assistant in extension, teaching and research projects, Purdue University, Department of Agricultural Economics, West Lafayette, Indiana, 1972 through 1974; Graduate Research Assistant, Oklahoma State University, Department of Agricultural Economics, Stillwater, Oklahoma, 1974 through 1975.

Professional Organizations: American Society of Farm Managers and Rural Appraisers.