AN ECONOMETRIC FORECASTING MODEL FOR A SEGMENT OF THE CONSTRUCTION MARKET

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CHAPTER I

INTRODUCTION

Construction is the largest single industry in the United States. It is a very volatile industry, and firms that are directly and indirectly engaged in construction in various segments need accurate forecasts of the construction business.

There are many ways to define or classify segments of the construction market. In this paper, the Engineering News-Record (ENR) reporting system is used. This study was conducted in cooperation with ENR, and the use of its reporting system facilitates the dissemination of the results to the construction industry. A segment of the construction market is defined in the "Type of Work" column in Table I. Forecasts of construction contracts for the period 1974-1980 are shown in Table I.

Econometric techniques are also used for forecasting. When mathematics and statistics are applied to economic theory, "econometric models" can be created and used to forecast future business volume. An econometric model is an equation or a set of related equations using mathematical and statistical techniques to analyze economic data. To illustrate this technique, a simplified econometric model of the home-building segment of the construction industry will be provided.

TABLE I

FORECAST OF 1974-1980 CONSTRUCTION CONTRACTS BY ENGINEERING NEWS-RECORD

Engineering News-Record

McGRAW-HILL'S CONSTRUCTION WEEKLY

Forecast of 1974-'80 construction contracts 50-state totals in millions of current dollars 1969-'80; 48 states excluding Alaska and Hawaii 1965-'69

	48 states					50 States †								% Change Annual		Annual average, compounded		
Type of work	1965	1966	1967	1968	1969	1969	1970	1971	1972	1973	1974	1975	1980	'73-'74	'74-'75	65-70 *a*	'70-'75	'75-'80
Total construction*	$34,644	$37,759	$40,403	$44,925	$51,354	$52,082	$52,484	58,620	63,344	72,330	81,350	83,100	113,150	+12	+2	+8	+9	+6
Heavy construction, total	10,805	12,929	14,511	14,283	16,545	16,710	19,201	19,993	19,362	22,980	31,195	31,525	48,400	+36	+1	+12	+9	+9
Water use & control	2,939	2,945	3,140	3,183	3,080	3,100	4,877	4,322	5,239	5,785	6,575	7,800	12,300	+14	+19	+10	+9	+9
Waterworks	724	849	970	887	899	904	1,107	734	900	1,025	1,125	1,275	1,750	+10	+13	+8	+2	+6
Sewerage	992	995	1,179	1,386	1,530	1,545	2,169	2,728	3,363	3,750	4,300	5,000	8,000	+15	+16	+17	+17	+9
Rivers, harbors, flood control	610	576	506	440	328	328	902	340	572	675	790	900	1,250	+17	+14	+8	0	+6
Hydroelectric and multi-purpose	613	525	485	410	273	273	604	440	309	250	260	300	1,000	+4	+15	+3	-13	+27
Irrigation	*c*		*c*	60	50	50	95	80	95	85	100	125	300	+18	+25		+5	+19
Transportation	5,711	6,581	6,876	6,911	8,601	8,725	9,150	8,968	9,063	10,070	11,360	12,225	19,100	+13	+8	+10	+5	+9
Highways	4,688	5,482	5,450	5,237	6,236	6,300	6,890	6,466	6,800	6,900	7,200	7,500	11,000	+4	+4	+8	+1	+7
Bridges	646	780	830	708	1,330	1,337	1,027	892	1,000	1,575	2,075	2,200	4,000	+32	+6	+10	+15	+12
Mass transit, including subways	*e* 135	150	330	300	301	301	271	365	500	700	1,150	1,500	2,500	+64	+30	+15	+40	+10
Airports (incl hangars & terminals)	127 *b*	146 *b*	173 *b*	600	734	778	605	1,010	750	850	900	975	1,500	+6	+8		+9	+9
Space and missile bases	115	23	93	66	0	9	357	235										
Electricity, gas, communications	1,144	2,321	3,570	3,100	3,415	3,425	4,295	5,900	4,100	6,000	12,000**	10,000	15,000	+100	-17	+30	+17	+8
Electric light and power	762	1,837	3,000	2,600	3,000	3,000	3,795											
Gas	*d* 281	393	475	400	300	300	350											
Communications	101	91	95	100	115	125	150											
Miscellaneous heavy construction	1,011	1,082	925	1,089	1,449	1,460	879	803	860	1,125	1,260	1,400	2,000	+12	+11	-6	+9	+7
Nonresidential building	17,219	19,393	20,141	22,612	25,641	25,950	24,045	25,668	26,725	31,475	34,155	36,575	44,250	+9	+7	+7	+8	+4
Manufacturing	3,064	3,623	3,701	3,768	3,888	3,915	3,614	2,611	3,012	5,000	6,500	7,000	5,500	+30	+8	+3	+13	-5
Commercial	5,457	5,835	6,081	7,744	7,684	9,786	9,091	9,658	11,457	13,250	13,930	14,900	19,250	+5	+7	+11	+9	+5
Offices	2,229	2,358	2,822	3,677	5,315	5,338	4,606	4,748	5,315	6,100	6,600	7,000	10,000	+8	+6	+15	+8	+7
Stores, shopping centers	2,255	2,275	2,189	2,787	2,927	2,961	2,936	3,230	4,293	5,000	4,800	5,200	6,250	-4	+8	+5	+11	+3
Educational	4,164	4,939	5,216	5,347	5,486	5,543	5,234	5,661	4,782	4,925	5,125	5,375	6,500	+4	+5	+4	+1	+3
Hospitals, medical, health	1,515	1,721	1,873	2,114	2,784	2,817	2,823	3,206	3,528	3,500	3,925	4,300	6,000	+12	+10	+13	+8	+7
Government service	842	939	960	1,112	1,140	1,154	1,017	1,575	1,459	1,850	1,675	1,800	2,250	-9	+7	+4	+11	+4
Recreation, religious, other	2,177	2,336	2,310	2,527	2,659	2,735	2,267	2,957	2,487	2,950	3,000	3,200	4,750	+2	+7	+0.2	+6	+7
Multiunit residential	6,620	5,437	5,751	8,030	9,168	9,422	9,238	12,959	17,257	17,875	16,000	15,000	20,500	-10	-6	+6	+9	+6
Apartments	4,997	4,040	4,323	6,551	7,671	7,831	7,853	11,419	15,131	15,200	13,350	12,500	17,000	-13	-6	+9	+9	+5

*Excludes homebuilding. †ENR estimates for 1971-'80. # Source of 1965-'70 building statistics: F. W. Dodge Division, McGraw-Hill Information Systems Co. **a** Based on data for 48 states, excluding Alaska and Hawaii. **b** Airport buildings included in nonresidential building for years 1965-'67; in airports starting 1968. **c** Irrigation included in hydro-electric and multi-purpose for years 1965-'67. **d** Includes natural gas and petroleum products pipelines. **e** Includes railroads

**Includes trans-Alaska pipeline valued at $4 billion.

Example of an Econometric Model

There are two types of variables in an econometric model. The first is an exogenous or independent variable whose value is determined outside of the econometric model. These values are supplied to the model as input data. The second is an endogenous or dependent variable whose values are determined within the model. An econometric model may be comprised of any number of equations, exogenous and endogenous variables. In this simplified example, there will be one equation, one exogenous variable, and one endogenous variable. The postulate of this particular model is that houses are built for people; therefore, the volume of residential construction is a function of population. The value of residential construction is reported by the U. S. Department of Commerce as fixed investment in residential structures. The variables are defined as shown below:

RESTRUCT = fixed investment in residential structures in billions of current dollars. This is the endogenous or dependent variable (Y).

POPULATE = population of the United States in millions. This is the exogenous or independent variable (X).

RESTRUCT = f(POPULATE).

A linear, first order model in which Y = f(X) would be written

$$Y = B_0 + B_1X + E$$

In this equation, which is usually called a "regression" equation, Y is the endogenous or dependent variable, B_0 is the Y intercept of the straight line, B_1 is the slope of the line, X is the exogenous or

independent variable, and E is the residual or the distance from any individual Y to the regression line. In this example, the regression equation is:

$$\text{RESTRUCT} = B_0 + B_1 \text{ (POPULATE)} + E$$

Historical data for both the endogenous and exogenous variables is required in order to compute the values of B_0 and B_1. In Table II, these values through 1973 are presented in addition to the forecast values for POPULATE for the period 1974-1980.

By minimizing the sum of the squares of the deviation from the fitted line, linear regression uses a technique known as the method of least squares for determining the equation for a straight line that best fits this data (1966-1973). A detailed explanation of this technique is presented in any statistics textbook (16). The slope of the regression equation is determined by either of the following formulae:

$$B_1 = \frac{\Sigma(X_i - \bar{X})(Y_i - \bar{Y})}{\Sigma(X_i - \bar{X})^2} = \frac{\Sigma X_i Y_i - \dfrac{(\Sigma X_i)(\Sigma Y_i)}{n}}{\Sigma X_i^2 - \dfrac{(\Sigma X_i)^2}{n}}$$

where

n = number of observations

$\bar{X}$ = average value of X

$\bar{Y}$ = average value of Y

TABLE II

HISTORICAL DATA 1966-1973 AND FORECASTS FOR 1974-1980

Year	RESTRUCT[1] Fixed Investment in Residential Structures in Billions of Current $	POPULATE[2] U. S. Population in Millions of People
1966	25.0	196.5
1967	25.1	198.6
1968	30.1	200.6
1969	32.6	202.6
1970	31.2	204.8
1971	42.7	207.0
1972	54.0	209.5
1973	58.0	212.2
1974		215.1
1975		218.2
1976		221.5
1977		225.1
1980		228.8

[1]Source: Business Conditions Digest Table A4, Series 44
Bureau of Economic Analysis
U. S. Department of Commerce.

[2]Source: Population Estimates and Projections, Series P-25 No. 470, September 1971, Bureau of the Census, U. S. Department of Commerce.

	(Col. 1)	(Col. 2)	(Col. 3) XY (Col. 1)	(Col. 4)	(Col. 5)
	Y	X	times	Y^2	X^2
Year	Restruct	Populate	Col. 2	Col. 1 squared	Col. 2 squared
1966	25.0	196.5	4912.50	625.00	38612.26
1967	25.1	198.6	4984.86	630.01	39441.96
1968	30.1	200.6	6038.06	906.01	40240.36
1969	32.6	202.6	6604.76	1062.76	41046.76
1970	31.2	204.8	6389.76	973.44	41943.04
1971	42.7	207.0	8838.90	1823.29	42849.00
1972	54.0	209.5	11313.00	2916.00	43890.25
1973	58.0	212.2	12307.60	3364.00	45028.84
	ΣY=298.7	ΣX=1631.8	ΣXY=61389.44	$\Sigma Y^2$12300.51	ΣX^2=333052.46

$$B_1 = \frac{\frac{(1631.8)(298.7)}{8}}{333052.46 - (1631.8)^2}$$

$$B_1 = 2.2426$$

The value of the Y intercept B_0 is determined by the formula:

$$B_0 = \bar{Y} - B_1\bar{X}$$

$$B_0 = 37.3375 - 2.2426(203.9750)$$

$$B_0 = -420.10$$

The next item is to determine if there is a linear relationship between the two variables and whether the regression line is meaningful. The first step is to compute the coefficient of correlation, (R), which measures the linear relationship between variables. If R = 0, there is

no linear relationship, and if R = 1, there is a perfect linear relationship.

$$R = \frac{n\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{\left[n\Sigma X^2 - (\Sigma X)^2\right]\left[n\Sigma Y^2 - (\Sigma Y)^2\right]}}$$

$$R = \frac{(8)(61389.44) - (1531.8)(298.7)}{\sqrt{\left[(8)(333052.46) - (1531.8)^2\right]\left[(8)(12300.51 - (298.7)^2\right]}}$$

In this example, R = 0.95, indicating that there is a strong linear relationship between the two variables.

To determine whether the regression line is meaningful, the coefficient of determination, (R^2), is computed by squaring the coefficient of correlation. The coefficient of determination, (R^2), is a measure of percentage of variation of the dependent or endogenous variable that is explained by the independent or exogenous variable. In this example, $R^2 = 0.90$, indicating that 90 percent of the variation of RESTRUCT is explained by POPULATE.

The last step is to predict values for the endogenous variable, which is Y or RESTRUCT. The equation used is

$$\hat{Y} = b_0 + b_1 X$$

where $\hat{Y}$, which is read "Y hat," denotes the predicted value of Y for a given value of X. b_0 and b_1 are "estimates" of B_0 and B_1. In the example, the equation would be

$$\widehat{\text{RESTRUCT}} = -420.10 + 2.2426\ (\text{POPULATE})$$

It is important to choose exogenous variables that can be forecast

more reliably than the endogenous variable. The forecasts of the exogenous variables are then introduced into the prediction equation to obtain the forecast values of the endogenous variable. Using the example model, the missing values in Table II can now be forecast as follows:

	RESTRUCT
Year	Forecast in Billions of Current $
1974	62.3
1975	69.2
1976	76.2
1977	84.7
1980	93.0

The model in this example was greatly simplified in order to demonstrate the technique. The example model can be discounted "a priori" because there are many more variables that influence residential construction. Examples of additional variables to increase accuracy of forecasts would be interest rates, available mortgage money, housing starts, vacancies, personal disposable income, unemployment rate, number of marriages, wage rates, and appropriate price deflators. Several equations and identities would be required to properly express the complex relationships between not only these variables, but also with the rest of the economy of the United States. In many econometric models, fixed investment in residential construction is a sector in a large-scale macroeconometric model. This will be discussed further in Chapter III. It is possible to have equations with several exogenous variables which must be solved by multiple regression analyses. The

solution of these equations is quite time-consuming if there are many exogenous variables. The computer has facilitated the solution of equations which require multiple regression analyses, and there are several statistical programs available for this purpose.

Predicting Future Economic Activity

There are three principal methods used by economists to predict future economic activity. The first is the use of an informal subjective method, as practiced to some extent by some business economists. In this approach, an economist evaluates the status of the economy, the economic policies in effect, and those policies soon to be implemented. By using his experience and judgement, he predicts the future economic activity of the economy. An example of such a prediction would be that the GNP will increase five percent next year. This is obviously a very subjective approach, and the quality of the predictions is dependent on the judgement of the economist. The desired variable is estimated directly. Depending upon who is making the prediction, many of the predictions made in this manner are very highly regarded.

The second method used by economists is a structural econometric model. It shows the interrelationships between the various facets of the economy. Of necessity, these are large sophisticated models in order to portray adequately the structure of the economy. These models can be used for policy analysis. By simulating an economic policy on a structural econometric model of the U. S. economy, an economist can determine the impact of that policy on the many sectors of the economy.

In econometric models, there are exogenous variables whose values are measured outside of the model and introduced into the model as data.

Next, the endogenous variables are determined. Their values are generated within the model. The solution of these variables is not normally deterministic because of the complicated interaction between the various sectors of the economy. Normally, there are many simultaneous equations that are solved by an iterative process. Structural econometric models can be used for forecasting purposes, but because of their complexity, a great deal of time and effort is required to service and update these models.

The third method used by economists is a forecasting econometric model. The model can be complicated or very simple. The test of the model is the accuracy of the results. The more endogenous variables to be determined, the more complex the model will have to be.

There are several large econometric models that are very useful in predicting the aggregate economic activity of the United States. The primary object that the econometricians desire to predict is Gross National Product (GNP), which is a measure of the value of all of the goods and services that are produced in the United States during a year. Considering the complexity of the U. S. economy, the work in the past has been focused on the problem of the proper interaction between the various sectors of the economy rather than attempting to disaggregate the forecasts within the various sectors. Construction is generally treated as three sectors. These are:

1) fixed investment in residential structures (homebuilding)

2) Fixed investment in nonresidential structures, and

3) a part of government purchases of goods and services.

The treatment of homebuilding forecasting is quite detailed in the literature, and is very useful to that sector of the construction

industry. The aggregation of the rest of the construction industry into two entries means that the forecasts are not directly useful to the rest of the construction industry.

Statement of the Problem

The problem is to develop econometric forecasting models that will accurately forecast the various sectors of the construction industry. The purpose of this study is to develop a methodology for preparing an econometric model of a segment of the construction industry using selected output from large-scale macroeconometric models as part of the input. In this manner, the model developed and presented in this paper can harness the power of the large-scale models. The complex economic relationships are incorporated in the large-scale models, and their forecasting capabilities are used in conjunction with the present model.

Objectives of an Econometric Model to Forecast Construction Volume

There are three principal objectivs of a good forecasting econometric model:

1) use existing available data
2) predict future construction volume (current dollar amount) of a segment of the construction industry with "acceptable" accuracy, and
3) require minimum servicing.

The lack of existing available data proved to be an acute problem in this research. The subject of existing available data is important, and Chapter III deals with sources of data and the lack of data.

What is "acceptable" accuracy? An econometric model that can predict future construction volume more accurately than existing predictions will be considered to be acceptable.

The question of minimum amount of servicing and updating of the econometric model is difficult to quantify. The Bureau of Economic Analysis model requires approximately 45 percent of the time of a staff of eight, including three PhD economists, to service and update. This level of effort is far in excess of a reasonable requirement to update and service this model. In order to make a prediction, it would be desirable to require no more than four hours' work of an economist-statistician and minimal keypunching and computer time.

Considering these restrictions, the use of a pre-programmed statistical package for multiple regression analysis can be used to reduce the servicing and computer time considerably. The limitations obviously imply a nonsophisticated model which again makes a multiple regression package very desirable. The particular statistical package used was the Statistical Analysis System II (50), and it is discussed in Appendix A.

The Selection of Office Buildings

The objective of this dissertation is to study a segment of the construction market that had not been modeled previously. The results of the model developed would be compared to estimates made by subjective means. These estimates are the best known forecasts now available. It was considered advisable to eliminate from consideration at this time segments of the construction market that are controlled more by government controls than by market forces. Thus, the segment of the construction market selected had to be relatively free of direct

government controls and not have been previously modeled.

Homebuilding was immediately eliminated from consideration because there are several econometric models[1] of the homebuilding market.

The segments of the construction industry shown in Table I correspond to the same categories shown each week in The Engineering News-Record "Scoreboard" (see Appendix B for an example).

The following categories of work were considered to have too much governmental control to meet the criterion to be used in this study:

water use and control

transportation

educational buildings, and

government service buildings.

This left the following categories:

electric light and power

gas

communications

manufacturing

commercial building composed of offices and banks, stores, and shopping centers

recreational, religious, and others.

With the current energy shortage, the electric light and power and gas segments are considered to be in a state of flux and would be better to study at another time.

After a preliminary investigation, office and bank buildings were selected as the segment of the construction market to be studied.

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[1]Interview - March, 1974, by the author with Mr. Robert J. Sheehan, Director Economic Research, National Association of Homebuilders.

The objective of a large-scale model is to forecast dependent (endogenous) variables which represent the state of the entire United States economy. The objective of the model to be developed in this study is to forecast only one dependent (endogenous) variable, the current dollar value of construction contracts for one segment of the construction industry. The current dollar value of a contract on the date that the contract is obtained will be used.

CHAPTER II

THE OFFICE BUILDING INDUSTRY

In this chapter, the general nature of the office building industry will be examined. Which structures are classified as office buildings, and who works in them? The share of the experienced civilian labor force who work in office buildings will be developed. Any trend in this share of the work force is very important to the office building industry. The allocation of space in office buildings is important to determine how much space is occupied per employee. With the background in the office building industry, a general description of the Econometric Forecasting Model developed in this study will be presented.

The term "office building" in this study shall include privately owned structures that are used primarily for office floor space for banks, savings and loan associations, professional, administrative, general purpose, and similar uses. To qualify as an office building, the structure must be physically separated from a manufacturing plant. Structures at manufacturing plant locations that are used for office space are classified under Plant and Equipment. Structures at colleges and universities that are used even exclusively for office space are still classified as educational buildings.

Stores are frequently located in the lower floors of office buildings. They are not reported in the total square feet of office space available in that building.

Using the definition of office buildings described above, the question of who works in office buildings will be addressed.

Who Works in Office Buildings

The U. S. Bureau of Labor Statistics (59) classifies employed persons into four main categories:

1) white collar workers

2) blue collar workers

3) service workers, and

4) farmers and farm laborers.

People who work in office buildings would be classified as white collar workers, but not all white collar workers work in office buildings. In the 1970 Census (55), there were 261 white collar occupations, and many of these such as teachers, food store managers, post office mail carriers, and many more are not allocated space in office buildings. A careful examination of the 261 white collar occupations revealed that there were people employed in 79 occupations that could be said to be allocated space in office buildings. This selection was arbitrary, and obviously not all of the people in the 79 occupations selected work in office buildings. Conversely, many of the people in the other 182 occupations do work in office buildings, so the end result was considered acceptable. A list of the 79 occupations selected is in Appendix C.

During the rest of this study, the people with the 79 occupations who are considered to be allocated space in office buildings will be classified as people with selected office-type occupations, and the numbers of people are shown in Table III. Also included in this table

TABLE III

PEOPLE WITH SELECTED OFFICE-TYPE OCCUPATIONS

Year	Number of People in the Experienced Labor Force in Millions	Number of People With Selected Office-Type Occupations in Millions	Share of Labor Force With Selected Office-Type Occupations in Percent
1920	42.206	4.275	10.1
1930	48.686	5.783	11.9
1940	51.742	7.164	13.8
1950	58.999	9.550	16.2
1960	67.990	11.782	17.3
1970	80.071	17.156	21.4
1973	84.409	19.377	23.0

Sources: U. S. Bureau of the Census:
Historical Statistics of the United States, Colonial Time to 1957, Series D 123-572.
Census of the Population: 1960, Volume I, Characteristics of the Population, Part 1, United States Summary.
1970 Census of the Population, Occupational Characteristics Final Report PC (2) - 7A.

U. S. Bureau of Labor Statistics:
Employment and Earnings, Volume 20, No. 9, March 1974.

is the share of the total labor force with these selected office-type occupations. These results are graphically shown in Figures 1 and 2.

Allocation of Space

There are three principal influences on the demand for office space. First, there has been an increase in the volume of office activities. Second, there has been an increase in the number of office workers accommodated in office buildings rather than in other types of structures. Third, there has been an increase in the allocation of floor space per worker in office buildings.

The increase in the volume of office activity is attributable to both an increase in population and to an increase in the share of the labor force with office-type occupations. This increase is shown in Figure 1, and is tabulated in Table III. Many office workers were formerly housed in administrative buildings at the site of manufacturing plants and in industrial and other commercial structures. The shift of office forces away from production and closer to the market, according to Fisher (26), has caused many of the office workers to be relocated into structures classified as office buildings. There has been an increase in the average amount of floor space per occupant in office buildings. This can be attributed to several factors. Room must be provided for more office machines and equipment; the increase in management-level personnel who are provided more space and the associated conference rooms, waiting rooms, reception areas, display areas, etc.; the general trend to make working conditions more pleasant for the employee to attract and retain capable workers. Ripnen (49) states that "morale and efficiency also increase as space

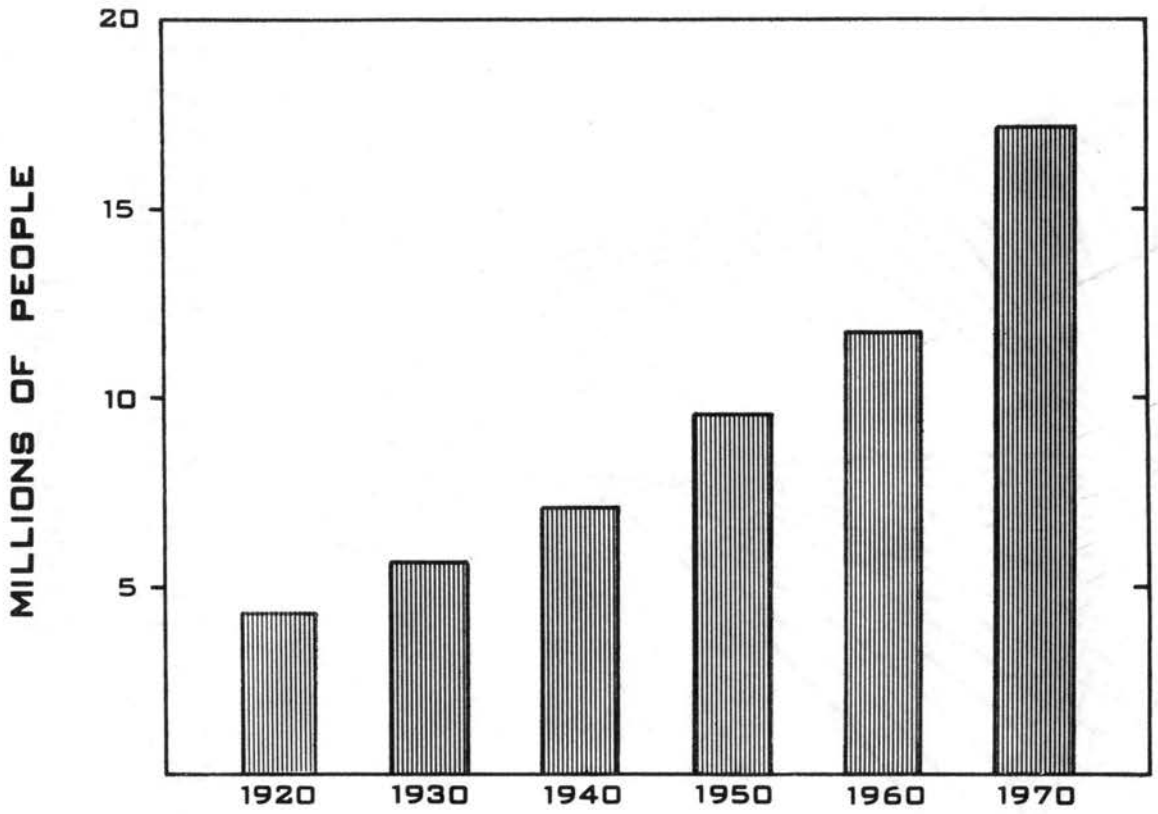


Figure 1. Number of People in the Experienced Civilian Force with Office-type Occupations

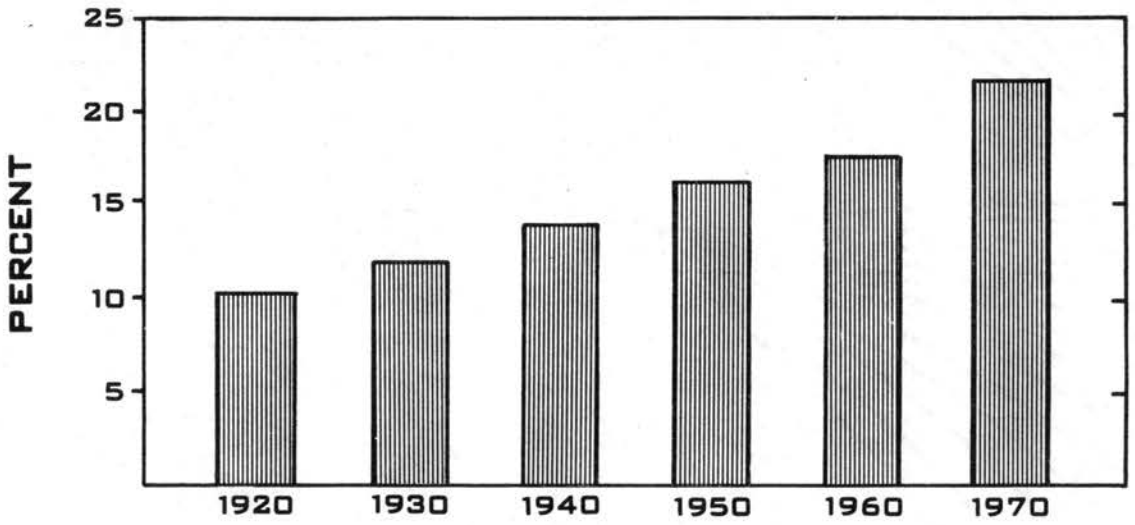


Figure 2. Percentage of Experienced Civilian Labor Force with Office-type Occupations

allotments are made more generous."

In newer buildings (less than five years old), the allocation of space is larger (166.9 square feet per employee in 1972) than the average allocation of space for buildings of all ages (158.8 square feet per employee in 1972).

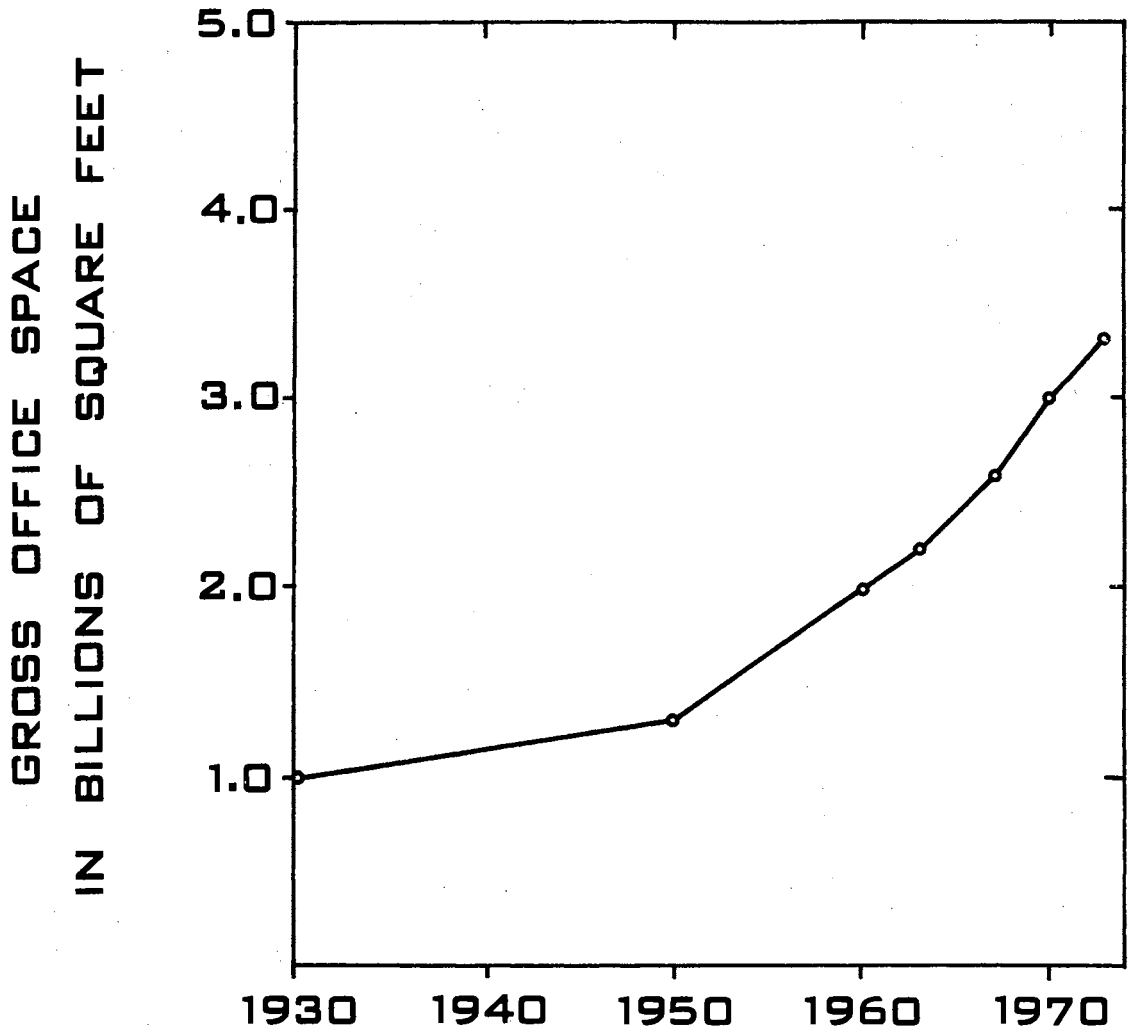
The larger allocation of space per employee in the newer buildings can be explained by two principal causes. First, the newer buildings are generally the prestigious structures, and the tenants are usually successful companies and corporations that allocate more space to managers--more private offices, and thus there is more floor space per employee. Second, most of the tenants in a new office building moved because of overcrowded conditions at their old location. Their idea is to occupy office space where there is room to grow as the company or corporation grows. In this manner, when the tenant initially occupies a new office building, the space per employee will be greater and as the number of workers increases, the allocation of space per employee will decrease. This approach is facilitated, according to Joedicke (32), by the introduction of commercially available movable partitions.

When office space becomes overcrowded, the tenant either obtains additional office space in the same building or moves to another building, and the cycle continues. Some firms lease, on a long-term basis, more office space than they initially require and sublet the excess space on a short-term lease. In this manner, the firm ensures the option of expanding its office space at regular intervals when the short-term sub-lease expires.

Office Building Occupancy

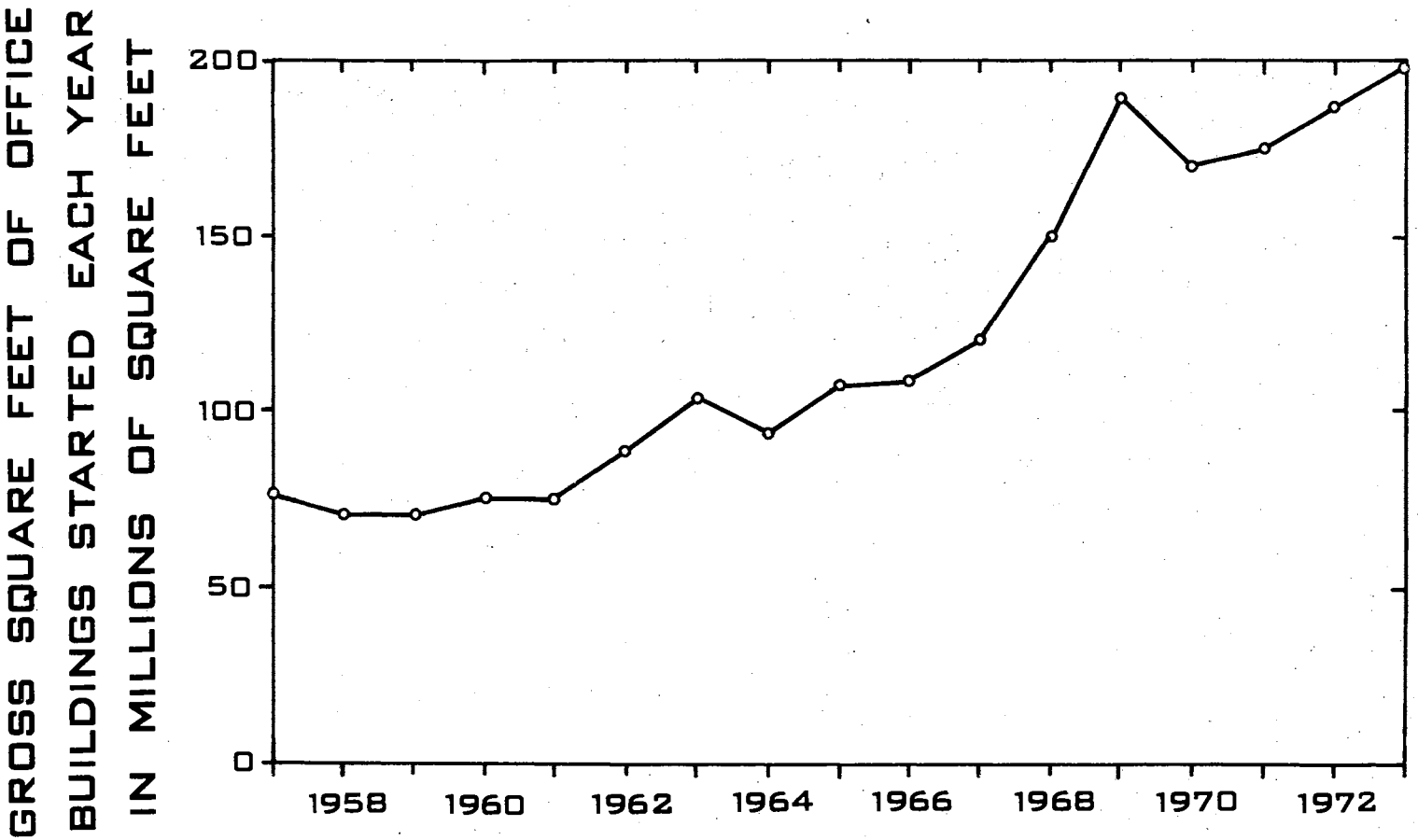
There has never been a national inventory of office building space, but Armstrong (2) does present an estimate of office space in the United States for several years, as shown in Figure 3. During World War II, there was very little office building with the exception of the 3.7 million square foot Pentagon Building, because construction materials were allocated to higher priority projects. After World War II, there was a boom in office building construction to meet the backlog requirement for office buildings. During the Korean conflict in the early 1950s, there was a period of approximately two years when construction materials for major projects were controlled. Since that time, there has been an increase in the construction of office buildings.

Figure 4 shows the number of gross square feet of office building space started in the United States for the period 1957-1974. The source of this data is The Dodge Construction Potentials, published by the F. W. Dodge Division of McGraw-Hill Information Systems Company, and this proprietary data is reproduced in this study with its consent. The important item to note is the uneven rate of increase of office building space started during 1968 and 1969. To find the impact of this rapid rate of increase of office buildings started, the occupancy of office buildings will be examined. In Figure 5, the occupancy rate for privately owned office buildings is shown. This occupancy rate is the ratio of the rented area to the total rentable area, and does not include space occupied by the owner of the building. This latter category is classified as non-competitive occupied area in the semi-annual survey of office space occupancy compiled by the Building Owners and Managers Association International (BOMA) and published in Skyscraper



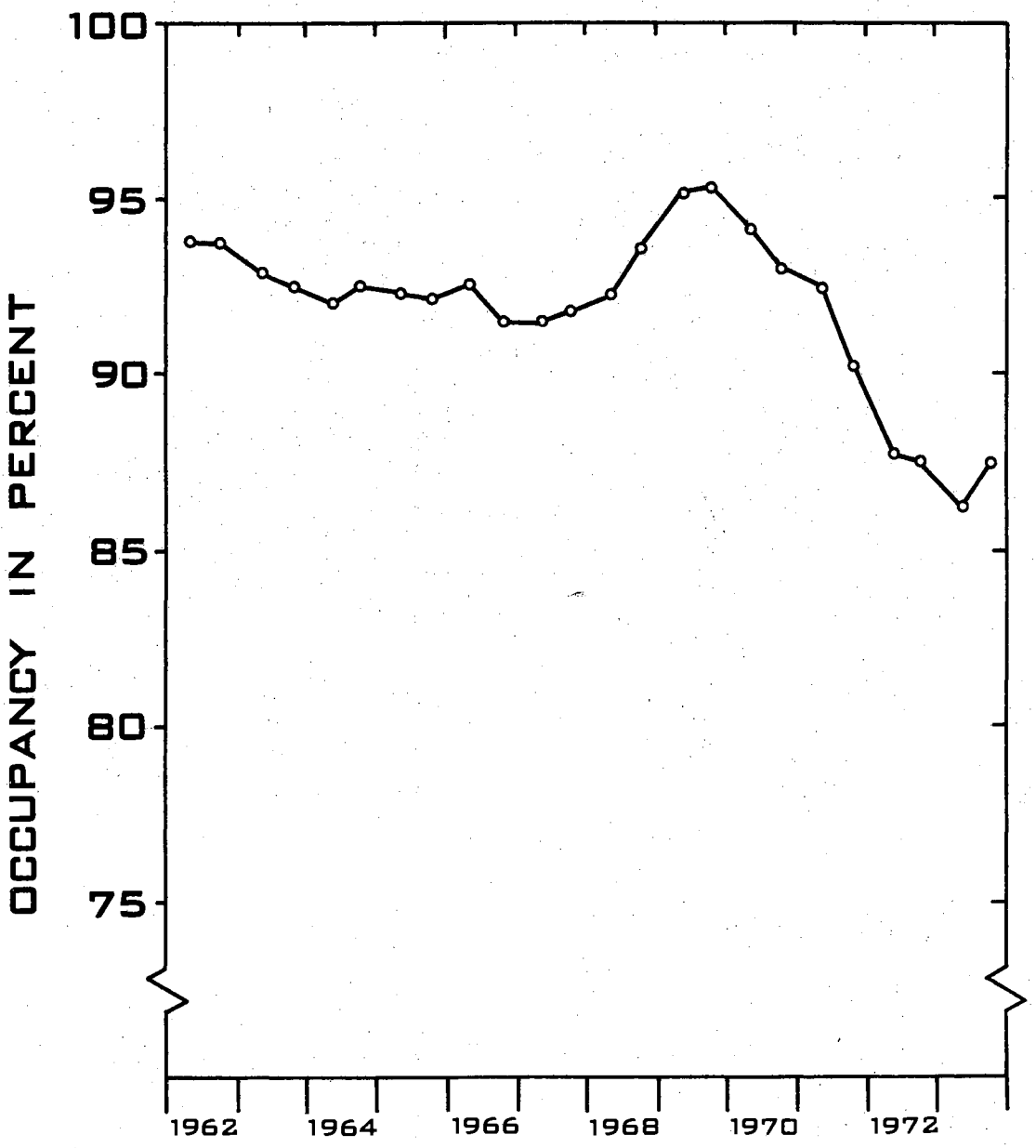
SOURCE: ARMSTRONG, REGINA B. The Office Industry, CAMBRIDGE: THE MIT PRESS, 1972.

Figure 3. Estimated U. S. Inventory of Office Space - 1930-1973



SOURCE: DODGE CONSTRUCTION POTENTIALS; McGRAW-HILL INFORMATION SYSTEMS COMPANY.

Figure 4. Annual Office Building Construction Started in the United States - 1957-1973



SOURCE: "SURVEY OF OFFICE SPACE OCCUPANCY" (CONDUCTED IN MAY AND OCTOBER OF EACH YEAR), SKYSCRAPER MANAGEMENT.

Figure 5. National Average Occupancy of Privately Owned Office Buildings - 1962-1973

Management (51). The reason only the rentable area was used in this study, is that it is a more sensitive figure and better reflects the demand for additional office space.

The building occupancy from 1963 to 1967 is relatively steady, and is close to an optimum occupancy of rentable space of 92-93 percent. By referring to Figure 4, this means that the rate of new office buildings started during 1961-1965 was at the rate that the market could absorb the completed buildings in 1963-1967. The average lead time from the date that the contract is let until the office building is completed and manifests itself in the occupancy survey is an average of two years. From Figure 5 it is noted that the occupancy rate increased sharply during 1968 and 1969, indicating that not enough office buildings were started during 1966 and 1967, as shown in Figure 4. Again referring to Figure 5, the rapid decrease in occupancy in 1970, 1971, and 1972 indicates that an excess amount of office space was started in 1968, 1969, and 1970, as shown in Figure 4.

During 1973, the national market could apparently absorb the amount of office space that was available. This means that the amount of office space started in 1971 was approximately correct. There is an excess of office building space on a national average, and it will take several years to absorb the excess that came on the market between 1970 and 1972.

The office building industry goes through periodic cycles of overbuilding and gradual assimilation of this excess office space, and then another cycle of overbuilding, etc. The classic example of overbuilding in the United States at this time is in the Central Business District (CBD) of New York City. There is an excess of over 10 million

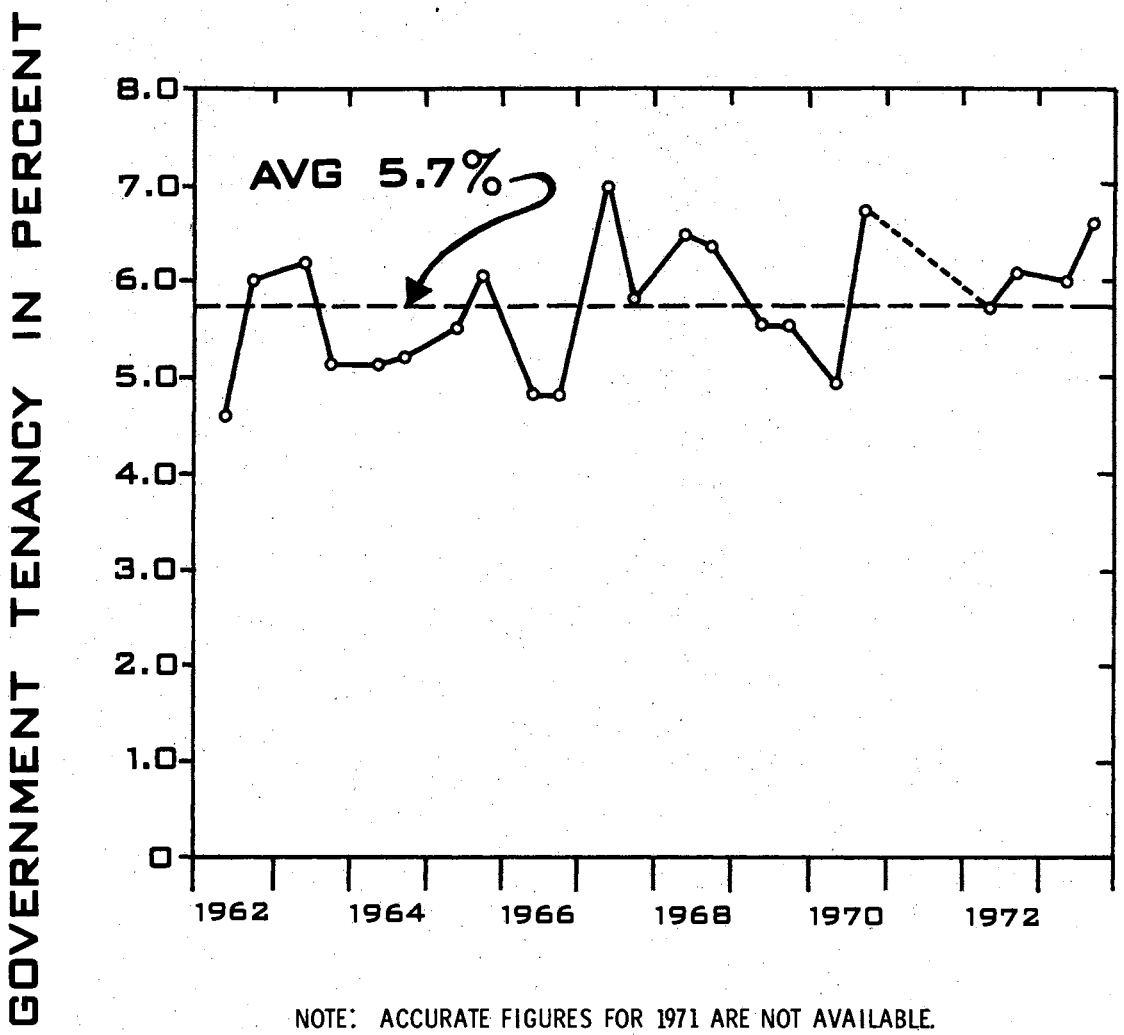
square feet of office space in new office buildings at this time, according to the realty brokerage firm of Julien J. Studley, Inc. (39).

Government tenancy in privately owned office buildings has remained relatively stable at the national level during the period 1962-1973, as shown in Figure 6.

An Econometric Forecasting Model

This model was developed by studying the past and determining the economic variables that best explain the one dependent variable which is the dollar value of construction contracts for office buildings (CONSTCON). The interrelationships between the variables have been specified as regression coefficients in a multiple regression equation. The lead and lag relationship between each independent variable and the rest of the model was also determined. This work was done using historical data. In order to make forecasts, estimates of future values of the independent variables are required. In the case where independent variables lead the model, values are available for as many quarters as the particular variable leads the model. An example of this type of relationship is illustrated in Table IV, where the date of the data for each observation is shown. Any horizontal row is a set of data for one observation. The selection of the actual independent variables used in this model is discussed in greater detail in Chapter IV.

The model developed in this study is a quarterly econometric forecasting model. This means that there is one observation for each quarter, and that there is a forecast for each quarter in the future for six quarters. The reason that six quarters in the future was chosen is that this is the length of time that one of the independent variables



NOTE: ACCURATE FIGURES FOR 1971 ARE NOT AVAILABLE. THE AUTHOR CONNECTED THE 1970 AND 1972 FIGURES WITH A DASHED LINE.

SOURCE: "SURVEY OF OFFICE SPACE OCCUPANCY" (CONDUCTED IN MAY AND OCTOBER OF EACH YEAR), SKYSCRAPER MANAGEMENT.

Figure 6. National Average of Government Tenancy in Privately Owned Office Buildings - 1962-1973

TABLE IV

AN EXAMPLE OF A LEAD RELATIONSHIP BETWEEN THE INDEPENDENT VARIABLES AND THE DEPENDENT VARIABLE IN A MULTIPLE REGRESSION MODEL

	Observation	Dependent Variable Y	Independent Variable X_1	Independent Variable X_2	Independent Variable X_3
HISTORICAL DATA USED TO DETERMINE REGRESSION COEFFICIENTS	1	1Q-1971	1Q-1971	3Q-1969	2Q-1969
	2	2Q-1971	2Q-1971	4Q-1969	3Q-1969
	3	3Q-1971	3Q-1971	1Q-1970	4Q-1969
	4	4Q-1971	4Q-1971	2Q-1970	1Q-1970
	5	1Q-1972	1Q-1972	3Q-1970	2Q-1970
	6	2Q-1972	2Q-1972	4Q-1970	3Q-1970
	7	3Q-1972	3Q-1972	1Q-1971	4Q-1970
	8	4Q-1972	4Q-1972	2Q-1971	1Q-1971
	9	1Q-1973	1Q-1973	3Q-1971	2Q-1971
	10	2Q-1973	2Q-1973	4Q-1971	3Q-1971
	11	3Q-1973	3Q-1973	1Q-1972	4Q-1971
	12	4Q-1973	4Q-1973	2Q-1972	1Q-1972
These are the forecasts computed by this model		1Q-1974 2Q-1974 3Q-1974 4Q-1974 1Q-1975 2Q-1975	Forecasts of this independent variable are required	3Q-1972 4Q-1972 1Q-1973 2Q-1973 3Q-1973 4Q-1973	2Q-1972 3Q-1972 4Q-1972 1Q-1973 2Q-1973 3Q-1973 4Q-1973

Model: $Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3$.

leads the model and there are no reliable forecasts for this variable. The availability of data has thus specified the horizon for this model.

The construction industry is said by Kittides (41) and many others to be the bellweather industry of the economy. The general condition of the economy of the United States is best specified by the Gross National Product (GNP). The investment in office buildings is included in the "Summary of Income and Product Accounts" as Fixed Investment in Non-residential Structures (FIXINVST).

Supply and demand for office space is obviously vital to this model and is accounted for by occupancy in percent. Note that this particular variable is unique to this model and is an essential economic variable for this model. Corporate Profit (CORPROFT) is incorporated as a measure of the availability of funds for investment. The interest rate on Federal Funds (FEDFUNDS) is also a measure of the availability of funds for investments.

One unique feature developed here is the use of the output from a large-scale structural and forecasting econometric model as input to this model. The future state of the U. S. economy is forecast by the large-scale econometric model and selected variables from it are used in the model developed in this study. In this manner, the results of sophisticated econometric techniques which use an extremely large data base are incorporated into this model.

In addition to variables from the large-scale econometric model, additional economic variables are introduced to furnish the data required for this model to forecast accurately the one dependent variable. This model is thus unique and is structured to forecast only one variable, and that is the dollar volume of construction contracts

(CONSTCON) for office buildings in the United States.

The dollar volume of construction contracts for office buildings on a quarterly basis is very volatile, and is illustrated in Figure 7. The item really needed by the construction industry is a good forecast of dollar volume of construction contracts for a year in the future; this is obtained by adding the estimates for four quarters in the future. It generally takes six weeks after a quarter ends to obtain the desired data from that quarter. It takes less than a day to update the model and make forecasts, and a month to get the forecast published and in the hands of the ultimate user. Therefore, the horizon of this model of six quarters is very realistic to make predictions a year in the future on an annual basis.

The details of the development of this model are covered in Chapter IV.

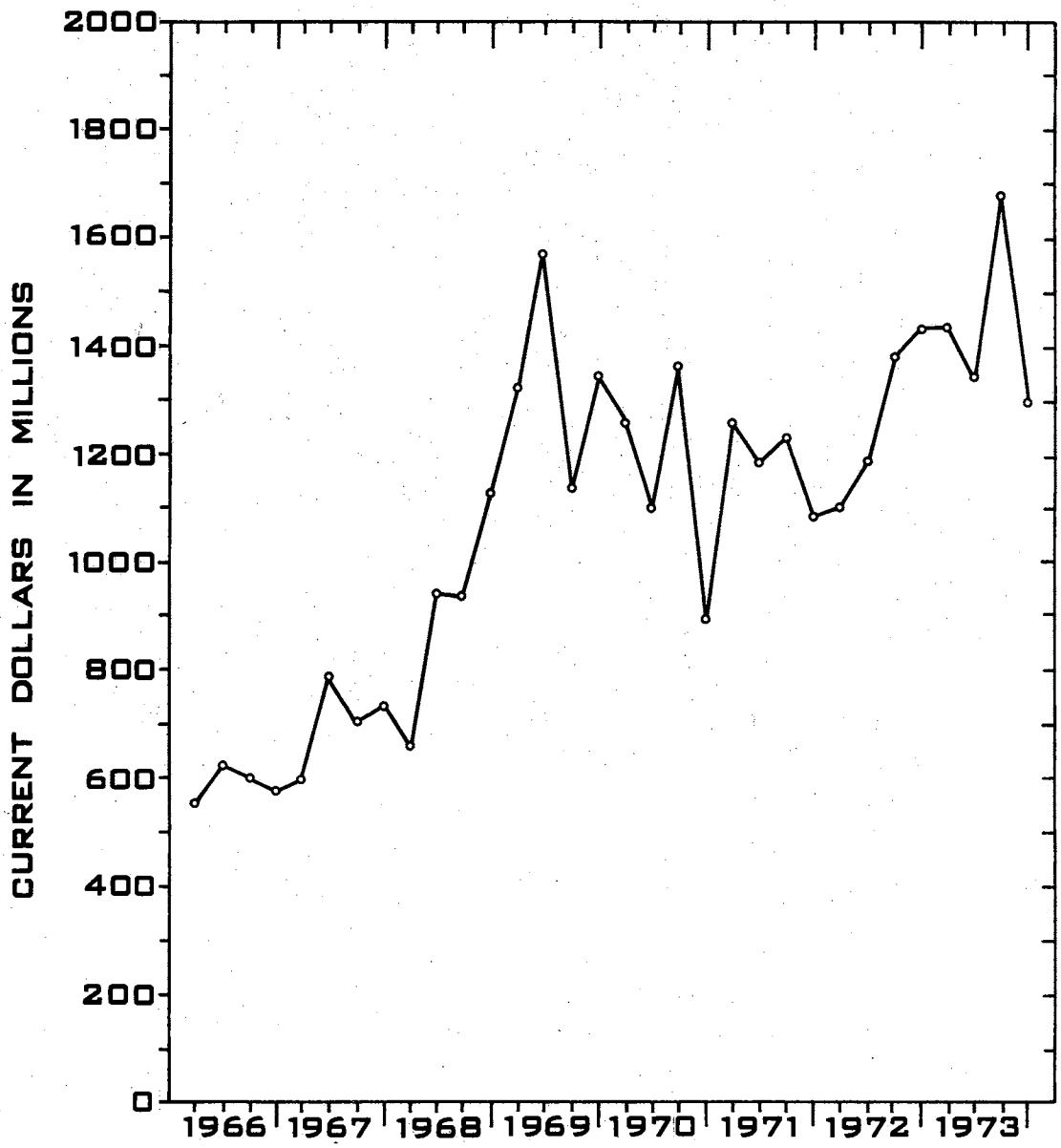


Figure 7. Construction Contracts (CONSTCON) for Office Buildings - 1966-1973

CHAPTER III

SOURCES OF DATA AND FORECASTS

In the model developed in this study, historical data is required for both the dependent and the independent variables. With this data, the regression coefficients can be calculated. Forecasts of the independent variable are required unless, as explained in Chapter II, that particular independent variable leads the model. The independent variables selected for the final model should be variables for which accurate forecasts are available. The term "accurate" in this context means that the value of the dependent variable computed using the forecast values of the independent variables in the regression equation is more accurate than directly forecasting the dependent variable.

Sources of historical data will be treated initially to include both government and private sources. Next, sources of forecasts will be examined.

The names of the variables chosen for this study are abbreviations or contractions of the variable represented. In the Statistical Analysis System II (SASII), a variable name may be up to eight characters long. Table V includes an explanation of all variables used.

Historical Government Data

Gross National Product (GNP) is the most comprehensive single measure of the aggregate economic output of the United States. Historical

TABLE V

EXPLANATION OF VARIABLES

Variable Name	Explanation
BID_VOL	Bidding volume for office buildings in millions of current dollars
BID58DOL	Bidding volume for office buildings in millions of constant 1958 dollars
CLERKEMP	Clerical employment in the United States in millions
CONSTCON	Value of construction contracts awarded for office buildings in the United States in millions of current dollars
CON58DOL	Value of construction contracts awarded for office buildings in the United States in millions of constant 1958 dollars
CORPBOND	The yield on corporate bonds in percent
CORPROFT	Corporate profit after taxes in billions of current dollars (seasonally adjusted at annual rates)
PROFIT58	Corporate profit after taxes in billions of constant 1958 dollars (seasonally adjusted at annual rates)
FEDFUNDS	Rate of return on federal funds in percent
FIXINVST	Fixed investment in nonresidential structures in billions of current dollars (seasonally adjusted at annual rates)
FIX58DOL	Fixed investment in nonresidential structures in billions of constant 1958 dollars
GNP	Gross national product in billions of current dollars (seasonally adjusted at annual rates)
GNP58DOL	Gross national product in billions of constant 1958 dollars (seasonally adjusted at annual rates)
GOVSECUR	The yield on U. S. Government securities (taxable), three-to-five year issues
NEWPLANS	New construction plans for office buildings in millions of current dollars
PLANS58	New construction plans for office buildings in millions of constant 1958 dollars
OCCUPNCY	Occupancy of office buildings in percent

data is available in many sources. The source used in this study is Table 1 of the Survey of Current Business (58). GNP is presented in both current dollars and in constant 1958 dollars. The reason this source was selected was that the adjusted GNP figures are published promptly at the end of each year in the Survey of Current Business. In several other government publications there is a delay of up to six months before the adjusted GNP figures are published. For the same reason, fixed investment in nonresidential structures (FIXINVST) is also obtained from Table 1 of the Survey of Current Business.

The source of data on corporations is Business Conditions Digest (BCD), which is published monthly by the U. S. Bureau of Economic Analysis (56). Corporate profit after taxes in current dollars (CORPROFT) is in Series 16, and corporate profit after taxes in 1958 dollars (PROFIT58) is in Series 18. The rate of return paid on corporate bonds (CORPBOND) is in Table B6, Series 116.

The Federal Reserve Bulletin, which is published monthly, is the source of both the interest rate on Federal Funds (FEDFUNDS) and the interest rate on the U. S. Government securities three-to-five year issues (GOVSECUR). These are both published in a table titled "Money Market Rates." Clerical employment is published in Table A49 of Employment and Earnings (59).

A search for a value of construction contracts for office buildings (CONSTCON) in government publications proved futile. The Survey of Current Business (58) publishes data from the Bureau of the Census on the estimated value of construction put in place. The value of construction put in place in a year may be different from the value of construction contracts awarded during that year. The data for

construction put in place is aggregated into four categories for public construction:

1) residential

2) industrial

3) commercial, and

4) public utilities.

Office buildings are included in Commercial Buildings with stores, shopping centers, and garages. This degree of aggregation and the fact that the data was not available for 1965, 1966, and 1967 required that this data source be eliminated from further consideration.

Construction Review (61) publishes data on the value of construction contracts awarded each month. The data is quite aggregated, and again Office Buildings were included in Commercial Buildings, which again included stores, shopping centers, and garages. Of greater importance was the fact that the source of this data was the F. W. Dodge Division of McGraw-Hill Information Systems Company. Aggregated Dodge data was the source quoted for construction contract awards reported in the Survey of Current Business, Business Conditions Digest, and The Federal Reserve Bulletin.

The obvious conclusion is that the government does not keep usable statistics on the value of construction contracts by category of construction. When this data is desired, a private source must be consulted and the most often quoted is the F. W. Dodge Division, McGraw-Hill Information Systems Company. This source is discussed in the next section.

Historical Private Data

Because construction is such a large industry, there is a demand for information about the industry. Engineering News-Record (ENR) is an excellent source of this data. The author had ready access to ENR data because this study was proposed by Mr. James Webber, who was at that time manager of the Business Data Department. He is presently the Director of Planning and Development, and was instrumental in obtaining access for the author to the Dodge Construction Potentials for Office Buildings. The ENR data is divided into two categories, which are New Plans and Bidding Volume. Both categories are tabulated weekly in the categories shown in Table I and published in the "Scoreboard" Section, which appear each week in ENR (20)(example in Appendix B). The New Plans category is the estimated dollar value of projects when design is started. This information is obtained from information supplied by designers. When the construction contract is awarded for a project that had been previously reported in New Plans, the value of the construction contract is supplied as Building Volume. In this manner, all construction contracts reported flow from New Plans to Bidding Volume. Design is initiated on many more projects than contracts are ever awarded, and this fall-out accounts for the large differences in data. A plot of both New Plans and Bidding Volume versus time for Office Buildings is included in Figure 8. The time interval selected for this plot was quarterly, because that makes the data compatible with the model. A regression analysis was conducted between Bidding Volume and New Plans, and the optimum lead relationship determined. This lead relationship was used in developing the model in this study.

The F. W. Dodge Division of McGraw-Hill Information Systems Company

is a private firm that has been publishing data on the construction industry for over 80 years. Dodge publishes five proprietary reports and special reports as desired. There are over 1400 news reporters nationwide, and the data is reported by county by category of construction. In this study, the value of contract construction (CONSTCON) on a quarterly basis for the entire United States was used. As stated previously, the term "Office Buildings" also includes bank buildings and buildings used by savings and loan associations. This proprietary data was published in Dodge Construction Potentials, and was provided to the author by the F. W. Dodge Division of McGraw-Hill Information Systems Company.

The Building Owners and Managers Association (BOMA) International conducts surveys of its members and periodically publishes statistics on Office Buildings. There is a "Survey of Office Space Occupancy" which is conducted as of May 1st and October 1st of each year. The results are published in "Skyscraper Management" (51). Also, BOMA International publishes annually the Office Building Experience Exchange Report (8), which includes data on space allocation, income, costs on analyses by age of the building, etc.

Sources of Forecasts

Six econometric models will be investigated to determine their purpose, character, and output. The treatment of the construction industry by each model will be examined and its relevance to this study will be evaluated. The six models are:

The Bureau of Economic Analysis Quarterly Econometric Model
(formerly Office of Business Economics OBE Model)

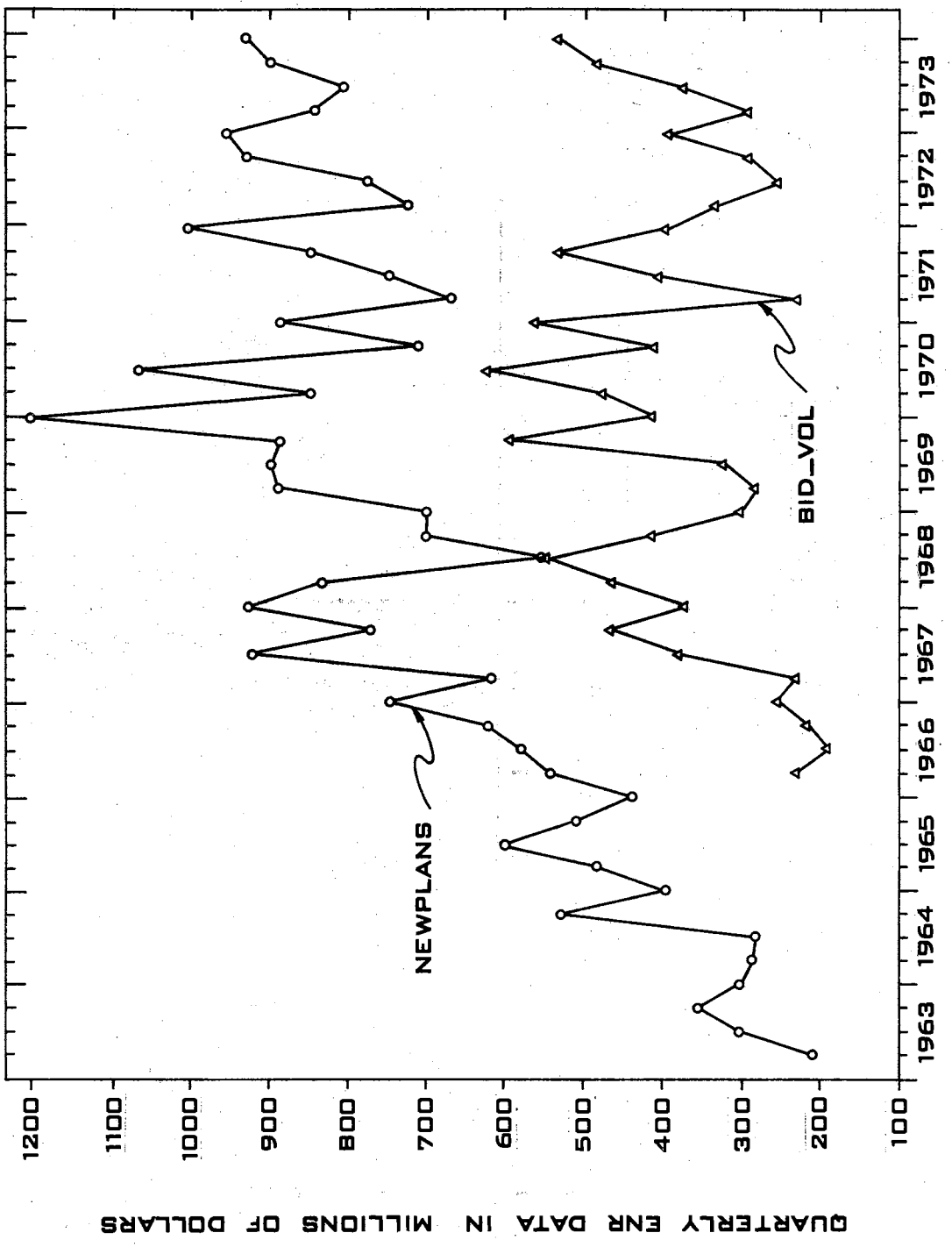


Figure 8. A Plot of ENR NEWPLANS and BID_VOL versus Time

The Brookings Model

The Wharton-EFU Model

The Fair Model

The National Association of Homebuilders Model

The Data Resources (DRI) Model.

These models generally treat the Gross National Product (GNP) of the United States as four major sectors:

1) Personal Consumption Expenditures

2) Gross Private Domestic Investment

3) Net Exports of Goods and Services

4) Government Purchases of Goods and Services.

Of particular interest to this study is the sector titled "Gross Private Investment." Note that all private construction is included in only two entries, Fixed Investment in Nonresidential Structures, and Fixed Investment in Residential Structures. The Gross National Product is generally presented as a summary of national product accounts, which shows how the output of the U. S. Economy was distributed. Thus, National Product Accounts is a group of accounts showing the market value of goods purchased by each of the four major sectors and selected subsectors of the U. S. Economy.

Charges against Gross National Product are represented by a summary of National Income Accounts, which is a group of accounts showing the cost of producing the current output of the U. S. Economy. The summary of National Income Accounts is shown in the top half of Table VI.

A complete explanation of each account is contained in the U. S. Department of Commerce Dictionary of Economic and Statistical Terms (62). With this background, the six econometric models will be examined.

TABLE VI

SUMMARY OF NATIONAL INCOME AND PRODUCT ACCOUNTS[1], 1974
IN BILLIONS OF CURRENT DOLLARS

Compensation of employees	785.2
Wages and salaries	691.4
Supplements to wages and salaries	93.9
Employer contributions for social insurance	49.0
Other labor income	44.9
Proprietors' income	84.2
Rental income of persons	25.1
Corporate profits and inventory valuation adjustment	109.0
Profits before tax	126.3
Profits tax liability	55.8
Profits after tax	70.4
Dividends	27.8
Undistributed profits	42.6
Inventory valuation adjustment	-17.3
Net interest	50.4
NATIONAL INCOME	1053.9
Business transfer payments	4.9
Indirect business tax and nontax liability	117.8
Less: Subsidies less current surplus of government enterprises	0.4
Capital consumption allowances	110.0
Statistical discrepancy	2.1
CHARGES AGAINST GROSS NATIONAL PRODUCT	1289.1
Personal consumption expenditures	804.1
Durable goods	130.8
Nondurable goods	335.9
Services	337.3
Gross private domestic investment	202.1
Fixed investment	194.2
Nonresidential	136.2
Structures	48.4
Producers' durable equipment	87.8
Residential structures	58.0
Change in business inventories	8.0
Net exports of goods and services	5.8
Exports	102.0
Imports	96.2
Government purchases of goods and services	227.1
Federal	106.6
National defense	73.9
Other	32.7
State and local	170.5
GROSS NATIONAL PRODUCT	1289.1

[1]Source: (62)

The Bureau of Economic Analysis (BEA) Quarterly Econometric Model

The Bureau of Economic Analysis, which is part of The Social and Economic Statistics Administration of the U. S. Department of Commerce, was formerly known as the Office of Business Economics (OBE). In much of the literature, the model is referred to as the Office of Business Economics (OBE) Quarterly Econometric Model.

This is a sophisticated large-scale structural econometric model of the economy of the United States. Because it is a structural model, it incorporates the interdependence of the many diverse elements of the economy. One of its principal uses according to Hirsch (30) is the analysis of the impact on the U. S. economy of alternative governmental macroeconomic policies. An example of such an analysis was to study the impact of a 10-percent increase in personal income tax. The results of this analysis indicated that a 10-percent increase in personal income tax would cause a major economic recession at that time.[1]

The other principal use of this model is to predict future economic activity. The results deteriorate as the forecast horizon lengthens, and Hirsch (30) states on page 25 that six quarters is the usual forecasting horizon for his model. On page 24, Hirsch also states that

> In practice we frequently deviate from forecasting in this pure sense by generating more than one set of outputs for a given time period based on alternative assumptions for some of the inputs.

The outputs from this model are exclusively for government use and they are not released to the public because these forecasts could conflict

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[1] Interview, March 11, 1974, by the author with Dr. Bruce Grimm, Bureau of Economic Analysis, U. S. Department of Commerce.

with the official government forecast because of different assumptions.

In order to have such a powerful model, it must be rather sophisticated. This model contains 63 stochastic equations and their general relationship is explained by Hirsch (30).

The Simplified Flow Chart of BEA Quarterly Model (Figure 9) illustrates the interaction of the major sectors of the economy. The top row or rounded boxes represents the exogenous or independent variables. This is fed into the model as data because its value is determined outside of the model. The rectangular boxes all represent endogenous or dependent variables whose values are determined within the model. The model is then solved by an algorithm that accomplished the following steps:

1) solve the identity equations with known values
2) solve the independent equations
3) solve the group simultaneous equations by an iterative process until the convergence is satisfactory (.01)
4) solve the remaining independent equations which use the output from the simultaneous equations.

The results are six tables which give predictions for the GNP in current and constant 1958 dollars and the various components of the GNP to include employment, income, and interest rates. Judgement must also be applied to the results provided by this model.[2] A determination has to be made whether or not the results are within the range of the model.

Also, the predicted values for the endogenous variables have to be compared with actual values for the past eight quarters. When a

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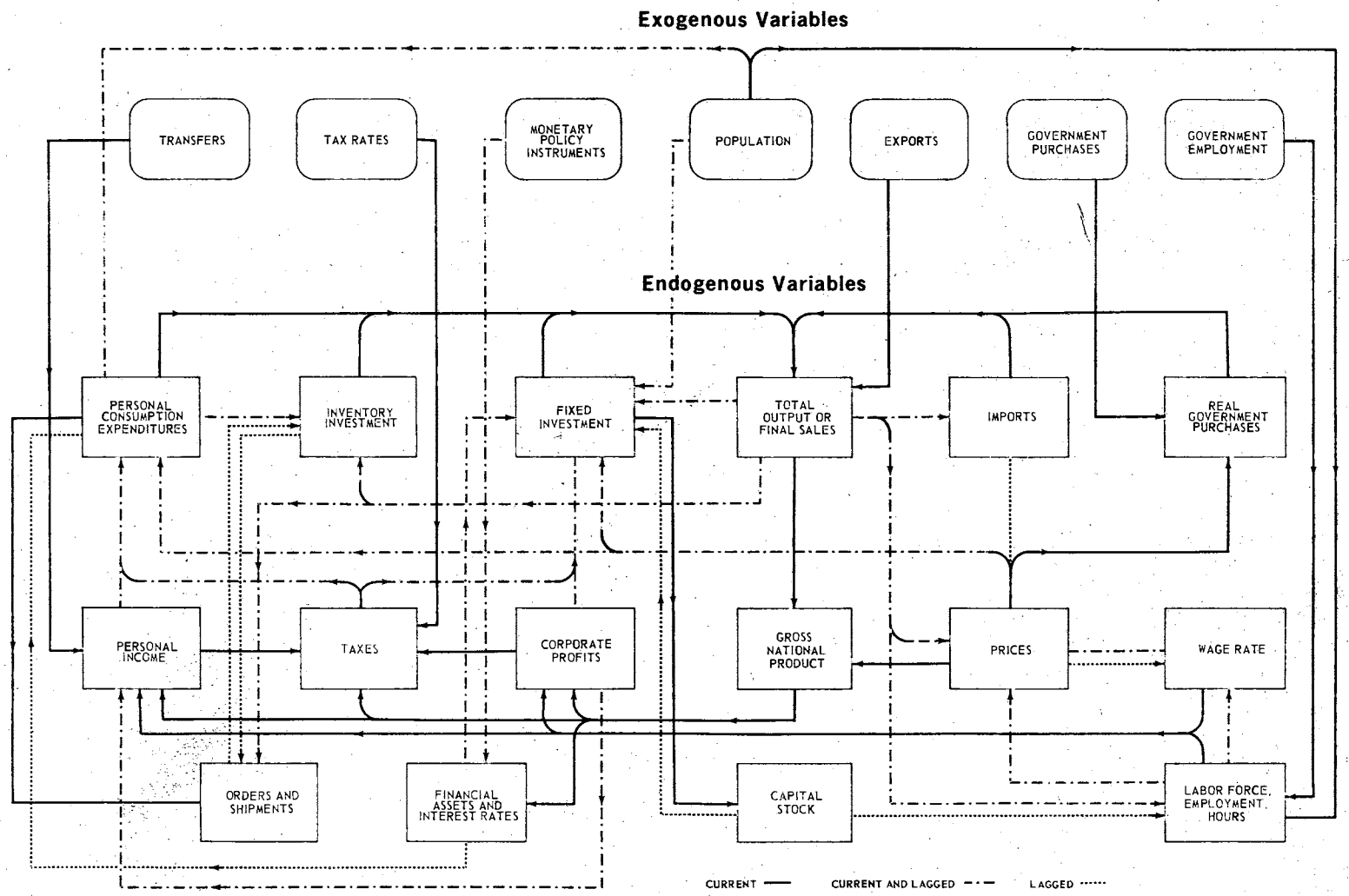
[2]Interview, March 12, 1974, by the author with Dr. Bruce Grimm, Bureau of Economic Analysis, U. S. Department of Commerce.



BEA Staff Paper #22 - July 1973 (30)

Figure 9. Simplified Flow Chart of BEA Quarterly Econometric Model

divergence is noted, future predictions must be adjusted.

The servicing and updating of such a sophisticated model is a major task. A staff of eight, which includes three PhD economists, spends approximately 45 percent of its time servicing and updating the BEA Model and an additional 35 percent of its time making forecasts with the model.[3]

Of major importance to this study is the fact that in the BEA Quarterly Econometric Model, the entire construction industry is represented by only three entries. These entries are Fixed Nonresidential Investment, Residential Structures, and a part of Government Purchases of Goods and Services.

Fixed Nonresidential Investment includes both Nonresidential Structures and Producers' Durable Equipment. This degree of aggregation makes the output of this model limited to GNP for the purposes of this study.

The Wharton - EFU Model

The Wharton - EFU (Economic Forecasting Unit) Model is considered to be the best known of all econometric forecasting models, according to Fair (25). This macroeconomic model has as its goal the forecasting of the Gross National Product of the United States and the summary of national income and product accounts. The forecasts of this model are reported in Business Week (9) and in the Wharton Quarterly.

This model is a combination of two previous models. One of these models was completed in 1963 by Dr. Michael K. Evans, and is known as

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[3]Interview, March 12, 1974, by the author with Dr. Bruce Grimm, Bureau of Economic Analysis, U. S. Department of Commerce.

the Evans Model. The other model was developed by Dr. Lawrence R. Klein under a grant from the Rockefeller Foundation, and is known as the Wharton Model. These two models and some new ideas were combined into the Wharton - EFU Model in 1965.

Evans (23) explains that there are 47 behavioral equations, 29 identities, and 120 variables. Of these variables, 77 are jointly dependent (endogenous) variables, and there are 12 independent (exogenous) variables.

There is a unique approach in the Personal Consumption sector. Instead of one equation for Durable Goods, one for Nondurable Goods, and one for Services, which is the standard approach, Nondurables and Services are combined in one equation, automobiles are handled in a second equation, and Other Durables are included in a third equation. These equations are used to determine three variables, which are

1) Manufacturing Investment in Plant and Equipment
2) Regulated and Mining Investment in Plant and Equipment
3) Commercial and Other Industrial Investment in Plant and Equipment.

The Housing subsector has one principal equation to determine the Investment in Private Non-farm Residential Construction. The Change in Business Inventories is covered by two equations, and Imports and Exports are determined by four equations. Government Purchases of Goods and Services are included in one of the identities. The remaining equations cover the charges against Gross National Product.

Of primary importance to this study is the fact that Construction is included in Government Purchases of Goods and Services, Residential Construction or Fixed Investment in Plant and Equipment. Because

Equipment or Producers' Durable Equipment represent almost two-thirds of Nonresidential Fixed Investment, the remaining portion, which is Plant or Structures, is masked to the point where it is of no use in forecasting construction in any one segment of the construction market. This latter category is disaggregated to Manufacturing, Regulated and Mining Industries, and Commercial and Other Industries Investment, but they all include Plant and Equipment.

The Brookings Quarterly Econometric Model of the United States

This is a very sophisticated large-scale structural econometric model of the economy of the United States. The Brookings Model development started as an economic research conference stimulated by the Social Science Research Council (SSRC) and held in Ann Arbor in 1959. From this conference, a proposal was approved for the development of a larger scale econometric model to be sponsored by SSRS. A grant was provided by The National Science Foundation, and work was under way. The approach was to assemble more than twenty of the best men in the field at a three-week conference at Dartmouth in 1962. A second conference for two weeks was held the next year.

Work continued at The Brookings Institute, guided by the advisory committee chaired by Professor James Duesenberry and sponsored by The National Science Foundation. The preliminary model was available in 1965. The output of years of work by more than twenty top economists supported by researchers and programmers was compiled into this large-scale econometric model. Fromm (28) states that when the model was expanded from eight to thirty-three sectors, the fullblown model

contained 359 equations. Duesenberry, et al. (18) predict that the model will eventually consists of more than 1000 equations.

In the Brookings model, one area is Nonbusiness Construction, which was developed by Maisel (17). This is divided into three areas:

1) New Dwellings

2) Other Residential Construction

3) Social and Other Nonresidential.

New Dwellings are orders for New Residential Construction, and account for over 60 percent of Nonbusiness Construction, according to Maisel (17). He further defines Other Residential Construction to include Additions, Alterations, or Other Improvements to Residential Structures.

Maisel (17) defines Social and Recreational Construction to include churches, private schools, hospitals, universities, recreational buildings, and a small component of other construction. If social and/or recreational buildings were built with public funds, then they appear in the Governmental sector.

Business Construction is included in Fixed Investment in Plant and Equipment, and Government Construction is part of Government Purchases of Goods and Services.

The use of a very large scale structural model for economic policy analysis has not been contested. The use of such a model for short-run forecasting has been questioned by Fair (25) who, on page 6, states:

> It should perhaps be pointed out that it is not really computer restrictions that are likely to hinder the use of large-scale models for short-run forecasting purposes, but the large number of man hours involved in collecting new data and keeping the models updated.

The Fair Model

This model was developed by Dr. Roy C. Fair at Princeton University in 1968 and 1969. This model is frequently referred to as the Fair (Princeton University) Model, and is a short-run forecasting model of the United States economy. Forecasts for four quarters in the future made by this model appear monthly in The Conference Board Statistical Bulletin (13). Fair (25) states on page 6 that

> The fact that industrial users want more detail than merely forecasts of the major components of GNP is beyond question, but forecasting the major components of GNP is still the main problem of economic forecasting, and accurate forecasts of these components should go a long way in helping individual users to forecast the particular economic variables they are interested in.

The Fair Model consists of 14 behavioral equations, six identities, and there are 19 dependent (endogenous) variables and 16 basic independent (exogenous) variables. There are seven equations explaining National Income Expenditure components. These are further disaggregated into three equations concerning personal consumption expenditures, one equation for each of the following areas:

1) Plant and Equipment Investment

2) Housing Investment

3) Inventory Investment

4) Import and Export.

There is one very unique feature of this model--there is no subjective "fine tuning" of this model. Fair (25) states that "given data on the exogenous variables of the model, the forecasts can be generated in a deterministic way." This means that the published forecasts are the actual values from the model, and that coefficients have not been re-instated by an econometrician to yield results that he believes are

more realistic than those produced by the econometric model. The fine tuning of the BEA model was explained to the author by Dr. Grimm.[4] The preliminary forecasts for the past several quarters (frequently eight quarters) are compared with actual results. When a divergence is noticed between forecast and actual data, then future forecasts are modified by the trend discovered in the divergence. Another technique to "fine tune" an econometric model is to compare immediate past estimates with actual figures and adjust either the constant terms or the values of the exogenous variables. This is explained by Evans, et al. (24).

Because of the comparative simplicity of the Fair Model, it can be easily re-estimated and updated each quarter. This model was designed to be a forecasting model, and that is its forte.

National Association of Homebuilders Models

There are two econometric models used by The National Association of Homebuilders. These models and their forecasting capabilities were explained by Sheehan.[5] The first model is somewhat sophisticated, and is comprised of 21 equations with 39 variables. The second model is much more simple, and has only two equations with 16 variables. When using the econometric models to forecast residential construction, Sheehan[6] stated that much better forecasts were obtained from the

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[4]Interview, March 12, 1974, by the author with Dr. Bruce Grimm, Bureau of Economic Analysis, U. S. Department of Commerce.

[5]Interview, March 12, 1974, by the author with Mr. Robert J. Sheehan, Director of Economic Research, The National Association of Homebuilders.

[6]Ibid.

second simpler model. He further stated that the most complete list and discussion of econometric models dealing with residential construction can be found in Ricks (48). Here were listed in alphabetical order the following models:

The Brady Model

The Brookings Model

The DHL III Model

The DRI Model

The Fair Model

The FRB-MIT-PENN Model

The Huang Model

The Maisel Model

The OBE (sic) Model

The Wharton Annual and Industry Forecasting Model

The New Wharton Quarterly Forecasting Model.

The point here is that there are several large-scale econometric models with a sector dealing with residential construction, forecasting models with residential construction, and some econometric models that address residential construction, principally.

The Data Resources Model

This model was developed by a corporation known as "Data Resources Incorporated," and it is frequently referred to as the DRI Model. It is a large-scale quarterly econometric model of the United States economy. It is a structural model, because it accounts for the complex interrelationships between the various facets of the economy. Alternate economic policies can be analyzed using this model. The unique feature

of this model is that in spite of the large size (698 equations and identities) its first purpose is accurate forecasting. In addition to the model, DRI maintains a proprietary national economic information system with over 13,000 time series of data[7] which are updated each working day. DRI uses a Burroughs B6700 and B7700 computer to provide its customers on line access to the model and the data base.

Another unique feature of the DRI Model is that one of its objectives is to provide sufficient points of contact for satellite models. The philosophy is for the DRI Model to provide data and forecasts to drive models for micro-economic forecasting. According to West,[8] the DRI Model is the largest econometric model of the United States economy in use today. Over 300 clients, which include some 30 government agencies, subscribe to the DRI forecasts and services. The model is updated monthly and revised annually. Thirty professional economists are employed by DRI to service the model and provide customer service.

The DRI Model was developed in 1968-1969 principally by Otto Eckstein, Edward W. Green, Allen Sinai, Martin Feldstein, Samuel Rea, Lester Thurow, V. Sandararajan, Peter Jones, Gary Fromm, Rosanne Hersh, and Robert Lacey. The number of professional people involved is provided as a measure of the massiveness of the undertaking which resulted in the DRI Model.

The DRI Model forecasts were selected for use in the model developed in this study because of the unique features of the DRI Model. It has the largest, most complete data base on the market today, and DRI

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[7]Telephone Interview - June 5, 1974, by the author with Mr. Robert West, Industrial Economist, Data Resources, Inc.

[8]Ibid.

has solved the problem of updating over 13,000 time series of data. Frequent forecasts are made, and the model is updated frequently. The quality of the forecasts is, in the author's opinion, the best that is available.

CHAPTER IV

THE MODEL

The detailed development of the model using the sources of data developed in the last chapter will now be explained. The concept is to use historical data to construct the "best" possible model and to compute the multiple regression coefficients. Determination of the "best" model involves both judgement and statistical calculations. Statistical calculations are useful in determining which independent variables contribute significantly to the model. The appropriate lead time for each independent variable must be computed. If the independent variable leads the model by a time interval equal to or greater than the horizon of the model, forecasts are not required for that particular variable because historical data can be used for that variable in conjunction with forecasts of the other independent variables. An example of this lead relationship would be if the horizon of the model were six quarters and if the lead time for one of the independent variables were four quarters. In this example, the historical data for each of the four quarters that the one independent variable leads the model would be used in conjunction with forecasts of the other independent variables. Forecasts would be required for the one independent variable for only two quarters to be used in conjunction with the forecasts of the other independent variables for forecasts of the dependent variable five and six quarters into the future. An evaluation of the

independent variables is required to determine the reliability of the forecasts of that variable. In order for an independent variable to be included in the model, it must be statistically significant and it must either lead the model or there must be a source of reliable forecasts for a time interval equal to the horizon of the model.

At the beginning of this research, it appeared that there should be a strong relationship between the two sources of ENR data, which are BID_Vol and NEWPLANS. Each of these variables is plotted versus time in Figure 8. The method of compiling the data for these two variables is explained in Chapter III. It takes time to design an office building; therefore NEWPLANS would be expected to lead BID_VOL. The optimum time that NEWPLANS leads BID_VOL was computed by a simple regression analysis

$$\text{BID\_VOL} = f(\text{NEWPLANS})$$

$$\text{BID\_VOL} = B_0 + B_1(\text{NEWPLANS}) + E$$

The results of this analysis are shown in Table VII. The optimum lead time is determined to be two quarters, because the best statistical indicators are in the column marked "2Q." The largest coefficient of determination (R-SQUARE) of 0.3679 and the largest "F" value of 17.4600 are in this column. The smallest standard deviation of 96.6574 is also in the "2Q" column. The "t" ratio for NEWPLANS, which is the ratio of the estimated regression coefficient to its standard error, is the greatest in this same column, indicating the best reliability of the estimated coefficient for a lead time of two quarters. Surprisingly, there is a weak relationship between these two variables. NEWPLANS explains only 37 percent of the variability in BID_VOL using the optimum lead time of two quarters. The computed regression coefficients

TABLE VII

THE EFFECT OF NEWPLANS LEADING BID_VOL IN A SIMPLE REGRESSION ANALYSIS

STATISTIC	Lead Time in Quarters										
	0Q	1Q	2Q	3Q	4Q	5Q	6Q	7Q	8Q	9Q	10Q
R-SQUARE	0.2053	0.1615	0.3679	0.1405	0.2458	0.0490	0.0503	0.1019	0.0621	0.1250	0.04723
STD. DEV.	108.3757	111.3247	96.6574	112.7099	105.5786	118.5572	118.4747	115.2139	117.7350	113.7223	118.6673
F VALUE	7.7516	5.7779	17.4600	4.9040	9.7783	1.5459	1.5898	3.4033	1.9880	4.2853	1.4874
t INTERCEPT	0.9072	1.5375	0.6362	1.9885	1.6211	3.2238	3.3044	3.3416	4.0593	3.8693	4.6830
t NEWPLANS	2.7842	2.4037	4.1785	2.2145	3.1270	1.2433	1.2609	1.8448	1.4100	2.0701	1.2196
DURBIN-WATSON D	1.5349	1.8627	1.6288	1.8264	1.3429	1.3987	1.2852	1.2608	1.3963	1.2022	1.3379

and the associated t-statistics (shown in parentheses) are:

$$\underset{\substack{\\ (0.6362)}}{\text{BID\_VOL} = 51.5923} + \underset{(4.1785)}{0.42219381\ \text{NEWPLANS}}$$

The results of this analysis indicate that there is a very poor linear relationship between NEWPLANS and BID_VOL even when the optimum lead relationship is used. The reason for this is that planning is started for many more office buildings than those that are actually constructed. This large amount of fall-out overshadows the relationship between NEWPLANS and BID_VOL. The significance of this is that NEWPLANS cannot be used to forecast the values of BID_VOL. Both NEWPLANS and BID_VOL are used separately in the development of the model. Later in this study, there is an analysis which determines a different optimum lead relationship between NEWPLANS and the complete model.

Correlation Coefficients

Next, a preliminary regression analysis was performed for a model with all of the independent variables.

CONSTCON = f(GNP, OCCUPNCY, BID_VOL, NEWPLANS, CORPBOND, CORPROFT, FIXINVST, FEDFUNDS, GOVSECUR, CLERKEMP)

An evaluation of the significance level of each variable will indicate which variables are either insignificant or for which there is a possible lead relationship.

An analysis of the correlation coefficients indicates the sequence of incorporating independent variables in the model. An initial indication of any lead relationships can be determined at this stage of the

model development. A computer calculation was made for each quarter that one of the independent variables led the model.

The first independent variable to be tested for a lead relationship was NEWPLANS. Table VIII shows the effect of leading NEWPLANS in the model. The optimum lead time is seven quarters, and this lead time for NEWPLANS was used for the remainder of the calculations.

The initial model investigated included all of the independent variables that had been selected for analysis.

CONSTCON = f(GNP, OCCUPNCY, BID_VOL, NEWPLANS, CORPBOND, CORPROFT, FIXINVST, FEDFUNDS, GOVSECUR, CLERKEMP)

The results of computing the correlation coefficients and t-statistic for this equation are shown below, where the t-statistic is shown in parentheses below each term:

CONSTCON = - 6812.26 + 6.72299233 GNP
(-2.3537) (4.5631)

+ 66.00158299 OCCUPNCY - 0.88916799 BID_VOL
(2.4384) (- 4.1963)

+ 0.03970140 NEWPLANS - 211.35808247 CORPBOND
(0.2257) (- 1.5951)

- 13.46722856 CORPROFT - 100.92685306 FIXINVST
(- 13472) (-4.4915)

+ 38.00440220 FEDFUNDS + 227.04990150 GOVSECUR
(1.3674) (1.99068)

- 13.04179733 CLERKEMP
(- 0.1070)

Where the t-statistic is below two, the term is not considered significant in the equation. From this analysis, the variables NEWPLANS, CORPBOND, CORPROFT, FEDFUNDS, and CLERKEMP are not significant in this

TABLE VIII

THE EFFECT OF LEADING NEWPLANS IN THE MODEL

STATISTIC	Lead Time in Quarters										
	0Q	1Q	2Q	3Q	4Q	5Q	6Q	7Q	8Q	9Q	10Q
R-SQUARE	0.9296	0.9295	0.9296	0.9275	0.9296	0.9296	0.9313	0.9349	0.9295	0.9294	0.9309
STD. DEV.	103.1728	103.2727	103.1628	103.2681	103.2100	103.1648	101.9215	99.2431	103.2556	103.2743	102.2564
F VALUE	27.7420	27.6844	27.7479	27.6870	27.7205	27.7467	28.4793	30.1521	27.6942	27.6834	28.2793
t INTERCEPT	-2.5339	02.1340	-2.3909	-2.5633	-2.4335	-2.3537	-2.4556	-2.2697	-2.5023	-2.1908	-2.4411
t GNP	4.7704	4.7666	4.2433	4.6305	4.7741	4.5631	4.7045	4.5977	4.4763	4.7614	4.5480
t OCCUPNCY	2.7093	2.4857	2.4012	2.7971	2.6980	2.4384	2.9335	2.4071	2.7100	2.5651	2.7816
t BID_VOL	-4.1737	-4.1191	-3.7866	-4.1884	-3.9400	-4.1963	-4.2723	-4.4987	-4.0617	-4.0617	-3.8557
t NEWPLANS	-0.2183	-0.0836	-0.2275	-0.0942	-0.1803	+0.2257	-0.7534	+9.3219	-0.1181	-0.0795	+0.6532
t CORPBOND	-1.5952	-1.4332	-1.2841	-1.5886	-1.2872	-1.5951	-1.4131	-1.6452	-1.5848	-1.5463	-1.4108
t CORPROFT	-1.3536	-1.3336	-1.2245	-1.3376	-1.2691	-1.3472	-1.3149	-1.2665	-1.2751	-1.3326	-1.0716
t FIXINVST	-4.5661	-4.5623	-4.4093	-4.4262	-4.5682	-4.4915	-4.6251	-4.6750	-4.4636	-4.5094	-4.3676
t FEDFUNDS	1.3663	1.2564	1.3233	1.3377	1.3612	1.3674	1.3688	1.3225	1.2932	1.2696	1.4774
t GOVSECUR	1.9951	1.8141	1.8465	1.9743	1.7438	1.9907	1.8794	2.2248	1.9365	1.9874	1.7015
t CLERKEMP	-0.1098	-0.1890	-0.1051	-0.1819	-0.2191	-0.1070	-0.4830	-0.1779	-0.1446	-0.0902	-0.3814
DURBIN-WATSON D	2.3434	2.3455	2.3359	2.3495	2.3482	2.3231	2.2368	2.2619	2.3521	2.3464	2.3802

equation. The next question is: which of these variables could have a lead relationship? CORPROFT and FEDFUNDS can logically lead CONSTCON. CORPROFT for one quarter could influence the construction of office buildings a certain number of quarters in the future. This seemed logical, so a lead relationship was investigated. The same logic applies to the rate of return on Federal Funds. The initial determination of lead time for CORPROFT as shown in Table XXIII, Appendix D, indicates that CORPROFT leads the model by seven quarters. This lead time appears logical, so it is incorporated in future calculations. The best lead time for FEDFUNDS appears to be six quarters, as shown in Table XXV, Appendix D, and this also appears logical and was incorporated in future calculations. This lead relationship must be verified in the final model. The significance level or t-statistic of these variables is now re-examined and is shown below:

$$\begin{aligned} \text{CONSTCON} = &-8739.4640 + 6.03781062\ \text{GNP} \\ &(-3.82930) \quad (4.90578) \\ &+ 91.27123837\ \text{OCCUPNCY} - 0.55769183\ \text{BID\_VOL} \\ &(4.25223) \quad (-2.28205) \\ &+ 0.04554121\ \text{NEWPLANS} - 28.65943770\ \text{CORPBOND} \\ &(0.26356) \quad (-0.27819) \\ &- 8.12798822\ \text{CORPROFT} - 82.26936016\ \text{FIXINVST} \\ &(-1.01623) \quad (-3.98406) \\ &- 40.11489566\ \text{FEDFUNDS} + 112.99071527\ \text{GOVSECUR} \\ &(-1.66046) \quad (1.35278) \\ &- 91.06667499\ \text{CLERKEMP} \\ &(-0.69460) \end{aligned}$$

At this time, the number of independent variables in the final model can be considered.

A multiple regression analysis is next performed on all possible

regression models, and the five models with the highest coefficient of determination are tabulated. There are five models with one variable, two variables, three variables, up to ten variables. This is accomplished by using the R-SQUARE procedures of SASII and is included in the computer printout in Appendix E.

An analysis of the results of the various multiple regressions tabulated by the SASII R-SQUARE procedure suggests that a model with five independent variables could produce the desired relationship. Five models were selected for further analysis:

1) CONSTCON = f(GNP, OCCUPNCY, NEWPLANS, FIXINVST, FEDFUNDS)
2) CONSTCON = f(GNP, OCCUPNCY, FIXINVST, FEDFUNDS, CLERKEMP)
3) CONSTCON = f(GNP, OCCUPNCY, BID_VOL, FIXINVST, GOVSECUR)
4) CONSTCON = f(GNP, OCCUPNCY, CORPROFT, FIXINVST, FEDFUNDS)
5) CONSTCON = f(GNP, OCCUPNCY, BID_VOL, FIXINVST, FEDFUNDS).

A detailed multiple regression analysis was computed for each model, and a summary of selected statistics is shown in Table IX. A computer printout of this is included in Appendix E. Equation (1) and Equation (2) were eliminated, because they each contained an independent variable that is not statistically significant. In Equation (1), it is NEWPLANS and in Equation (2) it is CLERKEMP. The evaluation of the three remaining equations is primarily judgemental. Better forecasts are available for the independent variables in Equation (4) than for either Equation (3) or Equation (5). The reason for this is that BID_VOL is not included in Equation (4) but is included in the other two equations. The model selected was:

CONSTCON = f(GNP, OCCUPNCY, CORPROFT, FIXINVST, FEDFUNDS)

TABLE IX

MULTIPLE REGRESSION STATISTICS FOR FIVE SELECTED MODELS

STATISTIC	Equation Number				
	(1)	(2)	(3)	(4)	(5)
R-SQUARE	0.8961	0.8964	0.9020	0.9102	0.9201
STD. DEV.	112.6697	112.5022	109.4028	104.7602	98.7822
F VALUE	44.8467	44.9957	47.8802	52.6891	59.9076
t INTERCEPT	-6.7250	-7.7442	-4.4444	-8.5334	-9.3004
t GNP	6.1840	5.0404	6.9457	7.8599	8.4061
t OCCUPNCY	6.5611	6.1298	3.6479	7.9412	8.9572
t NEWPLANS	1.1064*				
t FIXINVST	-3.3108	-3.6473	-4.1675	-4.1292	-4.2503
t FEDFUNDS	-4.0793	-4.0917		-4.1728	-4.2946
t CLERKEMP		-1.1425*			
t BID_VOL			-4.1522		-3.0687
t GOVSECUR			3.1990		
t CORPROFT				-2.3431	
DURBIN-WATSON D	2.5802	2.4532	1.9193	2.8016	2.5583

*Variable is not significant.

The regression coefficients are:

$$\begin{aligned} CONSTCON = &- 10355.82 + 5.23109761\ GNP \\ &(-8.5334) \quad (7.8599) \\ &+ 104.87361888\ OCCUPNCY - 15.01966058\ CORPROFT \\ &(7.9412) \quad (-2.3431) \\ &- 63.71735715\ FIXINVST - 57.35181672\ FEDFUNDS \\ &(-4.1292) \quad (-4.1728) \end{aligned}$$

The lead time relationships must be verified for the model selected. The lead relationship was investigated for each independent variable. The optimum lead time for CORPROFT is seven quarters, as shown in Figure 10, and selected statistics of the effect of leading CORPROFT are shown in Table X. The optimum lead time for FEDFUNDS is six quarters, as shown in Figure 11, and selected statistics of the effect of leading FEDFUNDS are shown in Table XI. Figure 12 and Table XII confirm that there is no lead time relationship for FIXINVST.

Figure 13 shows that there is definitely no lead time relationship for OCCUPNCY; the selected statistics are shown in Table XIII. There is no lead time relationship for GNP as shown in Figure 14 and confirmed by the selected statistics in Table XIV.

The residuals of the model were examined to ensure that there was no relationship in the data that had not been discovered. A plot of residual versus time is included in Figure 15. There is no discernible pattern in the plot of residuals, so the model is not rejected because of this test.

The "best" model is therefore

$$\begin{aligned} CONSTCON = &- 10355.82 + 5.231098\ GNP \\ &(-8.5334) \quad (-7.8599) \end{aligned}$$

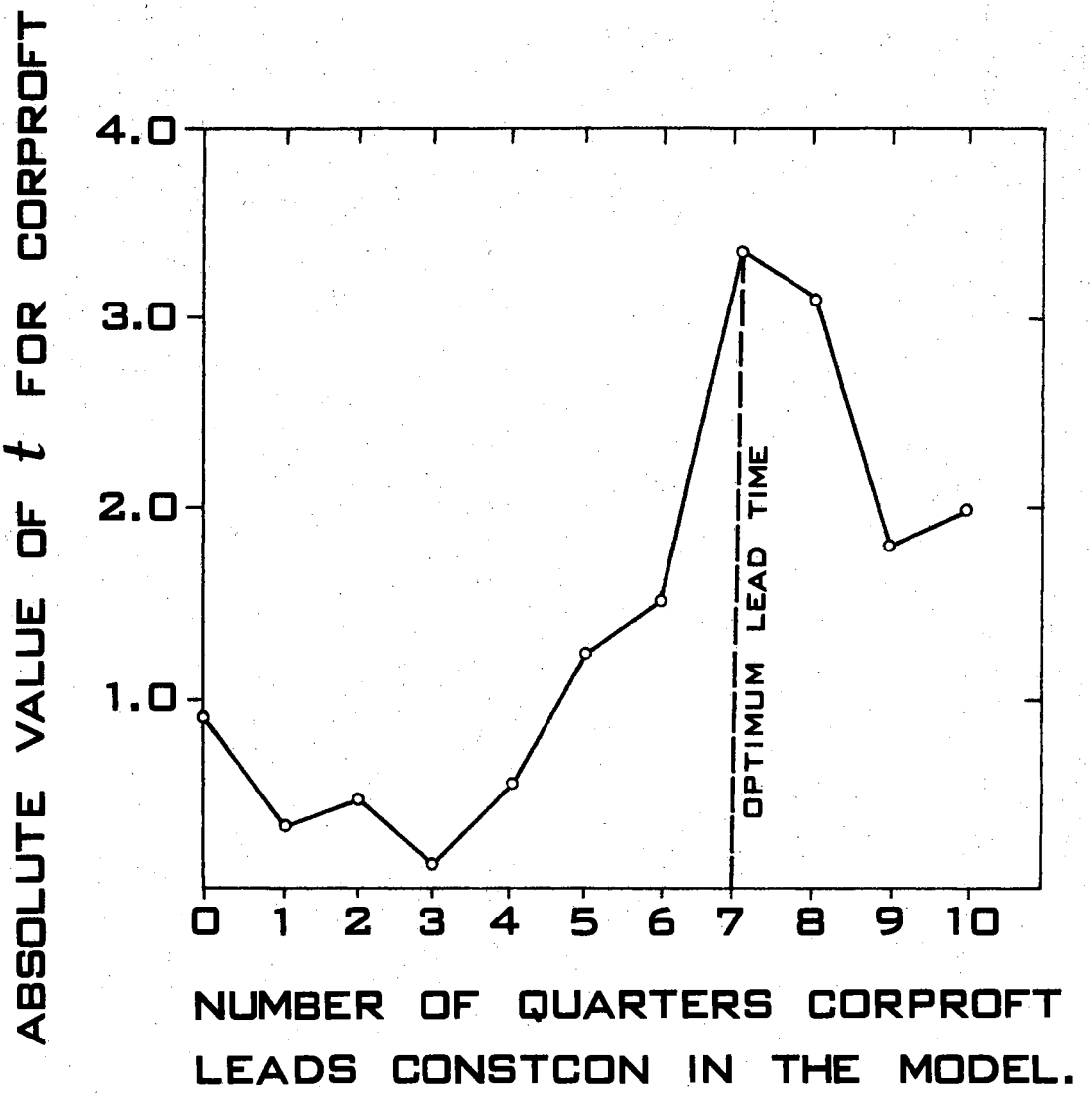
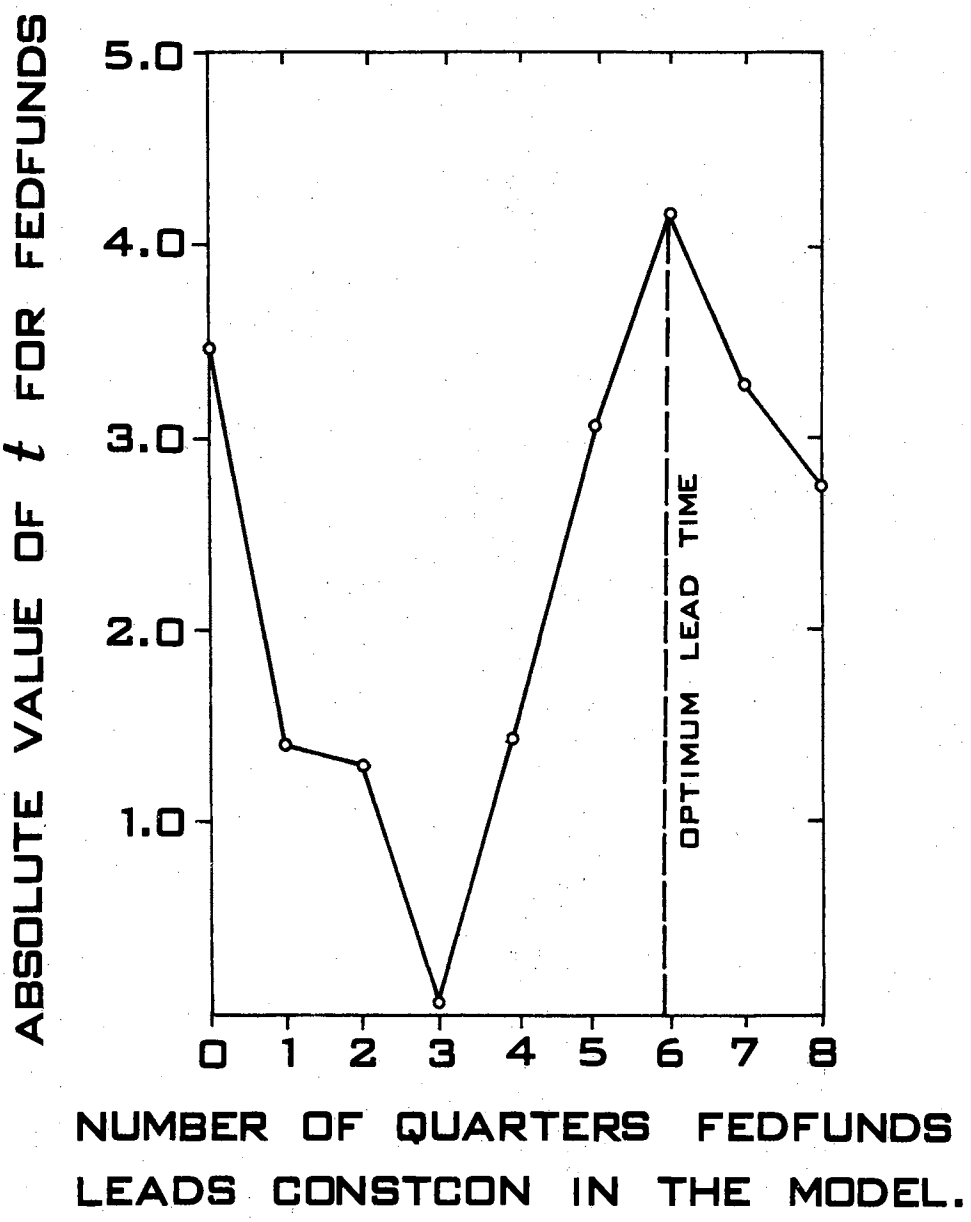


Figure 10. The Effect of Leading Corporate Profit (CORPROFT) in the Model

TABLE X

THE EFFECT OF LEADING CORPORATE PROFIT (CORPROFT) IN THE MODEL

STATISTIC	Lead Time in Quarters										
	0Q	1Q	2Q	3Q	4Q	5Q	6Q	7Q	8Q	9Q	10Q
R-SQUARE	.8567	.8530	.8534	.8523	.8540	.8602	.8647	.8970	.8923	.8686	.8719
STD. DEV.	132.32	134.06	133.82	134.35	133.54	130.68	128.59	112.15	114.70	126.69	125.09
F VALUE	31.08	30.15	30.27	30.00	30.43	32.00	33.22	45.31	43.09	34.38	35.40
t INTERCEPT	-2.84	-1.99	-2.65	-2.67	-2.96	-3.58	-4.25	-5.66	-5.71	-4.25	-4.09
t GNP	5.47	5.45	5.42	5.42	5.48	5.68	5.84	7.31	6.93	5.16	4.91
t OCCUPNCY	2.70	1.91	2.56	2.65	3.06	3.62	4.07	5.44	5.27	3.74	3.66
t CORPROFT	0.91	0.37	0.48	-0.16	-0.58	-1.23	-1.55	-3.37	-3.11	-1.81	-2.00
t FIXINVST	-2.98	-2.99	-2.92	-3.02	-3.10	-3.33	-3.48	-4.50	-4.59	-3.65	-3.74
t FEDFUNDS	0.72	0.64	0.69	1.34	1.73	2.34	2.60	3.45	2.60	1.69	1.08
DURBIN - WATSON D	2.03	2.05	2.01	2.01	2.01	2.09	2.34	2.59	2.42	2.42	2.20



NOTE: Corporate profit (CORPROFT) leads CONSTCON by 7 quarters in all of these calculations.

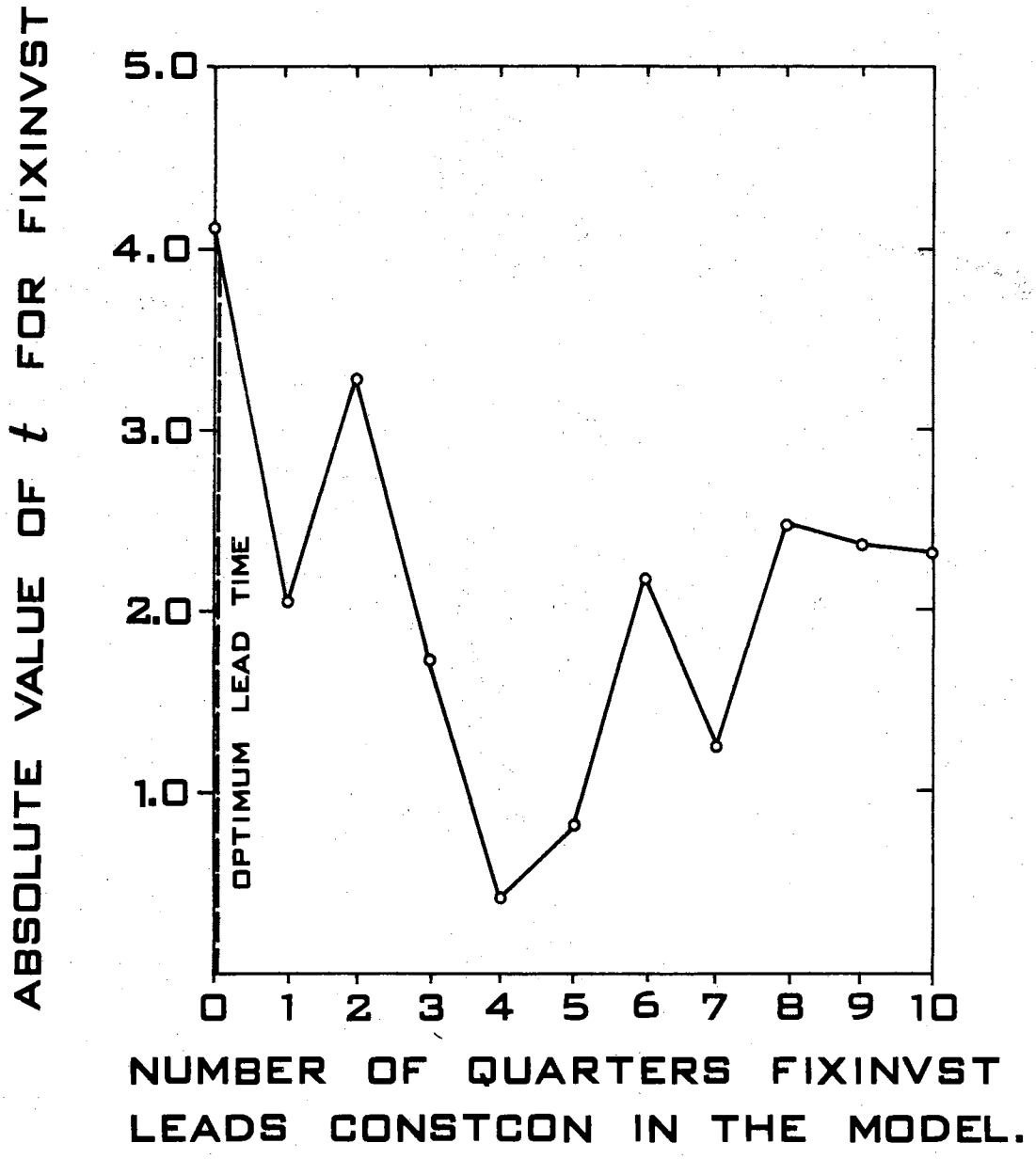
Figure 11. The Effect of Leading the Rate of Interest on Federal Funds (FEDFUNDS) in the Model

TABLE XI

THE EFFECT OF LEADING THE INTEREST RATE ON FEDERAL FUNDS (FEDFUNDS) IN THE MODEL

STATISTICS	Lead Time in Quarters								
	0Q	1Q	2Q	3Q	4Q	5Q	6Q	7Q	8Q
R-SQUARE	0.8970	0.8604	0.8589	0.8500	0.8609	0.8895	0.9102	0.8939	0.8841
STD. DEV.	112.15	130.61	131.31	135.36	130.37	116.17	104.76	113.85	119.01
F VALUE	45.31	32.04	31.65	29.48	32.18	41.88	52.69	43.81	39.66
t INTERCEPT	-5.66	-4.62	-3.90	-4.67	-5.81	-7.34	-8.53	-7.59	-7.11
t GNP	7.32	5.58	5.66	5.28	5.69	6.70	7.86	7.22	6.75
t OCCUPNCY	5.45	4.53	3.79	4.46	5.44	6.86	7.94	7.05	6.57
t CORPROFT	-3.37	-2.39	-2.32	-1.66	-1.56	-1.80	-2.34	-2.68	-2.80
t FIXINVST	-4.50	-3.11	-3.08	-2.54	-2.72	-3.25	-4.13	-4.04	-3.90
t FEDFUNDS	3.45	1.39	1.28	0.07	-1.42	-3.05	-4.17	-3.28	-2.76
DURBIN - WATSON D	2.59	2.25	1.96	1.90	2.11	2.58	2.80	2.68	2.52

Note: Corporate Profit (CORPROFT) leads by 7 quarters in all of the above calculations.



NOTE: Corporate profit (CORPROFT) leads by 7 quarters and the interest rate on federal funds (FEDFUNDS) leads CONSTCON by 6 quarters in all of these calculations.

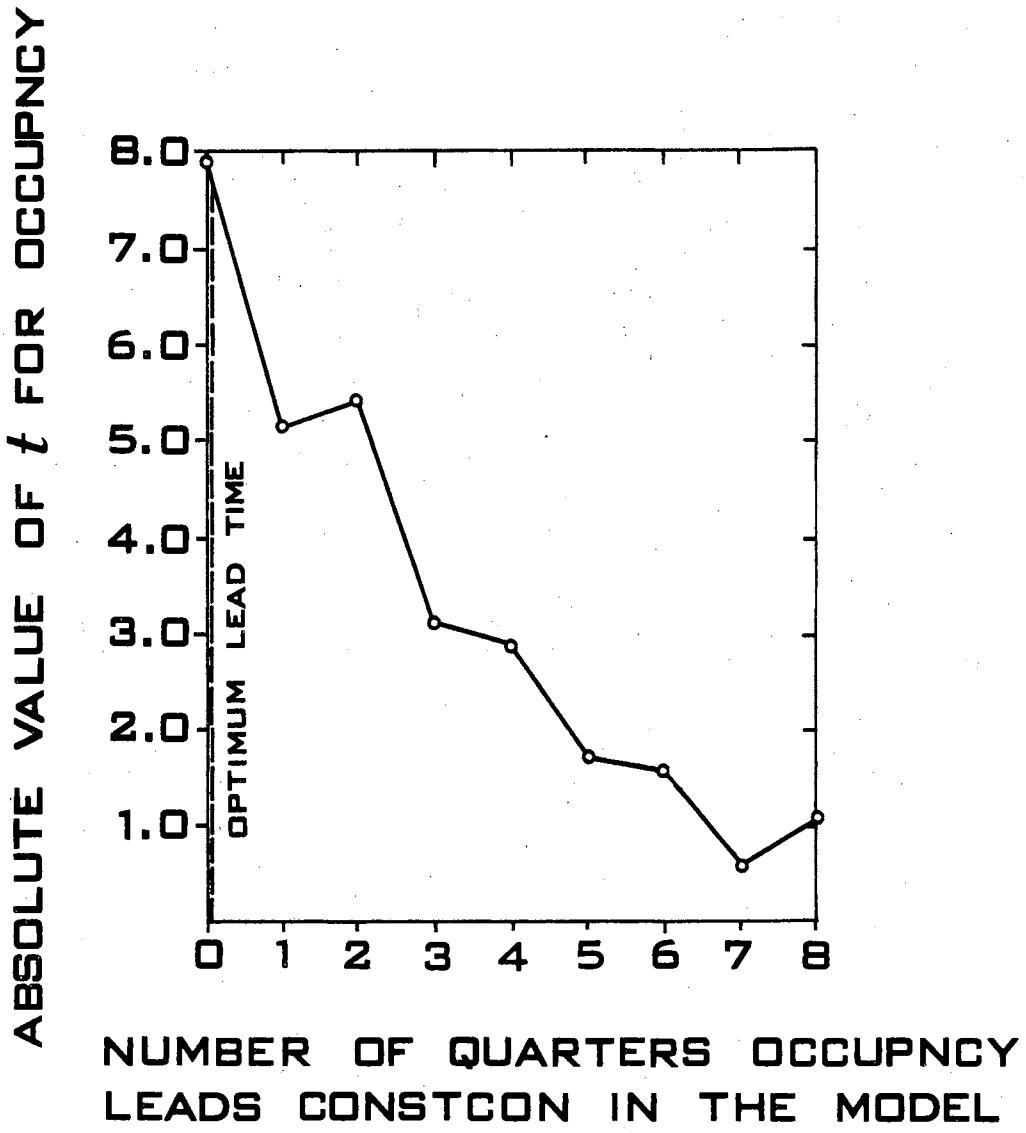
Figure 12. The Effect of leading Fixed Investment in Nonresidential Structures (FIXINVST) in the Model

TABLE XII

THE EFFECT OF LEADING FIXED INVESTMENT IN NONRESIDENTIAL STRUCTURES (FIXINVST) IN THE MODEL

STATISTIC	Lead Time in Quarters										
	0Q	1Q	2Q	3Q	4Q	5Q	6Q	7Q	8Q	9Q	10Q
R-SQUARE	0.9102	0.8722	0.8952	0.8668	0.8522	0.8549	0.8745	0.8599	0.8801	0.8780	0.8776
STD. DEV.	104.76	124.98	113.15	127.56	134.38	133.14	123.83	130.82	121.05	122.07	122.28
F VALUE	52.69	35.48	44.42	33.85	29.98	30.64	36.23	31.93	38.16	37.43	37.29
t INTERCEPT	-8.53	-6.71	-7.09	-5.69	-5.08	-5.42	-6.43	-5.82	-7.24	-7.05	-6.45
t GNP	7.85	5.71	7.58	5.88	4.51	3.65	2.60	3.40	3.29	3.23	2.72
t OCCUPNCY	7.94	6.26	6.72	5.40	4.80	5.10	6.03	5.38	6.77	6.58	6.09
t CORPROFT	-2.34	-1.71	-2.04	-1.44	-1.21	-1.43	-2.24	-1.74	-2.08	-1.83	-1.77
t FIXINVST	-4.12	-2.06	-3.30	-1.74	-0.41	+0.80	+2.19	+1.26	+2.49	2.39	2.37
t FEDFUNDS	-4.17	-2.92	-2.60	-1.88	-1.92	-2.59	-3.69	-2.98	-3.95	-3.60	-3.10
DURBIN - WATSON D	2.80	2.82	2.50	2.43	2.14	2.21	2.35	2.45	2.65	2.63	2.58

Note: Corporate Profit (CORPROFT) leads by 7 quarters in all of the above calculations.
The Interest Rate on Federal Funds (FEDFUNDS) leads by 6 quarters in all of the above calculations.



NOTE: Corporate profit (CORPROFT) leads by 7 quarters and the interest rate on federal funds (FEDFUNDS) leads CONSTCON by 6 quarters in all of these calculations.

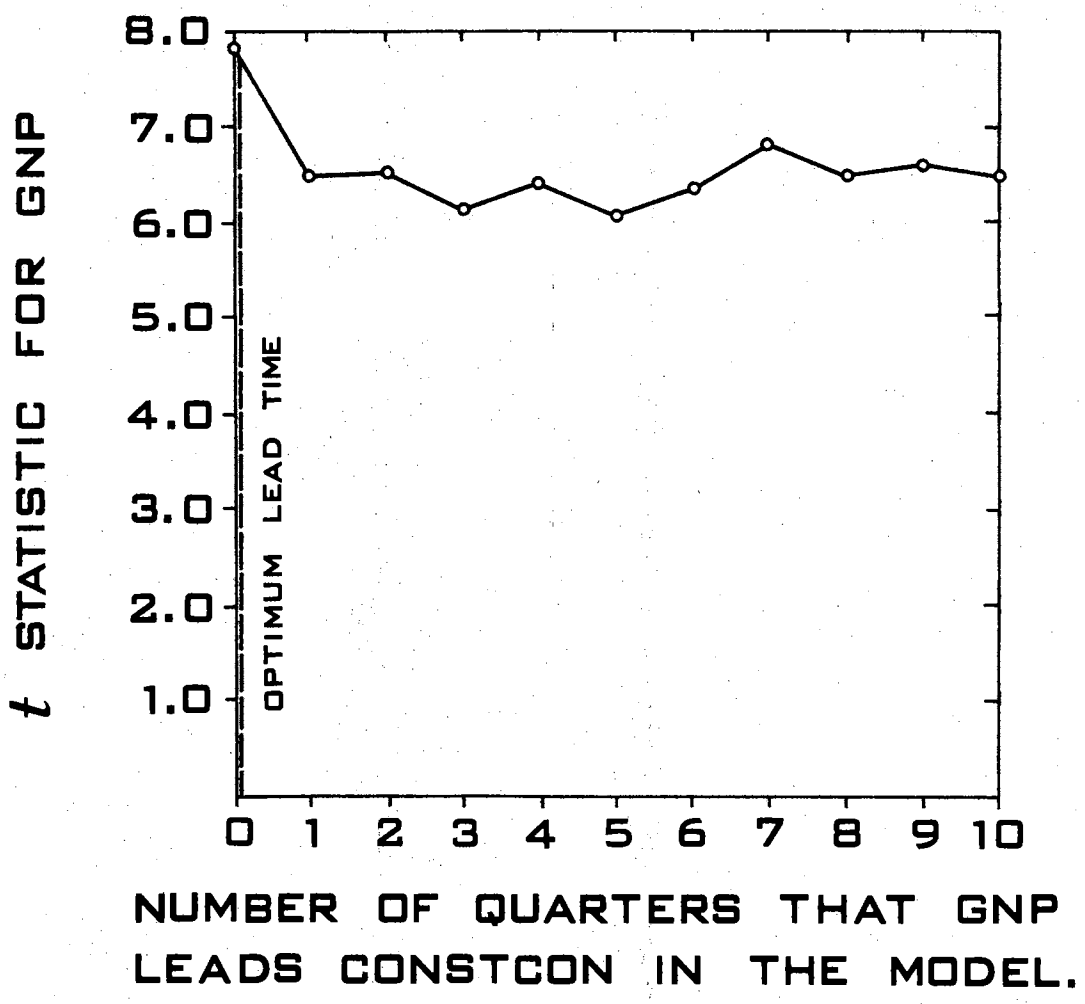
Figure 13. The Effect of Leading Occupancy (OCCUPNCY) in the Model

TABLE XIII

THE EFFECT OF LEADING OCCUPANCY (OCCUPNCY) IN THE MODEL

STATISTIC	Lead Time in Quarters								
	0Q	1Q	2Q	3Q	4Q	5Q	6Q	7Q	8Q
R-SQUARE	0.9102	0.8479	0.8552	0.7748	0.7669	0.7232	0.7176	0.6963	0.7065
STD. DEV.	104.76	136.32	132.98	165.87	168.77	183.87	185.75	192.62	189.38
F VALUE	52.69	28.99	30.72	17.89	17.11	13.59	13.21	11.92	12.51
t INTERCEPT	-8.53	-5.60	-5.85	-3.43	-3.19	-1.94	-1.69	+0.47	+0.99
t GNP	7.86	5.61	5.69	4.00	3.53	2.82	2.51	2.67	2.87
t OCCUPNCY	7.94	5.15	5.41	3.09	2.88	1.71	1.52	-0.59	-1.12
t CORPROFT	-2.34	-0.63	+0.14	+0.84	+1.76	+1.87	+2.00	+0.26	-0.27
t FIXINVST	-4.13	-2.98	-3.03	-2.15	-1.63	-1.24	-1.04	-1.54	-1.82
t FEDFUNDS	-4.17	-3.68	-4.15	-2.67	2.64	-1.74	-1.62	+0.37	+0.75
DURBIN - WATSON D	2.80	2.79	1.82	1.78	1.42	1.48	1.29	1.25	1.33

Note: Corporate Profit (CORPROFT) leads by 7 quarters in all of the above calculations.
The Interest Rate on Federal Funds (FEDFUNDS) leads by 6 quarters in all of the above calculations.



NOTE: Corporate profit (CORPROFT) leads by 7 quarters and the interest rate on federal funds (FEDFUNDS) leads CONSTCON by 6 quarters in all of these calculations.

Figure 14. The Effect of Leading Gross National Product (GNP) in the Model

TABLE XIV

THE EFFECT OF LEADING GROSS NATIONAL PRODUCT (GNP) IN THE MODEL

STATISTIC	Lead Time in Quarters										
	0Q	1Q	2Q	3Q	4Q	5Q	6Q	7Q	8Q	9Q	10Q
R-SQUARE	0.9102	0.8848	0.8863	0.8767	0.8827	0.8757	0.8814	0.8917	0.8840	0.8860	0.8842
STD. DEV.	104.76	118.64	117.84	122.72	119.73	123.23	120.36	115.04	119.07	118.01	118.95
F VALUE	52.69	39.93	40.55	36.98	39.12	36.64	38.66	42.80	39.61	40.42	39.70
t INTERCEPT	-8.53	-7.06	-6.85	-6.49	-6.64	-6.50	-6.68	-7.19	-6.76	-6.71	-6.43
t GNP	7.86	6.51	6.59	6.16	6.42	6.11	6.36	6.84	6.48	6.57	6.49
t OCCUPNCY	7.94	6.51	6.30	6.00	6.14	6.03	6.19	6.67	6.19	6.07	5.74
t CORPROFT	-2.34	-1.93	-2.08	-2.22	-2.35	-2.25	-2.25	-2.37	-1.67	-1.19	-0.72
t FIXINVST	-4.13	-3.24	-3.22	-2.86	-2.82	-2.38	-2.49	-2.70	-2.32	-2.18	-2.09
t FEDFUNDS	-4.17	-3.52	-3.69	-3.90	-4.46	-4.65	-5.15	-5.80	-5.52	-5.49	-5.31
DURBIN - WATSON D	2.80	2.86	2.56	2.55	2.50	2.52	2.56	2.65	2.70	2.60	2.50

Note: Corporate Profit (CORPROFT) leads by 7 quarters in all of the above calculations.
The Interest Rate on Federal Funds (FEDFUNDS) leads by 6 quarters in all of the above calculations.

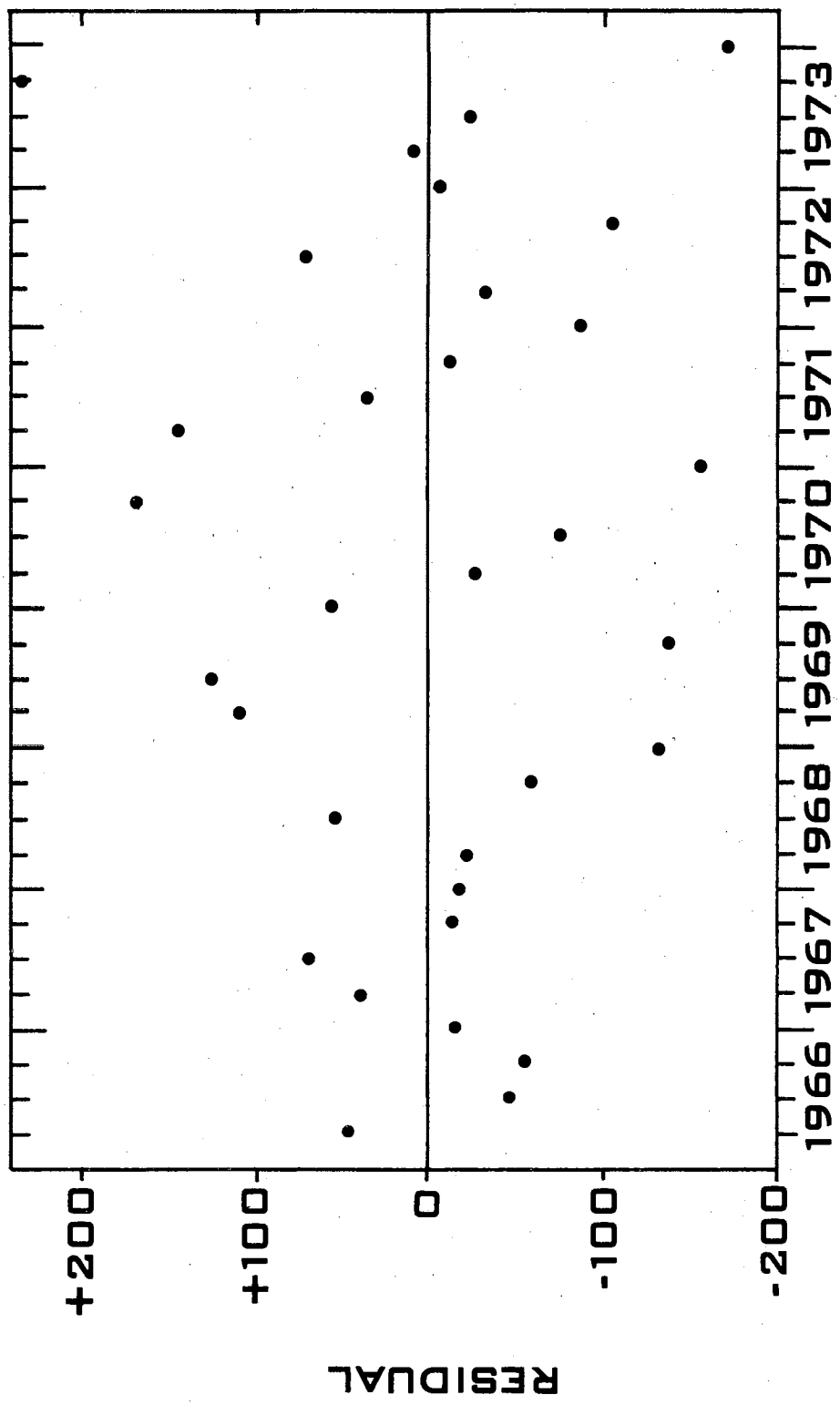


Figure 15. Plot of Residual versus Time in Quarters for the Model

+ 104.87362 OCCUPNCY - 15,019661 CORPROFT
(7.9421) (- 2.3431)

- 63.717357 FIXINVST - 57.351817 FEDFUNDS
(- 4.1292) (- 4.1728)

A comparison of forecast versus actual values of construction contracts for office buildings (CONSTCON) on an annual basis from 1966 through 1973 is included in Table XV. The alternating signs in the difference and percent difference columns indicate that the model tracks a very volatile market and tends to smooth out the fluctuations.

TABLE XV

COMPARISON OF FORECAST AND ACTUAL VALUES FOR CONSTRUCTION (CONSTCON) ON AN ANNUAL BASIS IN MILLIONS OF CURRENT DOLLARS

Year	Forecast CONSTCON	Actual CONSTCON	Difference	% Difference
1966	2,427.0	2,357.7	+ 69.3	+ 2.94
1967	2,744.2	2,822.5	- 78.3	- 2.77
1968	3,834.3	3,677.1	+157.2	+ 4.28
1969	5,199.0	5,357.4	-158.4	- 2.96
1970	4,693.0	4,607.0	+ 86.0	+ 1.87
1971	4,657.8	4,748.0	- 90.2	- 1.90
1972	5,353.1	5,186.0	+ 67.1	+ 1.27
1973	5,673.0	5,725.6	- 52.6	- 0.92

Forecasts of CONSTCON for each quarter for the next six quarters were computed next. The calculations are shown in Table XVI, and summarized in Table XVII. This forecast was made with data that was available soon after the fourth quarter of 1973. Throughout the development of this model, there were analyses of the model in both current dollars and in constant 1958 dollars. The analysis is more accurate for current dollars, which is the figure of greatest interest to the construction industry. The forecast of the value of construction contracts for office buildings in the United States (CONSTCON) for 1974 is $5,426,600,000.00 in current dollars, and $3,611,700,000.00 in constant 1958 dollars.

Verification of the Model

The model was verified by recomputing the multiple regression coefficients with the data that was available in the fourth quarter of 1971. Forecasts of the values of the independent variables that would have been available in the fourth quarter of 1971 were used to forecast the value of CONSTCON for each quarter for six quarters. For comparison purposes, the forecast values of CONSTCON for a year were computed. This figure was compared with the forecast made by two other agencies that forecast the value of construction contracts for Office Buildings.

The ENR forecast is for one year out of a long-range forecast shown in Table XX (Appendix B). The results are shown in Table XVIII. In comparing the 1972 forecasts, the date the forecasts were made is important. The ENR forecast for 1972 was made after three quarters of data for 1972 were available, and the model's forecast was made before any 1972 data would have been available.

TABLE XVI

QUARTERLY FORECASTS OF CONSTRUCTION (CONSTCON) FOR FIRST QUARTER 1974 THROUGH SECOND QUARTER 1975

CONSTCON = - 10355.82 + 5.231098 GNP + 104.87362 OCCUPNCY - 15.019661 CORPROFT - 63.717357 FIXINVST - 57.351817 FEDFUNDS

1Q 1974	= - 10355.82 + 7077.68	+ 9187.98	- 802.05	- 3275.07	- 271.85
	= 1560.9				
2Q 1974	= - 10355.82 + 7250.30	+ 9040.11	- 835.09	- 3402.51	- 294.79
	= 1402.2				
3Q 1974	= - 10355.82 + 7428.16	+ 9040.11	- 905.69	- 3549.06	- 375.08
	= 1282.6				
4Q 1974	= - 10355.82 + 7647.87	+ 8987.67	- 1004.82	- 3676.49	- 417.52
	= 1180.9				
1Q 1975	= - 10355.82 + 7820.49	+ 8987.67	- 1075.41	- 3772.07	- 605.64
	= 999.2				
2Q 1975	= - 10355.82 + 7993.12	+ 8935.23	- 1073.91	- 3835.78	- 573.52
	= 1089.3				

Note: This forecast was made with Fourth Quarter 1973 data available.

TABLE XVII

FORECAST OF CONSTRUCTION CONTRACTS FOR OFFICE BUILDINGS IN MILLIONS OF CURRENT DOLLARS

1Q - 1974	1560.9	
2Q - 1974	1402.2	
3Q - 1974	1282.6	
4Q - 1974	1180.9	
Total - 1974		5426.6
1Q - 1975	999.2	
2Q - 1975	1089.3	

Note: This forecast was made with fourth quarter 1973 data available.

TABLE XVIII

COMPARISON OF FORECASTS OF THE VALUE OF CONSTRUCTION CONTRACTS (CONSTCON) FOR OFFICE BUILDINGS*

Forecaster and Date	1972 Value	1972 %	1973 Value	1973 %	1974 Value	1974 %
ENR Nov. 2, 1972	4,800	-9.2	4,800	-16.2		
ENR Jan. 25, 1973	4,800	-9.2	4,950	-13.6	5,450	
ENR Oct. 25, 1973			6,100	+6.5	6,600	
ENR Jan. 24, 1974			6,100	+6.5	6,600	
NAHB Jan. 1974	3,758	N/A	3,844	N/A	3,700	
The Model 4Q 1971	5,536.2	+4.7				
The Model 1Q 1973			5,374.6	-6.1		
The Model 1Q 1974					5,426.6	
Actual	5,286.0		5,725.6		1Q and 2Q 1974 = 2,792.8	

*Values are in millions of current dollars.
% is the percentage error compared to the actual value.
(NAHB is the National Association of Homebuilders.)

The comparison of the 1973 forecasts is very illustrative. The January 25, 1973, ENR forecast and the models forecast for 1973 were made with the same data. The ENR forecast is in error by -13.5 percent, while the model is only 6.1 percent in error. Note that the ENR forecast of October 25, 1973, is not as good as the forecast by the model which would have been prepared nine months earlier.

Only a cursory comparison can be made for 1974 because only the figures for the first and second quarter actual CONSTCON are available.

The other system of forecasts uses the building permits issued at 14,000 permit-issuing places as the base. The technique employed may be acceptable, but the results are not useful because they do not agree with the most widely accepted base figures as compiled and reported by the F. W. Dodge Division of the McGraw-Hill Information Systems Company.

The results of the analysis of the forecasts that would have been made using the model indicate that more accurate forecasts are available many months earlier using the model.

Updating the Model

To update the model at the end of a quarter, the historical data for the past quarter is added to the data base, and new regression coefficients are calculated.

Once a year, the lead relationship of the selected independent variables should be verified.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to develop an econometric forecasting model for a segment of the construction market. The same method used in developing this model should be applicable to other segments of the construction market. The three principal objectives of this model were:

1) to use existing available data
2) to predict future construction volume of a segment of the construction market with "acceptable accuracy," and
3) to require minimum servicing.

The model was developed by formulating a list of possible economic variables that would logically explain the variations in the one dependent variable which was the value of construction contracts for one quarter for office buildings in the United States. Historical data for both the dependent and the independent variables was assembled. This historical data was studied to be able to specify the interrelationships between the economic variables in a multiple regression analysis. At this stage of development of the model, some preliminary multiple regression equations which contained all of the likely independent variables were examined. There were some independent variables thatlogically should lead the model by a certain time interval. The interest rate at the time the project is being financed is an example, because the financing would be arranged some time prior to the award of the

construction contract. The lead relationship for the selected independent variables was determined. The model (or models) being investigated at this time were preliminary, so the lead relationship must be verified in the final model selected.

Reliable forecasts were required for each independent variable used in the model for every quarter for the horizon of the model. For those selected independent variables that led the model by, say, six quarters, no forecasts were required because this unique time relationship permitted the use of historical data for that variable in conjunction with forecasts of the other independent variables.

Forecasts of selected economic variables which are a part of the output of a large-scale macroeconometric model were used as input to the model developed in addition to other independent variables. This unique feature of this study allowed the complex interrelationships of the many factors of the United States economy to be captured and introduced into the model developed. The "best" model was tentatively selected using both judgement and statistical calculations.

An evaluation of the independent variables was required to determine the reliability of forecasts and select the proper independent variables to be incorporated in the model. Statistical calculations are required to determine that the independent variables are significant in the model; that there is no systematic lack of fit; and that the model explains adequately the variations in the dependent variable. As stated earlier, the lead-time relationship of the variables in the final model must be verified.

The econometric forecasting model developed in this study provides a forecast of the value of construction contracts for office buildings

in the United States for each quarter for six quarters into the future in both current and constant 1958 dollars. Existing available data was used. These forecasts on an annual basis are considerably more accurate than any method currently available. The model developed can be updated and serviced by one person in a few hours any time a forecast is desired.

The objectives of this study have been accomplished.

Suggestions for Future Investigations

In the area of office buildings, a national inventory would produce very useful data. This should be updated periodically to indicate office space added to the inventory, office space deleted from the inventory, and office space under construction. Occupancy of existing structures and the leasing status of buildings under construction should also be included.

The lead time relationship could be investigated to determine if a multiple quarter lead time with an appropriate weight for each quarter would produce better results.

Econometric models at the national level for other sectors of the construction market should be developed. The ultimate objective would be to have forecasting models for all of the segments of the construction market. When models for all segments of the construction market as delineated by Engineering News-Record (Table I) have been completed, they could be used to provide forecasts of all of the various sectors of the construction market. These forecasts would be extremely valuable to the construction industry.

Models for regional construction markets should also be developed. A logical delineation of regions would be the nine regions used by the

F. W. Dodge Division of McGraw-Hill Information Systems Company.

Models for more localized markets should also be developed. The available sources of local data would have to be examined carefully and the historical data assembled. The forecasts of local construction would be extremely valuable to the contractors, subcontractors, material suppliers, engineers, architects, city planners, realtors, and others.

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APPENDIX A

THE STATISTICAL ANALYSIS SYSTEM II

Statistical Analysis System II (SASII)

This is a computer program for performing various statistical calculations. SASII was designed and implemented by Messrs. Anthony J. Barr and James Howard Goodnight, both with the Department of Statistics, North Carolina State University. The entire system is explained in an excellent manual by Ms. Jolayne Service (50). The complete program has approximately 35,000 source statements of which one-third is in FORTRAN, one-third is in PL/1, and one-third is in assembly language. The program can be implemented on any IBM 360 or 370 computer operating under Operating System (OS) with at least 140K of core storage available to the user. SASII has been implemented on the IBM 360-65 computer at the Oklahoma State University.

The data base for this study was constructed by merging eight separate data sets into one data set, as shown in Figure 16. Eight separate data sets were used, because it made the investigation of lead relationships much easier. A change of one data entry in one data set allowed the introduction of one quarter's lead time for that particular independent variable without changing any of the rest of the data base.

Three SASII procedures were used in this study. These were the PRINT, R-SQUARE, and REGR procedures. The print procedure permits printing in a tabular form of any or all of the variables in the data base. In this study, the ability to print several independent variables and the date of the particular data entry was extremely useful when lead-time relations were being investigated.

The R-SQUARE procedure performs regressions of a dependent variable on all combinations of independent variables specified. If there were

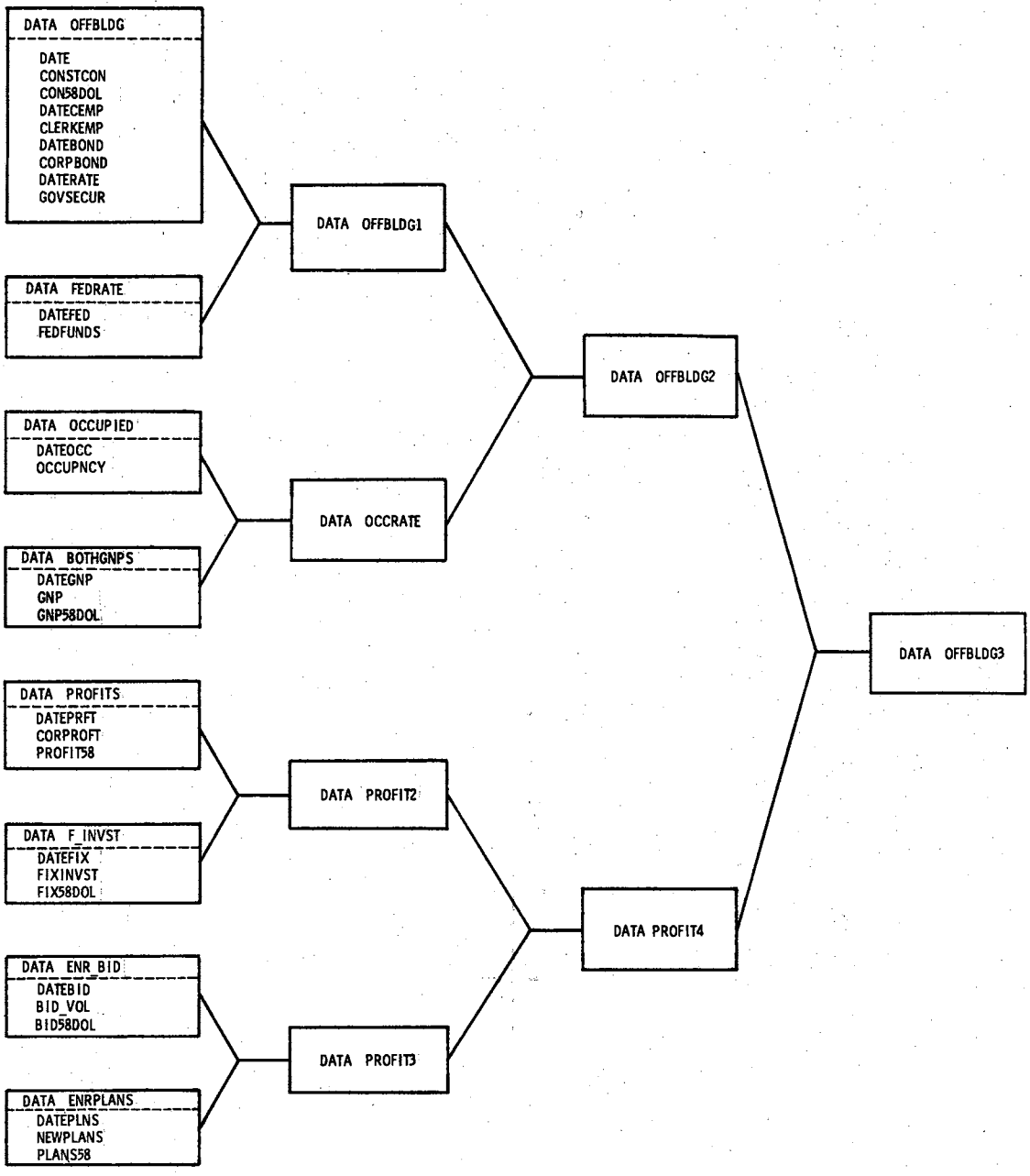


Figure 16. Organization of the Data Base used to Develop the Model

three independent variables, this procedure would perform three simple regression analyses with one independent variable, three multiple regression analyses with two independent variables, and one analysis with three variables. The output is arranged in descending order of the coefficient of determination, R^2 or R-SQUARE. The REGR procedure fits a linear model to the data using the principle of least square. Both simple and multiple regression analyses can be calculated. In addition to an analysis of variance, table-related statistics are provided. Service (50) explains very concisely the results that appear on a printout:

> Analysis of variance table and related statistics: For each dependent variable of each model considered, REGR prints an analysis of variance table. The first part of the table involves three sources of variation: REGRESSION (i.e., variation possibly attributable to the independent variables in the model); ERROR (residual variation, not accounted for by the dependent variable's relationship to the independent variables); and TOTAL (corrected for the mean of y if an intercept is included in the model and uncorrected if that term is excluded). Statistics in the table include degrees of freedom ("DF"); sums of squares; mean squares; an "F" value," the ratio of the REGRESSION mean square to the ERROR mean square; "PROB F," the significance probability of that F value: "R-SQUARE," the square of the multiple correlation coefficient of variability, expressed as a percentage. The second part of the table deals with the sources of variation that together comprise the source called REGRESSION. There is an entry for each effect in the model and for each independent non-classification SAS variable. Statistics for each entry include the degrees of freedom; the sequential sum of squares, the sum of squares adjusted for the effects and variables preceding that source; an F-value and significance probability associated with the sequential sum of squares; the partial sum of squares, a sum of squares adjusted for ALL other effects and variables in the model; and an F-value and significance probability associated with the partial sum of squares.

To illustrate a SASII computer printout, the example of an econometric model used in Chapter I has been included.

```
TITLE 'RESIDENTIAL STRUCTURES USING REGRESSION ANALYSIS'  ;
COMMENT

*************************************************************************

    THIS PROGRAM COMPUTES THE EQUATION TO FORECAST FIXED INVESTMENT
    IN RESIDENTIAL STRUCTURES AS A FUNCTION OF POPULATION USING
    SIMPLE LINEAR REGRESSION ANALYSIS.

*************************************************************************

              EXPLANATION OF VARIABLES

    RESTRUCT  FIXED INVESTMENT IN RESIDENTIAL STRUCTURES IN MILLIONS
                       OF CURRENT DOLLARS.
                       (SEASONALLY ADJUSTED AT ANNUAL RATES)
              SOURCE - BUSINESS CONDITIONS DIGEST   TABLE A4, SERIES 244
                       BUREAU OF ECONOMIC ANALYSIS
                       US DEPARTMENT OF COMMERCE.

    POPUPATE  TOTAL U.S. POPULATION IN MILLIONS OF PEOPLE.
              SOURCE - POPULATION ESTIMATES AND PROJECTIONS
                       SERIES P-25  NO.470 SEPTEMBER 1971.
                       BUREAU OF THE CENSUS
                       US DEPARTMENT OF COMMERCE.
                       ;
DATA RESANPOP  ;
INPUT DATERES 1-4  RESTRUCT 6-9  POPULATE 11-16  ;
CARDS


   8 OBSERVATIONS IN DATA SET RESANPOP       3  VARIABLES

PROCEDURE PRINT  DATA=RESANPOP  ;
VARIABLES DATERES RESTRUCT POPULATE  ;
```

RESIDENTIAL STRUCTURES USING REGRESSION ANALYSIS

OBS	DATERES	RESTRUCT	POPULATE
1	1966	25.0	196.5
2	1967	25.1	198.6
3	1968	30.1	200.6
4	1969	32.6	202.6
5	1970	31.2	204.8
6	1971	42.7	207.0
7	1972	54.0	209.5
8	1973	58.0	212.2

```
PROCEDURE REGR S C  DATA=RESANPOP  ;
MODEL     RESTRUCT = POPULATE / P CLI  ;
```

```
*****************************************************************************************
*                                                                                       *
*  PROC REGR    :  RESIDENTIAL STRUCTURES USING REGRESSION ANALYSIS                     *
*                                                                                       *
*  DATA SET     :  RESANPOP      NUMBER OF VARIABLES =  2      NUMBER OF CLASSES =  0  *
*                                                                                       *
*  VARIABLES    :  RESTRUCT POPULATE                                                    *
*                                                                                       *
*****************************************************************************************
```

RESIDENTIAL STRUCTURES USING REGRESSION ANALYSIS

N = 8

SIMPLE STATISTICS

VARIABLE	SUM	MEAN	UNCORRECTED SS	CORRECTED SS	VARIANCE	STANDARD DEV
RESTRUCT	298.70000000	37.33750000	12300.51000000	1147.79875000	163.97125000	12.80512593
POPULATE	1631.80000000	203.97500000	333052.46000000	206.05500000	29.43642857	5.42553487

RESIDENTIAL STRUCTURES USING REGRESSION ANALYSIS

N = 8 CORRELATION COEFFICIENTS / PROB > |R| UNDER HO: RHO=0

	RESTRUCT	POPULATE
RESTRUCT	1.000000 0.0000	C.950208 0.0003
POPLLATE	0.950208 0.0003	1.CC0000 0.0000

RESIDENTIAL STRUCTURES USING REGRESSION ANALYSIS

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE RESTRUCT

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	1	1036.34146978	1036.34146978	55.78863	0.0003	0.90289475	11.54339 %
ERROR	6	111.45728022	18.57621337				
						STD DEV	RESTRUCT MEAN
CORRECTED TOTAL	7	1147.79875000				4.31001315	37.33750

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
POPULATE	1	1036.34146978	55.78863	0.0003	1036.34146978	55.78863	0.0003

SOURCE	B VALUES	T FOR HO: B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	-420.10530562	-6.85741	0.0005	61.26301215	0.0
POPULATE	2.24264153	7.46918	0.0003	0.30025277	0.95020774

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR INDIVIDUAL	UPPER 95% CL FOR INDIVIDUAL
1	25.00000000	20.57375458	4.42624542	8.11237978	33.03512938
2	25.10000000	25.28330179	-0.18330179	13.42075167	37.14585190
3	30.10000000	29.76858484	0.33141516	18.31109503	41.22607466
4	32.60000000	34.25386790	-1.65386790	23.02238394	45.48535186
5	31.20000000	39.18767926	-7.98767926	27.98530866	50.39004986
6	42.70000000	44.12149062	-1.42149062	32.71688708	55.52609416
7	54.00000000	49.72809444	4.27190556	37.82840438	61.62778450
8	58.00000000	55.78322657	2.21677343	43.06938822	68.49706491

SUM OF RESIDUALS	=	-0.00000000
SUM OF SQUARED RESIDUALS	=	111.45728022
SUM OF SQUARED RESIDUALS - ERROR SS	=	0.00000000
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	0.26828515
DURBIN-WATSON D	=	1.30385862

APPENDIX B

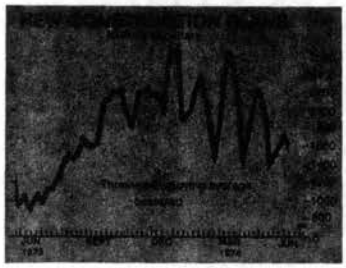
ENGINEERING NEWS-RECORD SCOREBOARD AND FORECAST OF 1973-1980 CONSTRUCTION CONTRACTS

TABLE XIX

CONSTRUCTION SCOREBOARD

LATEST WEEK

COST INDEXES ENR 20-cities 1913=100	June 6 Index value	Change from last month %	Change from last year %
Construction Cost	1999.1	+ 0.8	+ 5.2
Building Cost	1199.2	+ 0.3	+ 5.3
Common labor (CC)	3919.1	+ 1.4	+ 5.6
Skilled labor (BC)	1816.5	+ 1.4	+ 5.9
Materials	822.4	- 1.0	+ 4.4



50-state totals ENR-reported	Week of June 13	Cum. 24 weeks 1974	change '73-'74
	$ millions		%
BIDDING VOLUME			
Total construction*	797.7	24,584.3	+ 71
Heavy & highway	403.2	12,118.4	+ 92
Nonresidential bldg	354.5	10,697.0	+ 70
Housing, multiunit	40.1	1,768.9	+ 2
NEW PLANS			
Total construction*	1,460.3	47,308.7	+ 38
Heavy & highway, total	292.1	21,072.8	+ 62
Water use & control	83.3	5,238.9	- 8
Waterworks	29.7	928.6	+ 21
Sewerage	48.9	2,668.5	- 26
Treatment plants	10.4	837.5	- 39
Earthwork, waterways	4.7	1,641.8	+ 21
Transportation	26.2	2,534.5	- 28
Highways	7.0	1,173.9	- 10
Bridges	0.9	319.9	+ 10
Airports	18.2	596.0	+ 4
Terminals, hangars	4.7	274.6	+ 65
Elec, gas, comm	169.0	12,573.1	+ 308
Other heavy const	13.6	726.3	+ 8
Nonresidential bldg	1,082.5	20,168.7	+ 30
Manufacturing	97.3	5,077.4	+ 94
Commercial	136.5	4,576.9	+ 11
Offices	44.0	1,899.9	+ 23
Stores, shopping ctrs	84.3	2,052.6	+ 11
Educational	439.3	4,185.7	+ 26
College, university	341.3	1,551.5	+ 63
Medical	111.3	2,414.2	0
Hospital	93.7	1,798.4	- 7
Other	298.0	3,914.5	+ 28
Housing, multiunit*	85.8	6,067.2	+ 7
Apartments	60.3	4,802.4	+ 9

*Excludes 1-2 family houses. Minimum sizes included are: industrial plants, heavy and highway construction, $100,000; buildings, $500,000.

NEW CONSTRUCTION CAPITAL

	Week of June 6	Cum. 23 weeks 1974	change '73-'74
	$ millions		%
Total new capital	612.7	14,881.1	+ 15
Corporate securities	227.4	6,371.0	+ 10
State and municipal	346.2	8,159.2	+ 20
Federal grants, loans	39.1	351.0	+ 16
Federal projects	0.0	0.0	0

LATEST MONTH

ENR COST INDEXES IN 22 Cities Based on 1913 U.S. average—100

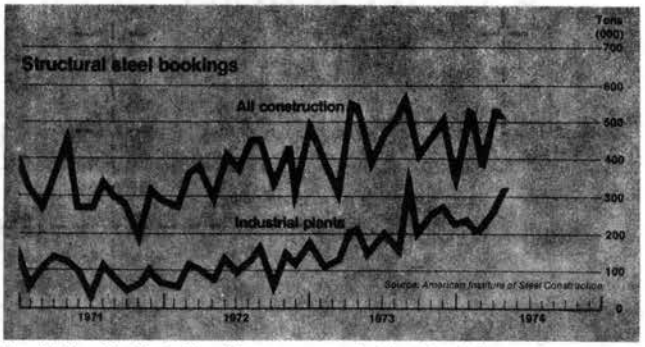
City	CONSTRUCTION COST JUN'74 Index	Percent change from last month	Percent change from last year	BUILDING COST JUN'74 Index	Percent change from last month	Percent change from last year
Atlanta	1567.72	+0.8	+4.4	1061.49	+1.1	+3.6
Baltimore	1771.74	-0.5	+3.9	1172.80	-0.8	+1.8
Birmingham	1505.59	+0.6	+5.4	1041.05	+0.9	+4.0
Boston	2033.92	+0.9	+3.7	1237.28	+1.5	+3.9
Chicago	2138.50	+0.7	+6.2	1272.32	+1.2	+7.1
Cincinnati	2225.43	+1.0	+7.2	1252.05	+1.9	+9.0
Cleveland	2230.85	+0.4	+4.7	1277.37	+3.2	+6.9
Dallas	1651.85	+4.9	+9.5	1059.96	+3.1	+7.0
Denver	1663.85	+5.5	+6.4	1162.83	+4.7	+7.3
Detroit	2253.62	+0.4	+0.8	1273.30	+0.6	+1.5
Kansas City	2151.89	+0.9	+3.0	1223.70	+3.5	+6.1
Los Angeles	2131.36	+0.5	+7.4	1224.72	+0.8	+4.1
Minneapolis	2075.86	+4.5	+5.9	1175.20	+2.4	+3.9
New Orleans	1559.38	+0.5	+6.6	1051.72	+0.8	+7.7
New York	2485.06	+1.2	+6.0	1436.61	+3.7	+7.0
Philadelphia	2179.88	+10.0	+15.5	1298.02	+4.3	+6.7
Pittsburgh	1946.47	+1.0	+2.9	1249.94	+1.5	+3.7
St. Louis	2162.92	+0.9	+1.8	1147.79	+1.7	+4.2
San Francisco	2246.58	+0.2	+1.0	1278.17	+0.4	+5.3
Seattle	1886.85	+0.5	+7.0	1087.71	+0.8	+6.4
U.S.-20 Cities' avg	**1993.47**	**+1.7**	**+4.9**	**1199.20**	**+1.9**	**+5.3**
Montreal	1800.56	+6.8	+18.0	1077.96	+4.2	+21.8
Toronto	1955.08	+5.7	+13.6	1094.98	+3.3	+10.0

ENR WAGE, MATERIALS AND COST INDEXES IN 20 CITIES

Based on each city's 1967 average—100

City	COMMON LABOR JUN Index	% chg fr '73	SKILLED LABOR JUN Index	% chg fr '73	MATERIALS PRICES JUN Index	% chg fr '73	Const Cost Index	Bldg Cost Index
Atlanta	202.95	+5.8	180.53	+5.5	172.54	+1.3	192.69	176.89
Baltimore	223.84	+6.4	185.68	+4.7	180.60	-1.5	200.85	183.44
Birmingham	188.24	+6.6	180.61	+4.6	166.55	+3.2	180.46	173.41
Boston	189.41	+4.2	177.86	+5.1	182.41	+2.5	187.53	179.90
Chicago	184.37	+5.3	181.34	+5.6	159.49	+9.2	177.33	171.49
Cincinnati	214.36	+4.4	194.97	+3.6	188.89	+1.7	209.43	194.72
Cleveland	183.44	+4.7	189.71	+8.3	166.26	+4.7	178.03	179.69
Dallas	233.67	+12.5	183.35	+10.0	156.80	+3.2	209.04	175.47
Denver	177.88	+6.7	191.47	+8.4	165.21	+5.7	170.27	177.79
Detroit	188.60	0	186.09	0	153.53	+4.0	179.91	172.25
Kansas City	222.71	+2.8	203.31	+8.1	173.69	+3.8	208.06	188.96
Los Angeles	181.56	+7.3	178.21	+1.8	185.45	+7.6	180.77	177.90
Minneapolis	189.51	+7.0	180.83	+4.7	173.44	+2.9	181.03	170.57
New Orleans	194.73	+4.9	174.91	+5.3	171.76	+10.5	186.45	173.42
New York	175.18	+5.4	177.19	+6.1	185.86	+8.6	178.70	180.64
Philadelphia	220.00	+20.4	193.68	+9.9	191.90	+2.4	212.78	193.01
Pittsburgh	180.78	+3.3	176.58	+5.1	182.39	+2.0	174.89	169.71
St. Louis	180.84	+1.3	164.81	+4.7	173.42	-3.4	179.06	168.15
San Francisco	178.70	0	171.87	+5.7	171.81	+4.6	177.49	171.79
Seattle	162.07	+6.8	163.91	+5.3	184.19	+7.7	167.14	172.07

TRENDS TO WATCH



Two-thirds of April steel bookings were earmarked for industrial construction.

TABLE XX

FORECASTS OF 1973-1980 CONSTRUCTION CONTRACTS BY ENGINEERING NEWS-RECORD

Engineering News-Record

McGRAW-HILL'S CONSTRUCTION WEEKLY—98TH YEAR OF PUBLICATION

Forecast of 1973-'80 construction contracts 50-state totals in millions of current dollars 1969-'80; 48 states excluding Alaska and Hawaii 1965-'69

	48 states					50 States †								% Change Annual		Annual average, compounded		
Type of work	1965	1966	1967	1968	1969	1969	1970	1971	1972	1973	1974	1975	1980	'72-'73	'73-'74	65-70 a	'70-'75	'75-'80
Total construction*	$34,644	$37,759	$40,403	$44,925	$51,354	$52,082	$52,484	58,620	63,455	68,820	75,380	83,500	112,150	+9	+10	+8	+10	+6
Heavy construction, total	10,805	12,929	14,511	14,283	16,545	16,710	19,201	19,993	19,605	23,040	26,855	30,950	48,050	+18	+17	+12	+9	+9
Water use & control	2,939	2,945	3,140	3,183	3,080	3,100	4,877	4,322	5,270	6,110	6,825	8,000	11,650	+16	+12	+10	+10	+8
Waterworks	724	849	970	887	899	904	1,107	734	870	975	1,065	1,200	1,800	+12	+9	+8	+2	+8
Sewerage	992	995	1,179	1,386	1,530	1,545	2,169	2,728	3,330	4,000	4,500	5,400	7,500	+20	+13	+17	+20	+7
Rivers, harbors, flood control	610	576	506	440	328	328	902	340	550	700	800	850	1,200	+27	+14	+8	0	+7
Hydroelectric and multi-purpose	613	525	485	410	273	273	604	440	425	350	360	425	850	-18	+3	+3	-7	+16
Irrigation	c		c	60	50	50	95	80	95	85	100	125	300	-11	+18	..	+6	+20
Transportation	5,711	6,581	6,876	6,911	8,601	8,725	9,150	8,968	9,275	10,005	10,955	12,550	21,900	+8	+9	+10	+6	+12
Highways	4,688	5,482	5,450	5,237	6,236	6,300	6,890	6,466	6,855	7,130	7,550	8,200	15,000	+4	+6	+8	+4	+13
Bridges	646	780	830	708	1,330	1,337	1,027	892	1,150	1,175	1,300	1,500	2,500	+2	+11	+10	+8	+11
Mass transit, including subways .... e	135	150	330	300	301	301	271	365	500	700	1,020	1,500	2,500	+40	+46	+15	+41	+11
Airports (incl hangars & terminals)	127 b	146	173 b	600	734	778	605	1,010	750	950	1,050	1,300	1,800	+27	+11	..	+17	+7
Space and missile bases	115	23	93	66	0	9	357	235	20	50	35	50	100	+150	-30	+25	-32	+16
Electricity, gas, communications	1,144	2,321	3,570	3,100	3,415	3,425	4,295	5,900	4,100	5,800	7,800	9,000	12,500	+41	+34	+30	+16	+7
Electric light and power	762	1,837	3,000	2,600	3,000	3,000	3,795											
Gas d	281	393	475	400	300	300	350											
Communications	101	91	95	100	115	125	150											
Miscellaneous heavy construction	1,011	1,082	925	1,089	1,449	1,460	879	803	960	1,125	1,275	1,400	2,000	+17	+13	-6	+10	+8
Nonresidential building	17,219	19,393	20,141	22,612	25,641	25,950	24,045	25,668	26,650	29,580	32,775	37,050	43,900	+11	+11	+7	+9	+4
Manufacturing	3,064	3,623	3,701	3,768	3,888	3,915	3,614	2,611	3,000	3,850	5,275	6,400	5,000	+28	+37	+3	+12	-5
Commercial	5,457	5,835	6,081	7,744	7,684	9,786	9,091	9,658	10,650	11,700	12,800	15,100	18,500	+10	+9	+11	+11	+4
Offices	2,229	2,358	2,822	3,677	5,315	5,338	4,606	4,748	4,800	4,950	5,450	7,000	9,000	+3	+10	+15	+8	+5
Stores, shopping centers	2,255	2,275	2,189	2,787	2,927	2,961	2,936	3,230	4,350	5,400	5,800	6,100	6,500	+24	+7	+5	+16	+2
Educational	4,164	4,939	5,216	5,347	5,486	5,543	5,234	5,661	4,900	4,800	5,000	5,250	7,000	-2	+4	+4	0	+6
Hospitals, medical, health	1,515	1,721	1,873	2,114	2,784	2,817	2,823	3,206	3,400	3,900	4,300	4,500	6,000	+15	+10	+13	+10	+6
Government service	842	939	960	1,112	1,140	1,154	1,017	1,575	1,700	2,030	1,800	2,000	2,400	+19	-11	+4	+15	+4
Recreation, religious, other	2,177	2,336	2,310	2,527	2,659	2,735	2,267	2,957	3,000	3,300	3,600	3,800	5,000	+10	+9	+0.2	+11	+6
Multiunit residential	6,620	5,437	5,751	8,030	9,168	9,422	9,238	12,959	17,200	16,200	15,750	15,500	20,200	-6	-3	+6	+11	+5
Apartments	4,997	4,040	4,323	6,551	7,671	7,831	7,853	11,419	15,200	13,950	13,325	13,000	17,500	-8	-4	+9	+11	+6

*Excludes homebuilding. †ENR estimates for 1971-'80. #Source of 1965-'70 building statistics: F. W. Dodge Division, McGraw-Hill Information Systems Co. **a** Based on data for 48 states, excluding Alaska and Hawaii. **b** Airport buildings included in nonresidential building for years 1965-'67; in airports starting 1968. **c** Irrigation included in hydro-electric and multi-purpose for years 1965-'67. **d** Includes natural gas and petroleum products pipelines. **e** Includes railroads

APPENDIX C

SELECTED OFFICE-TYPE OCCUPATIONS

Appendix C is a list of the 79 selected office-type occupations out of the 261 white collar occupations reported by the Bureau of the Census in the 1970 Census (55).

Accountants
Architects
Computer programmers
Computer systems analysts
Computer specialists, n.e.c. (not counted elsewhere)
Aeronautical and astronautical engineers
Chemical engineers
Civil engineers
Electrical and electronic engineers
Industrial engineers
Judges
Lawyers
Actuaries
Mathematicians
Statisticians
Operations and systems researchers and analysts
Personnel and labor relations workers
Chiropractors
Dentists
Physicians, medical and osteopathic
Dental hygienists
Economists
Political scientists
Psychologists
Sociologists
Urban and regional planners
Social scientists, n.e.c.
Draftsmen
Designers
Editors and reporters
Public relations men and publicity workers
Research workers, not specified
Professional technical, and kindred workers--allocated
Bank officers and financial managers
Managers and superintendents, building
Office managers, n.e.c.
Officials of lodges, societies, and unions
Wholesale trade managers and administrators, n.e.c. salaried
Finance, insurance, and real estate
Business and repair servides
Personal services
Wholesale trade managers and adminstrators, n.e.c. self-employed
Finance, insurance, and real estate
Business and repair services
Personal services
Advertising agents and salesmen
Insurance agents, brokers, and underwriters

Real estate agents and brokers
Stock and bond salesmen
Bank tellers
Billing clerks
Bookkeepers
Cashiers
Clerical supervisors, n.e.c.
File clerks
Messengers, including telegraph, and office boys
Bookkeeping and billing machine operators
Calculating machine operators
Computer and peripheral equipment operators
Duplicating machine operators
Keypunch operators
Tabulating machine operators
Office machine operators, n.e.c.
Payroll and timekeeping clerks
Proof readers
Real estate appraisers
Receptionists
Secretaries, legal
Secretaries, medical
Statistical clerks
Stenographers
Typists
Clerical and kindred workers--allocated

APPENDIX D

THE EFFECT OF LEADING THE INDEPENDENT VARIABLES IN A PRELIMINARY REGRESSION ANALYSIS

TABLE XXI

THE EFFECT OF LEADING FIXED INVESTMENT IN NONRESIDENTIAL (FIXINVST) IN A PRELIMINARY REGRESSION ANALYSIS

Lead Time in Quarters	Value of the Coefficient of Determination (R-SQUARE) for Different Numbers of Variables							
	3 Var	4 Var	5 Var	6 Var	7 Var	8 Var	9 Var	10 Var
0Q	0.8604*	0.8916*	0.9253*	0.9281*	0.9298*	0.9344*	0.9356*	0.9357*
1Q	0.8397	0.8642*	0.8850*	0.8908*	0.8937*	0.8939*	0.8941*	0.8945*
2Q	0.8638*	0.8844*	0.9021*	0.9050*	0.9065*	0.9072*	0.9075*	0.9075*
3Q	0.8512*	0.8856*	0.8930*	0.8937*	0.8960*	0.8963*	0.8966*	0.8968*
4Q	0.8403*	0.8699*	0.8820*	0.8850*	0.8874*	0.8887*	0.8896*	0.8896*
5Q	0.8397	0.8512	0.8623	0.8646	0.8655	0.8658*	0.8658*	0.8659
6Q	0.8397	0.8512	0.8635*	0.8688	0.8693*	0.8695*	0.8696*	0.8696*
7Q	0.8397	0.8512	0.8623	0.8646	0.8655	0.8656*	0.8656	0.8656
8Q	0.8397	0.8629*	0.8738*	0.8747	0.8752*	0.8755*	0.8755*	0.8755*
9Q	0.8397	0.8818*	0.8909*	0.8914*	0.8925	0.8941*	0.8956*	0.8956*
10Q	0.8397	0.8849*	0.8926*	0.8943*	0.8946*	0.8949*	0.8950*	0.8950*

*The variable FIXINVST is included in this regression analysis.

TABLE XXII

THE EFFECT OF LEADING THE OCCUPANCY RATE (OCCUPNCY) FOR OFFICE BUILDINGS IN A PRELIMINARY REGRESSION ANALYSIS

Lead Time in Quarters	Value of the Coefficient of Determination (R-SQUARE) for Different Numbers of Variables							
	3 Var	4 Var	5 Var	6 Var	7 Var	8 Var	9 Var	10 Var
0Q	0.8604*	0.8916*	0.9253*	0.9281*	0.9298*	0.9344*	0.9356*	0.9357*
1Q	0.8098	0.8630	0.9125	0.9163	0.9206	0.9232	0.9240	0.9240*
2Q	0.8098	0.8630*	0.9147*	0.9178*	0.9206	0.9238*	0.9263*	0.9280*
3Q	0.8164*	0.8630	0.9125	0.9173*	0.9206	0.9233*	0.9265*	0.9285*
4Q	0.8098	0.8630	0.9177*	0.9193*	0.9206	0.9232	0.9245*	0.9256*
5Q	0.8098	0.8630	0.9125	0.9163	0.9206	0.9232	0.9240	0.9243*
6Q	0.8098	0.8630	0.9125	0.9170*	0.9206	0.9232	0.9240	0.9243*
7Q	0.8098	0.8630	0.9125	0.9163	0.9206	0.9232	0.9253*	0.9260*
8Q	0.8098	0.8630	0.9125	0.9163	0.9206	0.9232	0.9240	0.9247*

*The variable OCCUPNCY is included in this regression analysis.

TABLE XXIII

THE EFFECT OF LEADING CORPORATE PROFICT (CORPROFT)
IN A PRELIMINARY REGRESSION ANALYSIS

Lead Time in Quarters	Value of the Coefficient of Determination (R-SQUARE) for Different Numbers of Variables							
	3 Var	4 Var	5 Var	6 Var	7 Var	8 Var	9 Var	10 Var
0Q	0.8604	0.8916	0.9253	0.9281*	0.9298*	0.9344*	0.9356*	0.9357*
1Q	0.8604	0.8916	0.9253	0.9303*	0.9310*	0.9329*	0.9332*	0.9332*
2Q	0.8604	0.8916	0.9253	0.9281	0.9294	0.9298*	0.9299*	0.9300*
3Q	0.8604	0.8916	0.9253	0.9281	0.9294	0.9296	0.9297*	0.9298*
4Q	0.8604	0.8916	0.9253	0.9281	0.9302*	0.9315*	0.9318*	0.9318*
5Q	0.8604	0.8916	0.9253	0.9281	0.9301*	0.9312*	0.9313*	0.9314*
6Q	0.8604	0.8916	0.9253	0.9281	0.9294	0.9299*	0.9305*	0.9305*
7Q	0.8604	0.8916	0.9253	0.9363*	0.9382*	0.9394*	0.9399*	0.9399*
8Q	0.8604	0.8946*	0.9253	0.9305*	0.9328*	0.9343*	0.9346*	0.9346*
9Q	0.8604	0.8945*	0.9253	0.9294*	0.9312*	0.9325*	0.9331*	0.9331*
10Q	0.8604	0.8944*	0.9253	0.9290*	0.9304*	0.9318*	0.9319*	0.9319*

*The variable CORPROFT is included in this regression analysis.

TABLE XXIV

THE EFFECT OF LEADING GROSS NATIONAL PRODUCT (GNP)
IN A PRELIMINARY REGRESSION ANALYSIS

Lead Time in Quarters	Value of the Coefficient of Determination (R-SQUARE) for Different Numbers of Variables							
	3 Var	4 Var	5 Var	6 Var	7 Var	8 Var	9 Var	10 Var
0Q	0.8604*	0.8916*	0.9253*	0.9363*	0.9382*	0.9394*	0.9399*	0.9399*
1Q	0.8269*	0.8717*	0.8997*	0.9032*	0.9075*	0.9089*	0.9112*	0.9124*
2Q	0.8214	0.8555*	0.8918*	0.8972*	0.8982*	0.9000*	0.9014*	0.9017*
3Q	0.8214	0.8402	0.8688*	0.8812*	0.8928*	0.8951*	0.9021*	0.9036*
4Q	0.8214	0.8747*	0.8909*	0.9099*	0.9189*	0.9208*	0.9227*	0.9236*
5Q	0.8214	0.8402	0.8571*	0.8728*	0.8859*	0.8948*	0.9014*	0.9093*
6Q	0.8214	0.8736*	0.8814*	0.8884*	0.8972*	0.9013*	0.9059*	0.9092*
7Q	0.8214	0.8656*	0.8802*	0.8884*	0.8989*	0.9026*	0.9100*	0.9143*
8Q	0.8214	0.8521*	0.8660*	0.8747*	0.8870*	0.8908*	0.8937	0.8978
9Q	0.8214	0.8812*	0.8902*	0.8970*	0.9082*	0.9161*	0.9229*	0.9257*
10Q	0.8214	0.8830*	0.8958*	0.8936*	0.9076*	0.9096*	0.9119*	0.9130*

*The variable GNP is included in this regression analysis. CORPROFT leads by seven quarters in all of the above calculations.

TABLE XXV

THE EFFECT OF LEADING THE INTEREST RATE ON FEDERAL FUNDS (FEDFUNDS) IN A PRELIMINARY REGRESSION ANALYSIS

Lead Time in Quarters	Value of the Coefficient of Determination (R-SQUARE) for Different Numbers of Variables							
	3 Var	4 Var	5 Var	6 Var	7 Var	8 Var	9 Var	10 Var
0Q	0.8604	0.8916	0.9253*	0.9363*	0.8382*	0.9394*	0.9399*	0.9399*
1Q	0.8604	0.8916	0.9164	0.9251	0.9314	0.9321	0.9321	0.9231*
2Q	0.8604	0.8916	0.9164	0.9251	0.9314	0.9386*	0.9415*	0.9415*
3Q	0.8604	0.8916	0.9164	0.9251	0.9363*	0.9419*	0.9421*	0.9421*
4Q	0.8604	0.8916	0.9164	0.9251	0.9314	0.9377*	0.9381*	0.9381*
5Q	0.8604	0.8916	0.9164	0.9251	0.9314	0.9321	0.9321	0.9321*
6Q	0.8604	0.9001*	0.9263*	0.9306*	0.9354	0.9393*	0.9398*	0.9400*
7Q	0.8604	0.8916	0.9173*	0.9252*	0.9322*	0.9359*	0.9359*	0.9359*
8Q	0.8604	0.8916	0.9164	0.9251	0.9314	0.9321	0.9322*	0.9322*

*The variable FEDFUNDS is included in this regression analysis. CORPROFT leads by seven quarters in all of the above calculations.

APPENDIX E

COMPUTER PRINTOUT OF THE MODEL

```
TITLE 'OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION' ;
COMMENT

**************************************************************************

    THIS PROGRAM PREDICTS FUTURE VOLUME OF OFFICE BUILDING CONSTRUCTION
    BY USING MULTIPLE REGRESSION ANALYSIS.

**************************************************************************


    NEWPLANS AND PLANS58 LEAD BY 7 QUARTERS.

    FEDFUNDS LEAD BY 6 QUARTERS.

    CORPROFT AND PROFIT58 LEAD BY 7 QUARTERS.

    ADJUSTED GNP AND GNP58DOL ARE USED IN THIS RUN.


         EXPLANATION OF VARIABLES

    BID_VOL   BIDDING VOLUME FOR OFFICE BUILDINGS IN MILLIONS OF CURRENT DOLLARS
              SOURCE - ENGINEERING NEWS RECORD
                       MCGRAW-HILL INC.

    BID58DOL  BIDDING VOLUME FOR OFFICE BUILDINGS IN MILLIONS OF 1958 DOLLARS.
              SOURCE - ENGINEERING NEWS RECORD
                       MCGRAW-HILL INC.
                       CURRENT DOLLAR AMOUNT MULTIPLIED BY THE
                       ENR BUILDING INDEX 1958=100

    CLERKEMP  CLERICAL EMPLOYMENT IN MILLIONS.
              SOURCE - EMPLOYMENT AND EARNINGS   TABLE A49.
                       BUREAU OF LABOR STATISTICS
                       US DEPARTMENT OF LABOR.

    CONSTCON  VALUE OF CONSTRUCTION CONTRACTS FOR OFFICE AND BANK BUILDINGS
                       IN THE U.S. IN MILLIONS OF CURRENT DOLLARS.
              SOURCE - DODGE CONSTRUCTION POTENTIALS
                       F.W. DODGE DIVISION
                       MCGRAW-HILL INFORMATION SYSTEMS CO.

    CON58DOL  VALUE OF CONSTRUCTION CONTRACTS FOR OFFICE AND BANK BUILDINGS
                       IN THE U.S. IN MILLIONS OF 1958 DOLLARS.
                       ( SEASONALLY ADJUSTED )
              SOURCE - DODGE CONSTRUCTION POTENTIALS
                       F.W. DODGE DIVISION
                       MCGRAW-HILL INFORMATION SYSTEMS CO.

    CORPBOND  RETURN PAID BY CORPORATE BONDS IN PERCENT.
              SOURCE - BUSINESS CONDITIONS DIGEST   TABLE B6, SERIES 116
                       BUREAU OF ECONOMIC ANALYSIS
                       SOCIAL AND ECONOMIC STATISTICS ADMINISTRATION
                       US DEPARTMENT OF COMMERCE.
```

```
CORPROFT   CORPORATE PROFIT AFTER TAXES IN BILLIONS OF CURRENT DOLLARS.
                ( SEASONALLY ADJUSTED AT ANNUAL RATES )
           SOURCE - BUSINESS CONDITIONS DIGEST   TABLE B5, SERIES 16
                    US DEPARTMENT OF COMMERCE.

PROFIT58   CORPORATE PROFIT AFTER TAXES IN BILLIONS OF 1958 DOLLARS.
                ( SEASONALLY ADJUSTED AT ANNUAL RATES )
           SOURCE - BUSINESS CONDITIONS DIGEST   TABLE B5, SERIES 18
                    US DEPARTMENT OF COMMERCE.

FEDFUNDS   FEDERAL FUNDS RATE IN PERCENT.
           SOURCE - FEDERAL RESERVE BULLETIN
                    TABLE - MONEY MARKET RATES
                    BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM.

FIXINVST   FIXED INVESTMENT IN NONRESIDENTIAL STRUCTURES IN BILLIONS OF
                    CURRENT DOLLARS.
                ( SEASONALLY ADJUSTED AT ANNUAL RATES )
           SOURCE - SURVEY OF CURRENT BUSINESS  TABLE 1
                    BUREAU OF ECONOMIC ANALYSIS
                    US DEPARTMENT OF COMMERCE.

FIX58DOL   FIXED INVESTMENT IN NONRESIDENTIAL STRUCTURES IN BILLIONS OF
                    1958 DOLLARS.
                ( SEASONALLY ADJUSTED AT ANNUAL RATES )
           SOURCE - SURVEY OF CURRENT BUSINESS  TABLE 1
                    BUREAU OF ECONOMIC ANALYSIS
                    US DEPARTMENT OF COMMERCE.

GNP        GROSS NATIONAL PRODUCT IN BILLIONS OF CURRENT DOLLARS.
                ( SEASONALLY ADJUSTED AT ANNUAL RATES )
           SOURCE - BUSINESS CONDITIONS DIGEST   TABLE A1, SERIES 200
                    BUREAU OF ECONOMIC ANALYSIS
                    US DEPARTMENT OF COMMERCE.

GNP58DOL   GROSS NATIONAL PRODUCT IN BILLIONS OF 1958 DOLLARS.
                ( SEASONALLY ADJUSTED AT ANNUAL RATES )
           SOURCE - BUSINESS CONDITIONS DIGEST   TABLE A1, SERIES 205
                    BUREAU OF ECONOMIC ANALYSIS

GOVSECLR   U.S. GOVERNMENT SECURITIES (TAXABLE), 3 TO 5 YEAR ISSUES.
           SOURCE - FEDERAL RESERVE BULLETIN
                    TABLE - MONEY MARKET RATES
                    BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM.

NEWPLANS   VALUE OF NEW PLANS FOR CONSTRUCTION OF OFFICE BUILDINGS
                    IN MILLIONS OF CURRENT DOLLARS.
           SOURCE - ENGINEERING NEWS RECORD
                    MCGRAW-HILL INC.

PLANS58    VALUE OF NEW PLANS FOR CONSTRUCTION OF OFFICE BUILDINGS
                    IN MILLIONS OF 1958 DOLLARS.
           SOURCE - ENGINEERING NEWS RECORD
                    MCGRAW-HILL INC.
                    CURRENT DOLLAR AMOUNT MULTIPLIED BY THE
                    ENR BUILDING INDEX 1958=100

OCCUPNCY   OCCUPANCY OF OFFICE BUILDINGS IN PERCENT.
           SOURCE - SKYSCRAPER MANAGEMENT MAGAZINE
                    BUILDING OWNERS AND MANAGERS ASSOCIATION. ;
```

```
DATA CFFBLDG  ;
INPUT DATE $ 1-7  CLERKEMP 21-25 3  CON58DOL 57-62  CORPBOND 64-68
      CONSTCON #2 9-14
      DATERATE $ #3 1-7  GOVSECUR #3 74-78  ;
CARDS
```

```
  32 OBSERVATIONS IN DATA SET CFFBLDG        7  VARIABLES
```

```
DATA  FEDRATE  ;
INPUT DATEFED $ 1-7  FEDFUNDS 29-33  ;
CARDS
```

```
  32 OBSERVATIONS IN DATA SET FEDRATE        2  VARIABLES
```

```
DATA  OCCUPIED  ;
INPUT DATEOCC $ 1-7  OCCUPNCY 14-19  ;
CARDS
```

```
  32 OBSERVATIONS IN DATA SET OCCUPIED       2  VARIABLES
```

```
DATA  BOTHGNPS  ;
INPUT DATEGNP $ 1-7  GNP 9-14  GNP58DOL 16-21  ;
CARDS
```

```
  32 OBSERVATIONS IN DATA SET BOTHGNPS       3  VARIABLES
```

```
DATA  PROFITS  ;
INPUT DATEPRFT $ 1-7  PROFIT58 9-13  CORPROFT 15-19  ;
CARDS
```

```
  32 OBSERVATIONS IN DATA SET PROFITS        3  VARIABLES
```

```
DATA  F_INVEST  ;
INPUT DATEFIX $ 1-7  FIX58DOL 9-13  FIXINVST 15-19  ;
CARDS
```

```
  32 OBSERVATIONS IN DATA SET F_INVEST       3  VARIABLES
```

```
DATA  ENR_BID  ;
INPUT DATEBID $ 1-7  BID58DOL 9-13  BID_VOL 15-19  ;
CARDS
```

```
  32 OBSERVATIONS IN DATA SET ENR_BID        3  VARIABLES

DATA  ENRPLANS  ;
INPUT DATEPLNS $ 1-7  PLANS58 9-14  NEWPLANS 16-21  ;
CARDS


  32 OBSERVATIONS IN DATA SET ENRPLANS       3  VARIABLES

DATA OFFBLDG1  ;
MERGE OFFBLDG FEDRATE  ;


  32 OBSERVATIONS IN DATA SET OFFBLDG1       9  VARIABLES

DATA  OCCRATE  ;
MERGE OCCUPIED BOTHGNPS  ;


  32 OBSERVATIONS IN DATA SET OCCRATE        5  VARIABLES

DATA  PROFIT2  ;
MERGE PROFITS F_INVEST  ;


  32 OBSERVATIONS IN DATA SET PROFIT2        6  VARIABLES

DATA  PROFIT3  ;
MERGE ENR_BID ENRPLANS  ;


  32 OBSERVATIONS IN DATA SET PROFIT3        6  VARIABLES

DATA OFFBLDG2  ;
MERGE OFFBLDG1 OCCRATE  ;


  32 OBSERVATIONS IN DATA SET OFFBLDG2      14  VARIABLES

DATA  PROFIT4  ;
MERGE PROFIT2 PROFIT3  ;


  32 OBSERVATIONS IN DATA SET PROFIT4       12  VARIABLES

DATA  OFFBLDG3  ;
MERGE OFFBLDG2 PROFIT4  ;


  32 OBSERVATIONS IN DATA SET OFFBLDG3      26  VARIABLES
```

```
PROCEDURE PRINT  DATA=OFFBLDG3  ;

VARIABLES DATE CONSTCON DATEGNP GNP DATEOCC OCCUPNCY DATEPRFT CORPROFT
          DATEFIX FIXINVST DATEFED FEDFUNDS  ;
```

OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

OBS	DATE	CONSTCON	DATEGNP	GNP	DATECCC	OCCUPNCY	DATEPRFT	CORPROFT	DATEFIX	FIXINVST	DATEFED	FEDFUNDS
1	1Q_1966	558.0	1Q_1966	729.5	1Q_1966	92.01	2Q_1964	38.5	1Q_1966	28.6	3Q_1964	3.46
2	2Q_1966	621.3	2Q_1966	743.3	2Q_1966	92.65	3Q_1964	39.1	2Q_1966	28.1	4Q_1964	3.58
3	3Q_1966	603.9	3Q_1966	755.9	3Q_1966	92.65	4Q_1964	39.0	3Q_1966	28.9	1Q_1965	3.97
4	4Q_1966	574.5	4Q_1966	770.7	4Q_1966	91.57	1Q_1965	43.8	4Q_1966	28.2	2Q_1965	4.08
5	1Q_1967	599.4	1Q_1967	774.4	1Q_1967	91.57	2Q_1965	43.8	1Q_1967	29.0	3Q_1965	4.07
6	2Q_1967	786.6	2Q_1967	784.5	2Q_1967	91.58	3Q_1965	44.1	2Q_1967	27.2	4Q_1965	4.17
7	3Q_1967	702.2	3Q_1967	800.9	3Q_1967	91.58	4Q_1965	46.3	3Q_1967	27.7	1Q_1966	4.56
8	4Q_1967	734.3	4Q_1967	815.9	4Q_1967	91.77	1Q_1966	49.2	4Q_1967	27.7	2Q_1966	4.91
9	1Q_1968	666.4	1Q_1968	834.0	1Q_1968	91.77	2Q_1966	49.2	1Q_1968	29.8	3Q_1966	5.34
10	2Q_1968	944.2	2Q_1968	857.4	2Q_1968	92.15	3Q_1966	49.4	2Q_1968	28.9	4Q_1966	5.57
11	3Q_1968	937.3	3Q_1968	875.2	3Q_1968	92.15	4Q_1966	49.3	3Q_1968	29.4	1Q_1967	4.82
12	4Q_1968	1129.2	4Q_1968	890.2	4Q_1968	93.61	1Q_1967	46.5	4Q_1968	30.3	2Q_1967	3.99
13	1Q_1969	1318.7	1Q_1969	907.0	1Q_1969	93.61	2Q_1967	46.5	1Q_1969	32.6	3Q_1967	3.89
14	2Q_1969	1568.4	2Q_1969	923.5	2Q_1969	95.07	3Q_1967	47.1	2Q_1969	32.3	4Q_1967	4.17
15	3Q_1969	1131.7	3Q_1969	941.7	3Q_1969	95.07	4Q_1967	50.1	3Q_1969	35.2	1Q_1968	4.79
16	4Q_1969	1338.6	4Q_1969	948.9	4Q_1969	95.25	1Q_1968	49.1	4Q_1969	35.1	2Q_1968	5.98
17	1Q_1970	1260.5	1Q_1970	958.5	1Q_1970	95.25	2Q_1968	50.7	1Q_1970	35.5	3Q_1968	5.94
18	2Q_1970	1094.2	2Q_1970	970.6	2Q_1970	94.00	3Q_1968	51.2	2Q_1970	36.1	4Q_1968	5.92
19	3Q_1970	1362.2	3Q_1970	987.4	3Q_1970	94.00	4Q_1968	52.8	3Q_1970	36.2	1Q_1969	6.58
20	4Q_1970	890.1	4Q_1970	991.8	4Q_1970	92.97	1Q_1969	49.5	4Q_1970	36.3	2Q_1969	8.33
21	1Q_1971	1257.9	1Q_1971	1027.2	1Q_1971	92.97	2Q_1969	49.7	1Q_1971	37.6	3Q_1969	8.98
22	2Q_1971	1181.1	2Q_1971	1046.9	2Q_1971	92.44	3Q_1969	47.9	2Q_1971	38.3	4Q_1969	8.94
23	3Q_1971	1226.0	3Q_1971	1063.5	3Q_1971	92.44	4Q_1969	47.1	3Q_1971	38.7	1Q_1970	8.57
24	4Q_1971	1083.0	4Q_1971	1084.2	4Q_1971	90.07	1Q_1970	44.6	4Q_1971	38.8	2Q_1970	7.88
25	1Q_1972	1204.9	1Q_1972	1112.5	1Q_1972	90.07	2Q_1970	43.9	1Q_1972	41.3	3Q_1970	6.70
26	2Q_1972	1283.1	2Q_1972	1142.4	2Q_1972	87.77	3Q_1970	45.4	2Q_1972	41.0	4Q_1970	5.57
27	3Q_1972	1371.3	3Q_1972	1166.5	3Q_1972	87.77	4Q_1970	41.4	3Q_1972	41.3	1Q_1971	3.86
28	4Q_1972	1426.7	4Q_1972	1199.2	4Q_1972	87.38	1Q_1971	43.2	4Q_1972	43.0	2Q_1971	4.56
29	1Q_1973	1427.4	1Q_1973	1242.5	1Q_1973	87.38	2Q_1971	45.8	1Q_1973	45.3	3Q_1971	5.48
30	2Q_1973	1338.5	2Q_1973	1272.0	2Q_1973	86.23	3Q_1971	46.6	2Q_1973	47.2	4Q_1971	4.75
31	3Q_1973	1672.2	3Q_1973	1304.5	3Q_1973	86.23	4Q_1971	48.0	3Q_1973	49.5	1Q_1972	3.54
32	4Q_1973	1287.5	4Q_1973	1337.5	4Q_1973	87.61	1Q_1972	55.2	4Q_1973	51.7	2Q_1972	4.30

```
PROCEDURE PRINT  DATA=CFFBLDG3  ;

VARIABLES GNP OCCUPNCY BID_VOL NEWPLANS CORPBOND CORPROFT FIXINVST FEDFUNDS
          GOVSECUR CLERKEMP CONSTCON  ;
```

OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

OBS	GNP	OCCUPNCY	BID_VOL	NEWPLANS	CORPBOND	CORPROFT	FIXINVST	FEDFUNDS	GOVSECUR	CLERKEMP	CONSTCON
1	729.5	92.01	229.9	281.7	5.12	38.5	28.6	3.46	4.95	11.471	558.0
2	743.3	92.65	190.0	528.9	5.53	39.1	28.1	3.58	4.94	11.635	621.3
3	755.9	92.65	217.3	392.4	6.00	39.0	28.9	3.97	5.47	11.923	603.9
4	770.7	91.57	256.9	483.7	6.04	43.8	28.2	4.08	5.29	12.220	574.5
5	774.4	91.57	230.8	597.6	5.48	43.8	29.0	4.07	4.65	12.095	599.4
6	784.5	91.58	377.7	509.0	5.85	44.1	27.2	4.17	4.70	12.238	786.6
7	800.9	91.58	467.6	435.1	6.23	46.3	27.7	4.56	5.28	12.343	702.2
8	815.9	91.77	370.5	538.8	6.78	49.2	27.7	4.91	5.66	12.624	734.3
9	834.0	91.77	461.7	575.9	6.45	49.2	29.8	5.34	5.63	12.694	666.4
10	857.4	92.15	543.9	619.4	6.94	49.4	28.9	5.57	5.78	12.816	944.2
11	875.2	92.15	414.9	746.0	6.71	49.3	29.4	4.82	5.35	12.823	937.3
12	890.2	93.61	301.7	614.0	7.05	46.5	30.3	3.99	5.63	12.876	1129.2
13	907.0	93.61	286.7	922.6	7.46	46.5	32.6	3.89	6.18	13.171	1318.7
14	923.5	95.07	324.4	766.8	7.73	47.1	32.3	4.17	6.37	13.281	1568.4
15	941.7	95.07	590.0	926.2	8.15	50.1	35.2	4.79	7.23	13.478	1131.7
16	948.9	95.25	412.6	831.5	8.87	49.1	35.1	5.98	7.67	13.655	1338.6
17	958.5	95.25	476.7	544.0	8.95	50.7	35.5	5.94	7.71	13.906	1260.5
18	970.6	94.00	622.8	698.9	9.44	51.2	36.1	5.92	7.77	13.748	1094.2
19	987.4	94.00	407.8	697.4	9.06	52.8	36.2	6.58	7.46	13.560	1362.2
20	991.8	92.97	559.7	888.0	8.75	49.5	36.3	8.33	6.43	13.639	890.1
21	1027.2	92.97	229.3	896.0	7.60	49.7	37.6	8.98	5.26	13.281	1257.9
22	1046.9	92.44	406.4	884.7	8.05	47.9	38.3	8.94	5.93	13.280	1181.1
23	1063.5	92.44	530.2	1199.8	8.09	47.1	38.7	8.57	6.37	13.506	1226.8
24	1084.2	90.07	397.1	845.9	7.64	44.6	38.8	7.88	5.53	13.691	1083.0
25	1112.5	90.07	334.9	1065.4	7.49	43.9	41.3	6.70	5.53	14.117	1204.9
26	1142.4	87.77	251.1	708.4	7.67	45.4	41.0	5.57	5.82	14.205	1283.1
27	1166.5	87.77	289.9	886.1	7.68	41.4	41.3	3.86	5.98	14.338	1371.3
28	1199.2	87.38	392.2	666.9	7.54	43.2	43.0	4.56	6.07	14.333	1426.7
29	1242.5	87.38	289.8	744.5	7.68	45.8	45.3	5.48	6.58	14.382	1427.4
30	1272.0	86.23	374.5	847.3	7.71	46.6	47.2	4.75	6.76	14.451	1338.5
31	1304.5	86.23	483.2	1031.2	8.17	48.0	49.5	3.54	7.47	14.630	1672.2
32	1337.5	87.61	528.9	722.0	7.97	55.2	51.7	4.30	6.86	14.750	1287.5

```
PROCEDURE RSQUARE  PRINT=5  DATA=OFFBLDG3  ;

VARIABLES GNP OCCUPNCY BID_VOL NEWPLANS CORPBOND CORPROFT FIXINVST FEDFUNDS
          GOVSECUR CLERKEMP CONSTCON  ;
```

N= 32 OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

ALL POSSIBLE REGRESSION MODELS FOR DEPENDENT VARIABLE CONSTCON

NUMBER IN MODEL	R-SQUARE	VARIABLES IN MODEL
1	0.46435696	NEWPLANS
1	0.55824140	CORPBOND
1	0.57691536	FIXINVST
1	0.64556027	GNP
1	0.73707352	CLERKEMP
2	0.75190724	CORPBOND CLERKEMP
2	0.75424707	BID_VOL CLERKEMP
2	0.75863160	NEWPLANS CLERKEMP
2	0.77142613	OCCUPNCY CLERKEMP
2	0.79514857	GNP OCCUPNCY
3	0.80641010	GNP OCCUPNCY CORPROFT
3	0.82137743	OCCUPNCY BID_VOL CLERKEMP
3	0.82243696	GNP OCCUPNCY BID_VOL
3	0.82956536	GNP OCCUPNCY FIXINVST
3	0.84213575	GNP OCCUPNCY FEDFUNDS
4	0.85165559	GNP BID_VOL FIXINVST GOVSECUR
4	0.85229280	GNP OCCUPNCY NEWPLANS FEDFUNDS
4	0.86347670	GNP OCCUPNCY BID_VOL FIXINVST
4	0.86464027	GNP OCCUPNCY BID_VOL FEDFUNDS
4	0.89120501	GNP OCCUPNCY FIXINVST FEDFUNDS
5	0.89609694	GNP OCCUPNCY NEWPLANS FIXINVST FEDFUNDS
5	0.89640554	GNP OCCUPNCY FIXINVST FEDFUNDS CLERKEMP
5	0.90203494	GNP OCCUPNCY BID_VOL FIXINVST GOVSECUR
5	0.91017306	GNP OCCUPNCY CORPROFT FIXINVST FEDFUNDS
5	0.92013226	GNP OCCUPNCY BID_VOL FIXINVST FEDFUNDS

N= 32 OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

ALL POSSIBLE REGRESSION MODELS FOR DEPENDENT VARIABLE CONSTCON

NUMBER IN MODEL	R-SQUARE	VARIABLES IN MODEL
6	0.92073955	GNP OCCUPNCY BID_VOL CORPBOND FIXINVST GOVSECUR
6	0.92186258	GNP OCCUPNCY BID_VOL CORPBOND FIXINVST FEDFUNDS
6	0.92237675	GNP OCCUPNCY BID_VOL CORPROFT FIXINVST FEDFUNDS
6	0.92438670	GNP OCCUPNCY BID_VOL NEWPLANS FIXINVST FEDFUNDS
6	0.92633390	GNP OCCUPNCY BID_VOL FIXINVST FEDFUNDS GOVSECUR
7	0.92766058	GNP OCCUPNCY BID_VOL NEWPLANS CORPBOND FIXINVST FEDFUNDS
7	0.92815858	GNP OCCUPNCY BID_VOL CORPBOND FIXINVST FEDFUNDS GOVSECUR
7	0.92932115	GNP OCCUPNCY BID_VOL CORPROFT FIXINVST FEDFUNDS GOVSECUR
7	0.93023004	GNP OCCUPNCY BID_VOL FIXINVST FEDFUNDS GOVSECUR CLERKEMP
7	0.93423027	GNP OCCUPNCY BID_VOL NEWPLANS FIXINVST FEDFUNDS GOVSECUR
8	0.93212410	GNP OCCUPNCY BID_VOL NEWPLANS CORPBOND FIXINVST FEDFUNDS CLERKEMP
8	0.93316828	GNP OCCUPNCY BID_VOL CORPROFT FIXINVST FEDFUNDS GOVSECUR CLERKEMP
8	0.93521015	GNP OCCUPNCY BID_VOL NEWPLANS CORPROFT FIXINVST FEDFUNDS GOVSECUR
8	0.93608261	GNP OCCUPNCY BID_VOL NEWPLANS CORPBOND FIXINVST FEDFUNDS GOVSECUR
8	0.93861998	GNP OCCUPNCY BID_VOL NEWPLANS FIXINVST FEDFUNDS GOVSECUR CLERKEMP
9	0.93278694	GNP OCCUPNCY BID_VOL NEWPLANS CORPBOND CORPROFT FIXINVST FEDFUNDS CLERKEMP
9	0.93337335	GNP OCCUPNCY BID_VOL CORPBOND CORPROFT FIXINVST FEDFUNDS GOVSECUR CLERKEMP
9	0.93737970	GNP OCCUPNCY BID_VOL NEWPLANS CORPBOND CORPROFT FIXINVST FEDFUNDS GOVSECUR
9	0.93867213	GNP OCCUPNCY BID_VOL NEWPLANS CORPBOND FIXINVST FEDFUNDS GOVSECUR CLERKEMP
9	0.93961972	GNP OCCUPNCY BID_VOL NEWPLANS CORPROFT FIXINVST FEDFUNDS GOVSECUR CLERKEMP
10	0.93972765	GNP OCCUPNCY BID_VOL NEWPLANS CORPBOND CORPROFT FIXINVST FEDFUNDS GOVSECUR CLERKEMP

```
PROCEDURE REGR S C  DATA=OFFBLDG3  ;

MODEL  CONSTCON = GNP OCCUPNCY NEWPLANS FIXINVST FEDFUNDS / P CLI  ;

MODEL  CONSTCON = GNP OCCUPNCY FIXINVST FEDFUNDS CLERKEMP / P CLI  ;

MODEL  CONSTCON = GNP OCCUPNCY BID_VOL FIXINVST GOVSECUR / P CLI  ;

MODEL  CONSTCON = GNP OCCUPNCY CORPROFT FIXINVST FEDFUNDS / P CLI  ;

MODEL  CONSTCON = GNP OCCUPNCY BID_VOL FIXINVST FEDFUNDS / P CLI  ;

MODEL  CONSTCON = GNP OCCUPNCY BID_VOL NEWPLANS CORPBOND CORPROFT FIXINVST
                  FEDFUNDS GOVSECUR CLERKEMP / P CLI  ;
```

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*************************************************************************************
*                                                                                   *
*  PROC REGR    :  OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION     *
*                                                                                   *
*  DATA SET     :  OFFBLDG3       NUMBER OF VARIABLES = 11      NUMBER OF CLASSES =  0 *
*                                                                                   *
*  VARIABLES    :  CLERKEMP CORPEQNE CONSTCON GOVSECUR FEDFUNDS OCCUPNCY GNP CORPROFT *
*                                                                                   *
*                  FIXINVST BID_VOL NEWPLANS                                        *
*                                                                                   *
*************************************************************************************
```

OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

N = 32

SIMPLE STATISTICS

VARIABLE	SUM	MEAN	UNCORRECTED SS	CORRECTED SS	VARIANCE	STANDARD DEV
CLERKEMP	425.16000000	13.28625000	5674.03670800	25.25465800	0.81466639	0.90258871
CORPBOND	235.88000000	7.37125000	1777.00940000	38.27895000	1.23480484	1.11121773
CONSTCON	34581.30000000	1080.66562500	40547397.68999997	3176575.51218750	102470.17781250	320.10963405
GOVSECUR	194.31000000	6.07218750	1205.45030000	25.56354688	0.82463054	0.90809170
FEDFUNDS	171.25000000	5.35156250	1000.31050000	83.85542187	2.70501361	1.64469256
OCCUPNCY	2928.64000000	91.52000000	268250.68880000	221.55600000	7.14696774	2.67338133
GNP	31260.20000000	976.88125000	31495158.45999998	957655.20875000	30892.10350806	175.76149609
CORPROFT	1494.00000000	46.68750000	70224.20000000	473.07500000	15.26048387	3.90646693
FIXINVST	1136.80000000	35.52500000	41856.06000000	1471.24000000	47.45935484	6.88907504
BIC_VOL	12251.10000000	382.84687500	5133658.23000000	443402.87968750	14303.31869960	119.59648281
NEWPLANS	23096.10000000	721.75312500	18003675.04999999	1333992.69968751	43032.02257056	207.44161244

OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

N = 32 CORRELATION COEFFICIENTS / PROB > |R| UNDER HO: RHO=0

	CLERKEMP	CORPBOND	CONSTCON	GOVSECUR	FEDFUNDS	OCCUPNCY	GNP	CORPROFT	FIXINVST	BID_VOL
CLERKEMP	1.000000 0.0000	0.781821 0.0001	0.858530 0.0001	0.676569 0.0001	0.271704 0.1325	-0.490613 0.0044	0.943797 0.0001	0.460802 0.0080	0.910734 0.0001	0.386689 0.0288
	NEWPLANS									
	0.666220 0.0001									

	CLERKEMP	CORPBOND	CONSTCON	GOVSECUR	FEDFUNDS	OCCUPNCY	GNP	CORPROFT	FIXINVST	BID_VOL
CORPBOND	0.781821 0.0001	1.000000 0.0000	0.747156 0.0001	0.879083 0.0001	0.513352 0.0027	0.094152 0.6083	0.609014 0.0002	0.671904 0.0001	0.591105 0.0004	0.588436 0.0004
	NEWPLANS									
	0.619322 0.0002									

	CLERKEMP	CORPBOND	CONSTCON	GOVSECUR	FEDFUNDS	OCCUPNCY	GNP	CORPROFT	FIXINVST	BID_VOL
CONSTCON	0.858530 0.0001	0.747156 0.0001	1.000000 0.0000	0.664555 0.0001	0.195420 0.2838	-0.259701 0.1512	0.803468 0.0001	0.387237 0.0286	0.759552 0.0001	0.211130 0.2461
	NEWPLANS									
	0.681467 0.0001									

	CLERKEMP	CORPBOND	CONSTCON	GOVSECUR	FEDFUNDS	OCCUPNCY	GNP	CORPROFT	FIXINVST	BID_VOL
GOVSECUR	0.676569 0.0001	0.879083 0.0001	0.664555 0.0001	1.000000 0.0000	0.160982 0.3788	0.089411 0.6265	0.512899 0.0027	0.623031 0.0001	0.538042 0.0015	0.601917 0.0003
	NEWPLANS									
	0.407244 0.0207									

	CLERKEMP	CORPBOND	CONSTCON	GOVSECUR	FEDFUNDS	OCCUPNCY	GNP	CORPROFT	FIXINVST	BID_VOL
FEDFUNDS	0.271704 0.1325	0.513352 0.0027	0.195420 0.2838	0.160982 0.3788	1.000000 0.0000	0.194255 0.2867	0.237960 0.1897	0.378327 0.0328	0.214532 0.2384	0.308473 0.0858
	NEWPLANS									
	0.511782 0.0028									

	CLERKEMP	CORPBOND	CONSTCON	GOVSECUR	FEDFUNDS	OCCUPNCY	GNP	CORPROFT	FIXINVST	BID_VOL

OCCUPNCY	-0.490613 0.0044	C.094152 0.6083	-0.259701 0.1512	0.089411 0.6265	C.154255 0.2867	1.000000 0.0000	-0.677351 0.0001	0.203850 0.2631	-0.659654 0.0001	0.130738 0.4757
	NEWPLANS									
	-0.151581 C.4076									

	CLERKEMP	CORPBOND	CONSTCON	GOVSECUR	FEDFUNDS	OCCUPNCY	GNP	CORPROFT	FIXINVST	BID_VOL
GNP	C.943757 0.0001	C.609014 C.0002	0.803468 0.C001	0.512899 0.0027	0.237960 0.1697	-0.677351 0.0001	1.000000 0.0000	0.311516 0.0826	0.983241 0.0001	0.248091 0.1710
	NEWPLANS									
	C.640066 C.0001									

	CLERKEMP	CORPBOND	CONSTCON	GOVSECUR	FEDFUNDS	OCCUPNCY	GNP	CORPROFT	FIXINVST	BID_VOL
CORPROFT	0.460802 0.0080	0.671904 0.0001	C.387237 0.0286	0.623031 0.0001	C.378327 0.0328	0.203850 0.2631	0.311516 0.0826	1.000000 C.0000	0.285339 0.1134	0.702439 0.0001
	NEWPLANS									
	0.324437 0.0700									

	CLERKEMP	CORPBOND	CONSTCON	GOVSECUR	FEDFUNDS	OCCUPNCY	GNP	CORPROFT	FIXINVST	BID_VOL
FIXINVST	C.910734 0.0001	0.591105 C.0004	0.759552 C.0001	0.538042 0.0015	0.214532 0.2384	-0.659654 0.0001	0.983241 0.0001	0.285339 0.1134	1.000000 0.0000	0.231835 0.2017
	NEWPLANS									
	C.610627 0.0002									

	CLERKEMP	CORPBOND	CONSTCON	GOVSECUR	FEDFUNDS	OCCUPNCY	GNP	CORPROFT	FIXINVST	BID_VOL
BID_VOL	0.386689 0.0288	C.588436 C.0004	0.211130 0.2461	0.601917 0.0003	0.208473 0.0858	C.130738 0.4757	0.248091 0.1710	0.702439 0.0001	0.231835 0.2017	1.000000 0.0000
	NEWPLANS									
	0.319193 C.075C									

	CLERKEMP	CORPBOND	CONSTCON	GOVSECUR	FEDFUNDS	OCCUPNCY	GNP	CORPROFT	FIXINVST	BID_VOL
NEWPLANS	C.666220 0.0001	C.619322 0.0002	0.681467 0.0001	0.407244 0.0207	0.511782 0.0028	-0.151581 0.4076	0.640066 0.0001	0.324437 0.0700	0.610627 0.0002	0.319193 0.0750
	NEWPLANS									
	1.000000 0.0000									

OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE CONSTCON

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	5	2846519.60104258	569303.92020852	44.84665	0.0001	0.89609694	10.42595
ERROR	26	330055.91114492	12694.45812096				
						STD DEV	CONSTCON MEAN
CORRECTED TOTAL	31	3176575.51218750				112.66968590	1080.66563

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
GNP	1	2050670.95035426	161.54064	0.0001	485458.29461656	38.24175	0.0001
OCCUPNCY	1	475178.53933832	37.43197	0.0001	536513.98725320	42.26364	0.0001
NEWPLANS	1	2573.19625154	0.20270	0.6563	15539.58875063	1.22412	0.2787
FIXINVST	1	106856.72397577	8.41759	0.0075	139147.15918492	10.96125	0.0027
FEDFUNDS	1	211240.19112268	16.64035	0.0004	211240.19112268	16.64035	0.0004

SOURCE	B VALUES	T FOR H0:B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	-8703.12092556	-6.72499	0.0001	1294.14694946	0.0
GNP	4.43397736	6.18399	0.0001	0.71700897	2.43454870
OCCUPNCY	83.09645597	6.50105	0.0001	12.78200729	0.69397635
NEWPLANS	0.17227704	1.10640	0.2787	0.15570936	0.11164121
FIXINVST	-54.60383981	-3.31078	0.0027	16.49275074	-1.17512849
FEDFUNDS	-63.01160133	-4.07926	0.0004	15.44682848	-0.32374756

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR INDIVIDUAL	UPPER 95% CL FOR INDIVIDUAL
1	558.00000000	446.01095159	111.98904841	181.74931542	710.27258777
2	621.30000000	622.70898241	-1.40898241	372.04831136	873.36965346
3	603.90000000	586.80368508	17.09631492	335.22183778	838.38553237
4	574.50000000	609.70268277	-35.20268277	364.42260268	854.98276286
5	599.40000000	602.67779775	-3.27779775	351.17443546	854.18116005
6	786.60000000	725.01393959	61.58606041	480.36836645	969.65951272
7	702.20000000	733.12345071	-30.92345071	486.78532359	979.46157784
8	734.30000000	811.23250604	-76.93250604	565.02894711	1057.43606497
9	666.40000000	756.11592212	-89.71592212	515.85134365	996.38050058
10	944.20000000	933.59248418	10.60751582	686.66360432	1180.52136404
11	937.30000000	1054.28433519	-116.98433519	804.67257383	1303.89609654
12	1129.20000000	1222.53042553	-93.33042553	968.42151224	1476.63933881
13	1318.70000000	1230.89826754	87.80173246	973.70290069	1488.09363438
14	1568.40000000	1397.27686071	171.12313929	1138.49976713	1656.05395429
15	1131.70000000	1308.01788014	-176.31788014	1050.81176711	1565.22399317
16	1338.60000000	1269.06182211	69.53817789	1021.33704632	1516.78659789
17	1260.50000000	1242.77728449	17.72271551	979.11558442	1506.43898456
18	1094.20000000	1187.74148183	-93.54148183	943.84138012	1431.64158355
19	1362.20000000	1214.92584500	147.27415500	969.24642849	1460.60526151
20	890.10000000	1065.95131282	-175.85131282	817.85914771	1314.04347793
21	1257.90000000	1112.34979491	145.55020509	859.10064508	1365.59894474
22	1181.10000000	1118.00907282	63.09092718	864.97855458	1371.03959107
23	1226.00000000	1247.37034810	-21.37034810	983.90967183	1510.83102438
24	1083.00000000	1119.26385600	-36.26385600	870.89275579	1367.63495620
25	1204.90000000	1220.40431500	-15.50431500	969.57609711	1471.23253290
26	1283.10000000	1187.93974818	95.16025182	941.86985150	1434.00964485
27	1371.30000000	1416.78091839	-45.48091839	1163.34853608	1670.21330071
28	1426.70000000	1354.66658483	72.03341517	1102.65073663	1606.68243302
29	1427.40000000	1376.46699769	50.93300231	1127.30205546	1625.63193993
30	1338.50000000	1371.66965815	-33.16965815	1121.29372086	1622.04559543
31	1672.20000000	1498.11087551	174.08912449	1230.00444570	1766.21730531
32	1287.50000000	1537.81991282	-250.31991282	1266.91790940	1808.72191624

SUM OF RESIDUALS	=	-0.00000000
SUM OF SQUARED RESIDUALS	=	330055.91114593
SUM OF SQUARED RESIDUALS - ERROR SS	=	0.00000101
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	-0.45763810
DURBIN-WATSON D	=	2.58017786

OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE CONSTCON

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	5	2847499.87923703	569499.97584741	44.99573	0.0001	0.89640554	10.41046 %
ERROR	26	329075.63295046	12656.75511348				
						STD DEV	CONSTCON MEAN
CORRECTED TOTAL	31	3176575.51218750				112.50224493	1080.66563

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
GNP	1	2050670.95035426	162.02186	0.0001	321552.83029027	25.40563	0.0001
OCCUPACY	1	475178.53933832	37.54347	0.0001	475574.58545192	37.57476	0.0001
FIXINVST	1	109340.21180934	8.63888	0.0068	168368.35187217	13.30265	0.0012
FEDFUNDS	1	195790.31079002	15.46923	0.0006	211903.94628497	16.74236	0.0004
CLERKEMP	1	16519.86694508	1.30522	0.2637	16519.86694508	1.30522	0.2637

SOURCE	B VALUES	T FOR HO:B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	-9601.58678399	-7.74421	0.0001	1239.84070820	0.0
GNP	5.76051262	5.04040	0.0001	1.14286821	3.16290486
OCCUPACY	101.16205926	6.12983	0.0001	16.50325199	0.84485043
FIXINVST	-66.61833870	-3.64728	0.0012	18.26521365	-1.43369235
FEDFUNDS	-63.74711351	-4.09174	0.0004	15.57945248	-0.32752655
CLERKEMP	-112.57298913	-1.14246	0.2637	98.53536147	-0.31741347

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR INDIVIDUAL	UPPER 95% CL FOR INDIVIDUAL
1	558.00000000	491.45398532	66.54601468	226.11483945	756.79313119
2	621.30000000	642.89032289	-21.59032289	386.48806856	899.29257722
3	603.90000000	604.89571578	-0.99571578	354.64815803	855.14327352
4	574.50000000	587.08275536	-12.58275536	339.37673033	834.78878040
5	599.40000000	569.81107587	29.58892413	321.54742721	818.07472452
6	786.60000000	726.44423477	60.15576523	482.15945676	970.72901278
7	702.20000000	750.92593423	-48.72593423	507.32599456	994.52587390
8	734.30000000	802.60991509	-68.30991509	555.48190103	1049.73792915
9	666.40000000	731.68531416	-65.28531416	486.98653811	976.38409020
10	944.20000000	936.48365599	7.71634401	690.14066737	1182.82664462
11	937.30000000	1052.73393546	-115.43393546	803.88164591	1301.58622500
12	1129.20000000	1273.82546220	-144.62546220	1011.62509512	1536.02582929
13	1318.70000000	1190.54557473	128.15442527	946.21141641	1434.87973306
14	1568.40000000	1423.04392047	145.35607953	1159.93848741	1686.14935354
15	1131.70000000	1272.99197865	-141.29197865	1021.55372978	1524.43022753
16	1338.60000000	1243.55418989	95.04581011	993.12777239	1493.98060738
17	1260.50000000	1246.50183981	13.99816019	986.20624742	1506.79743220
18	1094.20000000	1168.84193975	-74.64193975	919.08559184	1418.59828767
19	1362.20000000	1238.04734491	124.15265509	996.76408217	1479.33060764
20	890.10000000	1032.08413074	-141.98413074	778.92645085	1285.24181062
21	1257.90000000	1148.26794343	109.63205657	888.86898135	1407.66690551
22	1181.10000000	1164.16377105	16.93622895	901.71759019	1426.60995190
23	1226.00000000	1231.28588148	-5.28588148	976.80573634	1485.76602663
24	1083.00000000	1127.27208371	-44.27208371	879.32675432	1375.21741310
25	1204.90000000	1151.01424463	53.88575537	904.17503141	1397.85345784
26	1283.10000000	1172.69415246	110.40584754	922.55114527	1422.83715964
27	1371.30000000	1385.57236150	-14.27236150	1133.69395232	1637.45077068
28	1426.70000000	1377.17663070	49.52336930	1129.96793108	1624.38533032
29	1427.40000000	1409.22122716	18.17877284	1163.25189995	1655.19055437
30	1338.50000000	1375.01299433	-36.51299433	1124.86911441	1625.15687425
31	1672.20000000	1465.99091771	206.20908229	1206.84726174	1725.13457368
32	1287.50000000	1587.17456577	-299.67456577	1320.66009655	1853.68903500

SUM OF RESIDUALS	=	0.00000000
SUM OF SQUARED RESIDUALS	=	329075.63295261
SUM OF SQUARED RESIDUALS - ERROR SS	=	0.00000215
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	-0.43662893
DURBIN-WATSON D	=	2.45324368

OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE CONSTCON

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	5	2865382.10536052	573076.42107210	47.88015	0.0001	0.90203494	10.12365 %
ERROR	26	311193.40682697	11968.97718565			STD DEV	CONSTCON MEAN
CORRECTED TOTAL	31	3176575.51218750				109.40282074	1080.66563

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
GNP	1	2050670.95035426	171.33218	0.0001	577415.89818187	48.24271	0.0001
OCCUPNCY	1	475178.53933832	39.70085	0.0001	159271.44613547	13.30702	0.0012
BID_VOL	1	86683.61393763	7.24236	0.0123	206349.16390786	17.24033	0.0003
FIXINVST	1	130365.84370063	10.89198	0.0028	207873.81407509	17.36772	0.0003
GOVSECUR	1	122483.15802967	10.23339	0.0036	122483.15802967	10.23339	0.0036

SOURCE	B VALUES	T FOR HO:B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	-5940.33470675	-4.44435	0.0001	1336.60236361	0.0
GNP	4.46706967	6.94570	0.0001	0.64314201	2.45271858
OCCUPNCY	51.00140331	3.64788	0.0012	13.98111100	0.42593594
BID_VOL	-0.88322781	-4.15215	0.0003	0.21271587	-0.32998363
FIXINVST	-69.43151892	-4.16746	0.0003	16.66039499	-1.49423476
GOVSECUR	130.80146384	3.19897	0.0036	40.88866547	0.37105951

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR INDIVIDUAL	UPPER 95% CL FOR INDIVIDUAL
1	558.00000000	469.70346734	88.29653266	215.00103751	724.40589717
2	621.30000000	632.63846126	-11.33846126	387.22295212	878.05487041
3	603.90000000	678.59098068	-74.69098068	432.10193341	925.08002795
4	574.50000000	679.70407481	-105.20407481	439.53232871	919.87582092
5	599.40000000	580.02632639	19.37367361	336.66489112	823.38776165
6	786.60000000	627.42438643	159.17561357	386.05830439	868.79046846
7	702.20000000	662.43123871	39.76876129	418.50078222	906.36169520
8	734.30000000	874.59352678	-140.29352678	632.03025739	1117.15679617
9	666.40000000	725.16687814	-58.76687814	487.51122978	962.82252650
10	944.20000000	858.58410254	85.61589746	609.53889436	1107.62931072
11	937.30000000	961.07394095	-23.77394095	719.67661296	1202.47126895
12	1129.20000000	1176.65946552	-47.45946552	934.06705392	1419.25187711
13	1318.70000000	1177.20296470	141.49703530	940.86832843	1413.53760098
14	1568.40000000	1337.75570858	230.64429142	1091.87433777	1583.63707939
15	1131.70000000	1095.60892496	36.09107504	849.74349280	1341.47435713
16	1338.60000000	1358.13248822	-19.53248822	1108.93783820	1607.32713824
17	1260.50000000	1321.86090560	-61.36090560	1075.88194897	1567.83986222
18	1094.20000000	1149.31028828	-55.11028828	899.81873685	1398.80183971
19	1362.20000000	1366.75943170	-4.55943170	1123.95108522	1609.56777818
20	890.10000000	1058.05212924	-167.95212924	818.06670100	1298.03755748
21	1257.90000000	1264.70617593	-6.80617593	1005.33554012	1524.07681173
22	1181.10000000	1208.29197752	-27.19197752	969.04760626	1447.53634877
23	1226.00000000	1202.88176801	23.11823199	962.55403164	1443.20950438
24	1083.00000000	1175.21802403	-92.21802403	937.81266403	1412.62338402
25	1204.90000000	1182.59406806	21.90593194	941.16688322	1424.82125290
26	1283.10000000	1332.03259408	-48.93259408	1090.07903969	1573.98614847
27	1371.30000000	1405.51851277	-34.21851277	1161.46966400	1649.56736153
28	1426.70000000	1335.08548861	91.61451139	1095.64608544	1574.52489178
29	1427.40000000	1525.96838592	-98.56838592	1280.34602606	1771.59074577
30	1338.50000000	1415.91030966	-77.41030966	1169.63879447	1662.18182486
31	1672.20000000	1398.25975712	273.94024288	1141.51450386	1655.00501038
32	1287.50000000	1343.15324749	-55.65324749	1080.30908794	1605.99740703

SUM OF RESIDUALS	=	0.00000000
SUM OF SQUARED RESIDUALS	=	311193.40682763
SUM OF SQUARED RESIDUALS - ERROR SS	=	0.00000066
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	0.02324303
DURBIN-WATSON D	=	1.91932317

OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE CONSTCON

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	5	2891233.45395389	578246.69079078	52.68909	0.0001	0.91017306	9.69404 %
ERROR	26	285342.05823361	10974.69454745				
						STD DEV	CONSTCON MEAN
CORRECTED TOTAL	31	3176575.51218750				104.76017634	1080.66563

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
GNP	1	2050670.95035426	186.85449	0.0001	678001.70033230	61.77864	0.0001
OCCUPNCY	1	475178.53933832	43.29766	0.0001	692090.73536130	63.06241	0.0001
CORPROFT	1	35773.10172252	3.25960	0.0826	60253.44166194	5.49022	0.0270
FIXINVST	1	138518.42014225	12.62162	0.0015	187117.54817579	17.04991	0.0003
FEDFUNDS	1	191092.44239654	17.41210	0.0003	191092.44239654	17.41210	0.0003

SOURCE	B VALUES	T FOR H0:B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	-10355.81779764	-8.53342	0.0001	1213.56031535	0.0
GNP	5.23109761	7.85994	0.0001	0.66553922	2.87222078
OCCUPNCY	104.87361888	7.94118	0.0001	13.20629388	0.87584735
CORPROFT	-15.01966058	-2.34312	0.0270	6.41010893	-0.18329285
FIXINVST	-63.71735715	-4.12915	0.0003	15.43109396	-1.37126037
FEDFUNDS	-57.35181672	-4.17278	0.0003	13.74426894	-0.29466813

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR INDIVIDUAL	UPPER 95% CL FOR INDIVIDUAL
1	558.00000000	510.67894809	47.32105191	264.19959128	757.15830489
2	621.30000000	665.95187538	-44.65187538	428.76978508	903.13396568
3	603.90000000	660.02457707	-56.12457707	421.21977341	898.82938073
4	574.50000000	590.38039265	-15.88039265	361.83271236	818.92807293
5	599.40000000	559.33508625	40.06491375	328.07628627	790.59388622
6	786.60000000	717.66807130	68.93192870	490.09314980	945.24299280
7	702.20000000	716.18893170	-13.98893170	487.24926960	945.12859380
8	734.30000000	750.95123187	-16.65123187	514.81839586	987.08406788
9	666.40000000	687.16636738	-20.76636738	455.18791423	919.14482054
10	944.20000000	890.57679807	53.62320193	657.16224075	1123.99135538
11	937.30000000	996.34748552	-59.04748552	762.75283887	1229.94213217
12	1129.20000000	1260.24086929	-131.04086929	1023.89725429	1496.58448430
13	1318.70000000	1207.30856935	111.39143065	979.20621489	1435.41092380
14	1568.40000000	1440.78206556	127.61793444	1196.92430233	1684.63982880
15	1131.70000000	1270.59059819	-138.89059819	1036.56399784	1504.61719854
16	1338.60000000	1280.27448677	58.32551323	1049.65816875	1510.89080480
17	1260.50000000	1283.26869669	-22.76869669	1052.11943652	1514.41795686
18	1094.20000000	1170.67974590	-76.67974590	943.95866923	1397.80082258
19	1362.20000000	1190.50679404	171.69320596	961.87028179	1419.14330629
20	890.10000000	1048.33126103	-158.23126103	817.45936086	1279.16316120
21	1257.90000000	1110.39693909	147.50306091	874.95704306	1345.83683512
22	1181.10000000	1142.59385569	38.50614431	907.01362296	1378.17408842
23	1226.00000000	1237.17903378	-11.17903378	1003.57143090	1470.78663667
24	1083.00000000	1167.66244682	-84.66244682	933.66082316	1401.66407048
25	1204.90000000	1234.59802241	-29.69802241	1006.18343964	1463.01260517
26	1283.10000000	1211.19178664	71.90821336	983.78698521	1438.59658806
27	1371.30000000	1476.29628079	-104.99628079	1233.01356619	1719.57899538
28	1426.70000000	1430.95129331	-4.25129331	1196.53997991	1665.36260672
29	1427.40000000	1419.09310942	8.30689058	1190.01549004	1648.17072880
30	1338.50000000	1361.59394632	-23.09394632	1128.69171399	1594.49617864
31	1672.20000000	1433.42287056	238.77712944	1190.95348856	1675.89225257
32	1287.50000000	1458.66756306	-171.36756306	1194.50891608	1723.22621003

SUM OF RESIDUALS	=	-0.00000000
SUM OF SQUARED RESIDUALS	=	285342.05823488
SUM OF SQUARED RESIDUALS - ERROR SS	=	0.00000127
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	-0.48354325
DURBIN-WATSON D	=	2.80160333

OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE CONSTCON

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	5	2922869.60250597	584573.92050119	59.90764	0.0001	0.92013226	9.14086 %
ERROR	26	253705.90968152	9757.91960314				
						STD DEV	CONSTCON MEAN
CORRECTED TOTAL	31	3176575.51218750				98.78218262	1080.66563

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
GNP	1	2050670.95035426	210.15452	0.0001	689524.32108606	70.66305	0.0001
OCCUPNCY	1	475178.53933832	48.69671	0.0001	782886.81616902	80.23091	0.0001
BID_VOL	1	86683.61393763	8.88341	0.0062	91889.59021402	9.41692	0.0050
FIXINVST	1	130365.84370063	13.36000	0.0012	176274.50974412	18.06476	0.0002
FEDFUNDS	1	179970.65517512	18.44355	0.0002	179970.65517512	18.44355	0.0002

SOURCE	B VALUES	T FOR HO:B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	-10365.04254489	-9.30038	0.0001	1114.47466627	0.0
GNP	5.06098337	8.40613	0.0001	0.60205856	2.77881674
OCCUPNCY	100.18411848	8.95717	0.0001	11.18479450	0.83668320
BID_VOL	-0.52095467	-3.06870	0.0050	0.16976392	-0.19463440
FIXINVST	-61.06655922	-4.25027	0.0002	14.36770196	-1.31421258
FEDFUNDS	-55.73824993	-4.29460	0.0002	12.97869712	-0.28637778

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR INDIVIDUAL	UPPER 95% CL FOR INDIVIDUAL
1	558.00000000	485.76014604	72.23985396	255.93912047	715.58117161
2	621.30000000	664.35033335	-43.05033335	442.61307239	886.08759431
3	603.90000000	643.30549642	-39.40549642	421.79494407	864.81604878
4	574.50000000	625.99478132	-51.49478132	410.62457133	841.36499131
5	599.40000000	610.02147182	-10.62147182	391.70348715	828.33945649
6	786.60000000	689.95698545	96.64301455	474.14517061	905.76880029
7	702.20000000	673.65209068	28.34790932	453.72879461	893.97538676
8	734.30000000	799.87813481	-65.57813481	583.98594618	1015.77032345
9	666.40000000	691.76364594	-25.36364594	476.44821267	907.07907921
10	944.20000000	847.57825364	96.62174636	622.61678584	1072.53972145
11	937.30000000	1016.13731801	-78.83731801	798.17690305	1234.09773297
12	1129.20000000	1288.59579443	-159.39579443	1063.83119901	1513.36038985
13	1318.70000000	1246.55537386	72.14462614	1028.51910121	1464.59164652
14	1568.40000000	1459.40367911	108.99632089	1228.53068284	1690.27667538
15	1131.70000000	1201.49727907	-69.79727907	974.88427208	1428.11028606
16	1338.60000000	1288.16499781	50.43500219	1070.52205666	1505.80793895
17	1260.50000000	1281.16015004	-20.66015004	1063.19235700	1499.12794307
18	1094.20000000	1105.53125272	-11.33125272	883.32653864	1327.73596680
19	1362.20000000	1259.66712673	102.53287327	1047.35261136	1471.98164209
20	890.10000000	995.96420368	-105.86420368	774.19374910	1217.73465826
21	1257.90000000	1231.63004882	26.26995118	996.52924988	1466.73084776
22	1181.10000000	1145.45570468	35.64429532	923.38360332	1367.52780604
23	1226.00000000	1161.17036910	64.82963090	941.33443603	1381.00630217
24	1083.00000000	1130.18816730	-47.18816730	912.50958172	1347.86675288
25	1204.90000000	1218.92211403	-14.02211403	1006.50395589	1431.34026818
26	1283.10000000	1264.78223589	18.31776411	1046.51140337	1483.05306842
27	1371.30000000	1443.53133345	-72.23133345	1221.27567550	1665.78699141
28	1426.70000000	1373.83009492	52.86990508	1156.77963601	1590.88055383
29	1427.40000000	1454.58415695	-27.18415695	1236.02173687	1673.14657704
30	1338.50000000	1369.20902936	-30.70902936	1149.70852597	1588.70953275
31	1672.20000000	1404.05341230	268.14658770	1173.36646367	1634.74036093
32	1287.50000000	1508.80481825	-221.30481825	1273.21353069	1744.39610581

SUM OF RESIDUALS	=	0.00000000
SUM OF SQUARED RESIDUALS	=	253705.90968301
SUM OF SQUARED RESIDUALS - ERROR SS	=	0.00000149
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	-0.43413512
DURBIN-WATSON D	=	2.55829991

OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE CONSTCON

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	10	2985115.83020176	298511.58302018	32.74185	0.0001	0.93972765	8.83563 %
ERROR	21	191459.68198573	9117.12771361				
						STD DEV	CONSTCON MEAN
CORRECTED TOTAL	31	3176575.51218750				95.48365155	1080.66563

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
GNP	1	2050670.95035426	224.92511	0.0001	252088.26399337	27.64997	0.0001
OCCUPNCY	1	475178.53933832	52.11932	0.0001	126004.57368604	13.82064	0.0013
BIC_VCL	1	86683.61393763	9.50778	0.0056	71856.66901892	7.88150	0.0106
NEWPLANS	1	2820.28343585	0.30934	0.5840	20184.90105587	2.21395	0.1516
CORPEQNC	1	13601.06990670	1.49182	0.2355	342.82103394	0.03760	0.8461
CORPROFT	1	115.89187405	0.01271	0.9113	3352.92661656	0.36776	0.5507
FIXINVST	1	123165.96631296	13.50929	0.0014	167135.47898982	18.33203	0.0003
FEDFUNDS	1	197310.82035274	21.64177	0.0001	32742.37322640	3.59130	0.0719
GOVSECUR	1	28110.27316161	3.08324	0.0937	22047.69367120	2.41827	0.1349
CLERKEMP	1	7458.42152763	0.81807	0.3760	7458.42152763	0.81807	0.3760

SOURCE	B VALUES	T FOR HO:B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	-7554.75353825	-3.29229	0.0035	2294.67935421	0.0
GNP	5.76528598	5.25832	0.0001	1.10021494	3.17650708
OCCUPNCY	79.56695870	3.71761	0.0013	21.40270290	0.66449991
BIC_VCL	-0.65330442	-2.80740	0.0106	0.23270787	-0.24408172
NEWPLANS	0.21106820	1.48794	0.1516	0.14185300	0.13677916
CORPEQNC	-18.97171725	-0.19391	0.8481	97.83673082	-0.06585778
CORPROFT	-4.55685115	-0.60643	0.5507	7.51418420	-0.05560966
FIXINVST	-81.50494091	-4.28159	0.0003	19.03612864	-1.75406671
FEDFUNDS	-43.76519521	-1.89507	0.0719	23.09419411	-0.22486137
GOVSECUR	123.52896801	1.55508	0.1349	79.43579555	0.35042879
CLERKEMP	-110.50013863	-0.90447	0.3760	122.17107062	-0.31156881

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR INDIVIDUAL	UPPER 95% CL FOR INDIVIDUAL
1	558.00000000	484.71013459	73.28986541	249.54615670	719.87411247
2	621.30000000	699.34365989	-78.04365989	474.49351691	924.19380288
3	603.90000000	668.50515557	-64.60515557	444.59137488	892.41893626
4	574.50000000	636.14852162	-61.64852162	419.56155571	852.73548753
5	599.40000000	579.25783178	20.14216822	353.84581622	804.66984735
6	786.60000000	648.13453938	138.46546062	431.92666606	864.34241270
7	702.20000000	653.67228704	48.52771296	435.42559439	871.91897969
8	734.30000000	817.81626851	-83.51626851	594.22924303	1041.40329399
9	666.40000000	675.61958955	-9.21958955	450.14526553	901.09391357
10	944.20000000	854.83983733	89.36016267	631.43456624	1078.24510843
11	937.30000000	1011.81508136	-74.51508136	791.70059340	1231.92956932
12	1129.20000000	1258.86625760	-129.66625760	1029.67505582	1488.05745938
13	1318.70000000	1275.47441754	43.22558246	1048.66086016	1502.28797493
14	1568.40000000	1445.24163568	123.15836432	1215.62587479	1674.85739656
15	1131.70000000	1209.98941718	-78.28941718	977.31952333	1442.65931104
16	1338.60000000	1343.63492314	-5.03492314	1118.19388795	1569.07595833
17	1260.50000000	1234.16030389	26.33969611	991.36862697	1476.95198081
18	1094.20000000	1107.21878584	-13.01878584	866.16336182	1348.27420986
19	1362.20000000	1289.91825302	72.28174698	1058.09878047	1521.73772557
20	890.10000000	974.62710797	-84.52710797	744.32715658	1204.92705736
21	1257.90000000	1178.49902069	79.40097931	936.81116503	1420.18687636
22	1181.10000000	1159.45049939	21.64950061	931.82625563	1387.07474316
23	1226.00000000	1256.97222116	-30.97222116	1015.54363152	1498.40081081
24	1083.00000000	1118.18176454	-35.18176454	899.75161902	1336.61191006
25	1204.90000000	1175.71343511	29.18656489	935.50091698	1415.92595324
26	1283.10000000	1234.84040019	48.25959981	1009.18182834	1460.49897204
27	1371.30000000	1459.91720505	-88.61720505	1228.01472281	1691.81968728
28	1426.70000000	1341.89553087	84.80446913	1114.22228347	1569.56877826
29	1427.40000000	1491.03174896	-63.63174896	1259.63716626	1722.42633166
30	1338.50000000	1424.04388604	-85.54388604	1201.99215915	1646.09561293
31	1672.20000000	1498.18091436	174.01908564	1255.23419138	1741.12763734
32	1287.50000000	1373.57936512	-86.07936512	1108.36613290	1638.79259734

SUM OF RESIDUALS	=	0.00000000
SUM OF SQUARED RESIDUALS	=	191459.68198743
SUM OF SQUARED RESIDUALS - ERROR SS	=	0.00000170
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	-0.28308346
DURBIN-WATSON D	=	2.48050524

```
PROCEDURE PRINT  DATA=OFFBLDG3  ;

VARIABLES DATE CON58DOL DATEGNP GNP58DOL DATEOCC OCCUPNCY DATEPRFT PROFIT58
          DATEFIX FIX58DOL DATEFED FEDFUNDS  ;
```

OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

OBS	DATE	CON58DOL	DATEGNP	GNP58DOL	DATEOCC	OCCUPNCY	DATEPRFT	PROFIT58	DATEFIX	FIX58DOL	DATEFED	FEDFUNDS
1	1Q_1966	476.9	1Q_1966	649.1	1Q_1966	92.01	2Q_1964	35.5	1Q_1966	25.5	3Q_1964	3.46
2	2Q_1966	524.8	2Q_1966	655.0	2Q_1966	92.65	3Q_1964	35.9	2Q_1966	24.8	4Q_1964	3.58
3	3Q_1966	504.5	3Q_1966	660.2	3Q_1966	92.65	4Q_1964	35.6	3Q_1966	25.3	1Q_1965	3.97
4	4Q_1966	476.3	4Q_1966	668.1	4Q_1966	91.57	1Q_1965	39.8	4Q_1966	24.5	2Q_1965	4.08
5	1Q_1967	492.1	1Q_1967	666.6	1Q_1967	91.57	2Q_1965	39.6	1Q_1967	25.0	3Q_1965	4.07
6	2Q_1967	639.5	2Q_1967	671.6	2Q_1967	91.58	3Q_1965	39.7	2Q_1967	23.3	4Q_1965	4.17
7	3Q_1967	561.3	3Q_1967	678.9	3Q_1967	91.58	4Q_1965	41.5	3Q_1967	23.5	1Q_1966	4.56
8	4Q_1967	581.0	4Q_1967	683.6	4Q_1967	91.77	1Q_1966	43.8	4Q_1967	23.3	2Q_1966	4.91
9	1Q_1968	525.5	1Q_1968	692.6	1Q_1968	91.77	2Q_1966	43.4	1Q_1968	24.8	3Q_1966	5.34
10	2Q_1968	733.7	2Q_1968	705.3	2Q_1968	92.15	3Q_1966	43.3	2Q_1968	23.8	4Q_1966	5.57
11	3Q_1968	716.6	3Q_1968	712.3	3Q_1968	92.15	4Q_1966	42.8	3Q_1968	24.0	1Q_1967	4.82
12	4Q_1968	849.7	4Q_1968	716.5	4Q_1968	93.61	1Q_1967	40.1	4Q_1968	24.4	2Q_1967	3.99
13	1Q_1969	963.3	1Q_1969	722.4	1Q_1969	93.61	2Q_1967	39.9	1Q_1969	25.9	3Q_1967	3.89
14	2Q_1969	1125.1	2Q_1969	725.8	2Q_1969	95.07	3Q_1967	40.0	2Q_1969	25.4	4Q_1967	4.17
15	3Q_1969	796.4	3Q_1969	729.2	3Q_1969	95.07	4Q_1967	42.1	3Q_1969	27.3	1Q_1968	4.79
16	4Q_1969	920.6	4Q_1969	725.1	4Q_1969	95.25	1Q_1968	40.9	4Q_1969	27.0	2Q_1968	5.98
17	1Q_1970	854.0	1Q_1970	721.2	1Q_1970	95.25	2Q_1968	41.8	1Q_1970	27.0	3Q_1968	5.94
18	2Q_1970	724.6	2Q_1970	722.1	2Q_1970	94.00	3Q_1968	41.9	2Q_1970	26.9	4Q_1968	5.92
19	3Q_1970	823.4	3Q_1970	727.2	3Q_1970	94.00	4Q_1968	42.5	3Q_1970	26.7	1Q_1969	6.58
20	4Q_1970	574.0	4Q_1970	719.3	4Q_1970	92.97	1Q_1969	39.4	4Q_1970	26.3	2Q_1969	8.33
21	1Q_1971	779.3	1Q_1971	735.1	1Q_1971	92.97	2Q_1969	39.1	1Q_1971	26.9	3Q_1969	8.98
22	2Q_1971	709.3	2Q_1971	740.4	2Q_1971	92.44	3Q_1969	37.1	2Q_1971	27.1	4Q_1969	8.94
23	3Q_1971	715.3	3Q_1971	746.9	3Q_1971	92.44	4Q_1969	34.9	3Q_1971	27.2	1Q_1970	8.57
24	4Q_1971	621.0	4Q_1971	759.0	4Q_1971	90.07	1Q_1970	33.5	4Q_1971	27.2	2Q_1970	7.88
25	1Q_1972	676.1	1Q_1972	768.0	1Q_1972	90.07	2Q_1970	32.7	1Q_1972	28.5	3Q_1970	6.70
26	2Q_1972	711.3	2Q_1972	785.6	2Q_1972	87.77	3Q_1970	33.5	2Q_1972	28.2	4Q_1970	5.57
27	3Q_1972	761.0	3Q_1972	796.7	3Q_1972	87.77	4Q_1970	30.0	3Q_1972	28.2	1Q_1971	3.86
28	4Q_1972	767.1	4Q_1972	812.3	4Q_1972	87.38	1Q_1971	30.9	4Q_1972	29.1	2Q_1971	4.56
29	1Q_1973	748.5	1Q_1973	829.3	1Q_1973	87.38	2Q_1971	32.4	1Q_1973	30.2	3Q_1971	5.48
30	2Q_1973	690.3	2Q_1973	834.3	2Q_1973	86.23	3Q_1971	32.7	2Q_1973	31.0	4Q_1971	4.75
31	3Q_1973	853.6	3Q_1973	841.3	3Q_1973	86.23	4Q_1971	33.6	3Q_1973	32.8	1Q_1972	3.54
32	4Q_1973	656.9	4Q_1973	844.6	4Q_1973	87.61	1Q_1972	38.1	4Q_1973	32.6	2Q_1972	4.30

```
PROCEDURE RSQUARE  PRINT=5  DATA=OFFBLDG3  ;

VARIABLES GNP58DOL CCCUPANCY BID58DOL PLANS58 CORPBOND PROFIT58 FIX58DOL
          FEDFUNDS GOVSECUR CLERKEMP CON58DOL  ;
```

N= 32 OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

ALL POSSIBLE REGRESSION MODELS FOR DEPENDENT VARIABLE CON58DOL

NUMBER IN MODEL	R-SQUARE	VARIABLES IN MODEL
1	0.16766673	GNP58DOL
1	0.22330585	PLANS58
1	0.26338314	CLERKEMP
1	0.34209580	GOVSECUR
1	0.38956247	CORPBOND
2	0.43805051	PLANS58 CORPBOND
2	0.46543506	PLANS58 GOVSECUR
2	0.48303311	CORPBOND FEDFUNDS
2	0.54548766	OCCUPNCY CLERKEMP
2	0.65528502	GNP58DOL OCCUPNCY
3	0.67230709	GNP58DOL OCCUPNCY CLERKEMP
3	0.67934680	GNP58DOL OCCUPNCY BID58DOL
3	0.69282638	GNP58DOL OCCUPNCY CORPBOND
3	0.71394272	GNP58DOL OCCUPNCY FIX58DOL
3	0.74665561	GNP58DOL OCCUPNCY FEDFUNDS
4	0.75741527	GNP58DOL OCCUPNCY BID58COL FIX58DOL
4	0.75973415	GNP58DOL OCCUPNCY PLANS58 FEDFUNDS
4	0.76700074	GNP58DOL OCCUPNCY BID58DOL FEDFUNDS
4	0.78109887	GNP58DOL OCCUPNCY FEDFUNDS GOVSECUR
4	0.81886017	GNP58DOL OCCUPNCY FIX58DOL FEDFUNDS
5	0.82158404	GNP58DOL OCCUPNCY CORPBOND FIX58BOL FEDFUNDS
5	0.82508240	GNP58DOL OCCUPNCY FIX58COL FEDFUNDS CLERKEMP
5	0.82561382	GNP58DOL OCCUPNCY FIX58DOL FEDFUNDS GOVSECUR
5	0.84033861	GNP58DOL OCCUPNCY PROFIT58 FIX58DOL FEDFUNDS
5	0.85902221	GNP58DOL OCCUPNCY BID58DOL FIX58DOL FEDFUNDS

N= 32 OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

ALL POSSIBLE REGRESSION MODELS FOR DEPENDENT VARIABLE CON58DOL

NUMBER IN MODEL	R-SQUARE	VARIABLES IN MODEL
6	0.85921690	GNP58DOL OCCUPNCY BID58DOL FIX58DOL FEDFUNDS CLERKEMP
6	0.85966290	GNP58DOL OCCUPNCY BID58DOL PLANS58 FIX58DOL FEDFUNDS
6	0.85981821	GNP58DOL OCCUPNCY BID58DOL PROFIT58 FIX58DOL FEDFUNDS
6	0.86037187	GNP58DOL OCCUPNCY BID58DOL CORPBOND FIX58DOL FEDFUNDS
6	0.86147268	GNP58DOL OCCUPNCY BID58DOL FIX58DOL FEDFUNDS GOVSECUR
7	0.86154178	GNP58DOL OCCUPNCY BID58DOL CORPBOND FIX58DOL FEDFUNDS GOVSECUR
7	0.86245998	GNP58DOL OCCUPNCY BID58DOL PROFIT58 FIX58DOL FEDFUNDS GOVSECUR
7	0.86328921	GNP58DOL OCCUPNCY BID58DOL PLANS58 FIX58DOL FEDFUNDS GOVSECUR
7	0.86331934	GNP58DOL OCCUPNCY BID58DOL FIX58DOL FEDFUNDS GOVSECUR CLERKEMP
7	0.86417426	GNP58DOL OCCUPNCY BID58DOL CORPBOND FIX58DOL FEDFUNDS CLERKEMP
8	0.86430802	GNP58DOL OCCUPNCY BID58DOL CORPBOND FIX58DOL FEDFUNDS GOVSECUR CLERKEMP
8	0.86456111	GNP58DOL OCCUPNCY BID58DOL PROFIT58 FIX58DOL FEDFUNDS GOVSECUR CLERKEMP
8	0.86507199	GNP58DOL OCCUPNCY BID58DOL CORPBOND PROFIT58 FIX58DOL FEDFUNDS CLERKEMP
8	0.86543434	GNP58DOL OCCUPNCY BID58DOL PLANS58 FIX58DOL FEDFUNDS GOVSECUR CLERKEMP
8	0.86592579	GNP58DOL OCCUPNCY BID58DOL PLANS58 CORPBOND FIX58DOL FEDFUNDS CLERKEMP
9	0.86404935	GNP58DOL OCCUPNCY BID58DOL PLANS58 CORPBOND PROFIT58 FIX58DOL FEDFUNDS GOVSECUR
9	0.86533079	GNP58DOL OCCUPNCY BID58DOL CORPBOND PROFIT58 FIX58DOL FEDFUNDS GOVSECUR CLERKEMP
9	0.86615658	GNP58DOL OCCUPNCY BID58DOL PLANS58 PROFIT58 FIX58DOL FEDFUNDS GOVSECUR CLERKEMP
9	0.86634729	GNP58DOL OCCUPNCY BID58DOL PLANS58 CORPBOND FIX58DOL FEDFUNDS GOVSECUR CLERKEMP
9	0.86638704	GNP58DOL OCCUPNCY BID58DOL PLANS58 CORPBOND PROFIT58 FIX58DOL FEDFUNDS CLERKEMP
10	0.86691321	GNP58DOL OCCUPNCY BID58DOL PLANS58 CORPBOND PROFIT58 FIX58DOL FEDFUNDS GOVSECUR CLERKEMP

```
PROCEDURE REGR S C  DATA=OFFBLDG3  ;
MODEL CON58DOL = GNP58DOL FIX58DCL OCCUPNCY CORPBOND FEDFUNDS / P CLI  ;
MODEL CON58DOL = GNP58DCL FIX58DCL OCCUPNCY CLERKEMP FEDFUNDS / P CLI  ;
MODEL  CON58DOL = GNP58DOL OCCUPNCY BID58DOL FIX58DOL GOVSECUR / P CLI  ;
MODEL CON58DCL = GNP58DCL PROFIT58 FIX58DOL OCCUPNCY FEDFUNDS / P CLI  ;
MODEL CON58DOL = GNP58DCL FIX58DCL BID58DOL OCCUPNCY FEDFUNDS / P CLI  ;
MODEL  CON58DOL = GNP58DOL OCCUPNCY BID58DOL PLANS58 CORPBOND PROFIT58
                  FIX58DCL FEDFUNDS GOVSECUR CLERKEMP / P CLI  ;
```

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*************************************************************************************************
*                                                                                               *
*  PROC REGR    :  OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION                 *
*                                                                                               *
*  DATA SET     :  OFFBLDG3       NUMBER OF VARIABLES = 11       NUMBER OF CLASSES =  0         *
*                                                                                               *
*  VARIABLES    :  CLERKEMP CON58DOL CORPBOND GOVSECUR FEDFUNDS OCCUPNCY GNP58DOL PROFIT58     *
*                                                                                               *
*                  FIX58DOL BIC58DOL PLANS58                                                    *
*                                                                                               *
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OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

N = 32

SIMPLE STATISTICS

VARIABLE	SUM	MEAN	UNCORRECTED SS	CORRECTED SS	VARIANCE	STANDARD DEV
CLERKEMP	425.16000000	13.28625000	5674.03670800	25.25465800	0.81466639	0.90258871
CON58DCL	22563.00000000	705.09375000	16627139.76000000	718109.47875001	23164.82189516	152.19994052
CORPBOND	235.88000000	7.37125000	1777.00940000	38.27895000	1.23480484	1.11121773
GOVSECUR	194.31000000	6.07218750	1205.45030000	25.56354688	0.82463054	0.90809170
FEDFUNDS	171.25000000	5.35156250	1000.31050000	83.85542187	2.70501361	1.64469256
OCCUPNCY	2928.64000000	91.52000000	268250.68880000	221.55600000	7.14696774	2.67338133
GNP58DCL	23445.60000000	732.67500000	17276988.51999999	98983.54000001	3193.01741936	56.50679091
PROFIT58	1218.00000000	38.06250000	46873.84000000	513.71500000	16.57145161	4.07080479
FIX58DCL	853.70000000	26.67812500	22967.83000000	192.71468750	6.21660282	2.49331162
BID58DCL	7786.70000000	243.33437500	2101219.23000000	206447.45218750	6659.59523185	81.60634309
PLANS58	16156.90000000	504.90312500	8608571.23000000	450901.92968751	14545.22353831	120.60358012

OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

N = 32 CORRELATION COEFFICIENTS / PROB > |R| UNDER HO: RHO=0

	CLERKEMP	CON58DOL	CORP8OND	GOVSECUR	FEDFUNDS	OCCUPNCY	GNP58DOL	PROFIT58	FIX58DOL	BID58DOL
CLERKEMP	1.000000 0.0000	0.513209 0.0027	0.781821 0.0001	0.676569 0.0001	0.271704 0.1325	-0.490613 0.0044	0.937483 0.0001	-0.418795 0.0170	0.838877 0.0001	-0.109252 0.5517
	PLANS58									
	0.241857 0.1823									

	CLERKEMP	CON58DOL	CORP8OND	GOVSECUR	FEDFUNDS	OCCUPNCY	GNP58DOL	PROFIT58	FIX58DOL	BID58DOL
CON58DOL	0.513209 0.0027	1.000000 0.0000	0.624149 0.0001	0.584890 0.0004	0.058038 0.7524	0.211033 0.2463	0.409471 0.0200	0.056737 0.7578	0.264320 0.1438	-0.005762 0.9750
	PLANS58									
	0.472552 0.0063									

	CLERKEMP	CON58DOL	CORP8OND	GOVSECUR	FEDFUNDS	OCCUPNCY	GNP58DOL	PROFIT58	FIX58DOL	BID58DOL
CORP8OND	0.781821 0.0001	0.624149 0.0001	1.000000 0.0000	0.879083 0.0001	0.513352 0.0027	0.094152 0.6083	0.565825 0.0007	0.013189 0.9429	0.519530 0.0023	0.236146 0.1932
	PLANS58									
	0.440364 0.0117									

	CLERKEMP	CON58DOL	CORPBOND	GOVSECUR	FEDFUNDS	OCCUPNCY	GNP58DOL	PROFIT58	FIX58DOL	BID58DOL
GOVSECUR	0.676569 0.0001	0.584890 0.0004	0.879083 0.0001	1.000000 0.0000	0.160982 0.3788	0.084411 0.6265	0.504779 0.0032	0.085881 0.6402	0.558416 0.0009	0.305228 0.0894
	PLANS58									
	0.222542 0.2209									

	CLERKEMP	CON58DOL	CORPBOND	GOVSECUR	FEDFUNDS	OCCUPNCY	GNP58DOL	PROFIT58	FIX58DOL	BID58DOL
FEDFUNDS	0.271704 0.1325	0.058038 0.7524	0.513352 0.0027	0.160982 0.3788	1.000000 0.0000	0.194255 0.2867	0.129706 0.4792	0.016694 0.9277	0.082354 0.6541	0.139351 0.4469
	PLANS58									
	0.465478 0.0049									

	CLERKEMP	CON58DOL	CORPBOND	GOVSECUR	FEDFUNDS	OCCUPNCY	GNP58DOL	PROFIT58	FIX58DOL	BID58DOL
OCCUPNCY	-0.490613 0.0044	0.211033 0.2463	0.094152 0.6083	0.089411 0.6265	0.194255 0.2867	1.000000 0.0000	-0.700933 0.0001	0.722367 0.0001	-0.641471 0.0001	0.456667 0.0086
	PLANS58									
	0.350908 0.0489									

	CLERKEMP	CON58DOL	CORPBOND	GOVSECUR	FEDFUNDS	OCCUPNCY	GNP58DOL	PROFIT58	FIX58DOL	BID58DOL
GNP58DOL	0.937483 0.0001	0.409471 0.0200	0.565825 0.0007	0.504779 0.0032	0.129706 0.4792	-0.700933 0.0001	1.000000 0.0000	-0.583355 0.0005	0.907317 0.0001	-0.287526 0.1106
	PLANS58									
	0.109755 0.5499									

	CLERKEMP	CON58DOL	CORPBOND	GOVSECUR	FEDFUNDS	OCCUPNCY	GNP58DOL	PROFIT58	FIX58DOL	BID58DOL
PROFIT58	-0.418795 0.0170	0.056737 0.7578	0.013189 0.9429	0.085881 0.6402	0.016654 0.9277	0.722367 0.0001	-0.583355 0.0005	1.000000 0.0000	-0.615765 0.0002	0.706297 0.0001
	PLANS58									
	0.110548 0.5470									

	CLERKEMP	CON58DOL	CORPBOND	GOVSECUR	FEDFUNDS	OCCUPNCY	GNP58DOL	PROFIT58	FIX58DOL	BID58DOL
FIX58DOL	0.838877 0.0001	0.264320 0.1438	0.519530 0.0023	0.558416 0.0009	0.082354 0.6541	-0.641471 0.0001	0.907317 0.0001	-0.615765 0.0002	1.000000 0.0000	-0.339293 0.0575
	PLANS58									
	0.004171 0.9819									

	CLERKEMP	CON58DOL	CORPBOND	GOVSECUR	FEDFUNDS	OCCUPNCY	GNP58DOL	PROFIT58	FIX58DOL	BID58DOL
BID58DOL	-0.109252 0.5517	-0.005762 0.9750	0.236146 0.1932	0.305228 0.0894	0.139351 0.4469	0.456667 0.0086	-0.287526 0.1106	0.706297 0.0001	-0.339293 0.0575	1.000000 0.0000
	PLANS58									
	0.161339 0.3777									

	CLERKEMP	CON58DOL	CORPBOND	GOVSECUR	FEDFUNDS	OCCUPNCY	GNP58DOL	PROFIT58	FIX58DOL	BID58DOL
PLANS58	0.241857 0.1823	0.472552 0.0063	0.440364 0.0117	0.222542 0.2209	0.485478 0.0049	0.350908 0.0489	0.109755 0.5499	0.110548 0.5470	0.004171 0.9819	0.161339 0.3777
	PLANS58									
	1.000000 0.0000									

OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE CON58DOL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	5	589987.28657709	117997.45731542	23.94537	0.0001	0.82158404	9.95586 %
ERROR	26	128122.19217293	4927.77662204				
						STD DEV	CON58DOL MEAN
CORRECTED TOTAL	31	718109.47875001				70.19812406	705.09375

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
GNP58DOL	1	120403.06772709	24.43355	0.0001	211460.86975403	42.91202	0.0001
FIX58DOL	1	46683.12401231	9.47347	0.0049	49266.98442299	9.99781	0.0040
OCCUPNCY	1	345602.84364399	70.13363	0.0001	179059.21544819	36.33672	0.0001
CORPBOND	1	23150.89857049	4.69804	0.0395	1956.03650815	0.39694	0.5342
FEDFUNDS	1	54147.35262320	10.98819	0.0027	54147.35262320	10.98819	0.0027

SOURCE	B VALUES	T FOR HO:B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	-8580.19839993	-6.00911	0.0001	1427.86451047	0.0
GNP58DOL	5.36445026	6.55073	0.0001	0.81890915	1.99164250
FIX58DOL	-38.37447956	-3.16193	0.0040	12.13640372	-0.62864371
OCCUPNCY	72.88625199	6.02799	0.0001	12.09129413	1.28024193
CORPBOND	-17.25868000	-0.63003	0.5342	27.39331582	-0.12600630
FEDFUNDS	-30.77213837	-3.31484	0.0027	9.28313292	-0.33252777

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR INDIVIDUAL	UPPER 95% CL FOR INDIVIDUAL
1	476.90000000	434.74504272	42.15495728	269.53373314	599.95635229
2	524.80000000	529.13592084	-4.33592084	372.41307548	685.85876619
3	504.50000000	517.73110887	-13.23110887	361.70064058	673.76157715
4	476.30000000	508.01741503	-31.71741503	354.82750583	661.20732424
5	492.10000000	490.75608204	1.34391796	335.58510026	645.92706382
6	639.50000000	574.08088570	65.41911430	420.54759935	727.61417204
7	561.30000000	587.00704435	-25.70704435	433.97997205	740.03411665
8	581.00000000	613.48072195	-32.48072195	456.93843312	770.02301078
9	525.50000000	596.66239989	-71.16239989	447.75054074	745.57425904
10	733.70000000	715.32782854	18.37217146	561.69306972	868.96258735
11	716.60000000	772.25268465	-55.65268465	617.18260068	927.32276861
12	849.70000000	905.52043548	-55.82043548	746.06625360	1064.97461736
13	963.30000000	875.61012774	87.68987226	722.10821392	1029.11204156
14	1125.10000000	1006.17438397	118.92561603	842.53293511	1169.81583284
15	796.40000000	925.17463232	-128.77463232	766.24539488	1084.10386976
16	920.60000000	878.76716121	41.83283879	723.13129694	1034.40302548
17	854.00000000	857.69599631	-3.69599631	701.05706924	1014.33492339
18	724.60000000	767.41232409	-42.81232409	599.70528460	935.11936359
19	833.40000000	788.69460343	44.70539657	632.59809889	944.79110796
20	574.00000000	638.09134727	-64.09134727	477.78982383	798.39287071
21	779.30000000	699.67056576	79.62943424	535.00430473	864.33682679
22	709.30000000	675.26202223	34.03797777	516.76175881	833.76228565
23	715.30000000	716.98884499	-1.68884499	560.52499978	873.45269020
24	621.00000000	638.15745744	-17.15745744	483.54366460	792.77125028
25	676.10000000	675.45061166	0.64938834	524.37049371	826.53072961
26	711.30000000	645.40485456	65.89514544	491.24683574	799.56287338
27	761.00000000	757.39802230	3.60197770	600.28029868	914.51574592
28	767.10000000	758.59649488	8.10350512	604.95430934	913.03868042
29	748.50000000	777.25363935	-28.75363935	621.85308442	932.65419429
30	690.30000000	711.50301785	-21.20301785	555.34672168	867.65931401
31	853.60000000	709.27540111	144.32459889	543.36704907	875.18375315
32	656.90000000	815.30092148	-158.40092148	652.66407357	977.93776939

SUM OF RESIDUALS	=	-0.00000000
SUM OF SQUARED RESIDUALS	=	128122.19217343
SUM OF SQUARED RESIDUALS - ERROR SS	=	0.00000050
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	-0.39467922
DURBIN-WATSON D	=	2.49322767

OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE CON58DOL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	5	592499.49162592	118499.89832518	24.52828	0.0001	0.82508240	9.85777 %
ERROR	26	125609.98712409	4831.15335093				
						STD DEV	CON58DOL MEAN
CORRECTED TOTAL	31	718109.47875001				69.50649862	705.09375

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
GNP58DOL	1	120403.067727C9	24.92222	0.0001	122663.96575887	25.39020	0.0001
FIX58DOL	1	46683.12401231	9.66294	0.0045	53822.41516780	11.14070	0.0026
OCCUPNCY	1	345602.84364399	71.53630	0.0001	311193.32845413	64.41388	0.0001
CLERKEMP	1	16863.50348043	3.49058	0.0730	4468.24155699	0.92488	0.3451
FEDFUNDS	1	62946.95276210	13.02938	0.0013	62946.95276210	13.02938	0.0013

SOURCE	B VALUES	T FOR HO:B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	-8341.47743085	-8.52895	0.0001	978.01922569	0.0
GNP58DOL	6.00664356	5.03887	0.0001	1.19206180	2.23006757
FIX58DOL	-40.00503956	-3.33777	0.0026	11.98556537	-0.65535525
OCCUPNCY	71.57785282	8.02583	0.0001	8.96828002	1.26428596
CLERKEMP	-53.25755316	-0.96171	0.3451	55.37813165	-0.31583236
FEDFUNDS	-31.18843695	-3.60962	0.0013	8.64035659	-0.33702635

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR INDIVIDUAL	UPPER 95% CL FOR INDIVIDUAL
1	476.90000000	441.15925057	35.74074943	276.61644920	605.70205193
2	524.80000000	538.19094993	-13.39094993	380.92639922	695.45550063
3	504.50000000	521.92131095	-17.42131095	367.10867825	676.73394365
4	476.30000000	504.39352433	-28.09352433	352.40527087	656.38177780
5	492.10000000	482.35011772	9.74988228	329.46464091	635.23559454
6	639.50000000	570.37700751	69.12299249	418.10201899	722.65199603
7	561.30000000	588.46896411	-27.16896411	437.28473276	739.65319546
8	581.00000000	612.49566343	-31.49566343	458.87156063	766.11976623
9	525.50000000	589.40883954	-63.90883954	441.59836909	737.21931000
10	733.70000000	719.37907442	14.32092558	567.02966085	871.72848800
11	716.60000000	776.44309629	-59.84309629	622.47494764	930.41124493
12	849.70000000	913.82040090	-64.12040090	754.19613994	1073.44466185
13	963.30000000	876.65990409	86.64009591	724.78010542	1028.53969875
14	1125.10000000	1007.58158390	117.51841610	846.70714910	1168.45601871
15	796.40000000	922.16602797	-125.76602797	765.92114913	1078.41090682
16	920.60000000	875.95548787	44.64451213	721.70841910	1030.20255663
17	854.00000000	840.40946961	13.59053039	678.45766742	1002.36127180
18	724.60000000	768.68209888	-44.28209888	613.20627168	924.55792609
19	833.40000000	796.94504057	36.45495943	647.85175583	946.03832531
20	574.00000000	632.57027248	-58.57027248	474.43015633	790.71038863
21	779.30000000	702.26593704	77.03406296	541.91515712	862.61671696
22	709.30000000	689.25267304	20.04732696	527.85082405	850.65452203
23	715.30000000	723.79886689	-8.49886689	567.68484253	879.91289125
24	621.00000000	637.55911696	-16.55911696	484.60155958	790.51667435
25	676.10000000	653.72699555	22.37300445	501.85621899	805.59777211
26	711.30000000	636.45264169	74.84735831	481.70264374	791.20263964
27	761.00000000	749.37535784	11.62464216	592.18570802	906.56500766
28	767.10000000	757.43748111	9.66251889	604.87746078	909.99750143
29	748.50000000	784.24189605	-35.74189605	629.11725852	939.36653357
30	690.30000000	718.58933927	-28.28933927	563.27471725	873.90396128
31	853.60000000	716.83167969	136.76832031	554.17882594	879.48453344
32	656.90000000	813.88992979	-156.98992979	654.17958453	973.60027506

SUM OF RESIDUALS	=	-0.00000000
SUM OF SQUARED RESIDUALS	=	125609.98712484
SUM OF SQUARED RESIDUALS - ERROR SS	=	0.00000075
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	-0.36770930
DURBIN-WATSON D	=	2.44959503

OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE CON58DOL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	5	561855.26597451	112371.05319490	18.69804	0.0001	0.78240893	10.99467 %
ERROR	26	156254.21277550	6009.77741444				
						STD DEV	CON58DOL MEAN
CORRECTED TOTAL	31	718109.47875001				77.52275417	705.09375

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
GNP58DOL	1	120403.06772709	20.03453	0.0001	230975.39856875	38.43327	0.0001
OCCUPNCY	1	350163.31980529	58.26561	0.0001	107405.44145415	17.87178	0.0003
BIC58DOL	1	17278.99186198	2.87515	0.1019	49108.83439961	8.17149	0.0083
FIX58DOL	1	56061.70646753	9.32842	0.0052	73387.98213606	12.21143	0.0017
GOVSECUR	1	17948.18011261	2.98650	0.0958	17948.18011261	2.98650	0.0958

SOURCE	B VALUES	T FOR HO:B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	-5450.81124562	-4.06800	0.0004	1339.92423442	0.0
GNP58DOL	4.23757160	6.19546	0.0001	0.68353913	1.57326981
OCCUPNCY	46.03034720	4.22750	0.0003	11.36139809	0.84364970
BIC58DOL	-0.68612363	-2.85658	0.0083	0.24002239	-0.36788477
FIX58DOL	-57.70196944	-3.49449	0.0017	16.51229188	-0.94526312
GOVSECUR	59.57369868	1.72815	0.0958	34.47256098	0.35544286

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR INDIVIDUAL	UPPER 95% CL FOR INDIVIDUAL
1	476.90000000	412.60649587	64.29350413	231.58740892	593.62558282
2	524.80000000	532.56923335	-7.76923335	358.16352623	706.97494047
3	504.50000000	543.46798391	-38.96798391	368.74105583	718.19491198
4	476.30000000	538.89743998	-62.59743998	367.95540132	709.83947863
5	492.10000000	479.55985277	12.54014723	307.20146619	651.91823934
6	639.50000000	524.15056572	115.34943428	352.58320488	695.71792656
7	561.30000000	533.77360321	27.52639679	359.47235823	708.07484819
8	581.00000000	651.06089713	-70.06089713	475.78110806	826.34068619
9	525.50000000	556.12361569	-30.62361569	386.59830908	725.64892231
10	733.70000000	657.71104275	75.98895725	480.14787386	835.27421165
11	716.60000000	722.05410369	-5.45410369	551.10844877	892.99975861
12	849.70000000	863.33742735	-13.63742735	690.34533610	1036.32951860
13	963.30000000	845.73549506	117.56450494	677.94193598	1013.52905414
14	1125.10000000	957.05812208	168.04187792	781.38169349	1132.73455068
15	796.40000000	793.19970625	3.20029375	614.41548675	971.98392576
16	920.60000000	909.23118126	11.36881874	733.47061164	1084.99175089
17	854.00000000	866.54485697	-12.54485697	692.15136955	1040.93834439
18	724.60000000	760.79594880	-36.19594880	583.41524977	938.17664783
19	833.40000000	876.34028487	-42.94028487	701.10754102	1051.57302873
20	574.00000000	694.11569906	-120.11569906	527.76788510	860.46351302
21	779.30000000	796.99059118	-17.69059118	616.41548091	977.56570145
22	709.30000000	758.07783670	-48.77783670	591.43558611	924.72008730
23	715.30000000	766.13188728	-50.83188728	600.61365404	931.65012052
24	621.00000000	706.57003045	-85.57003045	540.80859749	872.33146341
25	676.10000000	694.80773942	-18.70773942	524.13318317	865.48229566
26	711.30000000	725.34230084	-14.04230084	553.73491453	896.94968714
27	761.00000000	770.31564800	-9.31564800	597.44936237	943.18193362
28	767.10000000	738.73475454	28.36524546	569.08913660	908.38037248
29	748.50000000	815.14624183	-66.64624183	642.38942675	987.90305692
30	690.30000000	720.54876588	-30.24876588	546.32997027	894.76756150
31	853.60000000	654.61381608	198.98618392	471.19573365	838.03189850
32	656.90000000	697.38683202	-40.48683202	513.42368024	881.34998380

SUM OF RESIDUALS	=	-0.00000000
SUM OF SQUARED RESIDUALS	=	156254.21277589
SUM OF SQUARED RESIDUALS - ERROR SS	=	0.00000039
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	0.17589960
DURBIN-WATSON D	=	1.61776568

OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE CON58DOL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	5	603455.12448577	120691.02489715	27.36893	0.0001	0.84033861	9.41807 %
ERROR	26	114654.35426424	4409.78285632				
						STD DEV	CON58DOL MEAN
CORRECTED TOTAL	31	718109.47875001				66.40619592	705.09375

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
GNP58DOL	1	120403.06772709	27.30363	0.0001	364219.07419768	82.59343	0.0001
PROFIT58	1	95118.75227030	21.56994	0.0001	15423.87441683	3.49765	0.0728
FIX58DOL	1	20338.04424305	4.61203	0.0412	64880.08358273	14.71276	0.0007
OCCUPNCY	1	282712.19840797	64.11023	0.0001	366019.26107496	83.00165	0.0001
FEDFUNDS	1	84883.06183736	19.24881	0.0002	84883.06183736	19.24881	0.0002

SOURCE	B VALUES	T FOR HO: B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	-8298.67152093	-9.94713	0.0001	834.27813521	0.0
GNP58DOL	5.22731491	9.08809	0.0001	0.57518284	1.94072869
PROFIT58	-8.49977342	-1.87020	0.0728	4.54484641	-0.22733858
FIX58DOL	-45.98967064	-3.83572	0.0007	11.98983486	-0.75339438
OCCUPNCY	75.56026503	9.11052	0.0001	8.29373625	1.32721113
FEDFUNDS	-35.68941981	-4.38735	0.0002	8.13462565	-0.38566456

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR INDIVIDUAL	UPPER 95% CL FOR INDIVIDUAL
1	476.90000000	448.71646418	28.18353582	292.17621794	605.25671042
2	524.80000000	552.42633429	-27.62633429	401.78072212	703.07194646
3	504.50000000	545.24459481	-40.74459481	394.46783196	696.02135765
4	476.30000000	502.10212675	-25.80212675	357.36521781	646.83903570
5	492.10000000	473.32316795	18.77683205	326.78552708	619.86080881
6	639.50000000	573.97886612	65.52113388	428.74506788	719.21266436
7	561.30000000	573.72186497	-12.42186497	428.17862285	719.26510710
8	581.00000000	589.80385755	-8.80385755	440.09017850	739.51753660
9	525.50000000	555.91864464	-30.41864464	408.76662732	703.07066196
10	733.70000000	689.64953376	44.05046624	541.56922414	837.72984338
11	716.60000000	748.05975558	-31.45975558	600.50994386	895.60956731
12	849.70000000	914.50823278	-64.80823278	764.37346515	1064.64300041
13	963.30000000	881.63378146	81.66621854	736.44855672	1026.81900621
14	1125.10000000	1021.87648875	103.22351125	867.27327677	1176.47970072
15	796.40000000	912.29202077	-115.89202077	762.97245312	1061.61158842
16	920.60000000	885.98710065	34.61289935	739.23957963	1032.73462166
17	854.00000000	859.37835321	-5.37835321	712.61719740	1006.13950902
18	724.60000000	774.09535846	-49.49535846	630.77294459	917.41777232
19	833.40000000	781.29771751	52.10228249	637.42805458	925.16738044
20	574.00000000	644.46351729	-70.46351729	497.94982929	790.97720530
21	779.30000000	678.81309966	100.48690034	529.52461392	828.10158541
22	709.30000000	675.70010713	33.59989287	526.58782051	824.81239374
23	715.30000000	736.98327384	-21.68327384	587.43982266	886.52672502
24	621.00000000	657.68129119	-36.68129119	509.63692314	805.72565925
25	676.10000000	693.85388768	-17.75388768	549.67275747	838.03501790
26	711.30000000	659.39210140	51.90789860	515.28929834	803.49490446
27	761.00000000	808.19341176	-47.19341176	654.19448213	962.19234139
28	767.10000000	786.24791970	-19.14791970	637.47635621	935.01948319
29	748.50000000	778.93970914	-30.43970914	633.09516529	924.78425299
30	690.30000000	704.89356384	-14.59356384	556.98410904	852.80301864
31	853.60000000	694.23776297	159.36223703	536.94371041	851.53181553
32	656.90000000	759.58609022	-102.68609022	598.57514500	920.59703543

SUM OF RESIDUALS	=	-0.00000000
SUM OF SQUARED RESIDUALS	=	114654.35426480
SUM OF SQUARED RESIDUALS - ERROR SS	=	0.00000056
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	-0.37752427
DURBIN-WATSON D	=	2.61809985

OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE CON58DOL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	5	616871.99181865	123374.39836373	31.68524	0.0001	0.85902221	8.84988 %
ERROR	26	101237.48693136	3893.74949736				
						STD DEV	CON58DOL MEAN
CORRECTED TOTAL	31	718109.47875001				62.39991584	705.09375

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
GNP58DOL	1	120403.06772709	30.92214	0.0001	374188.57444652	96.09981	0.0001
FIX58DOL	1	46683.12401231	11.98925	0.0019	66081.48841492	16.97117	0.0003
BID58DOL	1	3376.59854977	0.86718	0.3603	28840.74174971	7.40693	0.0114
OCCUPNCY	1	373444.29557273	95.90866	0.0001	445803.94745099	114.49220	0.0001
FEDFUNDS	1	72964.90595675	18.73898	0.0002	72964.90595675	18.73898	0.0002

SOURCE	B VALUES	T FOR HO:B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	-8371.49746955	-10.79928	0.0001	775.19016434	0.0
GNP58DOL	5.27675847	9.80305	0.0001	0.53848119	1.95982797
FIX58DOL	-45.11904216	-4.11961	0.0003	10.95226560	-0.73913191
BID58DOL	-0.42972811	-2.72157	0.0114	0.15789725	-0.23041099
OCCUPNCY	73.11945656	10.70010	0.0001	6.83352841	1.28433815
FEDFUNDS	-32.63658705	-4.32885	0.0002	7.53931219	-0.35267525

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR INDIVIDUAL	UPPER 95% CL FOR INDIVIDUAL
1	476.90000000	437.81717783	39.08282217	292.10496127	583.52939440
2	524.80000000	558.72356482	-33.92356482	417.80841312	699.63871651
3	504.50000000	542.20481095	-37.70481095	402.23636107	682.17326084
4	476.30000000	523.90676338	-47.60676338	388.03279416	659.78073260
5	492.10000000	502.52192395	-10.42192395	364.81219691	640.23165099
6	639.50000000	554.13959191	85.36040809	416.80070093	691.47848289
7	561.30000000	543.16201532	18.13798468	402.87793667	683.44609397
8	581.00000000	613.32845501	-32.32845501	476.65672716	750.00018286
9	525.50000000	551.10671265	-25.60671265	414.75430228	687.45912301
10	733.70000000	660.29667496	73.40332504	517.51319230	803.08015762
11	716.60000000	757.69414935	-41.09414935	620.31616463	895.07213406
12	849.70000000	933.08941038	-83.38941038	790.56021642	1075.61860434
13	963.30000000	906.82374901	56.47625099	768.24956781	1045.39793021
14	1125.10000000	1036.56751290	88.53248710	890.49356404	1182.64146177
15	796.40000000	873.48092652	-77.08092652	729.18391011	1017.77794292
16	920.60000000	890.57750146	30.02249854	752.59734059	1028.55766232
17	854.00000000	853.41911748	0.58088252	715.35919492	991.47904005
18	724.60000000	735.06464339	-10.46464339	595.08390954	875.04537724
19	833.40000000	812.64000493	20.75999507	678.84474096	946.43526891
20	574.00000000	618.35553321	-44.35553321	478.65609567	758.05497076
21	779.30000000	741.31113608	37.98886392	594.88681478	887.73545738
22	709.30000000	682.55137497	26.74862503	542.23630599	822.86644395
23	715.30000000	699.41676189	15.88323811	561.28811439	837.54540940
24	621.00000000	645.73385536	-24.73385536	508.25135402	783.21635670
25	676.10000000	688.82714833	-12.72714833	554.93498655	822.71931012
26	711.30000000	683.91298762	27.38701238	546.66491991	821.16105534
27	761.00000000	791.05336536	-30.05336536	651.92351174	930.18321898
28	767.10000000	761.14949361	5.95050639	624.20982234	898.08916488
29	748.50000000	794.69493595	-46.19493595	656.71394566	932.67592623
30	690.30000000	709.00277916	-18.70277916	570.17989536	847.82566296
31	853.60000000	682.91556852	170.68443148	534.72046337	831.11067367
32	656.90000000	777.51035372	-120.61035372	632.80576638	922.21494107

SUM OF RESIDUALS	=	-0.00000000
SUM OF SQUARED RESIDUALS	=	101237.48693194
SUM OF SQUARED RESIDUALS - ERROR SS	=	0.00000058
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	-0.35667823
DURBIN-WATSON D	=	2.49634140

OFFICE BUILDING CONSTRUCTION VOLUME USING MULTIPLE REGRESSION

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE CON58DOL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	10	622538.59463365	62253.85946337	13.67918	0.0001	0.86691321	9.56767 %
ERROR	21	95570.88411636	4550.99448173				
						STD DEV	CON58DOL MEAN
CORRECTED TOTAL	31	718109.47875001				67.46105900	705.09375

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
GNP58DOL	1	120403.067727C9	26.45643	0.0001	86801.03071395	19.07298	0.0003
OCCUPNCY	1	350163.31980529	76.94215	0.0001	78658.07675692	17.28371	0.0004
BID58DCL	1	17278.99186198	3.79675	0.0648	14301.53625200	3.14251	0.0908
PLANS58	1	27.96203959	0.00614	0.9383	1136.35249904	0.24969	0.6225
CORPBOND	1	15297.57277087	3.36137	0.0810	543.34292134	0.11939	0.7331
PROFIT58	1	5036.74690744	1.10674	0.3047	406.39614936	0.08930	0.7680
FIX58DCL	1	48530.470324C6	10.66371	0.0037	39267.21956164	8.62827	0.0079
FEDFUNDS	1	62241.88687726	13.67655	0.0014	21049.75324471	4.62531	0.0433
GOVSECLR	1	1502.00909345	0.33004	0.5717	377.84817924	0.08303	0.7761
CLERKEMP	1	2056.56722662	0.45189	0.5088	2056.56722662	0.45189	0.5088

SOURCE	B VALUES	T FOR HO:B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	-7029.69058393	-3.98134	0.0007	1765.65789067	0.0
GNP58DOL	5.60442717	4.36726	0.0003	1.28328153	2.08073796
OCCUPNCY	63.83312372	4.15737	0.0004	15.35421403	1.12122436
BID58DCL	-0.46172677	-1.77271	0.0908	0.26046349	-0.24756799
PLANS58	0.07483377	0.49969	0.6225	0.14975946	0.05929845
CORPBOND	26.05430706	0.34553	0.7331	75.40422401	0.19022352
PROFIT58	-1.81444270	-0.29883	0.7680	6.07185819	-0.04852986
FIX58DCL	-51.33767432	-2.93739	0.0079	17.47729713	-0.84100440
FEDFUNDS	-34.21084434	-2.15065	0.0433	15.90718906	-0.36968688
GOVSECUR	18.61950328	0.28614	0.7761	64.61934901	0.11109214
CLERKEMP	-61.88758864	-0.67223	0.5088	92.06302917	-0.36701091

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR INDIVIDUAL	UPPER 95% CL FOR INDIVIDUAL
1	476.90000000	435.95891173	40.94108827	268.37281910	603.54500436
2	524.80000000	573.40027962	-48.60027962	414.68972114	732.11083809
3	504.50000000	550.28437045	-45.78437045	392.53943260	708.02930830
4	476.30000000	525.75139694	-49.45139694	372.16527687	679.33751702
5	492.10000000	490.11595505	1.98404495	328.67053265	651.56137745
6	639.50000000	545.56176916	93.93823084	391.89609049	699.22744784
7	561.30000000	539.19065093	22.10934907	383.14165032	695.23965154
8	581.00000000	618.32306312	-37.32306312	457.71402718	778.93209906
9	525.50000000	535.86204730	-10.36204730	377.21045137	694.51364323
10	733.70000000	660.19039556	73.50960444	501.11322917	819.26756196
11	716.60000000	757.18063570	-40.58063570	601.89758369	912.46368770
12	849.70000000	929.87015522	-80.17015522	767.15166907	1092.58864136
13	963.30000000	917.72395915	45.57604085	754.84381287	1080.60410543
14	1125.10000000	1030.60209788	94.49790212	868.89201345	1192.31218230
15	796.40000000	870.46648127	-74.06648127	703.06200851	1037.87095403
16	920.60000000	899.79197645	20.80802355	740.89959627	1058.68435663
17	854.00000000	828.83025241	25.16974759	653.01938120	1004.64112363
18	724.60000000	751.25609621	-26.65609621	581.37596331	921.13622911
19	833.40000000	829.26414946	4.13585054	666.27127682	992.25702211
20	574.00000000	621.03605389	-47.03605389	459.26974026	782.80236753
21	779.30000000	721.00056330	58.29943670	549.64007373	892.36105286
22	709.30000000	691.83654646	17.46345354	530.50206913	853.17102380
23	715.30000000	723.52037683	-8.22037683	552.26424219	894.77651148
24	621.00000000	645.53904556	-24.53904556	492.64733562	798.43075550
25	676.10000000	663.13510361	12.96489639	495.59123960	830.67896762
26	711.30000000	679.35400067	31.94599933	521.65544209	837.05255925
27	761.00000000	801.24522915	-40.24522915	635.43810410	967.05235419
28	767.10000000	757.86766897	9.23233103	599.73824400	915.99709394
29	748.50000000	799.64558179	-51.14558179	636.05048437	963.24067921
30	690.30000000	723.50876659	-33.20876659	565.34063706	881.67689612
31	853.60000000	700.54858094	153.05141906	532.71803813	868.37912374
32	656.90000000	745.13783863	-88.23783863	566.97141964	923.30425763

SUM OF RESIDUALS	=	0.00000000
SUM OF SQUARED RESIDUALS	=	95570.88411713
SUM OF SQUARED RESIDUALS - ERROR SS	=	0.00000077
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	-0.27748977
DURBIN-WATSON D	=	2.42820205

VITA

Brisbane H. Brown, Jr.

Candidate for the Degree of

Doctor of Philosophy

Thesis: AN ECONOMETRIC FORECASTING MODEL FOR A SEGMENT OF THE CONSTRUCTION MARKET

Major Field: Civil Engineering

Biographical:

Personal Data: Born in Schofield Barracks, Hawaii, December 3, 1930, the son of Colonel (then Captain) and Mrs. Brisbane H. Brown.

Education: Graduated from Texas Military Institute (High School), San Antonio, Texas, in May, 1948; received the Bachelor of Science degree with a major in Physics from the Virginia Military Institute, Lexington, Virginia, in June, 1952; received the Bachelor of Science degree in Civil Engineering from the University of Missouri at Rolla, Rolla, Missouri, in May, 1959; completed sixteen hours of graduate work at the University of Colorado, Boulder, Colorado, 1960-1963; received the Master of Science degree with a major in Civil Engineering from the University of New Mexico, Albuquerque, New Mexico, in May, 1971; completed the requirements for the Doctor of Philosophy degree at Oklahoma State University in December, 1974.

Professional Experience: U. S. Army Corps of Engineers, 1952-1972, Lt. Col. (Ret.); Platoon Leader (18 months), Company Executive Officer (six months), Company Commander (12 months), 17th Armored Engineer Battalion, Dexheim, Germany, January, 1953-February, 1956; Assistant Operations Officer and Operations Officer (six months), 921st Engineer Group, Fort Leonard Wood, Missouri, March, 1956-September, 1957; Project Officer, Thule Area, Eastern Ocean District, U. S. Army Corps of Engineers during construction of the Ballistic Missile Early Warning System, July, 1959-July, 1960; Assistant Professor of Military Science, College of Engineering, the University of Colorado, Boulder, August, 1960-June, 1963; Assistant Post Engineer, 7th U. S. Army Training Center, Grafenwohr, Germany, July, 1963-July, 1966; Executive Officer, 20th Engineer Battalion (six

months), Liaison Officer, 18th Engineer Brigade, Viet Nam, August, 1966-August, 1967; Chief Engineering Branch, Test Command, Defense Nuclear Agency, Sandia Base, New Mexico, and Test Group Director of an underground nuclear test, September, 1967-June, 1970; Area Facilities Engineer, Yongsan, Korea, July, 1971-June, 1972; Graduate Teaching Assistant in Civil Engineering, August, 1972-May, 1973; Instructor, part-time in Civil Engineering, August, 1973-June, 1974, Oklahoma State University, Stillwater, Oklahoma.

Professional Activities: Registered Professional Engineer in the States of Texas, New Mexico, and Oklahoma; Member, National Society of Professional Engineers, Oklahoma Society of Professional Engineers, American Society of Civil Engineers, American Society for Engineering Education, Chi Epsilon, Sigma Tau; Post President, Albuquerque Post of The Society of Military Engineers.