ENROLLMENT FORECASTS FOR OKLAHOMA STATE UNIVERSITY

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CHAPTER I

RESEARCH PROBLEM

Introduction

Institutions of higher education need accurate enrollment forecasts because student enrollment, which translates into fiscal income, is one of the most influential factors in the areas of budget, program, and personnel planning. Enrollment patterns of the 1980's suggest an urgent need for integrated forecast system due to the fact that unstable enrollments, along with scarcity of funds, put pressure on colleges and universities.

Various factors, ranging from demography to economic climate, could influence higher education enrollments. Without knowing these factors, it will not be possible to forecast precisely the changing figures of student enrollment year after year. The variables affecting higher education enrollments may be as follows: (1) The number of traditional students (ages 18-24) has decreased due to the end of the baby boom in 1965; (2) The impact of twin problems--inflation and unemployment--on student and parental income has affected enrollments; (3) The returns from the investment in a college education have declined while the costs have increased, resulting in an enrollment decrease; and (4) Federal and state government's call for accountability of higher education as the result of actual cuts in grants and loans has resulted in fewer monies and programs, thus, lower enrollment. Needless to say, all important factors, such as demography, economic indicators, labor market, and public policy related to the enrollments, should be taken into consideration in order to build a reasonable and workable forecast model for a particular institution.

Enrollment forecasts are difficult to make in a period of declining growth and unstable fluctuation when turning points are unexpected. Enrollment forecasts are even more difficult in the 1980's than in any previous decade because of the variety of factors and techniques involved. Therefore, how to perform accurate enrollment forecasts during these times to facilitate planning becomes a challenge for decision makers in colleges and universities. Based upon the results of accurate enrollment forecasts and the information of enrollment trends, decision makers are able to detect where the demand for services will be in the future and to carry out effective budget, program, and personnel planning.

Statement of the Purpose

The purpose of this study is:

1. To use time series analysis in building the best

applicable models to produce accurate student enrollment forecasts for Oklahoma State University in the years 1986, 1987, 1988, and 1989. The subject categories include freshmen, males, females, undergraduate students, graduate students, and total students.

2. To use multiple regression and discriminant analyses in: (a) studying the important variables, such as demography, economic indicators, labor market, and public policy, that could influence undergraduate student and total student enrollments at Oklahoma State University during the 1960's, 1970's, and 1980's; and (b) constructing the predicted equation and discriminant function for one-year-ahead undergraduate student and total student enrollment forecasts.

Statement of the Problem

The problem of this study is to build student enrollment forecasting models based upon time series analysis (simple exponential smoothing, Brown's double exponential smoothing, Holt's two parameter exponential smoothing, and Box-Jenkins autoregressive integrated moving average), multiple regression analysis, and multiple discriminant analysis.

Definition of Terms

The following terms are well defined in Forecasting: Methods and Applications (Makridakis & Wheelwright, 1978).

Accuracy. The most commonly used criterion for evaluating the performance of enrollment forecasting models is accuracy. It refers to the correctness of the forecast as measured against actual enrollments. Accuracy can be measured by mean square error (MSE); or mean absolute percentage error (MAPE).

Applicability. Applicability is an important criterion in selecting a forecasting technique. Applicability refers to the ease with which a technique can be applied to a given situation and actual setting.

Causal model. The causal model assumes that enrollments to be forecast exhibit a cause/effect relationship with one or more other factors.

Curve fitting. One approach to forecasting is simply to fit some form of curve to the historical time series data. Use of a linear trend is, in fact, a curve fitting method.

Dependent variable. A dependent variable refers to a variable that is determined by some other factors. In regression analysis the variale being predicted is the dependent variable.

Forecasting. Forecasting is the prediction of values of a variable based on known past values of that variable or other related variables. Forecasts also may be based on expert judgments, which in turn are based on historical data and experience.

Gross national product (GNP). The most comprehensive measure of a nation's income is the gross national product. It includes the total output of goods and services for an economy over a specific period of time.

Independent variable. An independent variable is one whose values are determined outside of the system being modeled. An independent variable is used in a causal relationship to predict values of a dependent variable.

Integrated. This is a system of modeling where one or more of the techniques are included in the model.

Least squares estimation. This approach to estimating the parameter values in an equation minimizes the squares of the deviations that result from fitting that particular model.

Mean absolute percentage error (MAPE). The mean absolute percentage error is the average of the sum of all of the percentage errors for a given data set taken without regard to sign.

Mean squared error (MSE). The mean squared error is a measure of accuracy computed by squaring the individual error for each item in a data set and then finding the average value of the sum of those squares.

Model. A model is the symbolic representation of reality. In quantitative forecasting methods a specific model is used to represent the basic pattern contained in the data.

Smoothing. Incorporating two or more observations from periods during which the same causal factors were in effect provides a smoothed value. The term smoothed is used because such combinations tend to reduce randomness by allowing positive and negative random effects to partially offset each other.

Time-series model. A time-series model is a function that relates the values of a time series to previous values of that time series, its errors, or other related time series.

Limitations of the Study

The limitations of the enrollment forecasts in this study are as follow. First of all, the historical data involved in the study included the years 1962 through 1987 in which no major wars or domestic conflicts occurred. However, if any major war or domestic conflict were to occur in the forecasted future, the enrollment projection would be inaccurate. Secondly, long-range forecasts (5-10 years) can not be achieved in this study. This is partly because the historical series are not long enough and partly because numerous uncertainties, such as institutional tuition policies, federal financing plans, student attitudes, and other factors, may affect student enrollments and further violate the underlying assumptions that historical enrollment patterns will continue into the future.

CHAPTER II

REVIEW OF THE LITERATURE

Enrollment figures are the principal factors in determining the amount of support and capital outlay funds that the legislature is called upon to appropriate for institutions of higher education. Projected enrollment figures for each fiscal year can be used to calculate the magnitude of workloads and support funds in the areas of teaching staff, support staff, administrative and professional staff, instructional expenses, facilities, student services, and personnel. Thus, enrollment directly influences the budgets of colleges and universities and consequently affects their programs and personnel. Accurate enrollment figures become crucial to effective budgetary, program, and personnel planning.

However, building the applicable enrollment forecast model for a particular institution is not easy because a variety of factors and techniques could influence the validity and reliability of such a model. The challenge is to include all possible factors and to select forecasting techniques which make sense and forecast accurately. As Lins (1960, pp. 2, 6) pointed out, "All factors related to enrollment of a particular institution must be considered," and "good forecasts will call for logically integrated, analytical techniques."

Factors Affecting Higher Education Enrollments

Mangelson (1973) noted that,

> ...until studies incorporate mechanisms for explaining why enrollments are changing we will be unable to predict that change in enrollment trends will occur (p. 23).

Hence, the ability to forecast enrollment accurately is quite dependent upon the ability to select the important variables and to predict the cause and effect of such variables.

Wagschall (1983) indicated that declining enrollments--resulting from the end of the baby boom in 1965--made their first impact on higher education in the 1980s. Consequently, the graduating class of 1987 is the first in the past eighteen years to be drawn from a non-baby boom cohort. Definitely, the baby boom is one of the factors affecting higher education enrollments.

In addition, Mangelson (1973) described the factors influencing higher education enrollments as: social values, social conditions, diffusion of communication technology, public policy, and educational systems. The social values are the values placed on knowledge, self-improvement, and formal education combined to create an attitude which affects an individual's behavior and higher education enrollment. Social conditions such as demographics, economics, and leisure time are objective and measurable. The diffusion of communication technology is the impact of innovations such as computer-assisted instruction, cable TV, and a host of similar technologies. Public policy refers to the level of public financial support, and the educational system refers to the number of new institutions available.

Lins (1960) further provided a comprehensive list of the factors to be studied in the development of a student enrollment forecast model. These factors are: admission policy, housing, instructional facilities, staff, programs, high school graduates, post-baccalaureate students, veteran enrollments, related economic structure, international situation, birth rates, mortality rates, migration, education benefits and/or loan and scholarship programs, and Selective Service draft and deferments.

It is obvious, up to this point, that forecasting student enrollment is a difficult task due to the variety, non-measurability, and uncertainty of factors involved. For instance,

> domestic or international crises or changes in government policies, either federal or state, can make predictions about a given institution uncertain (Crossland, 1980, p. 22).

> Variables such as the value of a degree in terms of status or the value of increased

> education for personal enrichment are impossible to quantify (Frankel & Forrest, 1977, p. 7).
>
> Factors such as quality and diversity of programs, location, prestige, price relative to competitors, and recruitment policies will largely determine how students distribute themselves among the various campuses. (Breneman, 1984, p. 22).

Note that the historical data associated with the above factors are difficult to obtain.

However, considering two well-known national enrollment projects along with their assumptions, one should not be too pessimistic in dealing with enrollment forecasting factors. The Carnegie Council (1974) projected national enrollment to the end of this century by age group and gender based upon only college enrollment trends. The National Center for Education Statistics (1978) projected 10-year enrollment by type of college, sex, and enrollment status based upon only population as the determination of enrollment. These enrollment projections have been demonstrated to be fairly accurate for the short-to-medium term (one to five years).

Additionally, economic data have been quantified and accumulated by various agencies in longitudinal fashion and used as bases for enrollment forecasts. Witkowski (1974) stressed that short-term factors such as unemployment and inflation and long-term factors such as changes in the market for college graduates influence enrollment in higher education.

The economy of the 70's has been characterized by a combination of inflation and unemployment. These twin problems and governmental efforts to reduce expenditures to slow inflation have resulted in the creation of negative influences on college enrollment (Witkowski, 1974).

A number of factors which will affect enrollment patterns during the 1980s and beyond are: the state of economy, the rate of increase in college tuition relative to the growth in family income, trends in federal and state financial aid, and employment prospects for new graduates (Breneman, 1984).

Growing unemployment seems to have both a negative and a positive relationship with student enrollments. On the one hand, "changes in disposable income per capita are indicators of changing ability to pay for college" (Stewart & Kate, 1978, p. 23). Relative decreases in personal income per capita are expected to be associated with decreases in student enrollments. On the other hand, growing unemployment tends to encourage high school graduates and individuals who are laid-off from their jobs to enroll in colleges or universities as a means of gaining skills or a better education to improve their employment prospects (Magarrell, 1980). Thus, increases in unemployment rates are then expected to be associated with increases in student enrollments.

The depressed economy not only affects the ability of students to pursue higher education but also influences the ability of governments to provide financial aid such as grants and loans to students.

> Student financial aids are initially intended to reduce the monetary cost of attending institutions of higher education for target populations, thereby increasing student access (Folger, 1974, p. 405).

Therefore, decreases in student financial aids lead to a decline in student enrollments.

Increased costs in the higher education industry because of inflation have forced tuition increases and thus enrollment decreases (Folger, 1974). Jackson and Weathersby (1975) reviewed seven studies of empirical evidence concerning the relationship between tuition changes and individual demand for higher education. The results of this review show that low tuition and student grants do stimulate increases in enrollment. Hence, there is no doubt that tuition is negatively correlated with student enrollments while grants are positively correlated with student enrollments.

The combination of inflation and unemployment also has an effect on student and parental attitudes, which may not be favorable, toward enrollment in higher education. Students are not sure about the possibilities of getting a job after spending a number of years pursuing an expensive college education while parents are uncertain as to how long they will continue to be employed and be capable of supporting their children's education (Witkowski, 1974). As Campbell and Siegal (1967) stressed,

> an individual will purchase a college education if the present value of the expected stream of benefits resulting from education exceeds the present cost of the education (p. 485).

Witkowski (1974) further indicated that the return from investment in a college education has declined as costs have increased. This has resulted in a decline in enrollment. Honack and Weiler (1979), working for the University of Minnesota, constructed an enrollment forecast model containing tuition, beginning salaries of college graduates, salaries of non-college graduates, and other variables. These variables were found to be the significant determinators of student enrollments.

In summary, it is clear that economic climate indicators (per capita personal incomes) affect higher education enrollments, as do the demographics (number of high school graduates), public policy (amount of tuition and financial aids), and the labor market variable (unemployment rates).

The economy of Oklahoma has been studied for many years by the Office of Business and Economic Research at Oklahoma State University. Oklahoma and United States indicators, which may be found in the Oklahoma econometric model and are related to student enrollments, include: real Gross State/National Product (GSP/GNP), nonagricultural employment, per capita personal income, the unemployment rate of Oklahoma and the United States, oil or drilling rig activity of Oklahoma, and U.S. Consumer Price Index (p. 6).

According to a forecast released by the Office of Business and Economic Research on November 21, 1986, in Economic Outlook of Oklahoma, "the Oklahoma economy will remain sluggish for the remainder of 1986 and into 1987, with a rebound occurring in 1988" (p. 1). The enrollment forecast for Oklahoma State University must be based upon these available economic indicators in addition to demography, public policy, and labor market variables in order to reflect as nearly as possible what is likely to occur.

Techniques Being Used in Enrollment Forecasts

Wing (1974) classified enrollment forecasting techniques into four major groups--subjective judgment, intention survey, curve fitting, and causal model.

Subjective Judgment

The subjective judgment technique is a forecasting procedure based upon the judgment of the forecaster instead of quantitative techniques. Although the subjective judgment in enrollment forecasting is not a scientific method, it may be used as a supplementary procedure. Depending on experts' judgments to estimate the impact on student enrollments is necessary when objective measurements are not available for factors such as shifting federal financial patterns and changes in student attitude (Wing, 1974). A forecast based upon qualitative techniques or judgment is used when there is a lack of knowledge of any mathematical models which might be applied to the problem or when existing models failed to forecast with sufficient accuracy (Brown, 1978).

Intention Survey

The intention survey is based upon surveys of the intentions of high school graduates. If data have been collected in longitudinal fashion, the attitude and intention trend can be compared with enrollment trends to yield more accurate projections (Wing, 1974).

Curve Fitting

Curve fitting is a technique based upon primarily historical enrollment patterns. The assumption for forecasts is that the future depends upon the present while the present depends upon the past.

Time series techniques which belong to the curve fitting group include simple exponential smoothing, Brown's double exponential smoothing, Holt's two parameter exponential smoothing, and Box-Jenkins methodology. The assumption of time series analysis is that the current patterns based upon historical information will continue and that influences of the past are indicative of those factors which will occur in the future (Lin, 1960).

Simple exponential smoothing and Brown's double exponential smoothing. Simple exponential smoothing and Brown's double exponential smoothing techniques assume that the most recent observations contain the most information about what will happen in the future. According to Gardner (1980), these techniques are easily understood, simple to apply, and reasonably accurate. Furthermore, they can be used to weigh the historical data on the basis of assumed relative importance of more recent information.

Holt's two parameter exponential smoothing. Holt's two parameter exponential smoothing is similar in principle to Brown's double exponential smoothing model, except it does not apply the double smoothing formula. Instead, it smooths the trend values directly with another weighting factor (Makridakis & Wheelwright, 1978).

Box-Jenkins methodology. Box-Jenkins methodology is a systematic approach to modeling and forecasting student enrollments. Three stages--model identification, parameter estimation, and diagnostic checking--are recursively involved in the study until the best model is found. Mabert (1975) indicated that Box-Jenkins methodology is superior to other statistical techniques for two reasons: (1) the analyst does not arbitrarily select a specific model, but instead eliminates an inappropriate model until the most suitable model remains; and (2) the analyst can use a rational structure approach along with his/her experience and judgment to determine the specific model.

Causal Model

The causal model is based upon relationships between enrollments and a set of leading indicators such as high school graduates and unemployment rates. It includes the cohort survival method, the ratio method, the regression analysis, and the discriminant analysis.

Cohort survival method. The cohort survival method can be applied to enrollment forecasts. The number of students in a given cohort/group is estimated for the future by multiplying a survival rate by a base year number. A major disadvantage to this method is that individual transition history must be traced, and these data are not usually available in most colleges and universities (Lyell & Toole, 1974).

Ratio method. Many colleges and universities use the ratio method to forecast enrollments based upon one-to-one relationships between high school graduates and freshman enrollments. The ratio of freshman enrollments to high school graduates in each geographical area is calculated from historical data. Projected freshman enrollment in each geographical area is obtained by multiplying the above ratio by the projected number of high school graduates. The total projected freshman enrollment of the college or university is then the summation of the projected freshman enrollment from all geographical areas. The advantages of using the ratio method is the simplicity of calculation, minimal data requirement, and degree of accuracy. However, according to Lyell and Toole (1974), the ratio method is based on the assumption that the past is congruent with the future. To forecast the future enrollment, one needs to look back to the past. In a time of inflation, unemployment, and an increase in the rate of societal change, it is even more important to examine the total impact of events upon student numbers.

Regression analysis. Multiple regression is viable because once the key indicator variables and their lead times are determined, they may be used to predict enrollment change in an explanatory rather than simple projective manner (Lin, 1960). The important use of regression analysis is to examine the functional relationships between student enrollments and a set of leading indicators. The change in college and university enrollments may be discovered to be linearly related to demography only or to a combination of leading indicators such as demography, economic climate, labor market, and public policy.

However, the difficulty with multiple regression lies with the determination of the indicator variables, the high costs involved in the data collection, and the limitations created by the statistical assumptions.

Discriminant analysis. Discriminant analysis can be used to select the best set of predictor variables--such as demography, economic indicators, labor market, and public policy--to predict group membership. The annual percentage change of enrollment figures can be calculated and assigned into three groups--increased group, unchanged group, or decreased group.

The result of discriminant analysis as to increased group, unchanged group, or decreased group, serves as a validation check of multiple regression analysis.

In summary, there is no general agreement on the most important enrollment-influencing factors or on the most applicable forecasting techniques at a particular college or university. The numerous influencing factors and the available techniques do provide analysts the challenge of enrollment forecasts.

Curve fitting method and causal model are adopted in this study based upon the consideration of accuracy, cost, availability of historical data, and the applications of model.

CHAPTER III

DESIGN OF THE STUDY

This chapter deals with the design of an Oklahoma State University enrollment forecast containing an overview of the forecast design, forecasting flowchart, profile of independent variables, forecasting methodologies and relevant mathematical formulas, and the selection of the best models. The overview of the design of an Oklahoma State University enrollment forecast is presented in Table 1.

TABLE 1

OSU ENROLLMENT FORECAST DESIGN

Forecast Methods/Years To Be Forecasted	Dependent Variables	Independent Variables
(1) Simple Exponential Smoothing (2) Brown's Double Exponential Smoothing (3) Holt's Two Parameter Exponential Smoothing Years 1962 Through 1985 To Forecast 1986 Years 1962 Through 1986 To Forecast 1987 Years 1962 Through 1987 To Forecast 1988&89	Total Student Enrollments Undergraduate Enrollments Graduate Enrollments Freshman Enrollments Male Enrollments Female Enrollments	Historical Enrollment Data
(4) Box-Jenkins Methodology Years 1946 Through 1985 To Forecast 1986 Years 1946 Through 1986 To Forecast 1987 Years 1946 Through 1987 To Forecast 1988&89	Total Student Enrollments	Historical Enrollment Data
(5) Multiple Regression Analysis Years 1962 Through 1985 To Study Factors Years 1962 Through 1986 To Study Factors Years 1962 Through 1987 To Study Factors & Predict 1988	Total Student Enrollments Undergraduate Enrollments	Combined Variables in Literature And Variables Selected From Oklahoma Econometric Model Indicators
(6) Multiple Discriminant Analysis Years 1962 Through 1987 To Forecast 1988	Total Student Enrollments Undergraduate Enrollments	Combined Variables in Literature And Variables Selected From Oklahoma Econometric Model Indicators
Criteria To Evaluate The Accuracy Of Forecasts	(1) Mean Absolute Percentage Error (MAPE) (2) Mean Squared Error (MSE)	

Forecasting Flowchart

The systematic and integrated strategy of an enrollment forecast is demonstrated in this study. It involves five steps, including: 1) searching the important factors influencing student enrollments, 2) utilizing various forecasting techniques, 3) constructing forecast models under different subject categories, 4) evaluating the accuracy of forecasting results and selecting the best forecast models based on the objective criteria, and 5) applying the best forecast models to other institutions for generalization purpose. The illustration of logic flow for the above strategy is shown in Figure 1.

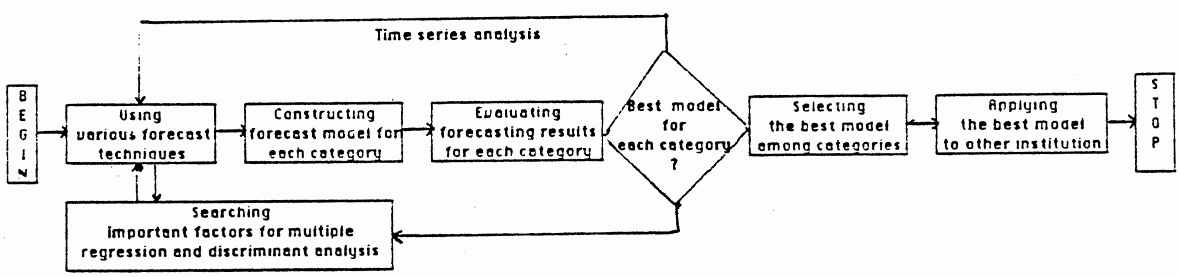

Figure 1. OSU Enrollment Forecasting Flowchart

The iteration process is necessary for choosing the most appropriate weighting factors in time series analysis and the significant variables in multiple regression analysis and multiple discriminant analysis. More than 740 model equations need to be constructed for the comparative analyses. The statistical packages - SPSSX, SAS and several self-developed FORTRAN programs are suitable for such a great deal of computation.

Profile of Independent Variables

Two methods are employed in this study to develop a factor (independent variables) pool, including a search of relevant literature and the consultation with the OSU Office of Institutional Research, the Office of Business and Economic Research, and the Office of High School and College Relations concerning important factors influencing Oklahoma State University student enrollments. The possible factors influencing Oklahoma State University student enrollments are listed in Table 2.

TABLE 2

POSSIBLE FACTORS INFLUENCING OSU ENROLLMENTS

Admission Policy, Recruitment Policy, Housing, Staff, Quality of Programs, Diversity of Programs, High School graduates, OU Enrollments, Junior College Students, University of Center At Tulsa, Tuition, Financial Aids, Birth Rates, Mortality Rates, Population Pool, Migration, Veteran Enrollments, Woman Enrollments, Minority Enrollments, Foreign Students, International Situation, Gross National Products, Prestige, Location, Military Drafts, Consumer Price Indices, Oklahoma Per Capita Incomes, Oklahoma Unemployment Rates, United States Oil Price, Oklahoma Oil Drilling Rig Activities, Leisure Time, Parent's Education, GPA, Retention Rates, Football, Computer Technology, Student/ Parent Attitudes Toward Higher Education, Others

Forecasting Methodologies and Relevant Mathematical Formulas

Time series analysis, multiple regression analysis, and multiple discriminant analysis are suggested for Oklahoma State University enrollment forecasts in this study. Time series analysis includes simple exponential smoothing, Brown's double exponential smoothing, Holt's two parameter exponential smoothing, and Box-Jenkins methodology.

Simple Exponential Smoothing

This method computes the weighted average of enrollment series and uses this weighted average to forecast the next year's enrollment. In the time series context, the most recent enrollments are given more weight and the preceding enrollments are given less weight.

The weighted average is estimated by the formula:

$$S'_t = \alpha X_t + \alpha(1-\alpha)X_{t-1} + \alpha(1-\alpha)^2 X_{t-2} + \ldots t\ \alpha(1-\alpha)^{N-1} X_{t-(N-1)} \quad (3.1)$$

where $0 < \alpha < 1$

The algorithm of simple exponential smoothing is presented as

$$S'_{t+1} = \alpha X_t + (1-\alpha)S't \quad (3.2)$$

where S'_{t+1} is the simple exponential forecasting value for year t+1.

X_t is this year's enrollment.

X_{t-1} is last year's enrollment.

S'_t is the simple exponential forecasting value for year t.

α is the weighted factor with value between 0 and 1.

Brown's Double Exponential Smoothing

Three steps - the initial forecast, the second and the third level forecast - are involved in the process of Brown's double exponential smoothing.

A. Using single exponential smoothing to handle the initial forecast:

$$S'_{t+1} = \alpha X_t + (1-\alpha) S'_t \quad (3.3)$$

where $0 < \alpha < 1$

B. Using double exponential smoothing to deal with the second level forecast:

$$S''_{t+1} = \alpha S'_{t+1} + (1-\alpha) S''_t \quad (3.4)$$

where S''_{t+1} is the second level exponential forecast for year t+1.

S''_t is the second level exponential forecast for year t .

where $0 < \alpha < 1$

C. Using a linear equation to allow trend variation calculate the third level forecast:

$$F_{t+m}=A_t+B_t m \tag{3.5}$$

where F_{t+m} is the third level exponential forecast

m is year ahead that is to be forecasted

$A=S'_{t+1}+(S'_{t+1}-S''_{t+1})$

$B=\frac{\alpha}{1-\alpha}(S'_{t+1}-S''_{t+1})$

$0 < \alpha < 1$

Holt's Two Parameter Exponential Smoothing

The initial iteration of Holt's two parameter exponential smoothing begins with the value of B_2 (equivalent to $X_2 - X_1$) and A_2 (equivalent to X_2). The equations can be used recursively for t = 3, 4, ..., n to calculate A_t and B_t.

The iteration algorithm is listed as follows:

$A_t=\alpha X_t+(1-\alpha)(A_{t-1}+B_{t-1})$

$$B_t=\beta(A_t-A_{t-1})+(1-\beta)B_{t-1} \tag{3.6}$$

$0 < \alpha < 1$

$0 < \beta < 1$

The forecast equation is written as follows:

$$F_{t+m}=A_t+B_t m \tag{3.7}$$

where F_{t+m} is the forecast for the m th year ahead.

A_t is an estimate of the intercept of the trend.

B_t is an estimate of the trend.

X_t is the most recent enrollment.

Box-Jenkins Methodology

The stationarity of enrollment series is required for the Box-Jenkins methodology. If the enrollment series is non-stationary due to the variance increasing over time, then natural logarithms need to be taken in order to achieve the stationarity. On the other hand, if the enrollment series is non-stationary due to mean value increasing over time, then the differencing is needed in order to achieve the stationarity.

There are three steps of Box-Jenkins methodology for modeling and forecasting enrollment series, namely, model identification, parameter estimation, and diagnostic checking.

A. Model identification – Model identification is based on the patterns of sample partial autocorrelation, an autoregressive enrollment (AR), a moving average enrollment model (MA), or a mixed enrollment model (ARMA) can then be identified.

The sample autocorrelation (SAC) measures the correlation between years y_t and y_{t+k} in an enrollment series. The formula is written as:

$$\gamma_k = \frac{\sum_{t=1}^{n-k} (y_t - \bar{y})(y_{t+k} - \bar{y})}{\sum_{t=1}^{n} (y_t - \bar{y})^2}, \quad k = 0, 1, 2, \ldots, k \tag{3.8}$$

where n is the number of years.

y_t is the enrollment series.

$\bar{y}$ is the average of the enrollment series.

The sample partial autocorrelation (SPAC) measures the strength of the relationship between years in an enrollment series. The formula is listed as:

$$B_{kk} = \begin{cases} \gamma_1 & , k = 1 \\ \dfrac{\gamma_k - \sum_{j=1}^{k-1} B_{k-1,j}\gamma_{k-j}}{1 - \sum_{j=1}^{k-1} B_{k-1,j}\gamma_j} & , k = 2, 3, 4, \ldots, k \end{cases} \tag{3.9}$$

where $B_{kj} = B_{k-1,j} - B_{kk}B_{k-1,k-j}$, $j = 1, 2, 3 \ldots, k-1$

Autoregressive enrollment model of order p, AR(p) is defined as:

$$\phi_p(B)Y_t = A_t \tag{3.10}$$

or $(1 - \phi_1 B^1 - \phi_2 B^2 - \ldots - \phi_p B^p)Y_t = A_t$

or $y_t = \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \ldots + \phi_p Y_{t-p} + A_t$

where $\phi_1, \phi_2, \ldots \phi_p$ are the coefficients

and $A_t \sim N(0, \sigma_A^2)$.

Moving average enrollment model of order q, MA(q) is defined as:

$$Y_t = \theta_q(B)A_t \tag{3.11}$$

or $Y_t = (1 - \theta_1 B^1 - \theta_2 B^2 - \ldots - \theta_q B^q)A_t$

or $Y_t = A_t - \theta_1 A_{t-1} - \theta_2 A_{t-2} - \ldots - \theta_q A_{t-q}$

where $\theta_1, \theta_2, \ldots, \theta_q$ are the coefficients

and $A_t \sim N(0, \sigma_A{}^2)$. (3.12)

Mixed model enrollment of order p, q, ARMA (p,q) is defined as:

$$\phi_p(B)Y_t = \theta_q(B)A_t$$

or $(1-\phi_1B^1-\phi_2B^2-\ldots-\phi_pB^p)y_t=(1-\theta_1B^1-\theta_2B^2-\ldots-\theta_qB^q)A_t$

or $y_t-\phi_1y_{t-1}-\phi_2y_{t-2}-\ldots-\phi_py_{t-p}=A_t-\theta_1A_{t-1}-\theta A_{t-2}-\ldots-\theta_qA_{t-q}$

When enrollment series is an autoregressive model of order p, ARMA (p,o), the sample autocorrelation function (r_k) exhibits one of the patterns: a decaying exponential, an oscillating decay, or a decaying sine wave, and also the sample partial autocorrelation function (B_{kk}) has large values at the p th lag.

The moving average enrollment model can be directly identified from the sample autocorrelation function instead of verifying the sample partial autocorrelation function. When large values at the q th lag in the sample autocorrelation takes place, it indicates that the q th order of the moving average enrollment model ARMA(o,q).

B. Parameter estimation —

1. Autoregressive parameters in terms of autocorrelation can be estimated as follows:

$$\rho_k = \phi_1\rho_{k-1} + \phi_2\rho_{k-2} + \ldots + \phi_p\rho_{k-p}, \text{ for } k > 0 \qquad (3.13)$$

The solution for the parameters ϕ is

$$\phi = P_p{}^{-1}\rho_p \qquad (3.14)$$

where $\phi = \begin{bmatrix} \phi_1 \\ \phi_2 \\ \vdots \\ \phi_p \end{bmatrix}$, $\rho_p = \begin{bmatrix} \rho_1 \\ \rho_2 \\ \vdots \\ \rho_p \end{bmatrix}$, $P_p = \begin{bmatrix} 1 & \rho_1 & \rho_2 & \cdots & \rho_{p-1} \\ \rho_1 & 1 & \rho_1 & \cdots & \rho_{p-2} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ \rho_{p-1} & \rho_{p-2} & \rho_{p-3} & \cdots & 1 \end{bmatrix}$

From the above formula, the autocorrelation function of a MA(q) process is zero, beyond the order q; that is, the autocorrelation function of a moving average process has a cut-off at lag q. This is the justification of how one can identify the order of ARMA enrollment model. If ρ_1, $\rho_2, \ldots, \rho_q$ are known, then q equations may be solved. For example, q = 1,

$$\rho_1 = \frac{-\theta_1}{1+\theta_1^2}, \text{ then } \theta_1 = \frac{1}{-2\rho_1} \pm \left[\frac{1}{(2\rho_1)^2} - 1\right]^{\frac{1}{2}} \tag{3.15}$$

For complex case $q > 1$, these equations must be solved by iteration procedure.

2. Moving average parameters in terms of the autocorrelation can be estimated as follows:

$$\rho_k = \begin{cases} \dfrac{-\theta_k + \theta_1\theta_{k+1} + \ldots + \theta_{q-k}\theta}{1+\theta_1^2+\theta_2^2+\ldots+\theta_q^2}, & k = 1, 2, \ldots, q \\ 0, & k > q \end{cases} \tag{3.16}$$

C. Diagnostic checking — Diagnostic checking is used to determine the adequacy of the estimated model. If the model is appropriate, then A_t (defined as $Y_t - Y_t$) will be independently and randomly distributed around zero.

The chi-square test can be used to evaluate whether the residual sample autocorrelations $\gamma_k(\hat{A})$, exhibit any systematic error. The test statistic is: $Q = n \sum_{k=1}^{k} \gamma_k(\hat{a})$

where

$$\gamma_k(\hat{A}) = \frac{\sum_{t=1}^{N-k} (A_t - \bar{A})(A_{t+k} - \bar{A})}{\sum_{t=1}^{n} (A_t - \bar{A})^2}, \quad k = 0, 1, 2, \ldots, k$$

N is the number of years.

k is the number of residual sample autocorrelation values that have been calculated.

n is the number of years minus maximum back order.

The Q statistic is evaluated against χ^2_{df} (where df = k-p-q). If Q is greater than χ^2_{k-p-q}, then the model is lack of fit and inappropriate. Thus, the iterative cycle of model identification, parameter estimation, and diagnostic checking must be repeated until a suitable model is found. If Q is smaller than χ^2_{k-p-q}, then the model is adequate. Thus, a forecasting equation can be developed from this model.

D. Forecasting — To forecast the m th year in the future at the end of the current period, the forecasting equation becomes:

$$\hat{Y}_t(m) = \phi_1 Y_{t+m-1} + \phi_2 Y_{t+m-2} + \ldots + \phi_p Y_{t+m-p} + A_t + \theta_1 A_{t+m-1} + \theta_2 A_{t+m-2} + \ldots + \theta_q A_{t+m-q} \quad (3.17)$$

The confidence interval can be determined as

$$y_{t+m}=\hat{y}_t(m) \pm Z\frac{\alpha}{2} \left[1 + \sum_{j=1}^{m-1} \psi_j^2\right]^{\frac{1}{2}} \cdot \; Sa \qquad (3.18)$$

where $Z\frac{\alpha}{2}$ is the percentage point for the desired level of confidence using the normal distribution.

The ψ_i weights can be calculated from the identity as

$$\phi_p(B)\ \psi(B) = \theta_q(B) \qquad (3.19)$$

or $(1-\phi_1B^1-\phi_2B^2-\ldots-\phi_pB^p)(1+\psi_1B^1\psi_2B^2+\ldots)=(1-\theta_1B^1-\theta_2B^2-\ldots-\theta_qB^q)$

Hence,

$$\psi_1 = \phi_1 - \theta_1$$

$$\psi_2 = \phi_1\ \psi_1 + \phi_2 - \theta_2$$

$$\vdots \quad \vdots \quad \vdots \quad \vdots$$

$$\psi_j = \phi_1\ \psi_{j-1} + \ldots + \phi_p\ \psi_{j-p} - \theta_q$$

$$Sa = \left[\frac{\sum_{t=1}^{n} (y_t - \hat{y}_t)^2}{n-1}\right]^{\frac{1}{2}} \qquad (3.20)$$

Multiple Regression Analysis

The enrollment model under consideration is written in the form as follows:

$$Y = X\beta + \varepsilon \qquad (3.21)$$

where Y is an (n x 1) vector of observed enrollment figures (dependent variable),

X is an (n x p) matrix of known values (independent variables), including U.S. Gross National Products and consumer price indices, Oklahoma unemployment rates, per capita incomes, oil drilling rig activities, high school graduates, other institution enrollments, and OSU tuition and financial aids.

β is a (p x 1) vector of unknown parameters which need to be estimated,

ε is an (n x 1) vector of unobserved errors,

n is total number of years,

p is the number of independent variables,

$E(\varepsilon) = 0$,

$V(\varepsilon) = I\alpha^2$.

The major concept of regression analysis is to use the least square estimate of β (the value of b) to minimize the error sum of square $\varepsilon'\varepsilon$

$$\varepsilon'\varepsilon = (Y-X\beta)'(Y-X\beta)$$

$$= Y'Y-\beta'X'Y-Y'X\beta+\beta'X'X\beta$$

$$= Y'Y-2\beta'X'Y+\beta'X'X\beta$$

$$\frac{\partial}{\partial\beta}\varepsilon'\varepsilon = \frac{\partial}{\partial\beta}(Y'Y-2\beta'X'Y+\beta'X'X\beta) = 0$$

$$(X'X)\hat{\beta}=X'Y$$

$$b=\hat{\beta}=(X'X)^{-1}X'Y \qquad (3.22)$$

The ANOVA table is constructed to test if the model is appropriate.

Source	df	SS	MS	F
Regression	p	$b'X'Y - n\bar{Y}^2$	MS_R	$F_{obs} = MS_R / MS_\varepsilon$
Residual	n-p	$Y'Y-b'X'Y$	MS_ε	
Total	n	$Y'Y-n\bar{Y}^2$		

The F_{obs} statistic is evaluated against F_{df_1, df_2} (where $df_1 = p$, $df_2 = n-p$). If F_{obs} is greater than F_{df_1},

df_2 and R square is large enough, then the model is considered to be appropriate. Note that R square is a measure of the variance about the mean explained by the fitted equation and it can be expressed in the form as follows:

$$\text{R square} = (b'X'Y-n\overline{Y}^2)/(Y'Y-n\overline{Y}^2) \qquad (3.23)$$

In this study, the backward elimination of multiple regression analysis is used to obtain the minimum number of variables to account for as much of the variance as accounted for by the total set. This method begins with the fitted regression which contains all independent variables and then sequentially removes variables not significantly contributing to the equation. When the deletion of any one variable produces significant loss to R square, then the procedure of backward elimination is completed.

Thus, the prediction derived from $b=(X'X)^{-1}X'Y$ is as follows:

$$\hat{Y} = Xb \qquad (3.24)$$

A prediction of Y at X_o is $\hat{Y}_o = X_o'b$ with variance

$$V(\hat{Y}_o) = X_o'(X'X)^{-1}X_o\sigma^2,$$

where $\hat{Y}_o$ is a predicted enrollment figure,

X_o is a vector containing significant independent variables for prediction,

b is a vector of estimate parameters.

The confidence interval, 100 $(1 - \alpha)\%$, for $\hat{Y}_o$ is

$$\hat{Y}_o + t\,(V,\, 1-\alpha/2)S\,\sqrt{X_o'\,(X'X)^{-1}X_o} \qquad (3.25)$$

where $S = \sum_{t=1}^{N} ((X_t-\bar{X})^2/N)^{1/2}$

Multiple Discriminant Analysis

The backward elimination procedure of multiple discriminant analysis can be used to select the best set of predictor variables to predict future enrollments to be: increased group, unchanged group, or decreased group.

In this study, annual percent changes of historical enrollment figures are calculated and categorized into one of three groups: increased group, unchanged group, and decreased group. The categorization of these groups is based upon the assumption of the agreed-upon estimated range of unavoidable 2.5 percent forecast error. If annual percent changes are more than positive 2.5 percent, then those years are categorized into Group 1--increased group. If annual percent changes are less than negative 2.5 percent, then those years are assigned to be Group 2--decreased group. If annual percent changes lie within the range of positive and negative 2.5 percent, then those years are treated as Group 0--unchanged group.

In addition to the above group categorizations, nine predictor variables are selected for entry into the analysis and the predictor variables with the least discriminant power is step-by-step removed from the discriminant functions. These predictor variables include U.S. Gross

National Products and consumer price indices, Oklahoma unemployment rates, per capita incomes, oil drilling rig activities, high school graduates, and other institution enrollments, and OSU tuition and financial aids.

The discriminant function is written as:

$$Z_{gi}=U_1X_{gi1}+U_2X_{gi2}+ \dots +U_pX_{gip} \qquad (3.26)$$

where Z's are the discriminant scores.

X's are the discriminant variables.

g is the number of groups (g = 1,2, . . . , G).

i is the i th member (i = 1,2, . . . , N_g).

p is the number of discriminant variables.

U's (eigenvector) are the weighted coefficients that maximize the discriminant criterion λ (Lambda).

The discriminant criterion λ is a ratio of variability among group means SS_A to that within groups SS_W. The formula of discriminant criterion is presented as:

$$\lambda=\frac{SS_A}{SS_W}=\frac{\sum_{g=1}^{G} (\bar{Z}_g - \bar{Z})^2}{\sum_{i=1}^{n_1} (Z_{1i}-\bar{Z}_1)^2+\sum_{i=1}^{n_2}(Z_{2i}-\bar{Z}_2)^2+\dots+\sum_{i=1}^{n_g} (Z_{gi}-\bar{Z}_g)^2} \qquad (3.27)$$

$$SS_A=\sum_{g=1}^{G} \left[(\bar{Z}_g-\bar{Z})^2\right]= \sum_{g=1}^{G} \left[(n'\bar{X}_g - n'\bar{X})^2\right]$$

$$= U'\left[\sum_{g=1}^{G} (\bar{X}_g - \bar{X}) (\bar{X}_g - \bar{X})'\right] U$$

$$= U'AU \qquad (3.28)$$

$$\text{where } U = \begin{bmatrix} U_1 \\ U_2 \\ \vdots \\ U_p \end{bmatrix}, \bar{X}_g=\begin{bmatrix} \bar{X}_{g1} \\ \bar{X}_{g2} \\ \vdots \\ \bar{X}_{gp} \end{bmatrix}, \bar{X} =\begin{bmatrix} \bar{X}_1 \\ \bar{X}_2 \\ \vdots \\ \bar{X}_p \end{bmatrix}$$

$$SS_W = \sum_{i=1}^{n_1} (Z_{1i} - \bar{Z}_1)^2 + \sum_{i=1}^{n_2} (Z_{2i}-\bar{Z}_2)^2 +. . .+ \sum_{i=1}^{n_g} (Z_{gi} - \bar{Z}_g)^2$$

$$= U'SS_x^{(1)}U + U'SS_x^{(2)}U +. . .+ U'SS_x^{(g)} U$$

$$= U' \left[SS_x^{(1)} + SS_x^{(2)} +. . .+ SS_x^{(g)} \right] U$$

$$= U' W U \qquad (3.29)$$

$$\text{since } \sum_{i=1}^{n_g} (Z_{gi}-\bar{Z}_g)^2 = U_1^2 \sum_{i=1}^{n_g} (X_{gi1}-\bar{X}_{g1})^2 +. . .+ U_p^2 \sum_{i=1}^{n_g} (X_{gip}-\bar{X}_{gp})$$

$$+2U_1U_2 \sum_{i=1}^{n_g} (X_{gi1}-\bar{X}_{g1}) (X_{gi2}-\bar{X}_{g2}) +. . .$$

$$+2U_{p-1}U_p \sum_{i=1}^{n_g} (X_{gi,(p-1)}-\bar{X}_{g,(p-1)}) (X_{gip}-\bar{X}_{gp})$$

$$=U_1^2 S_{11} +. . .+U_p^2 S_{pp}$$

$$+2U_1U_2S_{12} +. . .+2U_{p-1}U_p S_{(p-1),p}$$

$$=U'SS_x^{(g)} U \qquad (3.30)$$

$$\text{where } SS_x^{(g)} = \begin{bmatrix} S_{11} & S_{12} & S_{1p} \\ . & . & . \\ . & . & . \\ . & . & . \\ S_{p1} & S_{p2} & S_{pp} \end{bmatrix} \qquad (3.31)$$

$$\lambda = \frac{SS_A}{SS_W} = \frac{U'AU}{U'WU}$$

In order to maximize the discriminant criterion λ , three steps are needed mathematically: (1) taking derivative on λ , e.g., finding the slope of the curve, (2) assigning the derivative of λ to be zero (the point is maximum when slope equals to zero), and (3) solving the equation for λ , e.g. finding maximum value of λ .

$$\frac{\partial\lambda}{\partial U} = \frac{\partial}{\partial U} \frac{U'AU}{U'WU} = 0$$

$$\frac{(U'WU)\frac{\partial}{\partial U}(U'AU) - (U'AU)\frac{\partial}{\partial U}(U'WU')}{(U'WU)^2} = 0$$

$$\frac{2\left[(U'WU)(AU) - (U'AU)(WU)\right]}{(U'WU)^2} = 0$$

Dividing both numerator and demoninator by U'WU

$$\frac{2\ (AU-\lambda WU)}{U'WU} = 0$$

$$AU- \lambda WU=0 \qquad (3.32)$$

$$(A- \lambda W)U=0$$

assuming w^{-1} exists then multiply both sides by w^{-1}

$$(W^{-1}A- \lambda I)U=0 \qquad (3.33)$$

$$|W^{-1}A- \lambda I| =0$$

The values of λ can be obtained by solving the characteristics equation ($|W^{-1}A- \lambda I| =0$). The values of U can then be derived by plugging the values of λ into the equation $(W^{-1}A- \lambda I)U=0$

A number (the smaller of p and G-1) of discriminant functions can be generated based upon the known values of U's and X's. The second function is uncorrelated with the first, on which group differences are second in magnitudes.

It is important to examine if the predictor variables are from multivariate normal distribution and the covariance matrices for all groups are equal. The Box's M test is designed to test if the predictor variables departure from multivariate normality and if the covariance matrices are unequal. In addition, Wilk's Lambda λ is a statistic designed to test if the groups differ significantly on the basis of the linear combination Z, associated with the discriminant criterion λ.

A test of significance of the k th root, λ_k is carried out by computing

$$V_k = n-1- \frac{(P+G)}{2} \ln \frac{1}{\Lambda_k} \tag{3.34}$$

where $\frac{1}{\Lambda_k} = \prod_{i=K}^{\gamma} (1 + \lambda_i)$

γ is the number of non zero values of λ.

V_k has an approximate chi-square distribution with (p-K+1)(G-K) degree of freedom. Equations (3.34) used to test successively the significance of the functions remaining after λ through λ_{k-1} have been removed. When such a test is found nonsignificant, test procedures are complete.

The classification of the enrollment percent change group is based upon the discriminant score Z in the group for which the posterior probability $P(G_i|Z)$ is the largest. According to Bayes' rule, the posterior distribution consists of two components: prior distribution, $P(G_i)$, and the conditional distribution of discriminant scores given group membership are known, $P(Z|G_i)$. The formula of posterior probability is presented as follows:

$$P(G_i|Z) = \frac{P(Z|G_i) \cdot P(G_i)}{\sum_{i=1}^{g} P(Z|G_i) \cdot P(G_i)} \qquad (3.35)$$

In the SPSSX program, Fisher's linear discriminant function coefficients are calculated and can be used to classify the future case, where a case is assigned to the group for which the largest discriminant score is derived.

Selection of the Best Models

A variety of forecasting techniques are employed in this study to produce the large sets of enrollment forecasts for selecting the best models. The questions remaining under investigation are (1) Is one method "better" than its competitors? (2) How accurate is a particular forecast method?

Enrollment forecasts are never exact projections. Each set of forecast always has an error (X_t-F_t), difference of actual and forecast value, associated with it. This is because of the impossibility of encompassing all factors that affect student enrollment. The way of choosing the best forecasting models is to compare all models generated and to locate a set of forecast with the minimal forecast error.

Hence, the evaluation of enrollment forecast performance are carried out in the objective manner. The concept of least squared criterion may be used in evaluating enrollment forecast models. Two criteria along with their mathematical formulas are presented as follows:

A. Mean squared error

$$MSE = \frac{\sum_{t=1}^{N} (X_t - F_t)^2}{N} \qquad (3.36)$$

B. Mean absolute percentage error

$$MAPE = \frac{\sum_{t=1}^{N} \left| \frac{(X_t - F_t)}{X_t} \cdot 100 \right|}{N} \qquad (3.37)$$

The strategies of model comparisons and selections are described as follows:

A. Within multiple regression analysis, OSU undergraduate and total enrollment models are internally compared to determine if the models have the same structure. In addition, OSU total enrollment and OU total enrollment models are externally compared to achieve the cross validation.

B. Between multiple regression analysis and multiple discriminant analysis, the regression equation and discriminant function are systematically compared to see if these selected independent variables are identical.

C. Within time series analysis, the best forecast models are selected from various categories - freshmen, males, females, undergraduate students, graduate students, and total enrollments.

CHAPTER IV

DEVELOPING THE BEST FORECAST MODELS

Simple Exponential Smoothing and Brown's Double Exponential Smoothing Forecasts

The results of simple exponential smoothing and Brown's double exponential smoothing forecasts can be seen in the computer outputs of the self-developed Fortran programs as presented in Appendices A (Tables 15-32) and B (Tables 33-50). The way of estimating the parameters was to simulate the historical enrollment data using alternative values of ALPHA (0.1, 0.2, 0.3, . . ., 1.0) on Equation 3.1 through 3.5. For Brown's double exponential smoothing forecast, the coefficients A and B are added together for the one-year-ahead forecast with the exception of the year 1989. For 1989, we add coefficient A and two times coefficient B. More detailed calculations are presented in Appendix G. The determination of the best forecast model in each category is made by comparing the forecast errors obtained in simulation. Typically, the three sets of forecasts that have the smallest mean absolute percent error (MAPE) are judged to be the candidates for the best model.

Holt's Two Parameter Exponential Smoothing Forecast

The performance of Holt's two parameter exponential smoothing model in simulating the historical enrollment data can also be seen in the outputs of the Fortran program presented in Appendix C (Tables 51-68). The best sets of ALPHA and BETA for the candidate models are found by trying various combinations of values between 0.0 and 1.0 (on Equations 3.6 and 3.7) that minimize the mean absolute percent error. To prepare a forecast for the years 1963 through 1988, we add the trend component and the smoothed value for the one year ahead forecast. To forecast the year 1989, we double the trend component and add it with the smoothed value. More detailed calculations of Holt's two parameter exponential smoothing forecasts are shown in Appendix G.

Summary Results of the Exponential Smoothing Forecasts

The best models of simple exponential smoothing, Brown's double exponential smoothing and Holt's two parameter exponential smoothing forecasts, for each category are based upon the smallest values of the mean absolute percent error (MAPE), the mean squared error (MSE), and/or the most recent forecast errors. These models with asterisks are presented in Tables 3-5 and Figures 2-7.

TABLE 3

RESULTS OF SIMPLE/BROWN'S DOUBLE/HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING FORECAST, OSU TOTAL AND UNDERGRADUATE ENROLLMENTS

CATEGORY: OSU TOTAL ENROLLMENTS (Years 1962 Through 1987)

1986 Actual = 20634   1987 Actual = 20116   1988&1989 Actual = Unknown

MODEL NO.	METHODOLOGY	PARAMETER ALPHA	PARAMETER BETA	MAPE	MSE	1986 FORECAST	1986 % ERROR	1987 FORECAST	1987 % ERROR	1988 FORECAST	1989 FORECAST	BEST MODEL (MARK *)
Total-1	Simple Exponential	1.0	N.A.	3.37	531829.0	20901	1.09	20634	2.58	20116	N.A.	*
Total-2	Smoothing	0.9	N.A.	3.63	615023.1	20966	1.61	20667	2.74	20171	N.A.	
Total-3		0.8	N.A.	4.34	875447.4	21163	2.56	20793	3.36	20318	N.A.	
Total-4	Brown's Double	0.7	N.A.	2.60	374266.3	20301	1.61	20164	0.24	19657	19193	*
Total-5	Exponential Smoothing	0.6	N.A.	2.62	420388.0	20422	1.03	20151	0.17	19660	19198	
Total-6		0.9	N.A.	2.67	330249.2	20290	1.67	20301	0.92	19639	19159	
Total-7	Holt's Two Parameter	1.0	0.3	2.35	351799.2	20558	0.37	20314	0.98	19737	19357	**
Total-8	Exponential Smoothing	1.0	0.4	2.42	340437.2	20430	0.99	20245	0.64	19675	19235	
Total-9		1.0	0.2	2.42	375007.2	20751	0.57	20460	1.71	19873	19631	

CATEGORY: OSU UNDERGRADUATE ENROLLMENTS (Years 1962 Through 1987)

1986 Actual = 16845   1987 Actual = 16115   1988&1989 Actual = Unknown

MODEL NO.	METHODOLOGY	PARAMETER ALPHA	PARAMETER BETA	MAPE	MSE	1986 FORECAST	1986 % ERROR	1987 FORECAST	1987 % ERROR	1988 FORECAST	1989 FORECAST	BEST MODEL (MARK *)
Under-1	Simple Exponential	1.0	N.A.	3.50	414399.6	17240	2.34	16845	4.53	16115	N.A.	*
Under-2	Smoothing	0.9	N.A.	3.76	477154.0	17301	2.71	16891	4.81	16193	N.A.	
Under-3		0.8	N.A.	4.07	559610.5	17378	3.17	16952	5.19	16282	N.A.	
Under-4	Brown's Double	0.9	N.A.	2.66	261438.4	16684	0.96	16419	1.88	15447	14777	*
Under-5	Exponential Smoothing	0.8	N.A.	2.68	275158.8	16685	0.95	16386	1.68	15500	14874	
Under-6		0.7	N.A.	2.74	301247.4	16727	0.70	16369	1.57	15548	14958	
Under-7	Holt's Two Parameter	1.0	0.3	2.56	294655.4	16940	0.57	16517	2.49	15666	15217	
Under-8	Exponential Smoothing	1.0	0.4	2.58	280779.2	16827	0.10	16439	2.01	15580	15044	
Under-9		1.0	0.6	2.59	265769.2	16712	0.79	16397	1.75	15498	14881	**

TABLE 4

RESULTS OF SIMPLE/BROWN'S DOUBLE/HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING FORECAST, OSU MALE AND FEMALE ENROLLMENTS

CATEGORY: OSU MALE ENROLLMENTS (Years 1962 Through 1987)

1986 Actual = 11751 1987 Actual = 11280 1988&1989 Actual = Unknown

MODEL NO.	METHODOLOGY	PARAMETER ALPHA	BETA	MAPE	MSE	1986 FORECAST	1986 % ERROR	1987 FORECAST	1987 % ERROR	1988 FORECAST	1989 FORECAST	BEST MODEL (MARK *)
Male-1	Simple Exponential	1.0	N.A.	3.12	185204.8	12029	2.37	11751	4.18	11280	N.A.	*
Male-2	Smoothing	0.9	N.A.	3.34	206574.0	12071	2.72	11783	4.46	11330	N.A.	
Male-3		0.8	N.A.	3.59	234700.6	12127	3.20	11826	4.84	11389	N.A.	
Male-4	Brown's Double	0.6	N.A.	2.77	175691.1	11717	0.29	11416	1.21	10923	10545	*
Male-5	Exponential Smoothing	0.5	N.A.	2.79	193108.6	11859	0.92	11487	1.84	10989	10646	
Male-6		0.9	N.A.	2.81	166922.7	11633	1.00	11452	1.52	10845	10407	
Male-7	Holt's Two Parameter	1.0	0.2	2.52	158080.9	11895	1.23	11588	2.73	11056	10832	
Male-8	Exponential Smoothing	1.0	0.3	2.57	153903.0	11792	0.35	11502	1.96	10964	10648	**
Male-9		0.9	0.2	2.57	172375.2	11933	1.55	11605	2.88	11090	10867	

CATEGORY: OSU FEMALE ENROLLMENTS (Years 1962 Through 1987)

1986 Actual = 8883 1987 Actual = 8836 1988&1989 Actual = Unknown

MODEL NO.	METHODOLOGY	PARAMETER ALPHA	BETA	MAPE	MSE	1986 FORECAST	1986 % ERROR	1987 FORECAST	1987 % ERROR	1988 FORECAST	1989 FORECAST	BEST MODEL (MARK *)
Female-1	Simple Exponential	1.0	N.A.	4.13	118722.6	8872	0.12	8883	0.53	8836	N.A.	*
Female-2	Smoothing	0.9	N.A.	4.50	141091.3	8895	0.13	8884	0.55	8841	N.A.	
Female-3		0.8	N.A.	4.96	170960.3	8925	0.48	8891	0.63	8847	N.A.	
Female-4	Brown's Double	0.9	N.A.	2.69	46776.5	8656	2.55	8850	0.15	8794	8752	*
Female-5	Exponential Smoothing	0.8	N.A.	2.88	53154.9	8647	2.65	8802	0.39	8785	8735	
Female-6		0.7	N.A.	3.16	62531.0	8657	2.55	8758	0.88	8763	8696	
Female-7	Holt's Two Parameter	1.0	1.0	2.58	42459.8	8677	2.32	8894	0.66	8789	8742	**
Female-8	Exponential Smoothing	1.0	0.9	2.62	44145.7	8666	2.44	8872	0.41	8793	8749	
Female-9		1.0	0.8	2.65	46028.3	8658	2.53	8849	0.15	8792	8747	

TABLE 5

RESULTS OF SIMPLE/BROWN'S DOUBLE/HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING FORECAST, OSU GRADUATE AND FRESHMAN ENROLLMENTS

CATEGORY: OSU GRADUATE ENROLLMENTS (Years 1962 Through 1987)
1986 Actual = 3507   1987 Actual = 3625   1988&1989 Actual = Unknown

MODEL NO.	METHODOLOGY	PARAMETER ALPHA	PARAMETER BETA	MAPE	MSE	1986 FORECAST	1986 % ERROR	1987 FORECAST	1987 % ERROR	1988 FORECAST	1989 FORECAST	BEST MODEL (MARK *)
Grad-1	Simple Exponential	1.0	N.A.	4.49	23045.5	3376	3.74	3507	3.26	3625	N.A.	*
Grad-2	Smoothing	0.9	N.A.	4.73	24921.4	3377	3.70	3494	3.61	3612	N.A.	
Grad-3		0.8	N.A.	5.07	27668.4	3383	3.53	3482	3.94	3596	N.A.	
Grad-4	Brown's Double	0.6	N.A.	3.91	20371.2	3332	4.99	3498	3.49	3670	3735	*
Grad-5	Exponential Smoothing	0.5	N.A.	3.94	20118.5	3366	4.02	3482	3.95	3635	3681	
Grad-6		0.4	N.A.	4.28	21571.5	3414	2.64	3485	3.86	3608	3642	
Grad-7	Holt's Two Parameter	1.0	0.1	3.47	17472.1	3416	2.58	3557	1.89	3681	3738	**
Grad-8	Exponential Smoothing	0.9	0.2	3.50	18037.3	3384	3.51	3522	2.85	3660	3706	
Grad-9		0.9	0.1	3.53	17795.6	3424	2.38	3547	2.15	3672	3728	

CATEGORY: OSU FRESHMAN ENROLLMENTS (Years 1962 Through 1987)
1986 Actual = 4560   1987 Actual = 4177   1988&1989 Actual = Unknown

MODEL NO.	METHODOLOGY	PARAMETER ALPHA	PARAMETER BETA	MAPE	MSE	1986 FORECAST	1986 % ERROR	1987 FORECAST	1987 % ERROR	1988 FORECAST	1989 FORECAST	BEST MODEL (MARK *)
Fresh-1	Simple Exponential	1.0	N.A.	6.86	144602.6	4471	1.95	4560	9.17	4177	N.A.	
Fresh-2	Smoothing	0.9	N.A.	6.92	152785.6	4470	1.97	4551	8.95	4214	N.A.	
Fresh-3		0.8	N.A.	7.08	163219.2	4477	1.82	4543	8.77	4250	N.A.	*
Fresh-4	Brown's Double	0.9	N.A.	7.98	197941.8	4447	2.47	4630	10.84	3886	3590	
Fresh-5	Exponential Smoothing	0.4	N.A.	7.99	207652.3	4314	5.39	4371	4.66	4116	3985	**
Fresh-6		0.5	N.A.	8.33	194282.9	4255	6.68	4395	5.22	4088	3945	
Fresh-7	Holt's Two Parameter	1.0	0.1	7.08	169268.1	4436	2.72	4538	8.63	4119	4060	
Fresh-8	Exponential Smoothing	0.9	0.1	7.17	182455.8	4430	2.85	4523	8.28	4156	4101	
Fresh-9		0.8	0.1	7.44	200033.5	4434	2.76	4509	7.95	4191	4139	*

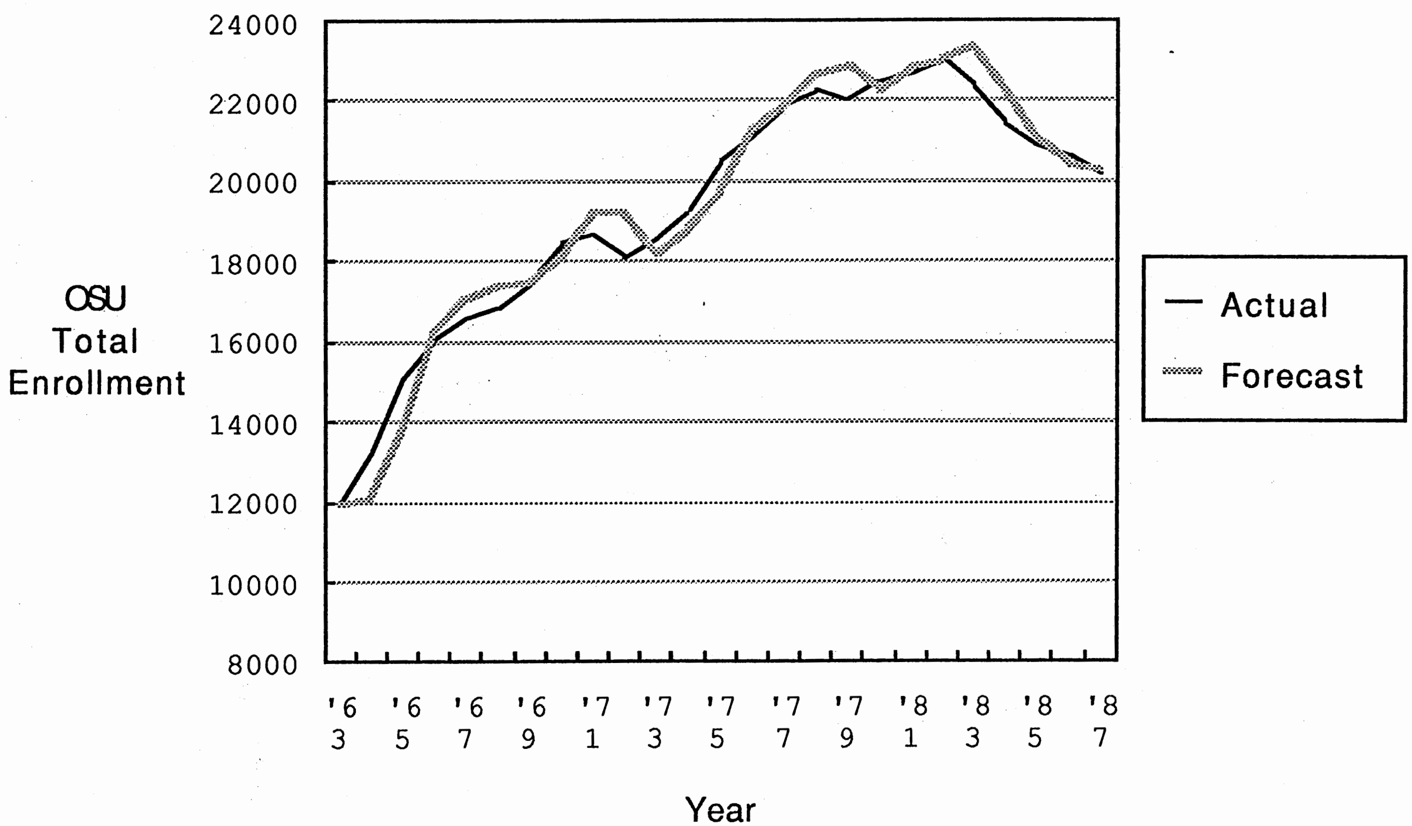

Figure 2. Holt's Two Parameter Exponential Smoothing Forecast for Total Enrollments with Alpha = 1.0 and Beta = 0.3

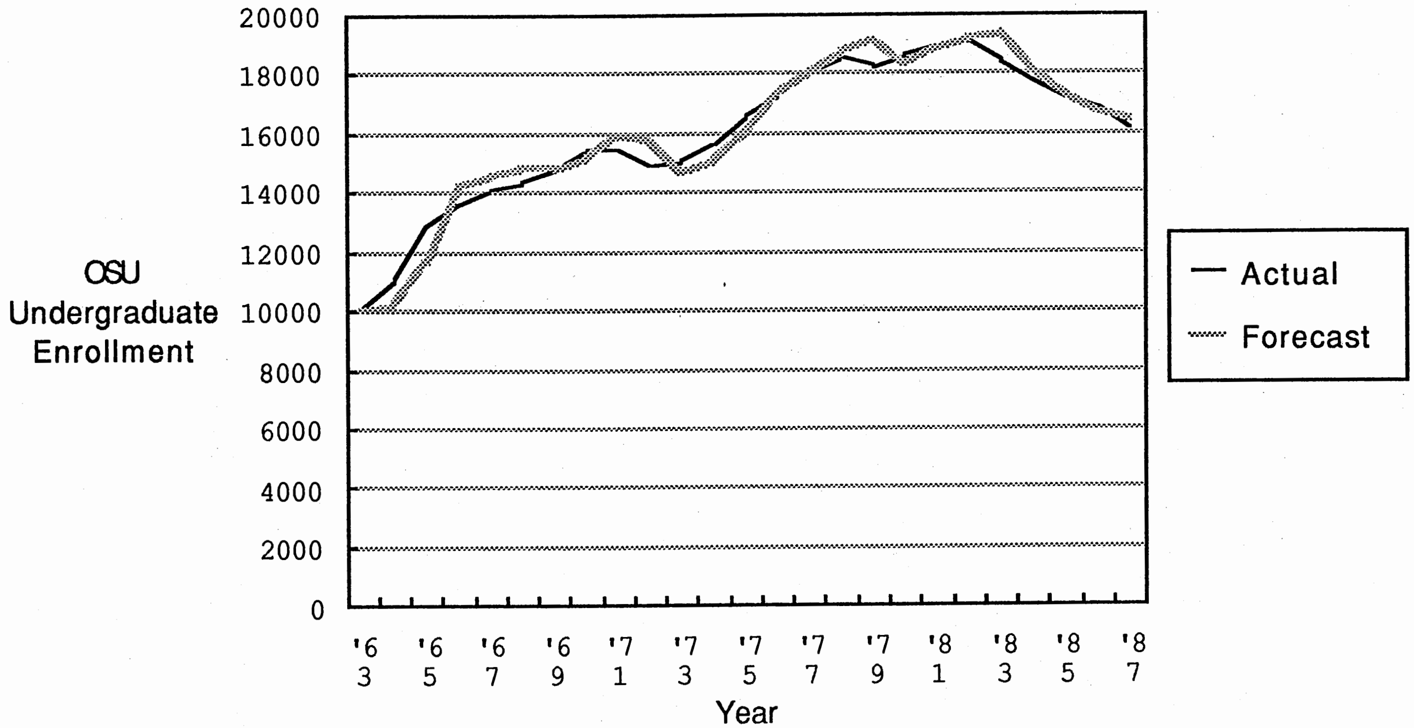

Figure 3. Holt's Two Parameter Exponential Smoothing Forecast for Undergraduate Enrollments with Alpha = 1.0 and Beta = 0.6

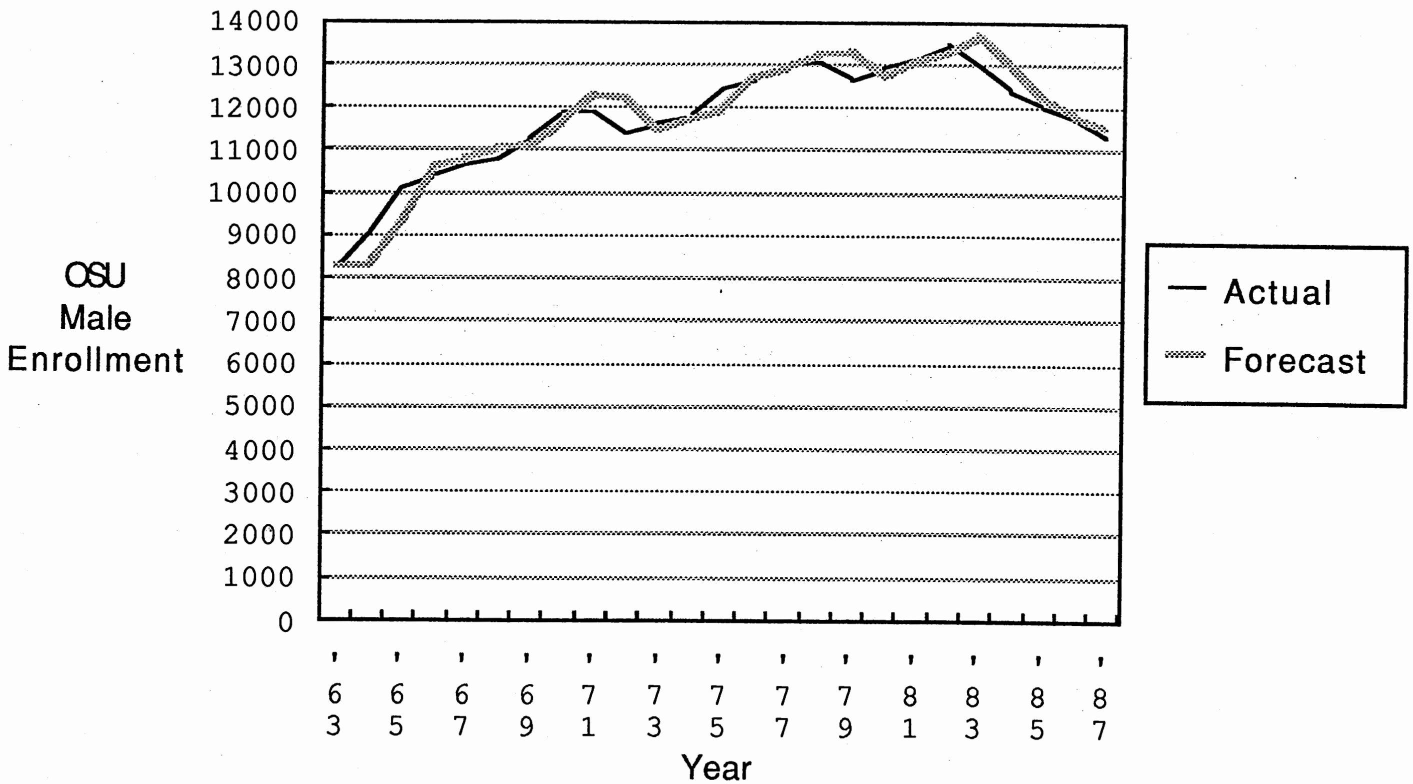

Figure 4. Holt's Two Parameter Exponential Smoothing Forecast for Male Enrollments with Alpha = 1.0 and Beta = 0.3

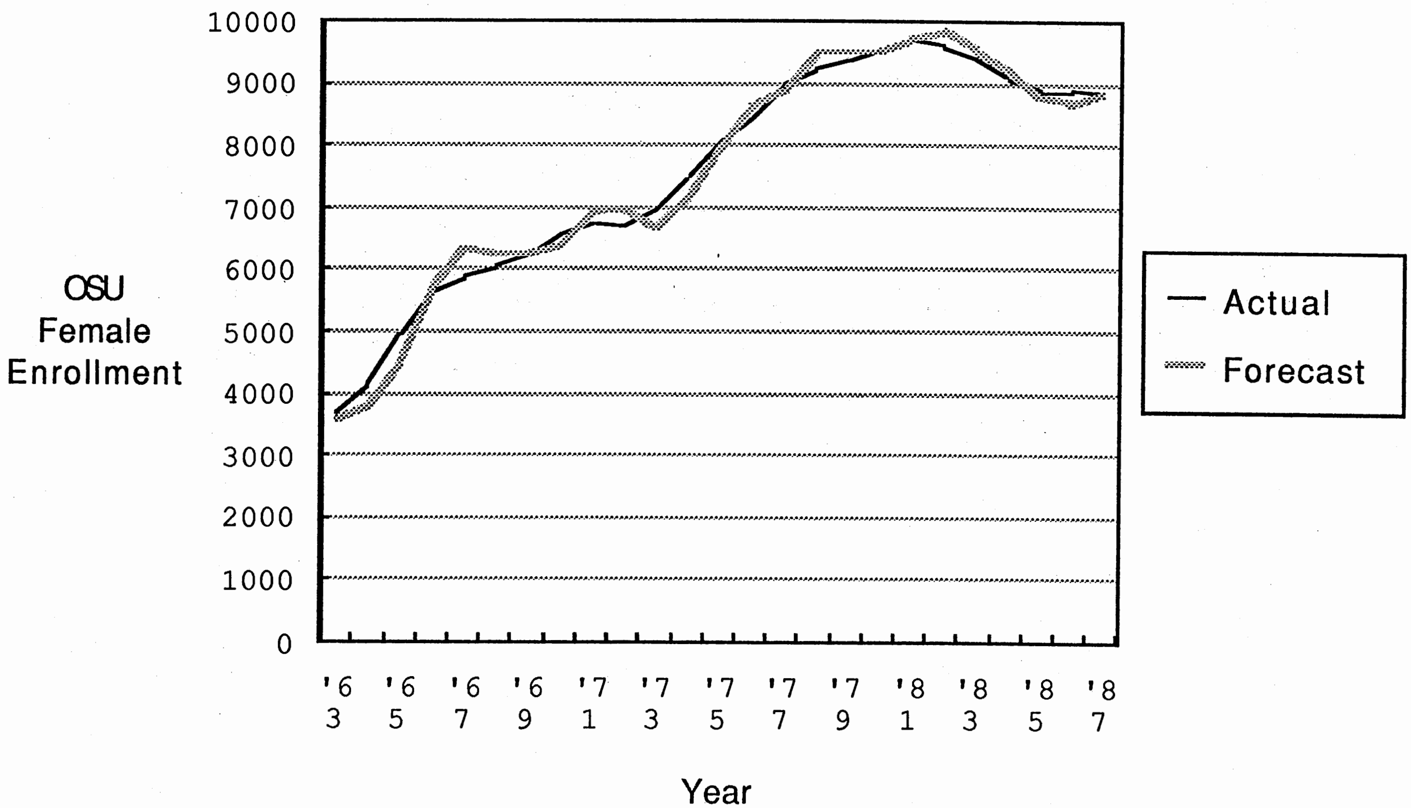

Figure 5. Holt's Two Parameter Exponential Smoothing Forecast for Female Enrollments with Alpha = 1.0 and Beta = 1.0

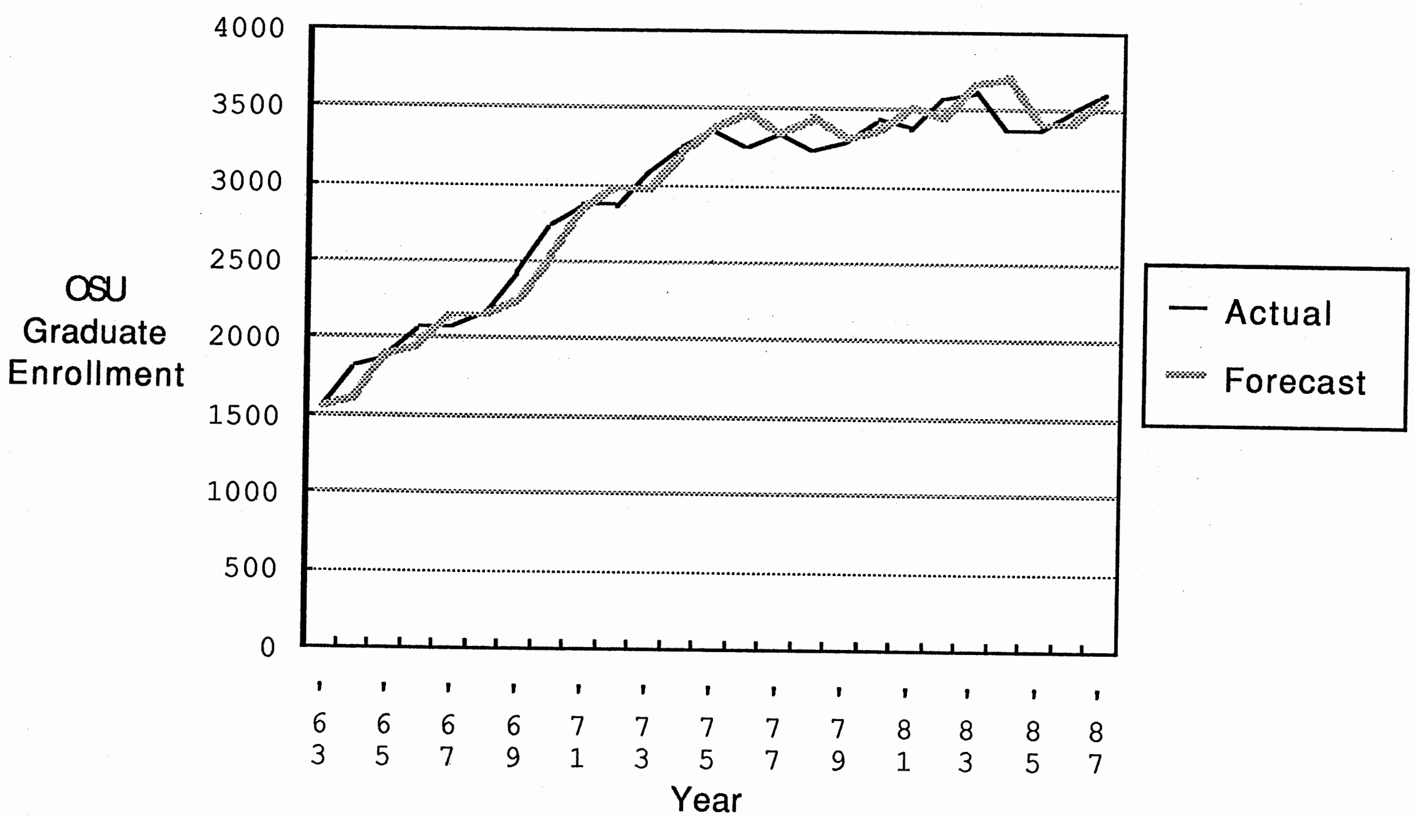

Figure 6. Holt's Two Parameter Exponential Smoothing Forecast for Graduate Enrollments with Alpha = 1.0 and Beta = 0.1

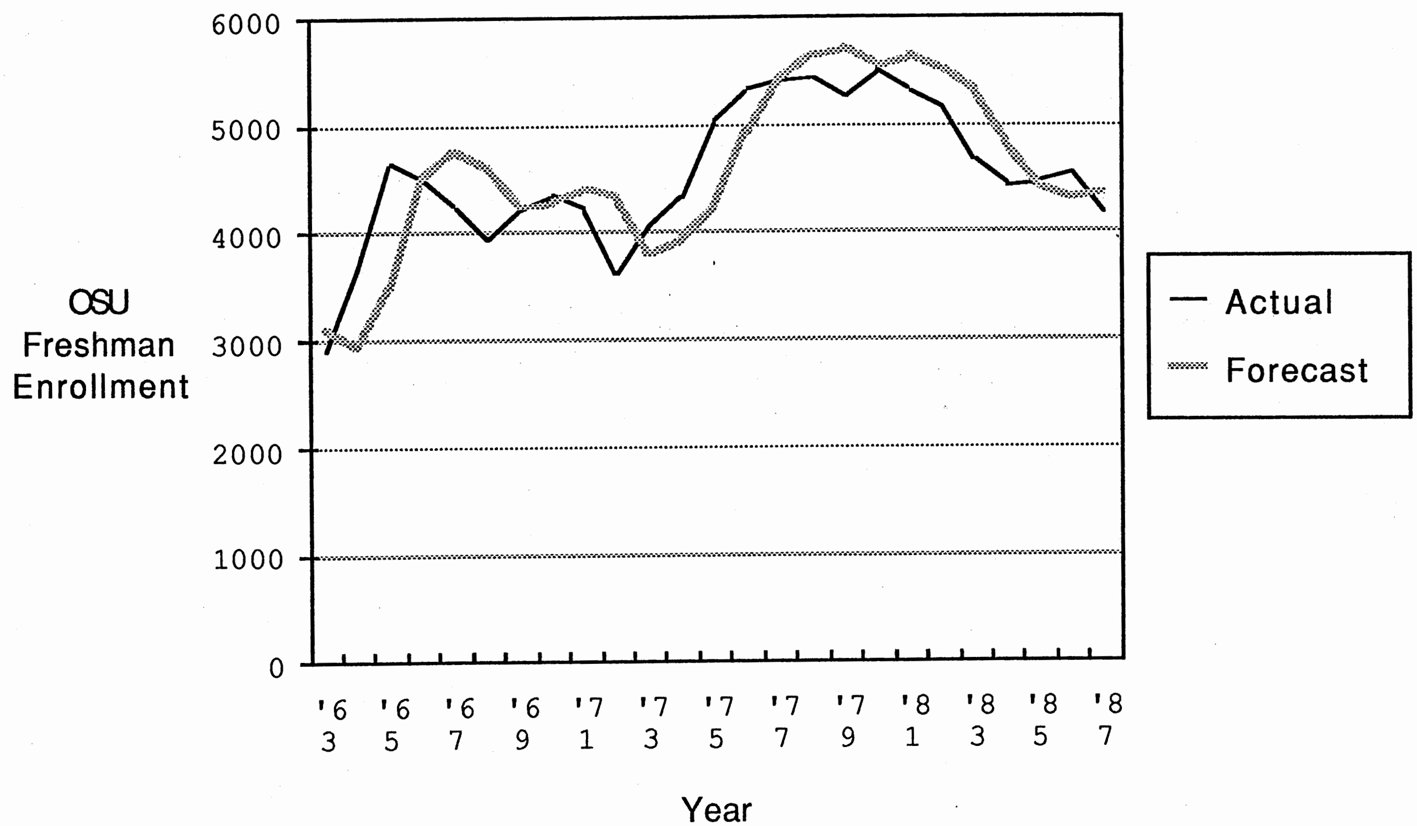

Figure 7. Brown's Double Exponential Smoothing Forecast for Freshmen Enrollments with Alpha = 0.4

Box-Jenkins Methodology

Step 1. Model Identification

Model identification was achieved by the IDENTITY procedure of Box-Jenkins in SPSSX which is a computer program for identifying the ARIMA model.

Initially, the Oklahoma State University enrollment series was plotted as Figure 13. The resulting plot indicates an increase in enrollment before the year 1983 and also an apparent decline in enrollment from that year on. It tends to indicate a need for regular differencing and possible log transformation in order to achieve stationarity. Another indication that differencing is necessary comes from observing the autocorrelation function (Figure 15) which tends to die out slowly at high lag.

Three sets of differencings (d = 0, d = 1, and d = 2) along with the autocorrelation functions and the partial autocorrelation functions were plotted in order to identify the tentative models. The summary of model identifications are shown as Table 6.

TABLE 6

OSU TOTAL ENROLLMENT MODEL IDENTIFICATION

ENROLLMENT SERIES	TENTATIVE MODELS ARIMA(P, D, Q)	SAMPLE AUTOCORRELATION (PAC)	SAMPLE PARTIAL AUTOCORRELATION (SPAC)
Years 1946 Through 1985	ARIMA(1, 0, 0)	Sine Wave (Figure 15)	Cuts Off After Lag 1 (Figure 16)
	ARIMA(1, 0, 1)	Peak At Lag 1, Dies Out Slowly (Figure 15)	Cuts Off After Lag 1 (Figure 16)
	ARIMA(2, 0, 1)	Peak At Lag 1 And 2, Dies Out Slowly (Figure 15)	Cuts Off After Lag 1 (Figure 16)
	ARIMA(1, 1, 1)	Cuts Off At Lag 1 (Figure 18)	Cuts Off After Lag 1 (Figure 19)
	ARIMA(0, 2, 0)	No Spike At Any Lag (Figure 21)	No Spike At Any Lag (Figure 22)
Years 1946 Through 1986	ARIMA(1, 0, 0)	Sine Wave (Figure 24)	Cuts Off After Lag 1 (Figure 25)
	ARIMA(1, 0, 1)	Peak At Lag 1, Dies Out Slowly (Figure 24)	Cuts Off After Lag 1 (Figure 25)
	ARIMA(2, 0, 1)	Peak At Lag 1 And 2, Dies Out Slowly (Figure 24)	Cuts Off After Lag 1 (Figure 25)
	ARIMA(1, 1, 1)	Cuts Off At Lag 1 (Figure 27)	Cuts Off After Lag 1 (Figure 28)
	ARIMA(0, 2, 0)	No Spike At Any Lag (Figure 30)	No Spike At Any Lag (Figure 31)
Years 1946 Through 1987	ARIMA(1, 0, 0)	Sine Wave (Figure 33)	Cuts Off After Lag 1 (Figure 34)
	ARIMA(1, 0, 1)	Peak At Lag 1, Dies Out Slowly (Figure 33)	Cuts Off After Lag 1 (Figure 34)
	ARIMA(2, 0, 1)	Peak At Lag 1 And 2, Dies Out Slowly (Figure 33)	Cuts Off After Lag 1 (Figure 34)
	ARIMA(1, 1, 1)	Cuts Off At Lag 1 (Figure 36)	Cuts Off After Lag 1 (Figure 37)
	ARIMA(0, 2, 0)	No Spike At Any Lag (Figure 39)	No Spike At Any Lag (Figure 40)

Step 2. Parameter Estimation

Estimates of the coefficients of the identified tentative models were obtained by the ESTIMATE procedure in the Box-Jenkins in SPSSX.

TABLE 7

PARAMETER ESTIMATION

ENROLLMENT SERIES	TENTATIVE MODELS ARIMA(P, D, Q)	NONLINEAR ESTIMATION PARAMETER	STD ERROR	T RATIO
Years 1946 Through 1985	ARIMA(1, 0, 0)	CON=0.94531	0.23505	4.0218
		AR1=0.901	0.024804	36.3250
	ARIMA(1, 0, 1)	CON=1.4293	0.36314	3.9360
		AR1=0.85	0.038277	22.2060
		MA1= -0.799	0.085818	-9.3104
	ARIMA(2, 0, 1)	CON=0.05525	0.30662	0.18019
		AR1=0.10156	0.15009	0.67666
		AR2=0.89375	0.15507	5.7634
		MA1=-0.96875	0.056008	-17.297
	ARIMA(1, 1, 1)	CON=0.017187	0.011329	1.5171
		AR1=0.27812	0.29932	0.92918
		MA1=-0.15781	0.30277	-0.52123
Years 1946 Through 1986	ARIMA(1, 0, 0)	CON=0.94531	0.22968	4.1159
		AR1=0.901	0.024216	37.2070
	ARIMA(1, 0, 1)	CON=1.0281	0.31495	3.2644
		AR1=0.89219	0.03325	26.8330
		MA1=-0.72812	0.09578	-7.6021
	ARIMA(2, 0, 1)	CON=0.003	0.29495	0.010171
		AR1=0.10156	0.1327	0.76534
		AR2=0.9	0.14637	6.1486
		MA1=-1.0453	0.065436	-15.975
	ARIMA(1, 1, 1)	CON=0.016625	0.010826	1.5356
		AR1=0.29219	0.28942	1.0095
		MA1=-0.14844	0.29539	-0.50251
Years 1946 Through 1987	ARIMA(1, 0, 0)	CON=0.94531	0.22458	4.2092
		AR1=0.901	0.02366	38.0820
	ARIMA(1, 0, 1)	CON=1.4302	0.3494	4.0935
		AR1=0.85	0.036762	23.122
		MA1=-0.79844	0.084505	-9.4484
	ARIMA(2, 0, 1)	CON=0.001	0.26489	0.0037752
		AR1=0.30625	0.13125	2.3333
		AR2=0.69475	0.13657	5.0872
		MA1=-0.96719	0.052863	-18.296
	ARIMA(1, 1, 1)	CON=0.015063	0.010251	1.4694
		AR1=0.31875	0.27965	1.1398
		MA1=-0.12912	0.28864	-0.44735

Step 3. Diagnostic Checking

In the ARIMA (1, 0, 0) model from year 1964 through year 1987, chi-square test for testing the null hypothesis that residual series is white noise yields a test statistic of 73.95. Comparing this figure with chi-square (df = 20), we find that the observe significant level (OSL) is less than .0001, so we cannot reject the null hypothesis. Thus, there is not evidence to indicate that the residuals are anything other than a white noise series. In a word, ARIMA (1, 0, 0) is an appropriate candidate model for conducting one-step ahead of the enrollment forecast. Several appropriate candidate models are shown as Table 8.

TABLE 8

DIAGNOSTIC CHI-SQUARE STATISTICS FOR RESIDUAL SERIES

ENROLLMENT SERIES	TENTATIVE MODELS ARIMA(P, D, Q)	LAG	CHI SQUARE	D.F.	PROB	APPROPRIATE/ INPROPRIPATE
Years 1946 Through 1985	ARIMA(1, 0, 0)	6	33.52	4	0.0000	APPROPRIATE
		12	35.84	10	0.0001	
		18	45.38	16	0.0001	
		24	56.43	22	0.0001	
		30	72.4	28	0.0000	
	ARIMA(1, 0, 1)	6	22.12	3	0.0001	APROPRIPATE
		12	26.55	9	0.0017	
		18	34.06	15	0.0033	
		24	41.88	21	0.0044	
		30	58.64	27	0.0004	
	ARIMA(2, 0, 1)	6	11.67	2	0.0029	INAPROPRIPATE
		12	12.79	8	0.1194	
		18	27.72	14	0.0155	
		24	34.1	20	0.0255	
		30	37.54	26	0.0668	
	ARIMA(1, 1, 1)	6	4.63	3	0.2013	INAPROPRIPATE
		12	5.88	9	0.7522	
		18	13.26	15	0.5820	
		24	16.53	21	0.7389	
		30	19.89	27	0.8353	

TABLE 8 (Continued)

Years 1946 Through 1986	ARIMA(1, 0, 0)	6	34.13	4	0.0000	APPROPRIATE
		12	36.52	10	0.0001	
		18	46.11	16	0.0001	
		24	57.07	22	0.0001	
		30	73.07	28	0.0000	
	ARIMA(1, 0, 1)	6	13.77	3	0.0032	INPROPRIPATE
		12	16.74	9	0.0530	
		18	23.08	15	0.0825	
		24	26.86	21	0.1755	
		30	39.16	27	0.0613	
	ARIMA(2, 0, 1)	6	14.72	2	0.0006	APROPRIPATE
		12	15.86	8	0.0444	
		18	31.29	14	0.0050	
		24	38.53	20	0.0076	
		30	42.57	26	0.0215	
	ARIMA(1, 1, 1)	6	4.91	3	0.1783	INPROPRIPATE
		12	6.22	9	0.7181	
		18	13.32	15	0.5777	
		24	16.51	21	0.7404	
		30	19.98	27	0.8318	
Years 1946 Through 1987	ARIMA(1, 0, 0)	6	34.64	4	0.0000	APPROPRIATE
		12	36.99	10	0.0001	
		18	46.76	16	0.0001	
		24	58	22	0.0000	
		30	73.95	28	0.0000	
	ARIMA(1, 0, 1)	6	23.03	3	0.0000	APPROPRIATE
		12	27.9	9	0.0010	
		18	35.61	15	0.0020	
		24	43.06	21	0.0031	
		30	60.71	27	0.0002	
	ARIMA(2, 0, 1)	6	10.59	2	0.0050	INAPPROPRIATE
		12	11.38	8	0.1809	
		18	23.44	14	0.0535	
		24	29.64	20	0.0759	
		30	34.72	26	0.1179	
	ARIMA(1, 1, 1)	6	4.93	3	0.1770	INAPPROPRIATE
		12	6.09	9	0.7306	
		18	13.2	15	0.5869	
		24	16.35	21	0.7495	
		30	20.12	27	0.8255	

Step 4. Forecasting

Forecasts of the appropriate models were performed by the FORECAST procedure of the Box-Jenkins in SPSSX. The forecasting begins with year 1948. The actual enrollments were compared to the forecasted enrollments to see how accurate each model performed. The results of the Box-Jenkins forecast can be seen in Appendix D (Tables 69-74). The summary results of the Box-Jenkins forecast are shown as Table 9 and Figure 8.

TABLE 9

COMPARISON OF BOX-JENKINS ENROLLMENT FORECASTS

OSU TOTAL ENROLLMENTS (Years 1946 Through 1987)
1986 Actual = 20634 1987 Actual = 20116 1988&1989 Actual = Unknown

MODEL ARIMA(P,D,Q)	1946-87 MAPE	1986 FORECAST	1986 % ERROR	1987 FORECAST	1987 % ERROR	1988 FORECAST	1989 FORECAST	BEST MODEL (MARK *)
ARIMA(1,0,0)	4.76	20092	2.63	19860	1.27	19410	18796	*
ARIMA(1,0,1)	5.05	19880	3.65	20019	0.48	19091	18190	

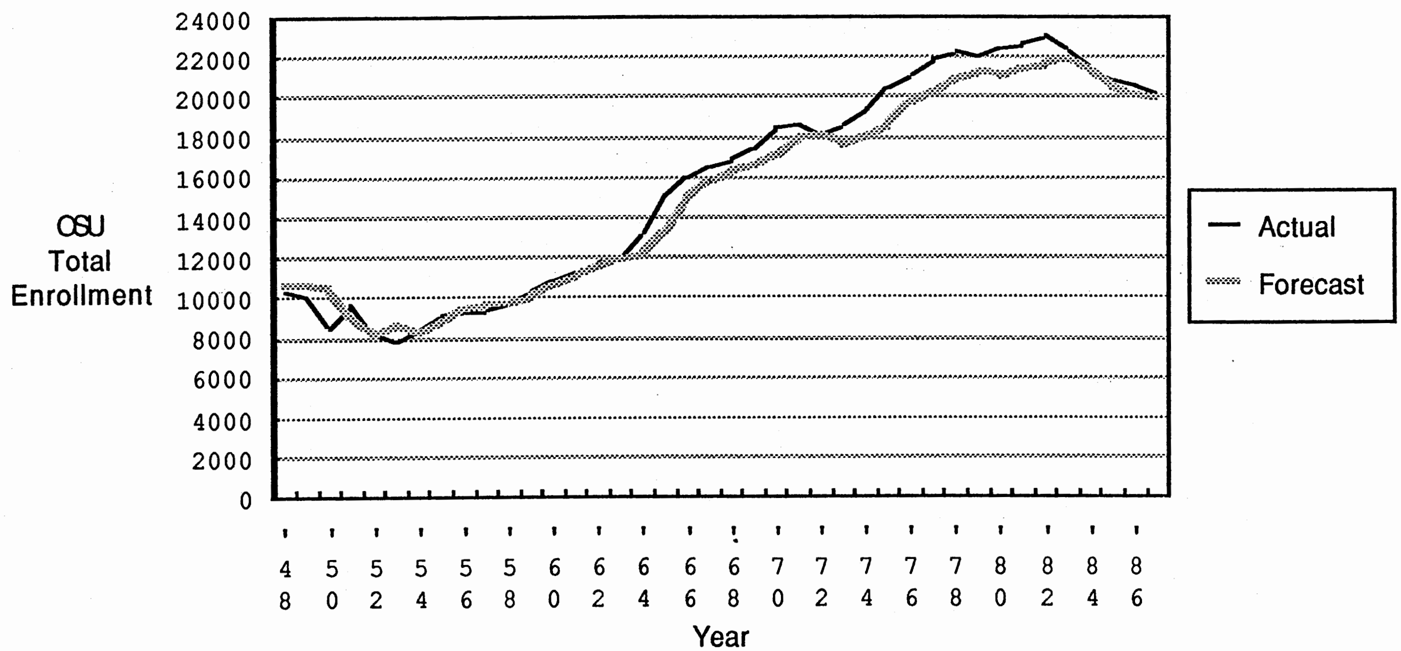

Figure 8. Results of Box-Jenkins ARIMA (1,0,0) Forecast, OSU Total Enrollment

Multiple Regression Analysis

Table 10 presents the summary results of the multiple regression procedure which includes the regression coefficient estimates and other relevant information extracted from Tables 75 through 82 in Appendix E. The main interest lies with the effect of these selected independent variables on undergraduate and total student enrollments and the accuracy of enrollment prediction. Before discussing this result, several other empirical findings must be considered.

First, the overall significance of each regression model is indicated by rejecting the null hypothesis that all coefficients are equal to zero at the observed significant level (OSL) of .0001. Meanwhile, the coefficients of determination (R squares) indicate that the large percents of variances in enrollments are explained by these independent variables. Second, all variables entered in the equation have the algebric sign one would expect. Third, the regression models for OSU undergraduate enrollments, OSU total enrollments, and OU total enrollments contain the same independent variables particularly in years 1962 through 1987. Fourth, the results of the Durbin Watson test indicate that the residuals are independent of one another, e.g., no serial correlation for each regression model. Fifth, the results of the scatterplot indicate that there is no relationship between the residuals and predicted values, e.g. the assumption of linearity and homogeneity of variance are held.

The OSU undergraduate enrollment and total enrollment regression models are used to describe the effect that various predictor variables - HIGHSCH, UNEMPLY, OILRIG, USGNP, and TUITION - have on the dependent variables being examined. The empirical findings are: (1) an increase of 34 undergraduate enrollments and 45 total student enrollments is associated with an increase of 100 Oklahoma high school graduates; (2) a change of 1% Oklahoma unemployment rate is positively related with 263 undergraduate enrollments and 376 total students enrollments; (3) an increase of one Oklahoma oil drilling rig activity causes an increase of three undergraduate enrollments and three total student enrollments; (4) an increment of four undergraduate enrollments and five total student enrollments is related to that of one billion dollar United States Gross National products; (5) an increase of $1.00 per credit hour in OSU tuition induces a decrease of 54 undergraduate enrollments and 62 total student enrollments; and (6) four independent variables - OSU financial aids, Oklahoma per capita incomes, Oklahoma other-institution enrollments, and U.S. Consumer Price Indices are not retained in these regression models.

TABLE 10

SUMMARY RESULTS OF MULTIPLE REGRESSION (BACKWARD) PROCEDURE

Variables	OSU Undergraduate Enrollments (Year 1962 To 1985)	OSU Undergraduate Enrollments (Year 1962 To 1986)	OSU Undergraduate Enrollments (Year 1962 To 1987)	OSU Total Enrollments (Year 1962 To 1985)	OSU Total Enrollments (Year 1962 To 1986)	OSU Total Enrollments (Year 1962 To 1987)	OU Total Enrollments (Year 1962 To 1987)
(Independent Variables)	Are Cofficients Significant ?						
HIGHSCH	0.338009**	0.363978**	0.343445**	0.489064**	0.519846**	0.445878**	0.343076**
UNEMPLY			262.601784*	238.934029*	233.146241*	376.206047**	474.909955**
OILRIG	2.370619**	2.863338**	3.155138**	2.589032*	3.198811**	3.25861**	
USGNP	2.880564**	2.577**	4.101154**	3.137439**	2.773912**	5.008987**	5.147921**
TUITION			-54.043886*			-61.576131*	-52.741291**
(CONSTANT)	-4747.168979**	-4993.676467**	-7345.30512**	-8851.205391**	-9113.119549**	-10512.1728**	-7370.731356**
	Are Models Fitted ?						
Coefficient Signs (+, -) expected ?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Null Hypo.: All Coefficients Equal To Zero	Reject Null Hypothesis P < .0001	Reject Null Hypothesis P < .0001	Reject Null Hypothesis P < .0001	Reject Null Hypothesis P < .0001	Reject Null Hypothesis P < .0001	Reject Null Hypothesis P < .0001	Reject Null Hypothesis P < .0001
R Squares	0.9614	0.9584	0.9595	0.9704	0.9675	0.9687	0.9751
Durbin Watson Statistics (Test Results)	1.02189 No Serial Correlation	1.01896 No Serial Correlation	1.10285 No Serial Correlation	1.1296 No Serial Correlation	1.13831 No Serial Correlation	1.3197 No Serial Correlation	1.09145 No Serial Correlation
Plots Of Residuals Vs. Predicted Values	No Systematic Pattern	No Systematic Pattern	No Systematic Pattern	No Systematic Pattern	No Systematic Pattern	No Systematic Pattern	No Systematic Pattern
Residual Means	0	0	0	0	0	0	0
	Is Model Workable ?						
Average % Predicted Error	2.79%	2.67%	2.88%	2.47%	2.52%	2.53%	2.09%
1983 % Predicted Error	3.27%	4.06%	1.84%	0.22%	1.11%	0.95%	1.48%
1984 % Predicted Error	1.15%	0.16%	1.75%	1.84%	0.48%	0.74%	1.44%
1985 % Predicted Error	3.47%	1.69%	0.85%	3.50%	1.68%	1.52%	0.73%
1986 % Predicted Error		3.44%	1.87%		3.51%	2.30%	0.98%
1987 % Predicted Error			2.29%			1.01%	0.52%

HIGHSCH - Oklahoma High School Graduates
UNEMPLY - Oklahoma Unemployment Rates (%)
OILRIG - Oklahoma Oil Drilling Rig Activities

USGNP - U.S. Gross National Products (billion)
TUITION - OSU/OU In-State Tuition&Fees (per credit hour -average of 3 divisions)

** Statistical Significance at .01 Level (Using t Test)
* Statistical Significance at .05 Level (Using t Test)

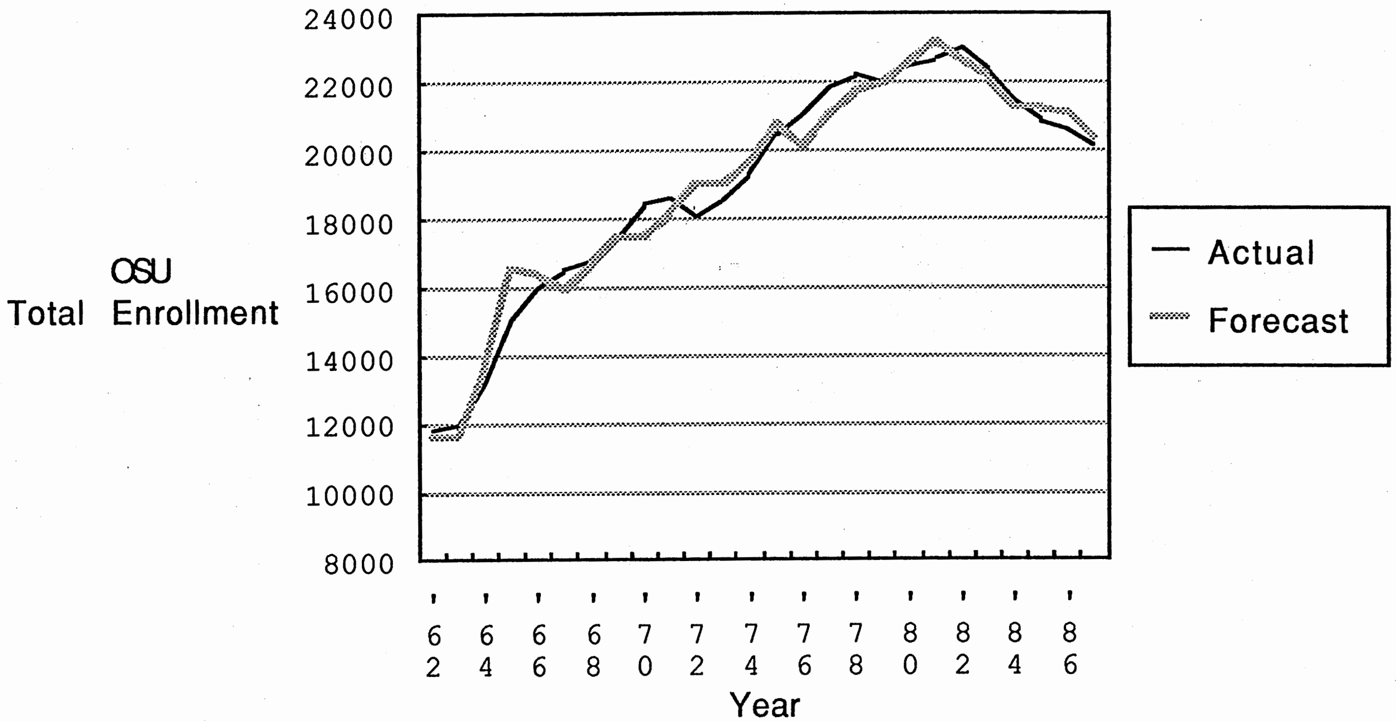

Figure 9. Results of Multiple Regression Prediction, OSU Total Enrollment

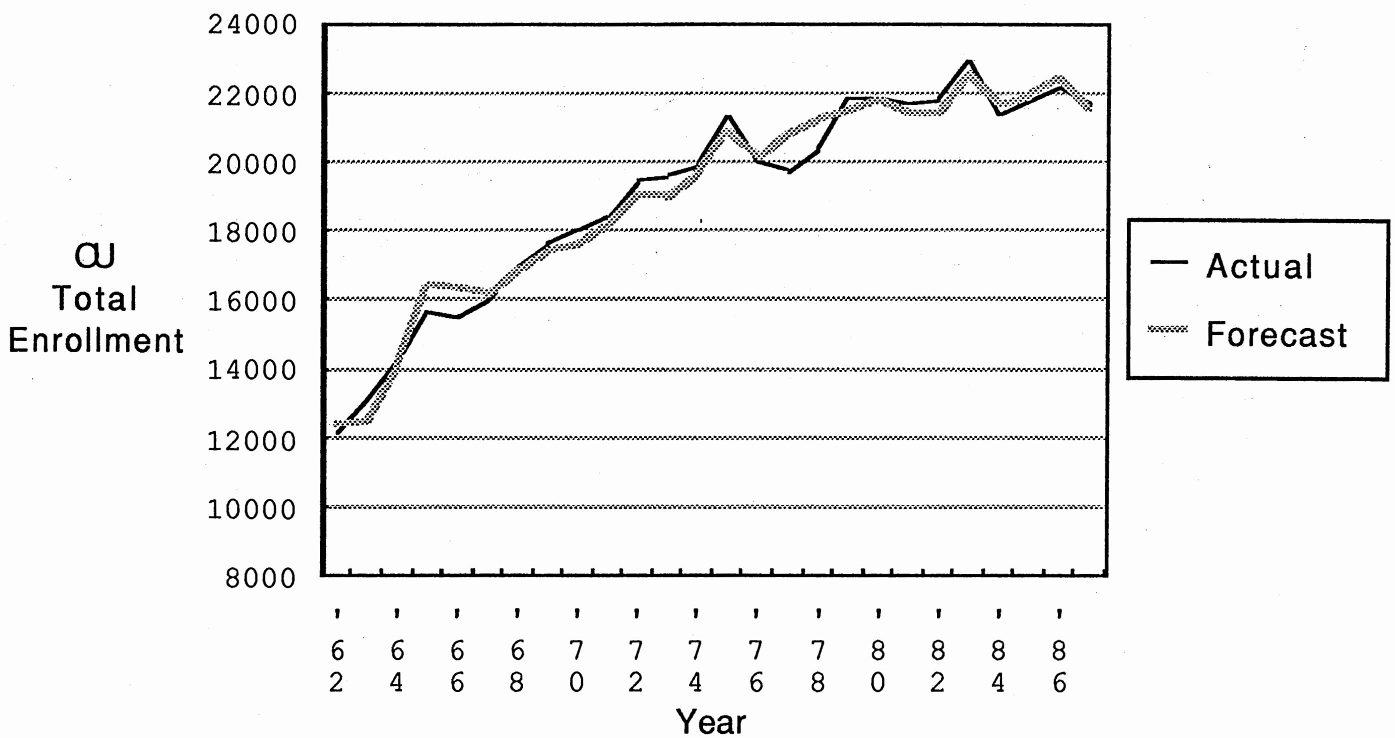

Figure 10. Results of Multiple Regression Prediction, OU Total Enrollment

TABLE 11

FORECAST RESULTS OF INTEGRATED FORECAST SYSTEM AND RATIO METHOD

CATEGORY	YEAR	ACTUAL	Integrated Forecast System(IFS) FORECAST	DIFFERENCE	% ERROR	Ratio Method* FORECAST	DIFFERENCE	% ERROR	% Accuracy Improvement by IFS
Total Enrollments	1985	20901	21194	293	1.40%	21095	194	0.93%	-0.47%
	1986	20634	20558	-76	0.37%	21042	408	1.98%	1.61%
	1987	20116	20314	198	0.98%	20936	820	4.08%	3.09%
	1988	N.A.	19737	N.A.	N.A.	20516	N.A.	N.A.	N.A.
	1989	N.A.	19357	N.A.	N.A.	20801	N.A.	N.A.	N.A.
Undergraduate Enrollments	1985	17240	17268	28	0.16%	17440	200	1.16%	1.00%
	1986	16845	16712	-133	0.79%	16860	15	0.09%	-0.70%
	1987	16115	16397	282	1.75%	16502	387	2.40%	0.65%
	1988	N.A.	15498	N.A.	N.A.	16015	N.A.	N.A.	N.A.
	1989	N.A.	14881	N.A.	N.A.	16258	N.A.	N.A.	N.A.
Graduate Enrollments	1985	3376	3407	31	0.92%	3240	-136	4.03%	3.11%
	1986	3507	3417	-90	2.57%	3285	-222	6.33%	3.76%
	1987	3625	3557	-68	1.88%	3475	-150	4.14%	2.26%
	1988	N.A.	3681	N.A.	N.A.	3600	N.A.	N.A.	N.A.
	1989	N.A.	3738	N.A.	N.A.	3575	N.A.	N.A.	N.A.

* used by OSU Office of Institutional Research (Student Profile, Fall 1984-87)

Discriminant Analysis

With regard to discriminant analysis, it is applied to nine lagged independent variables (lag 1) suspected of reflecting enrollment changes for the entire time horizon from the year 1962 to 1987. The reasons for using lagged variables are to make the enrollment forecasts possible and to improve the forecasting accuracy. Tables 12 through 14 are the summary results of discriminant analysis. With regard to total student enrollments, the Wilk's lambda (λ) statistic for three groups of annual enrollment percentage changes were computed and found to be 0.12, with a significance of p = 0.001. It was concluded that the significant differences existed among increased-group (2.5% or above), decreased-group (-2.5% or below), and unchanged-group (between -2.5% and 2.5%). It was also concluded that the two discriminant functions with independent variables UNEMPLY, PINCOME, OILRIG, USGNP, COMPFIG, TUITION, FINAID, and HIGHSCH were retained and accounted for 100 cumulative percent of the total variance.

The first function seperates increased-group and unchanged-group from decreased-group. The second function seperates increased-group and unchanged-group with the decreased-group in the middle. The results of classification show that 22 of 25 (88%) "grouped" cases were correctly classified for total student enrollments over the past 25 years.

The predict equations for classifying the group memberships in 1988 are those Fishers linear discriminant functions as follows:

Z_0 = constant + (each coefficient x the lagged variables in 1988)

Z_1 = constant + (each coefficient x the lagged variables in 1988)

Z_2 = constant + (each coefficient x the lagged variables in 1988)

The algorithms for the classification are

If ($Z_o > \text{Max}$ (Z_1, Z_2)) then Class = 0,

If ($Z_1 > \text{Max}$ (Z_0, Z_2)) then Class = 1,

If ($Z_2 > \text{Max}$ (Z_0, Z_1)) then Class = 2.

The results of the prediction show that the annual percent change of total student enrollments in the fall of 1988 should belong to the decreased group (Class = 2). In the same manner, the annual percent change of undergraduate enrollments in the fall of 1988 should also belong to the decreased group (Tables 83 and 84). However, in the same computer printout, the results of using Box's method to test violations of the assumptions (the variables in each group are from multi-variate normal distribution and the covariance matrices for all groups are equal) indicate that the models may not be constructed as well as they should be. The probable cause of this is the fact that some covariance matrices are singular for the decreased group where a few cases (six cases for undergraduate and five cases for graduate enrollments) are included in the analysis. Even though the results of classification are highly accurate (88%) for both undergraduate and total student enrollments, one must still be cautious when using these models.

TABLE 12

GROUP MEMBERSHIPS FOR DISCRIMINANT ANALYSIS

Group 1: Greater Than 2.5%
Group 2: Less Than -2.5%
Group 0: Between -2.5% and +2.5%

YEAR	OSU TOTAL ENROLLMENTS	ANNUAL % CHANGE	GROUP MEMBERSHIP	OSU UNDERGRADUATE ENROLLMENTS	ANNUAL % CHANGE	GROUP MEMBERSHIP
1961	11301			9608		
1962	11795	4.37%	1	10006	4.14%	1
1963	11961	1.41%	0	10107	1.01%	0
1964	13214	10.48%	1	11065	9.48%	1
1965	15079	14.11%	1	12877	16.38%	1
1966	16010	6.17%	1	13596	5.58%	1
1967	16546	3.35%	1	14120	3.85%	1
1968	16841	1.78%	0	14366	1.74%	0
1969	17492	3.87%	1	14763	2.76%	1
1970	18444	5.44%	1	15395	4.28%	1
1971	18655	1.14%	0	15472	0.50%	0
1972	18080	-3.08%	2	14889	-3.77%	2
1973	18560	2.65%	1	15065	1.18%	0
1974	19280	3.88%	1	15631	3.76%	1
1975	20490	6.28%	1	16599	6.19%	1
1976	21129	3.12%	1	17313	4.30%	1
1977	21904	3.67%	1	18015	4.05%	1
1978	22287	1.75%	0	18521	2.81%	1
1979	22003	-1.27%	0	18218	-1.64%	0
1980	22490	2.21%	0	18602	2.11%	0
1981	22709	0.97%	0	18916	1.69%	0
1982	23053	1.51%	0	19120	1.08%	0
1983	22366	-2.98%	2	18410	-3.71%	2
1984	21449	-4.10%	2	17779	-3.43%	2
1985	20901	-2.55%	2	17240	-3.03%	2
1986	20634	-1.28%	0	16845	-2.29%	2
1987	20116	-2.51%	2	16115	-4.33%	2

TABLE 13

SUMMARY RESULTS OF DISCRIMINANT ANALYSIS FOR TOTAL ENROLLMENT

STEP	ACTION ENTERED	ACTION REMOVED	VARS IN	WILKS' LAMBDA	SIG.	LABEL
1	UNEMPLY		1	.67801	.0139	OK UNEMPLOYMENT RATES
2	PINCOME		2	.43817	.0014	OK PER CAPITA INCOMES
3	OILRIG		3	.43504	.0078	OK DRILLING RIG ACTIVITIES
4	USGNP		4	.35085	.0062	US GROSS NATIONAL PRODUCTS
5	PINDEX		5	.25119	.0022	US PRICE INDICES
6	COMPFIG		6	.18993	.0014	OK OTHER INSTI ENROLLMENTS
7	TUITION		7	.14848	.0012	OSU TUITION
8	FINAID		8	.12622	.0019	OSU STUDENT AIDS
9	HIGHSCH		9	.10635	.0028	OK HIGH SCHOOL GRADUATES
10		PINDEX	8	.11999	.0014	US PRICE INDICES

CANONICAL DISCRIMINANT FUNCTIONS EVALUATED AT GROUP MEANS

GROUP	FUNC 1	FUNC 2
0	0.32479	-0.88568
1	1.40657	0.63492
2	-3.67907	0.37740

CLASSIFICATION FUNCTION COEFFICIENTS
(FISHER'S LINEAR DISCRIMINANT FUNCTIONS)

STATUS =	0	1	2
UNEMPLY	172.8660	176.6496	169.8190
PINCOME	-215.3253	-219.1924	-204.9525
OILRIG	1.734981	1.761963	1.683103
USGNP	2.056651	2.098354	1.974365
COMPFIG	-0.2409184E-01	-0.2453851E-01	-0.2416861E-01
TUITION	0.8492330	0.7469233	2.145388
FINAID	-0.1460926E-04	-0.1570595E-04	-0.1906831E-04
HIGHSCH	0.2911540E-01	0.2940207E-01	0.3116442E-01
(CONSTANT)	-2213.503	-2294.823	-2152.654

TEST OF EQUALITY OF GROUP COVARIANCE MATRICES USING BOX'S M

THE RANKS AND NATURAL LOGARITHMS OF DETERMINANTS PRINTED ARE THOSE OF THE GROUP COVARIANCE MATRICES.

GROUP LABEL	RANK	LOG DETERMINANT
0	8	68.561434
1	8	64.113288
2	< 5	(TOO FEW CASES TO BE NON-SINGULAR)
POOLED WITHIN-GROUPS COVARIANCE MATRIX	8	79.335138

SINCE SOME COVARIANCE MATRICES ARE SINGULAR, THE USUAL PROCEDURE WILL NOT WORK. THE NON-SINGULAR GROUPS WILL BE TESTED AGAINST THEIR OWN POOLED WITHIN-GROUPS COVARIANCE MATRIX. THE LOG OF ITS DETERMINANT IS 80.940504

BOX'S M	APPROXIMATE F	DEGREES OF FREEDOM		SIGNIFICANCE
267.30	3.6365	36	988.4	0.0000

CANONICAL DISCRIMINANT FUNCTIONS

FUNCTION	EIGENVALUE	PERCENT OF VARIANCE	CUMULATIVE PERCENT	CANONICAL CORRELATION	:	AFTER FUNCTION	WILKS' LAMBDA	CHI-SQUARED	D.F.	SIGNIFICANCE
					:	0	0.1199874	39.227	16	0.0010
1*	4.10863	86.68	86.68	0.8968015	:	1	0.6129716	9.0546	7	0.2488
2*	0.63140	13.32	100.00	0.6221161	:					

* MARKS THE 2 CANONICAL DISCRIMINANT FUNCTIONS REMAINING IN THE ANALYSIS.

TABLE 14

SUMMARY RESULTS OF CLASSIFICATION FOR TOTAL ENROLLMENT

CASE SEQNUM	MIS VAL	SEL	ACTUAL GROUP	HIGHEST PROBABILITY GROUP	P(D/G)	P(G/D)	2ND HIGHEST GROUP	P(G/D)	DISCRIMINANT SCORES...	
1			0	0	0.5706	0.5201	1	0.4797	0.4248	0.0689
2			1	1	0.5853	0.7524	0	0.2476	1.9749	-0.2300
3			1	1	0.8275	0.9566	0	0.0434	1.7875	1.1183
4			1	1	0.3634	0.9225	0	0.0773	0.4151	1.6555
5			1	1	0.7592	0.9116	0	0.0884	2.1192	0.4275
6			0 **	1	0.7006	0.5957	0	0.4042	0.6996	0.1747
7			1	1	0.8113	0.8499	0	0.1501	1.8931	0.2089
8			1	1	0.7951	0.9124	0	0.0876	2.0635	0.4710
9			0	0	0.3284	0.6376	1	0.3531	-0.4114	0.3124
10			2	2	0.1780	0.7733	0	0.2053	-1.8272	0.2282
11			1	1	0.3246	0.7898	0	0.2084	0.0212	1.2104
12			1	1	0.6866	0.5840	0	0.4160	1.2406	-0.2163
13			1	1	0.9577	0.9154	0	0.0846	1.4129	0.9290
14			1	1	0.3168	0.9910	0	0.0090	2.6002	1.5700
15			1 **	0	0.6614	0.7246	1	0.2741	-0.0560	-0.1600
16			0	0	0.5980	0.6656	1	0.3344	1.3364	-0.9144
17			0 **	1	0.3282	0.6333	0	0.3667	2.1205	-0.6759
18			0	0	0.3275	0.9881	1	0.0119	0.2263	-2.4766
19			0	0	0.5285	0.9566	1	0.0342	-0.7964	-1.1218
20			0	0	0.5655	0.9660	1	0.0340	0.5485	-2.0297
21			2	2	0.1394	0.9996	0	0.0004	-4.0826	-1.5662
22			2	2	0.2755	1.0000	0	0.0000	-4.3864	1.8188
23			2	2	0.2548	1.0000	0	0.0000	-4.6958	1.6816
24			0	0	0.1424	0.9842	2	0.0120	-1.2252	-2.2088
25			2	2	0.7779	0.9990	0	0.0010	-3.4034	-0.2755

CLASSIFICATION RESULTS -

ACTUAL GROUP		NO. OF CASES	PREDICTED GROUP MEMBERSHIP 0	1	2
GROUP	0	9	7 77.8%	2 22.2%	0 0.0%
GROUP	1	11	1 9.1%	10 90.9%	0 0.0%
GROUP	2	5	0 0.0%	0 0.0%	5 100.0%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 88.00%

CHAPTER V

RESEARCH FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Research Findings

Enrollment forecast models for Oklahoma State University were developed using an integrated forecast system which included four time series analyses (simple exponential smoothing, Brown's double exponential smoothing, Holt's two parameter exponential smoothing, and Box-Jenkins methodology), multiple regression analysis, and multiple discriminant analysis. These forecast models are used to assist the University in planning effectively for future personnel, program, and budget needs.

The results of this empirical study have demonstrated that the integrated forecast system appears to accomplish the purpose of the study. These concepts are briefly reviewed as follows: The first purpose of the study was to use time series analysis to construct the best enrollment forecast models for various categories - freshman, undergraduate, graduate, male, female, and total enrollments - and the conducting of two-year ahead forecasts. As shown in Tables 3-5, and 11, and Figures 2-7, the best models of time series methods appear to be relatively accurate (MAPE - between 2.35 and 2.59). The best models of freshman enrollments (MAPE = 7.99) and graduate enrollments (MAPE = 3.47) are not as accurate as they should be, in part, because the assumption of time series analysis may be violated, e.g. freshman enrollments of this year do not depend upon those of last year; in part, because the enrollment trend behaves as a quadratic instead of a linear form. Therefore, other forecasting techniques such as ratio method, multiple regression analysis, and triple exponential smoothing method are recommended for these categories. In addition to accuracy, time series methods also present two promising advantages - minimal data requirements and easy computations.

The results of time series methods indicate that Oklahoma State University will face a slight decline in student enrollments over the next two years (1988-89). Approximate changes in figures are: (1) total enrollments decreasing by 380 each year, (2) male and female enrollments decreasing by 316 and 47, respectively, each year, and (3) undergraduate enrollments decreasing by 617 and graduate enrollments increasing by 56 (see Tables 3-5).

One of the striking findings, based upon the different models, is that the sums of the changes in the above cited male and female forecast values are almost equal to the changes in total enrollment values. This finding may serve as an indicator of the consistency and accuracy of time series methods among these categories. However, the fact that changes in undergraduate and graduate forecast values are not equal to the changes in total enrollments may be due to the questionable accuracy of the graduate enrollment forecast. The sophisticated Box-Jenkins methodology appears to have a systematic pattern of forecast errors. More data points are definitely required for this methodology. All above time series forecasts are based upon the assumption that the historical enrollment patterns of undergraduate, graduate, male, female, and total enrollments will continue into future years 1988-89.

A second purpose of the study was to: (1) develop a causal model-regression equation which explains the important factors impacting on Oklahoma State University student enrollments and predicts a one-year projected enrollment; and (2) to derive the discriminant functions that distinguish the three groups of the annual percent enrollment changes associated with the variables selected and predict a one-year projected enrollment.

First, the results of the study support the fact that the regression model appears to fit the data well. The empirical findings are: (1) The four important assumptions of regression analysis are met. These are the linear relationships between the dependent variables and the independent variables, the constant variance over the entire range of observations, the residuals being independent of one another, and the plot of residuals seems to be a normal distribution with a zero mean. (2) The most important variables - U.S. Gross National Products, Oklahoma high school graduates, Oklahoma unemployment rates, Oklahoma oil drilling rig activities, and OSU tuition are retained in the model. The estimated coefficients for these selected variables are statistically significant, and the signs of coefficients are appropriate as one would expect. The coefficients of determinant (R squares are greater than .95) also show that the large proportions of variations in enrollments are explained by these selected variables. (3) Within the institution, the model structures of multiple regression equations between undergraduate enrollments and total enrollments are identical. In addition, the model structures for OSU total enrollments and Oklahoma University (OU) total enrollments shows an external consistency.

Second, the results of the study also support the fact that the regression model provides the information on how important variables affect OSU total enrollments. The empirical results are: (1) an increase of 34 undergraduate enrollments and 45 total student enrollments is associated with an increase of 100 Oklahoma high school graduates, (2) an increase of 1% Oklahoma unemployment rate causes an increase of 263 undergraduate enrollments and 376 total student enrollments, (3) an increase of three undergraduate enrollments and three total student enrollments is tied to an increase of one oil drilling rig count in Oklahoma, (4) an increment of four undergraduate enrollments and five total student enrollments is related to that of one billion dollar U.S. Gross National Products, and (5) an increase of $1.00 per average student credit hour of three divisions - low, upper, and graduate level - in OSU in-state tuition and fees induces a decrease of 54 undergraduate enrollments and 62 total student enrollments.

Third, the results of regression estimation are as accurate (MAPE = 2.48) as those of time series methods. Based upon the results of regression analysis, it is suggested that Oklahoma State University should experience a slight decrease in undergraduate enrollments in the fall of 1988 although total student enrollments should hold steady. This prediction is based upon the assumption that all independent variables not considered or selected in this study would remain fairly constant over the fall of 1988, and changes in the selected and forecasted variables could sensitively affect undergraduate and total student enrollments. One must be cautious when interpreting the predicted results of the regression models because their projections are based upon the fixed values of OSU tuition, and the forecasted values of Oklahoma high school graduates, unemployment rates, and oil drilling rig activities, and U.S. Gross National Products.

With respect to discriminant analysis, the empirical findings show that: (1) The backward elimination procedure and Wilk's lambda selection rules are being utilized to produce two discriminant functions that contain the best set of discriminant variables - U.S. Gross National Products, U.S. Consumer Price Indices, Oklahoma high school graduates, Oklahoma unemployment rates, Oklahoma oil drilling rig activities, Oklahoma per Capita incomes, OSU student aids, and OSU tuition and fees. (2) The value of Wilk's lambda is statistically significant, and thus, two discriminant functions are appropriate to classify the annual percent enrollment change to be the increased group, the decreased group, or the unchanged group. (3) The discriminant functions developed for both total student enrollments and undergraduate enrollments are almost identical. (4) The high percentage (88%) of the predicted group memberships are correct for both undergraduate enrollments and total enrollments over the past 25 years.

Thus, the results of discriminant analysis reveal that in the fall of 1988, OSU undergraduate and total enrollments should belong to the decreased group, instead of the increased or unchanged group. However, these discriminant functions may not be constructed as well as they should be because the assumptions of multivariate normality and covariance matrix equality may be violated. Even though the results of classification show high accuracy, one must be cautious when using these models to carry out the forecasts.

It is concluded that employing this integrated forecast system - time series methods (simple exponential smoothing, Brown's double exponential smoothing, Holt's two parameter exponential smoothing, and Box-Jenkins ARIMA methodology), multiple regression analysis, and multiple discriminant analysis for enrollment forecasting could be applied to other institutions of higher education in the State of Oklahoma, and this integrated forecast system could be further modified and replicated in other states. However, one should be aware not only of the strengths of the models mentioned as above, but also the weaknesses of these models. For example, the drawback of the time series models is their inability to detect turning points and their failure to explain the relationship between causes and effects. In constructing regression equations and discriminant functions for forecasting, one must do two things: (1) select independent variables for which the historical data are available and future values can be obtained, and (2) reconstruct and reevaluate the models when new academic years arrive.

Conclusions

This study was designed to develop an integrated enrollment forecast system: time series analyses, multiple regression analysis, and discriminant analysis for Oklahoma State University to plan effectively in the areas of personnel, program, and budget needs.

The calculations of time series methods were based upon the assumption that the historical enrollment patterns will continue into the future and require only the historical enrollment data to carry out the forecasts. The backward elimination procedure of regression analysis and discriminant analysis are based upon the linear relationship between the dependent variable - enrollments and nine other independent variables - U.S. Gross National Products, U.S. consumer price indices, Oklahoma unemployment rates, Oklahoma per capita incomes, Oklahoma oil drilling rig activities, Oklahoma high school graduates, Oklahoma other institution enrollments, and OSU student aids and tuition and fees.

The results of the empirical study indicate that time series methods, particularly Holt's two parameter exponential smoothing, performs the forecasts with relative accuracy. Forecasts using Holt's two parameter exponential smoothing show that Oklahoma State University will continue to face a slight decrease in male, female, undergraduate, and total student enrollments and an increase in graduate enrollments over the fall of 1988 and the fall of 1989. The regression models for undergraduate and total student enrollments are workable. They provide information on how demography (Oklahoma high school graduates), economic indicators (U.S. Gross National Products, Oklahoma unemployment rates and oil drilling rig activities), and public policies (OSU tuition and fees and financial aids) affect student enrollments. Discriminant analyses might not work as well as they should because only a few cases were classified as the decreased group, e.g., the assumptions of multivariate normality and covariance matrix equality may be violated. Another finding in this study indicates that the selection of the appropriate forecasting techniques along with the important variables is crucial in the development of student enrollment forecasting models.

The integrated forecast system can not help one to know what exactly will happen in the future, but it works to help one to reduce the range of uncertainty surrounding higher education decisions. Hence, in search of better forecasting techniques, more important variables, and more data points for college and university enrollment forecasts, the process of integrated forecast systems must have an ongoing, looping, and futuristic orientation. It should not be limited to quantifiable approaches only. The knowledge and wisdom of the decision makers should be blended into the system.

In summary, this integrated forecast system would allow institutions of higher education to develop more precise possibilities as to what the near future enrollments will be. This would be a substantial help to the decision makers when charting future directions for their colleges and universities.

Recommendations

There are three areas that seem to provide promise for follow-up research. First, to make the regression model operational, one could use the prior year values instead of the future year values, e.g., estimates of total student enrollments may be made based on the lagged independent variables and possibly the lagged dependent variable itself. Reliance on lagged variables and time series regression analysis is not only convenient in forecasting but also has justification in theory: the United States economy rarely changes its patterns drastically within one or two years unless wars, strikes, or political violence occur. Second, in addition to the breakdown of the enrollments into the categories of male, female, undergraduate, and graduate, enrollments should be analyzed by academic colleges to reflect the relationship between program offerings and prospective employment opportunities and further analyzed by simulation procedure on how to maximize total student enrollments by means of educational policies - both financial aids and tuition and fees, given that other selected variables remaining constant. The information obtained through this analytical procedure should be utilized in formulating policies for colleges and universities. Third, the integrated forecast system should be constructed not only on the basis of the headcount, but also on the student credit hours, particularly using the weighted full-time equivalent student credit hours so that the results of the forecasts could serve as the justification for budgeting requests where the unit costs are required.

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APPENDIXES

APPENDIX A

SIMPLE EXPONENTIAL SMOOTHING FORECASTS

TABLE 15

SIMPLE EXPONENTIAL SMOOTHING FORECASTS FOR TOTAL ENROLLMENTS WITH ALPHA = 1.0

YEAR	TOTAL ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962	11795	.		
1963	11961	11795.00	-166.00	1.39
1964	13214	11961.00	-1253.00	9.48
1965	15079	13214.00	-1865.00	12.37
1966	16010	15079.00	-931.00	5.82
1967	16546	16010.00	-536.00	3.24
1968	16841	16546.00	-295.00	1.75
1969	17492	16841.00	-651.00	3.72
1970	18444	17492.00	-952.00	5.16
1971	18655	18444.00	-211.00	1.13
1972	18080	18655.00	575.00	3.18
1973	18560	18080.00	-480.00	2.59
1974	19280	18560.00	-720.00	3.73
1975	20490	19280.00	-1210.00	5.91
1976	21129	20490.00	-639.00	3.02
1977	21904	21129.00	-775.00	3.54
1978	22287	21904.00	-383.00	1.72
1979	22003	22287.00	284.00	1.29
1980	22490	22003.00	-487.00	2.17
1981	22709	22490.00	-219.00	0.96
1982	23053	22709.00	-344.00	1.49
1983	22366	23053.00	687.00	3.07
1984	21449	22366.00	917.00	4.28
1985	20901	21449.00	548.00	2.62
1986	20634	20901.00	267.00	1.29
1987	20116	20634.00	518.00	2.58
1988		20116.00		

ALPH = 1.0 MAPE = 3.37 MSE = 531829.00

TABLE 16

SIMPLE EXPONENTIAL SMOOTHING FORECASTS FOR TOTAL ENROLLMENTS WITH ALPHA = 0.9

YEAR	TOTAL ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962	11795			
1963	11961	11795.00	-166.00	1.39
1964	13214	11944.40	-1269.60	9.61
1965	15079	13087.04	-1991.96	13.21
1966	16010	14879.80	-1130.20	7.06
1967	16546	15896.98	-649.02	3.92
1968	16841	16481.09	-359.91	2.14
1969	17492	16805.01	-686.99	3.93
1970	18444	17423.30	-1020.70	5.53
1971	18655	18341.93	-313.07	1.68
1972	18080	18623.69	543.69	3.01
1973	18560	18134.36	-425.64	2.29
1974	19280	18517.43	-762.57	3.96
1975	20490	19203.74	-1286.26	6.28
1976	21129	20361.37	-767.63	3.63
1977	21904	21052.23	-851.77	3.89
1978	22287	21818.82	-468.18	2.10
1979	22003	22240.18	237.18	1.08
1980	22490	22026.71	-463.29	2.06
1981	22709	22443.67	-265.33	1.17
1982	23053	22682.46	-370.54	1.61
1983	22366	23015.94	649.94	2.91
1984	21449	22430.99	981.99	4.58
1985	20901	21547.20	646.20	3.09
1986	20634	20965.62	331.62	1.61
1987	20116	20667.16	551.16	2.74
1988		20171.11		

ALPH = 0.9 MAPE = 3.63 MSE = 615023.06

TABLE 17

SIMPLE EXPONENTIAL SMOOTHING FORECASTS FOR TOTAL ENROLLMENTS WITH ALPHA = 0.7

YEAR	TOTAL ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962	11795			
1963	11961	11795.00	-166.00	1.39
1964	13214	11911.20	-1302.80	9.86
1965	15079	12823.16	-2255.84	14.96
1966	16010	14402.24	-1607.76	10.04
1967	16546	15527.67	-1018.33	6.15
1968	16841	16240.50	-600.50	3.57
1969	17492	16660.84	-831.16	4.75
1970	18444	17242.65	-1201.35	6.51
1971	18655	18083.59	-571.41	3.06
1972	18080	18483.57	403.57	2.23
1973	18560	18201.07	-358.93	1.93
1974	19280	18452.32	-827.68	4.29
1975	20490	19031.69	-1458.31	7.12
1976	21129	20052.50	-1076.50	5.09
1977	21904	20806.05	-1097.95	5.01
1978	22287	21574.61	-712.39	3.20
1979	22003	22073.28	70.28	0.32
1980	22490	22024.08	-465.92	2.07
1981	22709	22350.22	-358.78	1.58
1982	23053	22601.36	-451.64	1.96
1983	22366	22917.50	551.50	2.47
1984	21449	22531.45	1082.45	5.05
1985	20901	21773.73	872.73	4.18
1986	20634	21162.82	528.82	2.56
1987	20116	20792.64	676.64	3.36
1988		20318.99		

ALPH = 0.7 MAPE = 4.34 MSE = 875447.37

TABLE 18

SIMPLE EXPONENTIAL SMOOTHING FORECASTS FOR UNDERGRADUATE ENROLLMENTS WITH ALPHA = 1.0

YEAR	UNDERGRADUATE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962	10006			
1963	10107	10006.00	-101.00	1.00
1964	11065	10107.00	-958.00	8.66
1965	12877	11065.00	-1812.00	14.07
1966	13596	12877.00	-719.00	5.29
1967	14120	13596.00	-524.00	3.71
1968	14366	14120.00	-246.00	1.71
1969	14763	14366.00	-397.00	2.69
1970	15395	14763.00	-632.00	4.11
1971	15472	15395.00	-77.00	0.50
1972	14889	15472.00	583.00	3.92
1973	15065	14889.00	-176.00	1.17
1974	15631	15065.00	-566.00	3.62
1975	16599	15631.00	-968.00	5.83
1976	17313	16599.00	-714.00	4.12
1977	18015	17313.00	-702.00	3.90
1978	18521	18015.00	-506.00	2.73
1979	18218	18521.00	303.00	1.66
1980	18602	18218.00	-384.00	2.06
1981	18916	18602.00	-314.00	1.66
1982	19120	18916.00	-204.00	1.07
1983	18410	19120.00	710.00	3.86
1984	17779	18410.00	631.00	3.55
1985	17240	17779.00	539.00	3.13
1986	16845	17240.00	395.00	2.34
1987	16115	16845.00	730.00	4.53
1988		16115.00		

ALPH = 1.0 MAPE = 3.50 MSE = 414399.56

TABLE 19

SIMPLE EXPONENTIAL SMOOTHING FORECASTS FOR UNDERGRADUATE ENROLLMENTS WITH ALPHA = 0.9

YEAR	UNDERGRADUATE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962	10006			
1963	10107	10006.00	-101.00	1.00
1964	11065	10096.89	-968.11	8.75
1965	12877	10968.18	-1908.82	14.82
1966	13596	12686.11	-909.89	6.69
1967	14120	13505.01	-614.99	4.36
1968	14366	14058.50	-307.50	2.14
1969	14763	14335.25	-427.75	2.90
1970	15395	14720.22	-674.78	4.38
1971	15472	15327.52	-144.48	0.93
1972	14889	15457.55	568.55	3.82
1973	15065	14945.85	-119.15	0.79
1974	15631	15053.08	-577.92	3.70
1975	16599	15573.20	-1025.80	6.18
1976	17313	16496.42	-816.58	4.72
1977	18015	17231.34	-783.66	4.35
1978	18521	17936.63	-584.37	3.16
1979	18218	18462.56	244.56	1.34
1980	18602	18242.45	-359.55	1.93
1981	18916	18566.04	-349.96	1.85
1982	19120	18881.00	-239.00	1.25
1983	18410	19096.10	686.10	3.73
1984	17779	18478.61	699.61	3.94
1985	17240	17848.96	608.96	3.53
1986	16845	17300.89	455.89	2.71
1987	16115	16890.58	775.58	4.81
1988		16192.55		

ALPH = 0.9 MAPE = 3.76 MSE = 477154.00

TABLE 20

SIMPLE EXPONENTIAL SMOOTHING FORECASTS FOR UNDERGRADUATE ENROLLMENTS WITH ALPHA = 0.8

YEAR	UNDERGRADUATE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962	10006			
1963	10107	10006.00	-101.00	1.00
1964	11065	10086.80	-978.20	8.84
1965	12877	10869.36	-2007.64	15.59
1966	13596	12475.47	-1120.53	8.24
1967	14120	13371.89	-748.11	5.30
1968	14366	13970.37	-395.62	2.75
1969	14763	14286.87	-476.13	3.23
1970	15395	14667.77	-727.23	4.72
1971	15472	15249.55	-222.45	1.44
1972	14889	15427.51	538.51	3.62
1973	15065	14996.70	-68.30	0.45
1974	15631	15051.34	-579.66	3.71
1975	16599	15515.06	-1083.94	6.53
1976	17313	16382.21	-930.79	5.38
1977	18015	17126.84	-888.16	4.93
1978	18521	17837.36	-683.64	3.69
1979	18218	18384.27	166.27	0.91
1980	18602	18251.25	-350.75	1.89
1981	18916	18531.85	-384.15	2.03
1982	19120	18839.16	-280.84	1.47
1983	18410	19063.83	653.83	3.55
1984	17779	18540.76	761.76	4.28
1985	17240	17931.35	691.35	4.01
1986	16845	17378.27	533.27	3.17
1987	16115	16951.65	836.65	5.19
1988		16282.32		

ALPH = 0.8 MAPE = 4.07 MSE = 559610.50

TABLE 21

SIMPLE EXPONENTIAL SMOOTHING FORECASTS FOR MALE ENROLLMENTS WITH ALPHA = 1.0

YEAR	MALE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962	8236			
1963	8268	8236.00	-32.00	0.39
1964	9072	8268.00	-804.00	8.86
1965	10123	9072.00	-1051.00	10.38
1966	10376	10123.00	-253.00	2.44
1967	10658	10376.00	-282.00	2.65
1968	10799	10658.00	-141.00	1.31
1969	11279	10799.00	-480.00	4.26
1970	11860	11279.00	-581.00	4.90
1971	11899	11860.00	-39.00	0.33
1972	11397	11899.00	502.00	4.40
1973	11619	11397.00	-222.00	1.91
1974	11799	11619.00	-180.00	1.53
1975	12435	11799.00	-636.00	5.11
1976	12677	12435.00	-242.00	1.91
1977	12966	12677.00	-289.00	2.23
1978	13067	12966.00	-101.00	0.77
1979	12649	13067.00	418.00	3.30
1980	12948	12649.00	-299.00	2.31
1981	13144	12948.00	-196.00	1.49
1982	13476	13144.00	-332.00	2.46
1983	12979	13476.00	497.00	3.83
1984	12382	12979.00	597.00	4.82
1985	12029	12382.00	353.00	2.93
1986	11751	12029.00	278.00	2.37
1987	11280	11751.00	471.00	4.18
1988		11280.00		

ALPH = 1.0 MAPE = 3.12 MSE = 185204.75

TABLE 22

SIMPLE EXPONENTIAL SMOOTHING FORECASTS FOR MALE ENROLLMENTS WITH ALPHA = 0.9

YEAR	MALE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962	8236			
1963	8268	8236.00	-32.00	0.39
1964	9072	8264.80	-807.20	8.90
1965	10123	8991.28	-1131.72	11.18
1966	10376	10009.82	-366.18	3.53
1967	10658	10339.37	-318.62	2.99
1968	10799	10626.13	-172.87	1.60
1969	11279	10781.71	-497.29	4.41
1970	11860	11229.27	-630.73	5.32
1971	11899	11796.92	-102.08	0.86
1972	11397	11888.79	491.79	4.32
1973	11619	11446.18	-172.82	1.49
1974	11799	11601.71	-197.29	1.67
1975	12435	11779.27	-655.73	5.27
1976	12677	12369.42	-307.58	2.43
1977	12966	12646.24	-319.76	2.47
1978	13067	12934.02	-132.98	1.02
1979	12649	13053.70	404.70	3.20
1980	12948	12689.46	-258.54	2.00
1981	13144	12922.14	-221.86	1.69
1982	13476	13121.81	-354.19	2.63
1983	12979	13440.58	461.58	3.56
1984	12382	13025.16	643.16	5.19
1985	12029	12446.31	417.31	3.47
1986	11751	12070.73	319.73	2.72
1987	11280	11782.97	502.97	4.46
1988		11330.29		

ALPH = 0.9 MAPE = 3.34 MSE = 206574.00

TABLE 23

SIMPLE EXPONENTIAL SMOOTHING FORECASTS FOR MALE ENROLLMENTS WITH ALPHA = 0.8

YEAR	MALE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962	8236			
1963	8268	8236.00	-32.00	0.39
1964	9072	8261.59	-810.41	8.93
1965	10123	8909.92	-1213.08	11.98
1966	10376	9880.38	-495.62	4.78
1967	10658	10276.87	-381.13	3.58
1968	10799	10581.77	-217.23	2.01
1969	11279	10755.55	-523.45	4.64
1970	11860	11174.30	-685.70	5.78
1971	11899	11722.86	-176.14	1.48
1972	11397	11863.77	466.77	4.10
1973	11619	11490.35	-128.65	1.11
1974	11799	11593.27	-205.73	1.74
1975	12435	11757.85	-677.15	5.45
1976	12677	12299.57	-377.43	2.98
1977	12966	12601.51	-364.49	2.81
1978	13067	12893.10	-173.90	1.33
1979	12649	13032.21	383.21	3.03
1980	12948	12725.64	-222.36	1.72
1981	13144	12903.52	-240.48	1.83
1982	13476	13095.90	-380.10	2.82
1983	12979	13399.98	420.98	3.24
1984	12382	13063.19	681.19	5.50
1985	12029	12518.23	489.23	4.07
1986	11751	12126.84	375.84	3.20
1987	11280	11826.16	546.16	4.84
1988		11389.23		

ALPH = 0.8 MAPE = 3.59 MSE = 234700.56

TABLE 24

SIMPLE EXPONENTIAL SMOOTHING FORECASTS FOR FEMALE ENROLLMENTS WITH ALPHA = 1.0

YEAR	FEMALE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962	3559			
1963	3693	3559.00	-134.00	3.63
1964	4142	3693.00	-449.00	10.84
1965	4956	4142.00	-814.00	16.42
1966	5634	4956.00	-678.00	12.03
1967	5888	5634.00	-254.00	4.31
1968	6042	5888.00	-154.00	2.55
1969	6213	6042.00	-171.00	2.75
1970	6584	6213.00	-371.00	5.63
1971	6756	6584.00	-172.00	2.55
1972	6683	6756.00	73.00	1.09
1973	6941	6683.00	-258.00	3.72
1974	7482	6941.00	-541.00	7.23
1975	8055	7482.00	-573.00	7.11
1976	8452	8055.00	-397.00	4.70
1977	8995	8452.00	-543.00	6.04
1978	9220	8995.00	-225.00	2.44
1979	9354	9220.00	-134.00	1.43
1980	9542	9354.00	-188.00	1.97
1981	9685	9542.00	-143.00	1.48
1982	9577	9685.00	108.00	1.13
1983	9387	9577.00	190.00	2.02
1984	9067	9387.00	320.00	3.53
1985	8872	9067.00	195.00	2.20
1986	8883	8872.00	-11.00	0.12
1987	8836	8883.00	47.00	0.53
1988		8836.00		

ALPH = 1.0 MAPE = 4.13 MSE = 118722.62

TABLE 25

SIMPLE EXPONENTIAL SMOOTHING FORECASTS FOR FEMALE ENROLLMENTS WITH ALPHA = 0.9

YEAR	FEMALE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962	3559			
1963	3693	3559.00	-134.00	3.63
1964	4142	3679.60	-462.40	11.16
1965	4956	4095.76	-860.24	17.36
1966	5634	4869.97	-764.03	13.56
1967	5888	5557.59	-330.41	5.61
1968	6042	5854.96	-187.04	3.10
1969	6213	6023.29	-189.71	3.05
1970	6584	6194.02	-389.98	5.92
1971	6756	6545.00	-211.00	3.12
1972	6683	6734.89	51.89	0.78
1973	6941	6688.18	-252.82	3.64
1974	7482	6915.71	-566.29	7.57
1975	8055	7425.37	-629.63	7.82
1976	8452	7992.03	-459.97	5.44
1977	8995	8406.00	-589.00	6.55
1978	9220	8936.10	-283.90	3.08
1979	9354	9191.61	-162.39	1.74
1980	9542	9337.76	-204.24	2.14
1981	9685	9521.57	-163.43	1.69
1982	9577	9668.65	91.65	0.96
1983	9387	9586.16	199.16	2.12
1984	9067	9406.91	339.91	3.75
1985	8872	9100.99	228.99	2.58
1986	8883	8894.89	11.89	0.13
1987	8836	8884.18	48.18	0.55
1988		8840.81		

ALPH = 0.9 MAPE = 4.50 MSE = 141091.25

TABLE 26

SIMPLE EXPONENTIAL SMOOTHING FORECASTS FOR FEMALE ENROLLMENTS WITH ALPHA = 0.8

YEAR	FEMALE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962	3559			
1963	3693	3559.00	-134.00	3.63
1964	4142	3666.20	-475.80	11.49
1965	4956	4046.84	-909.16	18.34
1966	5634	4774.16	-859.84	15.26
1967	5888	5462.03	-425.97	7.23
1968	6042	5802.80	-239.20	3.96
1969	6213	5994.16	-218.84	3.52
1970	6584	6169.23	-414.77	6.30
1971	6756	6501.04	-254.96	3.77
1972	6683	6705.01	22.01	0.33
1973	6941	6687.40	-253.60	3.65
1974	7482	6890.28	-591.72	7.91
1975	8055	7363.65	-691.35	8.58
1976	8452	7916.73	-535.27	6.33
1977	8995	8344.95	-650.05	7.23
1978	9220	8864.98	-355.02	3.85
1979	9354	9148.99	-205.01	2.19
1980	9542	9312.99	-229.01	2.40
1981	9685	9496.20	-188.80	1.95
1982	9577	9647.23	70.23	0.73
1983	9387	9591.04	204.04	2.17
1984	9067	9427.80	360.80	3.98
1985	8872	9139.16	267.16	3.01
1986	8883	8925.43	42.43	0.48
1987	8836	8891.48	55.48	0.63
1988		8847.09		

ALPH = 0.8 MAPE = 4.96 MSE = 170960.31

TABLE 27

SIMPLE EXPONENTIAL SMOOTHING FORECASTS FOR GRADUATE ENROLLMENTS WITH ALPHA = 1.0

YEAR	GRADUATE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962	1502			
1963	1556	1502.00	-54.00	3.47
1964	1827	1556.00	-271.00	14.83
1965	1885	1827.00	-58.00	3.08
1966	2071	1885.00	-186.00	8.98
1967	2076	2071.00	-5.00	0.24
1968	2163	2076.00	-87.00	4.02
1969	2433	2163.00	-270.00	11.10
1970	2734	2433.00	-301.00	11.01
1971	2869	2734.00	-135.00	4.71
1972	2864	2869.00	5.00	0.17
1973	3087	2864.00	-223.00	7.22
1974	3252	3087.00	-165.00	5.07
1975	3355	3252.00	-103.00	3.07
1976	3242	3355.00	113.00	3.49
1977	3338	3242.00	-96.00	2.88
1978	3234	3338.00	104.00	3.22
1979	3289	3234.00	-55.00	1.67
1980	3433	3289.00	-144.00	4.19
1981	3372	3433.00	61.00	1.81
1982	3580	3372.00	-208.00	5.81
1983	3629	3580.00	-49.00	1.35
1984	3363	3629.00	266.00	7.91
1985	3376	3363.00	-13.00	0.39
1986	3507	3376.00	-131.00	3.74
1987	3625	3507.00	-118.00	3.26
1988		3625.00		

ALPH = 1.0 MAPE = 4.49 MSE = 23045.50

TABLE 28

SIMPLE EXPONENTIAL SMOOTHING FORECASTS FOR GRADUATE ENROLLMENTS WITH ALPHA = 0.9

YEAR	GRADUATE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962	1502			
1963	1556	1502.00	-54.00	3.47
1964	1827	1550.60	-276.40	15.13
1965	1885	1799.36	-85.64	4.54
1966	2071	1876.44	-194.56	9.39
1967	2076	2051.54	-24.46	1.18
1968	2163	2073.55	-89.45	4.14
1969	2433	2154.06	-278.94	11.47
1970	2734	2405.11	-328.89	12.03
1971	2869	2701.11	-167.89	5.85
1972	2864	2852.21	-11.79	0.41
1973	3087	2862.82	-224.18	7.26
1974	3252	3064.58	-187.42	5.76
1975	3355	3233.26	-121.74	3.63
1976	3242	3342.83	100.83	3.11
1977	3338	3252.08	-85.92	2.57
1978	3234	3329.41	95.41	2.95
1979	3289	3243.54	-45.46	1.38
1980	3433	3284.45	-148.55	4.33
1981	3372	3418.15	46.15	1.37
1982	3580	3376.61	-203.39	5.68
1983	3629	3559.66	-69.34	1.91
1984	3363	3622.07	259.07	7.70
1985	3376	3388.91	12.91	0.38
1986	3507	3377.29	-129.71	3.70
1987	3625	3494.03	-130.97	3.61
1988		3611.90		

ALPH = 0.9 MAPE = 4.73 MSE = 24921.41

TABLE 29

SIMPLE EXPONENTIAL SMOOTHING FORECASTS FOR GRADUATE ENROLLMENTS WITH ALPHA = 0.8

YEAR	GRADUATE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962	1502			
1963	1556	1502.00	-54.00	3.47
1964	1827	1545.20	-281.80	15.42
1965	1885	1770.64	-114.36	6.07
1966	2071	1862.13	-208.87	10.09
1967	2076	2029.23	-46.77	2.25
1968	2163	2066.64	-96.36	4.45
1969	2433	2143.73	-289.27	11.89
1970	2734	2375.15	-358.85	13.13
1971	2869	2662.23	-206.77	7.21
1972	2864	2827.65	-36.35	1.27
1973	3087	2856.73	-230.27	7.46
1974	3252	3040.95	-211.05	6.49
1975	3355	3209.79	-145.21	4.33
1976	3242	3325.96	83.96	2.59
1977	3338	3258.79	-79.21	2.37
1978	3234	3322.16	88.16	2.73
1979	3289	3251.63	-37.37	1.14
1980	3433	3281.53	-151.47	4.41
1981	3372	3402.71	30.71	0.91
1982	3580	3378.14	-201.86	5.64
1983	3629	3539.63	-89.37	2.46
1984	3363	3611.13	248.13	7.38
1985	3376	3412.62	36.63	1.08
1986	3507	3383.32	-123.68	3.53
1987	3625	3482.26	-142.74	3.94
1988		3596.45		

ALPH = 0.8 MAPE = 5.07 MSE = 27668.43

TABLE 30

SIMPLE EXPONENTIAL SMOOTHING FORECASTS FOR FRESHMAN ENROLLMENTS WITH ALPHA = 1.0

YEAR	FRESHMAN ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962	3115			
1963	2897	3115.00	218.00	7.53
1964	3680	2897.00	-783.00	21.28
1965	4658	3680.00	-978.00	21.00
1966	4490	4658.00	168.00	3.74
1967	4236	4490.00	254.00	6.00
1968	3929	4236.00	307.00	7.81
1969	4208	3929.00	-279.00	6.63
1970	4347	4208.00	-139.00	3.20
1971	4211	4347.00	136.00	3.23
1972	3608	4211.00	603.00	16.71
1973	4064	3608.00	-456.00	11.22
1974	4340	4064.00	-276.00	6.36
1975	5047	4340.00	-707.00	14.01
1976	5328	5047.00	-281.00	5.27
1977	5409	5328.00	-81.00	1.50
1978	5444	5409.00	-35.00	0.64
1979	5257	5444.00	187.00	3.56
1980	5499	5257.00	-242.00	4.40
1981	5326	5499.00	173.00	3.25
1982	5165	5326.00	161.00	3.12
1983	4672	5165.00	493.00	10.55
1984	4433	4672.00	239.00	5.39
1985	4471	4433.00	-38.00	0.85
1986	4560	4471.00	-89.00	1.95
1987	4177	4560.00	383.00	9.17
1988		4177.00		

ALPH = 1.0 MAPE = 6.86 MSE = 144602.56

TABLE 31

SIMPLE EXPONENTIAL SMOOTHING FORECASTS FOR FRESHMAN ENROLLMENTS WITH ALPHA = 0.9

YEAR	FRESHMAN ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962	3115			
1963	2897	3115.00	218.00	7.53
1964	3680	2918.80	-761.20	20.68
1965	4658	3603.88	-1054.12	22.63
1966	4490	4552.59	62.59	1.39
1967	4236	4496.26	260.26	6.14
1968	3929	4262.02	333.02	8.48
1969	4208	3962.30	-245.70	5.84
1970	4347	4183.43	-163.57	3.76
1971	4211	4330.64	119.64	2.84
1972	3608	4222.96	614.96	17.04
1973	4064	3669.50	-394.50	9.71
1974	4340	4024.55	-315.45	7.27
1975	5047	4308.45	-738.55	14.63
1976	5328	4973.14	-354.86	6.66
1977	5409	5292.51	-116.49	2.15
1978	5444	5397.35	-46.65	0.86
1979	5257	5439.33	182.33	3.47
1980	5499	5275.23	-223.77	4.07
1981	5326	5476.62	150.62	2.83
1982	5165	5341.06	176.06	3.41
1983	4672	5182.60	510.60	10.93
1984	4433	4723.06	290.06	6.54
1985	4471	4462.00	-9.00	0.20
1986	4560	4470.10	-89.90	1.97
1987	4177	4551.01	374.01	8.95
1988		4214.40		

ALPH = 0.9 MAPE = 6.92 MSE = 152785.62

TABLE 32

SIMPLE EXPONENTIAL SMOOTHING FORECASTS FOR FRESHMAN ENROLLMENTS WITH ALPHA = 0.8

YEAR	FRESHMAN ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962	3115			
1963	2897	3115.00	218.00	7.53
1964	3680	2940.60	-739.40	20.09
1965	4658	3532.12	-1125.88	24.17
1966	4490	4432.82	-57.18	1.27
1967	4236	4478.56	242.56	5.73
1968	3929	4284.51	355.51	9.05
1969	4208	4000.10	-207.90	4.94
1970	4347	4166.42	-180.58	4.15
1971	4211	4310.88	99.88	2.37
1972	3608	4230.97	622.97	17.27
1973	4064	3732.59	-331.41	8.15
1974	4340	3997.72	-342.28	7.89
1975	5047	4271.54	-775.46	15.36
1976	5328	4891.91	-436.09	8.18
1977	5409	5240.78	-168.22	3.11
1978	5444	5375.35	-68.65	1.26
1979	5257	5430.27	173.27	3.30
1980	5499	5291.65	-207.35	3.77
1981	5326	5457.53	131.53	2.47
1982	5165	5352.30	187.30	3.63
1983	4672	5202.46	530.46	11.35
1984	4433	4778.09	345.09	7.78
1985	4471	4502.02	31.02	0.69
1986	4560	4477.20	-82.80	1.82
1987	4177	4543.44	366.44	8.77
1988		4250.29		

ALPH = 0.8 MAPE = 7.08 MSE = 163219.19

APPENDIX B

BROWN'S DOUBLE EXPONENTIAL SMOOTHING FORECASTS

TABLE 33

BROWN'S DOUBLE EXPONENTIAL SMOOTHING FORECASTS
FOR TOTAL ENROLLMENTS WITH ALPHA = 0.7

YEAR	TOTAL ENROLLMENT	FORECAST	A COEFFICIENT	B COEFFICIENT	ERROR	ABSOLUTE % ERROR
1962	11795					
1963	11961	11795.01	11795.00	0.01	-165.99	1.39
1964	13214	12027.42	11946.06	81.36	-1186.58	8.98
1965	15079	13769.99	13107.21	662.79	-1309.01	8.68
1966	16010	16265.39	14961.19	1304.21	255.39	1.60
1967	16546	17212.05	16032.98	1179.07	666.05	4.03
1968	16841	17458.66	16605.95	852.72	617.66	3.67
1969	17492	17446.66	16896.59	550.07	-45.34	0.26
1970	18444	18060.21	17487.92	572.30	-383.79	2.08
1971	18655	19169.80	18409.45	760.35	514.80	2.76
1972	18080	19209.43	18701.33	508.10	1129.43	6.25
1973	18560	18136.34	18181.65	-45.31	-423.66	2.28
1974	19280	18684.16	18521.87	162.29	-595.84	3.09
1975	20490	19680.64	19226.37	454.26	-809.36	3.95
1976	21129	21268.01	20417.16	850.86	139.01	0.66
1977	21904	21924.25	21141.51	782.74	20.25	0.09
1978	22287	22678.64	21905.82	772.83	391.64	1.76
1979	22003	22903.18	22322.25	580.93	900.18	4.09
1980	22490	22223.86	22084.02	139.85	-266.14	1.18
1981	22709	22736.30	22466.04	270.26	27.30	0.12
1982	23053	22968.34	22711.45	256.89	-84.66	0.37
1983	22366	23343.75	23045.38	298.37	977.75	4.37
1984	21449	22273.29	22454.00	-180.71	824.29	3.84
1985	20901	20938.57	21523.18	-584.61	37.57	0.18
1986	20634	20301.37	20904.38	-603.01	-332.63	1.61
1987	20116	20164.03	20604.06	-440.02	48.03	0.24
1988		19656.76	20120.32	-463.56		

ALPH = 0.7 MAPE = 2.60 MSE = 374266.31

TABLE 34

BROWN'S DOUBLE EXPONENTIAL SMOOTHING FORECASTS
FOR TOTAL ENROLLMENTS WITH ALPHA = 0.6

YEAR	TOTAL ENROLLMENT	FORECAST	A COEFFICIENT	B COEFFICIENT	ERROR	ABSOLUTE % ERROR
1962	11795					
1963	11961	11795.00	11795.00	0.01	-166.00	1.39
1964	13214	11994.21	11934.45	59.77	-1219.79	9.23
1965	15079	13517.73	13018.83	498.90	-1561.27	10.35
1966	16010	15890.15	14829.19	1060.96	-119.85	0.75
1967	16546	17094.93	15990.82	1104.11	548.93	3.32
1968	16841	17540.32	16633.82	906.49	699.32	4.15
1969	17492	17607.63	16952.89	654.74	115.63	0.66
1970	18444	18123.61	17510.50	613.11	-320.39	1.74
1971	18655	19121.20	18392.74	728.46	466.20	2.50
1972	18080	19290.22	18729.59	560.63	1210.22	6.69
1973	18560	18398.58	18273.63	124.95	-161.42	0.87
1974	19280	18717.23	18534.17	183.06	-562.77	2.92
1975	20490	19575.62	19189.95	385.65	-914.38	4.46
1976	21129	21058.54	20343.70	714.84	-70.46	0.33
1977	21904	21857.94	21117.73	740.21	-46.06	0.21
1978	22287	22653.43	21896.63	756.80	366.43	1.64
1979	22003	22970.52	22345.63	624.89	967.52	4.40
1980	22490	22434.39	22157.80	276.59	-55.61	0.25
1981	22709	22777.71	22481.10	296.61	68.71	0.30
1982	23053	22991.87	22720.00	271.88	-61.13	0.27
1983	22366	23337.11	23043.22	293.89	971.11	4.34
1984	21449	22465.66	22521.37	-55.71	1016.66	4.74
1985	20901	21189.96	21611.66	-421.71	288.96	1.38
1986	20634	20421.50	20947.23	-525.73	-212.50	1.03
1987	20116	20150.78	20600.00	-449.22	34.78	0.17
1988		19659.82	20121.56	-461.74		

ALPH = 0.6 MAPE = 2.62 MSE = 420388.00

TABLE 35

BROWN'S DOUBLE EXPONENTIAL SMOOTHING FORECASTS FOR TOTAL ENROLLMENTS WITH ALPHA = 0.9

YEAR	TOTAL ENROLLMENT	FORECAST	A COEFFICIENT	B COEFFICIENT	ERROR	ABSOLUTE % ERROR
1962	11795					
1963	11961	11795.04	11795.00	0.04	-165.96	1.39
1964	13214	12093.81	11959.34	134.47	-1120.19	8.48
1965	15079	14244.65	13202.80	1041.86	-834.35	5.53
1966	16010	16788.40	15070.66	1717.74	778.40	4.86
1967	16546	17105.02	16017.78	1087.24	559.02	3.38
1968	16841	17186.05	16551.59	634.47	345.05	2.05
1969	17492	17199.46	16844.45	355.01	-292.54	1.67
1970	18444	18081.07	17489.07	592.00	-362.93	1.97
1971	18655	19326.38	18440.37	886.01	671.38	3.60
1972	18080	19003.93	18661.71	342.21	923.93	5.11
1973	18560	17683.07	18089.23	-406.16	-876.93	4.72
1974	19280	18855.40	18551.23	304.17	-424.60	2.20
1975	20490	19923.86	19275.75	648.11	-566.14	2.76
1976	21129	21591.02	20484.34	1106.69	462.02	2.19
1977	21904	21866.06	21133.61	732.45	-37.94	0.17
1978	22287	22666.82	21903.62	763.21	379.82	1.70
1979	22003	22746.39	22290.80	455.59	743.39	3.38
1980	22490	21863.90	22010.43	-146.53	-626.10	2.78
1981	22709	22844.37	22483.74	360.63	135.37	0.60
1982	23053	22961.37	22710.35	251.02	-91.63	0.40
1983	22366	23377.35	23052.08	325.27	1011.35	4.52
1984	21449	21882.23	22376.11	-493.88	433.23	2.02
1985	20901	20608.60	21453.34	-844.74	-292.40	1.40
1986	20634	20290.22	20898.08	-607.85	-343.78	1.67
1987	20116	20301.21	20630.56	-329.34	185.21	0.92
1988		19638.53	20117.86	-479.32		

ALPH = 0.9 MAPE = 2.67 MSE = 330249.19

TABLE 36

BROWN'S DOUBLE EXPONENTIAL SMOOTHING FORECASTS
FOR UNDERGRADUATE ENROLLMENTS WITH
ALPHA = 0.9

YEAR	UNDERGRADUATE ENROLLMENT	FORECAST	A COEFFICIENT	B COEFFICIENT	ERROR	ABSOLUTE % ERROR
1962	10006					
1963	10107	10006.00	10006.00	0.00	-101.00	1.00
1964	11065	10046.39	10042.35	4.04	-1018.61	9.21
1965	12877	10457.87	10413.09	44.78	-2419.13	18.79
1966	13596	11470.30	11328.75	141.55	-2125.70	15.63
1967	14120	12462.13	12235.55	226.58	-1657.87	11.74
1968	14366	13351.86	13058.96	292.89	-1014.14	7.06
1969	14763	14050.40	13716.95	333.46	-712.60	4.83
1970	15395	14668.89	14306.93	361.96	-726.11	4.72
1971	15472	15321.29	14930.29	391.01	-150.71	0.97
1972	14889	15772.58	15375.55	397.04	883.58	5.93
1973	15065	15816.18	15454.48	361.69	751.18	4.99
1974	15631	15877.39	15545.75	331.64	246.39	1.58
1975	16599	16110.48	15788.69	321.79	-488.52	2.94
1976	17313	16627.68	16286.35	341.33	-685.32	3.96
1977	18015	17243.14	16874.39	368.74	-771.86	4.28
1978	18521	17920.62	17521.01	399.62	-600.37	3.24
1979	18218	18560.39	18136.76	423.63	342.39	1.88
1980	18602	18847.06	18437.12	409.94	245.06	1.32
1981	18916	19158.97	18758.84	400.14	242.97	1.28
1982	19120	19461.91	19071.50	390.42	341.91	1.79
1983	18410	19715.57	19338.83	376.74	1305.57	7.09
1984	17779	19570.08	19245.56	324.52	1791.08	10.07
1985	17240	19178.17	18925.29	252.88	1938.17	11.24
1986	16845	18655.77	18480.43	175.35	1810.77	10.75
1987	16115	18106.81	18003.89	102.92	1991.81	12.36
1988		17413.01	17389.76	23.25		

ALPH = 0.9 MAPE = 2.66 MSE = 261438.37

TABLE 37

BROWN'S DOUBLE EXPONENTIAL SMOOTHING FORECASTS FOR UNDERGRADUATE ENROLLMENTS WITH ALPHA = 0.8

YEAR	UNDERGRADUATE ENROLLMENT	FORECAST	A COEFFICIENT	B COEFFICIENT	ERROR	ABSOLUTE % ERROR
1962	10006					
1963	10107	10006.00	10006.00	0.00	-101.00	1.00
1964	11065	10066.59	10057.50	9.09	-998.41	9.02
1965	12877	10674.73	10575.78	98.95	-2202.27	17.10
1966	13596	12095.04	11797.89	297.15	-1500.96	11.04
1967	14120	13292.77	12860.53	432.24	-827.23	5.86
1968	14366	14221.35	13714.66	506.69	-144.65	1.01
1969	14763	14814.83	14295.12	519.71	51.83	0.35
1970	15395	15303.43	14788.39	515.05	-91.57	0.59
1971	15472	15873.42	15350.13	523.29	401.42	2.59
1972	14889	16155.85	15668.69	487.16	1266.85	8.51
1973	15065	15882.89	15509.75	373.14	817.89	5.43
1974	15631	15765.30	15465.77	299.53	134.30	0.86
1975	16599	15984.25	15696.81	287.45	-614.75	3.70
1976	17313	16640.55	16297.77	342.78	-672.45	3.88
1977	18015	17386.79	16983.50	403.30	-628.21	3.49
1978	18521	18167.01	17707.18	459.84	-353.99	1.91
1979	18218	18839.24	18347.55	491.70	621.24	3.41
1980	18602	18958.18	18522.40	435.78	356.18	1.91
1981	18916	19180.25	18776.53	403.73	264.25	1.40
1982	19120	19425.43	19045.48	379.95	305.43	1.60
1983	18410	19622.12	19269.66	352.46	1212.12	6.58
1984	17779	19247.30	19003.94	243.37	1468.30	8.26
1985	17240	18609.68	18498.46	111.22	1369.68	7.94
1986	16845	17899.09	17911.14	-12.05	1054.09	6.26
1987	16115	17254.59	17361.51	-106.92	1139.59	7.07
1988		16463.92	16673.40	-209.48		

ALPH = 0.8 MAPE = 2.68 MSE = 275158.81

TABLE 38

BROWN'S DOUBLE EXPONENTIAL SMOOTHING FORECASTS FOR UNDERGRADUATE ENROLLMENTS WITH ALPHA = 0.7

YEAR	UNDERGRADUATE ENROLLMENT	FORECAST	A COEFFICIENT	B COEFFICIENT	ERROR	ABSOLUTE % ERROR
1962	10006					
1963	10107	10006.00	10006.00	0.00	-101.00	1.00
1964	11065	10086.80	10070.64	16.16	-978.20	8.84
1965	12877	10885.52	10712.84	172.67	-1991.48	15.47
1966	13596	12651.38	12160.07	491.31	-944.62	6.95
1967	14120	13898.38	13255.93	642.45	-221.62	1.57
1968	14366	14718.12	14040.21	677.91	352.12	2.45
1969	14763	15114.33	14492.76	621.57	351.33	2.38
1970	15395	15454.84	14889.48	565.36	59.84	0.39
1971	15472	15972.32	15416.54	555.79	500.32	3.23
1972	14889	16127.85	15652.12	475.74	1238.85	8.32
1973	15065	15612.50	15334.98	277.52	547.50	3.63
1974	15631	15452.02	15262.10	189.92	-178.98	1.15
1975	16599	15785.12	15566.57	218.56	-813.87	4.90
1976	17313	16654.79	16306.01	348.78	-658.21	3.80
1977	18015	17530.14	17076.04	454.10	-484.86	2.69
1978	18521	18372.12	17840.45	531.67	-148.88	0.80
1979	18218	19022.89	18467.40	555.49	804.89	4.42
1980	18602	18934.47	18507.76	426.71	332.47	1.79
1981	18916	19095.21	18721.69	373.52	179.21	0.95
1982	19120	19325.36	18980.52	344.85	205.36	1.07
1983	18410	19505.92	19193.93	311.99	1095.92	5.95
1984	17779	18941.18	18804.53	136.65	1162.18	6.54
1985	17240	18148.08	18197.38	-49.30	908.08	5.27
1986	16845	17372.31	17566.91	-194.59	527.31	3.13
1987	16115	16755.86	17034.83	-278.96	640.86	3.98
1988		15964.21	16345.71	-381.50		

ALPH = 0.7 MAPE = 2.74 MSE = 301247.37

TABLE 39

BROWN'S DOUBLE EXPONENTIAL SMOOTHING FORECASTS FOR MALE ENROLLMENTS WITH ALPHA = 0.6

YEAR	MALE ENROLLMENT	FORECAST	A COEFFICIENT	B COEFFICIENT	ERROR	ABSOLUTE % ERROR
1962	8236					
1963	8268	8236.00	8236.00	0.00	-32.00	0.39
1964	9072	8274.40	8262.88	11.53	-797.60	8.79
1965	10123	9243.05	8944.38	298.66	-879.95	8.69
1966	10376	10597.66	9982.21	615.45	221.66	2.14
1967	10658	10947.11	10411.46	535.65	289.11	2.71
1968	10799	11135.84	10704.26	431.58	336.84	3.12
1969	11279	11163.22	10852.89	310.32	-115.78	1.03
1970	11860	11612.48	11260.47	352.01	-247.52	2.09
1971	11899	12261.51	11820.39	441.12	362.51	3.05
1972	11397	12267.62	11957.00	310.62	870.62	7.64
1973	11619	11533.50	11536.30	-2.80	-85.50	0.74
1974	11799	11633.30	11605.32	27.98	-165.70	1.40
1975	12435	11860.12	11772.48	87.64	-574.88	4.62
1976	12677	12637.62	12343.02	294.60	-39.38	0.31
1977	12966	12979.47	12670.70	308.78	13.47	0.10
1978	13067	13272.09	12968.16	303.93	205.09	1.57
1979	12649	13329.91	13099.81	230.10	680.91	5.38
1980	12948	12742.92	12757.94	-15.02	-205.08	1.58
1981	13144	12974.00	12915.19	58.81	-170.00	1.29
1982	13476	13236.80	13116.79	120.01	-239.20	1.77
1983	12979	13643.86	13437.73	206.13	664.86	5.12
1984	12382	13052.16	13085.37	-33.22	670.16	5.41
1985	12029	12214.75	12489.22	-274.47	185.75	1.54
1986	11751	11717.38	12058.72	-341.34	-33.62	0.29
1987	11280	11416.39	11745.62	-329.23	136.39	1.21
1988		10923.49	11301.82	-378.33		

ALPH = 0.6 MAPE = 2.77 MSE = 175691.06

TABLE 40

BROWN'S DOUBLE EXPONENTIAL SMOOTHING FORECASTS FOR MALE ENROLLMENTS WITH ALPHA = 0.5

YEAR	MALE ENROLLMENT	FORECAST	A COEFFICIENT	B COEFFICIENT	ERROR	ABSOLUTE % ERROR
1962	8236					
1963	8268	8236.00	8236.00	0.00	-32.00	0.39
1964	9072	8268.01	8260.00	8.01	-803.99	8.86
1965	10123	9080.01	8871.00	209.01	-1042.99	10.30
1966	10376	10332.01	9862.25	469.76	-43.99	0.42
1967	10658	10845.76	10365.00	480.76	187.76	1.76
1968	10799	11138.76	10704.94	433.82	339.76	3.15
1969	11279	11232.82	10883.94	348.88	-46.18	0.41
1970	11860	11627.89	11267.46	360.43	-232.11	1.96
1971	11899	12220.43	11801.97	418.46	321.43	2.70
1972	11397	12317.46	11979.36	338.11	920.46	8.08
1973	11619	11735.11	11627.12	107.99	116.11	1.00
1974	11799	11727.00	11648.03	78.97	-72.00	0.61
1975	12435	11877.97	11781.00	96.97	-557.03	4.48
1976	12677	12531.98	12295.75	236.23	-145.02	1.14
1977	12966	12913.24	12640.75	272.49	-52.76	0.41
1978	13067	13238.49	12952.81	285.68	171.49	1.31
1979	12649	13352.68	13109.87	242.81	703.68	5.56
1980	12948	12891.82	12824.92	66.89	-56.18	0.43
1981	13144	13014.90	12933.96	80.95	-129.10	0.98
1982	13476	13224.95	13111.73	113.22	-251.05	1.86
1983	12979	13589.23	13413.24	175.99	610.23	4.70
1984	12382	13154.99	13131.55	23.43	772.99	6.24
1985	12029	12405.44	12575.25	-169.81	376.44	3.13
1986	11751	11859.20	12123.11	-263.91	108.20	0.92
1987	11280	11487.09	11778.05	-290.96	207.09	1.84
1988		10989.04	11331.77	-342.73		

ALPH = 0.5 MAPE = 2.79 MSE = 193108.56

TABLE 41

BROWN'S DOUBLE EXPONENTIAL SMOOTHING FORECASTS FOR MALE ENROLLMENTS WITH ALPHA = 0.9

YEAR	MALE ENROLLMENT	FORECAST	A COEFFICIENT	B COEFFICIENT	ERROR	ABSOLUTE % ERROR
1962	8236					
1963	8268	8236.04	8236.00	0.04	-31.96	0.39
1964	9072	8293.66	8267.68	25.98	-778.34	8.58
1965	10123	9720.69	9064.22	656.47	-402.31	3.97
1966	10376	11101.35	10118.98	982.37	725.35	6.99
1967	10658	10778.12	10383.25	394.88	120.12	1.13
1968	10799	10956.80	10659.20	297.60	157.80	1.46
1969	11279	10970.42	10800.58	169.84	-308.58	2.74
1970	11860	11695.71	11275.91	419.80	-164.29	1.39
1971	11899	12411.26	11858.36	552.90	512.26	4.31
1972	11397	12042.15	11904.12	138.02	645.15	5.66
1973	11619	11018.95	11403.45	-384.50	-600.05	5.16
1974	11799	11714.57	11613.00	101.57	-84.43	0.72
1975	12435	11968.14	11798.16	169.98	-466.86	3.75
1976	12677	12978.48	12430.33	548.16	301.48	2.38
1977	12966	12984.01	12680.02	304.00	18.01	0.14
1978	13067	13255.62	12966.18	289.44	188.62	1.44
1979	12649	13205.57	13068.89	136.69	556.57	4.40
1980	12948	12340.44	12654.56	-314.12	-607.56	4.69
1981	13144	13119.95	12941.92	178.03	-24.05	0.18
1982	13476	13341.30	13143.76	197.54	-134.70	1.00
1983	12979	13781.36	13474.66	306.70	802.36	6.18
1984	12382	12643.86	12987.03	-343.16	261.86	2.11
1985	12029	11829.36	12384.62	-555.26	-199.64	1.66
1986	11751	11633.46	12027.00	-393.54	-117.54	1.00
1987	11280	11451.52	11749.82	-298.30	171.52	1.52
1988		10844.51	11281.71	-437.20		

ALPH = 0.9 MAPE = 2.81 MSE = 166922.69

TABLE 42

BROWN'S DOUBLE EXPONENTIAL SMOOTHING FORECASTS
FOR FEMALE ENROLLMENTS WITH ALPHA = 0.9

YEAR	FEMALE ENROLLMENT	FORECAST	A COEFFICIENT	B COEFFICIENT	ERROR	ABSOLUTE % ERROR
1962	3559					
1963	3693	3559.00	3559.00	0.00	-134.00	3.63
1964	4142	3800.20	3691.66	108.54	-341.80	8.25
1965	4956	4523.98	4138.58	385.40	-432.02	8.72
1966	5634	5687.08	4951.68	735.40	53.08	0.94
1967	5888	6326.97	5634.53	692.44	438.97	7.46
1968	6042	6229.29	5892.39	336.90	187.29	3.10
1969	6213	6229.07	6043.87	185.20	16.07	0.26
1970	6584	6385.35	6213.16	172.20	-198.65	3.02
1971	6756	6915.15	6582.01	333.14	159.15	2.36
1972	6683	6961.85	6757.59	204.26	278.85	4.17
1973	6941	6664.24	6685.79	-21.55	-276.76	3.99
1974	7482	7140.87	6938.23	202.64	-341.13	4.56
1975	8055	7957.55	7478.59	478.97	-97.45	1.21
1976	8452	8611.95	8054.02	557.93	159.95	1.89
1977	8995	8882.02	8453.60	428.42	-112.98	1.26
1978	9220	9513.83	8993.87	519.96	293.83	3.19
1979	9354	9504.93	9222.94	281.99	150.93	1.61
1980	9542	9515.30	9355.51	159.79	-26.70	0.28
1981	9685	9723.18	9541.73	181.44	38.18	0.39
1982	9577	9835.92	9685.38	150.54	258.92	2.70
1983	9387	9520.46	9579.59	-59.13	133.46	1.42
1984	9067	9221.13	9388.34	-167.20	154.13	1.70
1985	8872	8776.49	9068.54	-292.04	-95.51	1.08
1986	8883	8656.37	8871.04	-214.66	-226.62	2.55
1987	8836	8849.65	8880.73	-31.08	13.65	0.15
1988		8794.02	8836.13	-42.12		

ALPH = 0.9 MAPE = 2.69 MSE = 46776.50

TABLE 43

BROWN'S DOUBLE EXPONENTIAL SMOOTHING FORECASTS
FOR FEMALE ENROLLMENTS WITH ALPHA = 0.8

YEAR	FEMALE ENROLLMENT	FORECAST	A COEFFICIENT	B COEFFICIENT	ERROR	ABSOLUTE % ERROR
1962	3559					
1963	3693	3559.00	3559.00	0.00	-134.00	3.63
1964	4142	3773.40	3687.64	85.76	-368.60	8.90
1965	4956	4448.91	4127.25	321.66	-507.09	10.23
1966	5634	5581.92	4935.71	646.20	-52.08	0.92
1967	5888	6311.46	5631.91	679.55	423.46	7.19
1968	6042	6313.48	5904.94	408.55	271.48	4.49
1969	6213	6287.67	6052.86	234.81	74.67	1.20
1970	6584	6403.04	6215.99	187.05	-180.96	2.75
1971	6756	6879.66	6576.77	302.89	123.66	1.83
1972	6683	6984.71	6760.95	223.77	301.71	4.51
1973	6941	6725.76	6695.07	30.69	-215.24	3.10
1974	7482	7100.84	6932.39	168.45	-381.16	5.09
1975	8055	7879.16	7466.75	412.41	-175.84	2.18
1976	8452	8572.94	8047.97	524.97	120.94	1.43
1977	8995	8904.42	8456.84	447.58	-90.58	1.01
1978	9220	9496.94	8991.37	505.56	276.94	3.00
1979	9354	9559.40	9231.07	328.33	205.40	2.20
1980	9542	9559.09	9362.21	196.88	17.09	0.18
1981	9685	9728.64	9542.68	185.95	43.64	0.45
1982	9577	9844.77	9686.74	158.03	267.77	2.80
1983	9387	9574.36	9587.71	-13.34	187.36	2.00
1984	9067	9261.26	9394.50	-133.23	194.26	2.14
1985	8872	8817.22	9074.77	-257.55	-54.78	0.62
1986	8883	8647.32	8869.81	-222.48	-235.68	2.65
1987	8836	8801.93	8873.57	-71.64	-34.07	0.39
1988		8784.81	8834.64	-49.83		

ALPH = 0.8   MAPE = 2.88   MSE = 53154.92

TABLE 44

BROWN'S DOUBLE EXPONENTIAL SMOOTHING FORECASTS
FOR FEMALE ENROLLMENTS WITH ALPHA = 0.7

YEAR	FEMALE ENROLLMENT	FORECAST	A COEFFICIENT	B COEFFICIENT	ERROR	ABSOLUTE % ERROR
1962	3559					
1963	3693	3559.00	3559.00	0.00	-134.00	3.63
1964	4142	3746.60	3680.94	65.66	-395.40	9.55
1965	4956	4365.82	4106.41	259.41	-590.18	11.91
1966	5634	5451.48	4902.88	548.60	-182.52	3.24
1967	5888	6255.61	5617.57	638.04	367.61	6.24
1968	6042	6378.98	5921.08	457.91	336.98	5.58
1969	6213	6365.11	6072.32	292.79	152.11	2.45
1970	6584	6444.95	6226.69	218.26	-139.05	2.11
1971	6756	6857.89	6571.49	286.41	101.89	1.51
1972	6683	7001.66	6765.17	236.49	318.66	4.77
1973	6941	6792.02	6711.68	80.35	-148.98	2.15
1974	7482	7080.94	6927.59	153.35	-401.06	5.36
1975	8055	7795.79	7445.91	349.88	-259.21	3.22
1976	8452	8508.57	8031.67	476.90	56.57	0.67
1977	8995	8906.27	8457.09	449.19	-88.73	0.99
1978	9220	9479.68	8987.02	492.67	259.68	2.82
1979	9354	9608.80	9243.37	365.43	254.80	2.72
1980	9542	9617.52	9376.93	240.59	75.52	0.79
1981	9685	9752.39	9548.80	203.59	67.39	0.70
1982	9577	9861.64	9691.07	170.58	284.64	2.97
1983	9387	9633.72	9602.61	31.11	246.72	2.63
1984	9067	9319.42	9409.20	-89.78	252.42	2.78
1985	8872	8876.25	9089.71	-213.46	4.25	0.05
1986	8883	8656.84	8872.38	-215.54	-226.16	2.55
1987	8836	8757.92	8862.64	-104.72	-78.08	0.88
1988		8762.53	8828.98	-66.45		

ALPH = 0.7 MAPE = 3.16 MSE = 62530.96

TABLE 45

BROWN'S DOUBLE EXPONENTIAL SMOOTHING FORECASTS
FOR GRADUATE ENROLLMENTS WITH ALPHA = 0.6

YEAR	GRADUATE ENROLLMENT	FORECAST	A COEFFICIENT	B COEFFICIENT	ERROR	ABSOLUTE % ERROR
1962	1502					
1963	1556	1502.00	1502.00	0.00	-54.00	3.47
1964	1827	1566.80	1547.36	19.44	-260.20	14.24
1965	1885	1898.48	1785.37	113.11	13.48	0.72
1966	2071	1995.42	1887.16	108.26	-75.58	3.65
1967	2076	2194.38	2058.91	135.47	118.38	5.70
1968	2163	2187.79	2094.94	92.85	24.79	1.15
1969	2433	2250.89	2166.97	83.93	-182.11	7.48
1970	2734	2553.35	2403.86	149.49	-180.65	6.61
1971	2869	2919.62	2705.10	214.52	50.62	1.76
1972	2864	3073.40	2877.10	196.30	209.40	7.31
1973	3087	3018.42	2897.50	120.92	-68.58	2.22
1974	3252	3221.63	3076.03	145.61	-30.37	0.93
1975	3355	3403.68	3247.14	156.54	48.68	1.45
1976	3242	3501.80	3362.79	139.01	259.80	8.01
1977	3338	3329.05	3283.57	45.48	-8.95	0.27
1978	3234	3385.27	3336.57	48.71	151.27	4.68
1979	3289	3252.45	3258.20	-5.75	-36.55	1.11
1980	3433	3290.56	3283.15	7.41	-142.44	4.15
1981	3372	3468.89	3410.21	58.68	96.89	2.87
1982	3580	3411.30	3387.50	23.80	-168.70	4.71
1983	3629	3637.54	3553.01	84.53	8.54	0.24
1984	3363	3711.82	3630.37	81.46	348.82	10.37
1985	3376	3374.69	3418.81	-44.12	-1.31	0.04
1986	3507	3332.14	3375.79	-43.65	-174.86	4.99
1987	3625	3498.32	3479.02	19.30	-126.68	3.49
1988		3669.63	3604.73	64.90		

ALPH = 0.6 MAPE = 3.91 MSE = 20371.18

TABLE 46

BROWN'S DOUBLE EXPONENTIAL SMOOTHING FORECASTS
FOR GRADUATE ENROLLMENTS WITH ALPHA = 0.5

YEAR	GRADUATE ENROLLMENT	FORECAST	A COEFFICIENT	B COEFFICIENT	ERROR	ABSOLUTE % ERROR
1962	1502					
1963	1556	1502.00	1502.00	0.00	-54.00	3.47
1964	1827	1556.00	1542.50	13.50	-271.00	14.83
1965	1885	1840.50	1759.25	81.25	-44.50	2.36
1966	2071	1966.25	1873.87	92.38	-104.75	5.06
1967	2076	2163.38	2044.81	118.56	87.38	4.21
1968	2163	2194.56	2097.84	96.72	31.56	1.46
1969	2433	2259.72	2170.89	88.83	-173.28	7.12
1970	2734	2521.83	2389.68	132.15	-212.17	7.76
1971	2869	2866.15	2680.95	185.19	-2.85	0.10
1972	2864	3054.19	2868.28	185.90	190.19	6.64
1973	3087	3049.90	2911.54	138.36	-37.10	1.20
1974	3252	3225.35	3077.72	147.63	-26.65	0.82
1975	3355	3399.63	3245.34	154.29	44.63	1.33
1976	3242	3509.29	3366.16	143.13	267.29	8.24
1977	3338	3385.13	3308.82	76.31	47.13	1.41
1978	3234	3414.31	3349.78	64.53	180.31	5.58
1979	3289	3298.53	3279.08	19.45	9.53	0.29
1980	3433	3308.45	3291.38	17.07	-124.55	3.63
1981	3372	3450.07	3401.86	48.21	78.07	2.32
1982	3580	3420.20	3391.51	28.69	-159.80	4.46
1983	3629	3608.69	3540.05	68.64	-20.31	0.56
1984	3363	3697.63	3623.92	73.72	334.63	9.95
1985	3376	3436.71	3446.66	-9.94	60.71	1.80
1986	3507	3366.06	3391.18	-25.12	-140.94	4.02
1987	3625	3481.88	3471.76	10.11	-143.12	3.95
1988		3635.11	3589.22	45.89		

ALPH = 0.5 MAPE = 3.94 MSE = 20118.54

TABLE 47

BROWN'S DOUBLE EXPONENTIAL SMOOTHING FORECASTS FOR GRADUATE ENROLLMENTS WITH ALPHA = 0.4

YEAR	GRADUATE ENROLLMENT	FORECAST	A COEFFICIENT	B COEFFICIENT	ERROR	ABSOLUTE % ERROR
1962	1502					
1963	1556	1502.00	1502.00	0.00	-54.00	3.47
1964	1827	1545.20	1536.56	8.64	-281.80	15.42
1965	1885	1779.28	1725.55	53.73	-105.72	5.61
1966	2071	1917.58	1846.94	70.64	-153.42	7.41
1967	2076	2110.96	2015.77	95.19	34.96	1.68
1968	2163	2178.18	2088.59	89.60	15.18	0.70
1969	2433	2255.63	2168.47	87.17	-177.37	7.29
1970	2734	2484.69	2369.15	115.55	-249.31	9.12
1971	2869	2799.68	2644.25	155.44	-69.32	2.42
1972	2864	3010.57	2844.05	166.53	146.57	5.12
1973	3087	3059.84	2916.77	143.07	-27.16	0.88
1974	3252	3224.64	3077.22	147.42	-27.36	0.84
1975	3355	3393.95	3242.15	151.80	38.95	1.16
1976	3242	3514.58	3369.02	145.57	272.58	8.41
1977	3338	3442.08	3340.13	101.95	104.08	3.12
1978	3234	3460.77	3375.47	85.30	226.77	7.01
1979	3289	3364.65	3315.63	49.02	75.65	2.30
1980	3433	3353.15	3316.23	36.91	-79.85	2.33
1981	3372	3453.94	3404.25	49.69	81.94	2.43
1982	3580	3438.07	3401.50	36.58	-141.93	3.96
1983	3629	3588.19	3528.91	59.29	-40.81	1.12
1984	3363	3680.12	3614.31	65.81	317.12	9.43
1985	3376	3492.24	3477.16	15.08	116.24	3.44
1986	3507	3414.32	3417.85	-3.52	-92.68	2.64
1987	3625	3484.94	3473.63	11.31	-140.06	3.86
1988		3608.29	3574.58	33.71		

ALPH = 0.4 MAPE = 4.28 MSE = 21571.51

TABLE 48

BROWN'S DOUBLE EXPONENTIAL SMOOTHING FORECASTS FOR FRESHMAN ENROLLMENTS WITH ALPHA = 0.9

YEAR	FRESHMAN ENROLLMENT	FORECAST	A COEFFICIENT	B COEFFICIENT	ERROR	ABSOLUTE % ERROR
1962	3115					
1963	2897	3115.00	3115.00	0.00	218.00	7.52
1964	3680	2722.60	2899.18	-176.58	-957.40	26.02
1965	4658	4269.34	3670.42	598.92	-388.66	8.34
1966	4490	5567.86	4654.11	913.75	1077.86	24.01
1967	4236	4541.49	4500.78	40.71	305.49	7.21
1968	3929	4032.34	4239.05	-206.72	103.34	2.63
1969	4208	3639.61	3930.03	-290.42	-568.39	13.51
1970	4347	4372.30	4202.32	169.98	25.30	0.58
1971	4211	4496.77	4347.25	149.52	285.77	6.79
1972	3608	4131.91	4213.86	-81.95	523.91	14.52
1973	4064	3106.93	3613.24	-506.31	-957.07	23.55
1974	4340	4323.34	4054.43	268.92	-16.66	0.38
1975	5047	4622.24	4339.83	282.41	-424.76	8.42
1976	5328	5669.28	5042.76	626.52	341.28	6.41
1977	5409	5681.54	5331.41	350.12	272.54	5.04
1978	5444	5541.10	5411.72	129.38	97.10	1.78
1979	5257	5495.73	5444.97	50.77	238.73	4.54
1980	5499	5116.79	5259.39	-142.59	-382.21	6.95
1981	5326	5662.20	5495.18	167.03	336.20	6.31
1982	5165	5224.06	5329.36	-105.29	59.06	1.14
1983	4672	5012.48	5165 59	-153.11	340.48	7.29
1984	4433	4246.57	4675.41	-428.84	-186.43	4.21
1985	4471	4153.33	4431.14	-277.81	-317.67	7.11
1986	4560	4447.36	4467.82	-20.46	-112.64	2.47
1987	4177	4629.68	4558.87	70.80	452.68	10.84
1988		3885.69	4181.53	-295.84		

ALPH = 0.9 MAPE = 7.98 MSE = 197941.81

TABLE 49

BROWN'S DOUBLE EXPONENTIAL SMOOTHING FORECASTS
FOR FRESHMAN ENROLLMENTS WITH ALPHA = 0.4

YEAR	FRESHMAN ENROLLMENT	FORECAST	A COEFFICIENT	B COEFFICIENT	ERROR	ABSOLUTE % ERROR
1962	3115					
1963	2897	3115.00	3115.00	0.00	218.00	7.52
1964	3680	2940.60	2975.48	-34.88	-739.40	20.09
1965	4658	3497.24	3413.82	83.42	-1160.76	24.92
1966	4490	4509.27	4240.12	269.15	19.27	0.43
1967	4236	4762.99	4496.93	266.06	526.99	12.44
1968	3929	4607.46	4425.72	181.74	678.46	17.27
1969	4208	4246.43	4173.24	73.19	38.43	0.91
1970	4347	4288.87	4221.83	67.04	-58.13	1.34
1971	4211	4402.41	4326.07	76.34	191.41	4.55
1972	3608	4325.62	4279.91	45.71	717.62	19.89
1973	4064	3797.23	3866.34	-69.11	-266.77	6.56
1974	4340	3941.54	3967.96	-26.42	-398.46	9.18
1975	5047	4233.88	4196.55	37.33	-813.12	16.11
1976	5328	4921.71	4754.28	167.43	-406.29	7.63
1977	5409	5414.17	5181.73	232.44	5.17	0.10
1978	5444	5642.47	5410.86	231.61	198.47	3.65
1979	5257	5715.30	5515.45	199.86	458.30	8.72
1980	5499	5548.52	5421.99	126.53	49.52	0.90
1981	5326	5635.43	5516.82	118.61	309.43	5.81
1982	5165	5506.49	5437.39	69.10	341.49	6.61
1983	4672	5302.40	5287.94	14.46	630.40	13.49
1984	4433	4812.54	4898.95	-86.40	379.54	8.56
1985	4471	4422.50	4569.63	-147.13	-48.50	1.08
1986	4560	4314.18	4453.54	-139.37	-245.82	5.39
1987	4177	4371.47	4471.50	-100.03	194.47	4.66
1988		4115.86	4247.01	-131.15		

ALPH = 0.4 MAPE = 7.99 MSE = 207652.25

TABLE 50

BROWN'S DOUBLE EXPONENTIAL SMOOTHING FORECASTS
FOR FRESHMAN ENROLLMENTS WITH ALPHA = 0.5

YEAR	FRESHMAN ENROLLMENT	FORECAST	A COEFFICIENT	B COEFFICIENT	ERROR	ABSOLUTE % ERROR
1962	3115					
1963	2897	3115.00	3115.00	0.00	218.00	7.52
1964	3680	2897.00	2951.50	-54.50	-783.00	21.28
1965	4658	3625.50	3484.25	141.25	-1032.50	22.17
1966	4490	4799.25	4399.87	399.38	309.25	6.89
1967	4236	4889.36	4567.30	322.06	653.36	15.42
1968	3929	4558.05	4399.34	158.72	629.05	16.01
1969	4208	4087.71	4086.26	1.45	-120.29	2.86
1970	4347	4209.45	4177.93	31.52	-137.55	3.16
1971	4211	4378.53	4312.61	65.91	167.53	3.98
1972	3608	4276.92	4252.88	24.04	668.92	18.54
1973	4064	3632.03	3775.23	-143.19	-431.97	10.63
1974	4340	3920.81	3956.01	-35.20	-419.19	9.66
1975	5047	4304.80	4235.20	69.60	-742.20	14.71
1976	5328	5116.60	4861.45	255.15	-211.40	3.97
1977	5409	5583.15	5275.15	308.00	174.15	3.22
1978	5444	5717.00	5452.54	264.46	273.00	5.01
1979	5257	5708.46	5512.25	196.21	451.46	8.59
1980	5499	5453.21	5369.86	83.35	-45.79	0.83
1981	5326	5582.36	5487.55	94.80	256.36	4.81
1982	5165	5420.80	5390.09	30.71	255.80	4.95
1983	4672	5195.71	5228.95	-33.23	523.71	11.21
1984	4433	4638.77	4802.93	-164.16	205.77	4.64
1985	4471	4268.84	4484.44	-215.60	-202.16	4.52
1986	4560	4255.40	4420.46	-165.06	-304.60	6.68
1987	4177	4394.95	4483.85	-88.91	217.95	5.22
1988		4088.09	4231.48	-143.39		

ALPH = 0.5 MAPE = 8.33 MSE = 194282.94

APPENDIX C

HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING FORECASTS

TABLE 51

HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING FORECASTS FOR TOTAL ENROLLMENTS WITH ALPHA 1.0 AND BETA = 0.3

YEAR	SMOOTH	TREND	TOTAL ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962			11795			
1963	11795.00	116.20	11961	11911.20	-49.80	0.42
1964	11961.00	131.14	13214	12092.14	-1121.86	8.49
1965	13214.00	467.70	15079	13681.70	-1397.30	9.27
1966	15079.00	886.89	16010	15965.89	-44.11	0.28
1967	16010.00	900.12	16546	16910.12	364.12	2.20
1968	16546.00	790.88	16841	17336.88	495.88	2.94
1969	16841.00	642.12	17492	17483.12	-8.88	0.05
1970	17492.00	644.78	18444	18136.78	-307.22	1.67
1971	18444.00	736.95	18655	19180.95	525.95	2.82
1972	18655.00	579.16	18080	19234.16	1154.16	6.38
1973	18080.00	232.91	18560	18312.91	-247.09	1.33
1974	18560.00	307.04	19280	18867.04	-412.96	2.14
1975	19280.00	430.93	20490	19710.93	-779.07	3.80
1976	20490.00	664.65	21129	21154.65	25.65	0.12
1977	21129.00	656.95	21904	21785.95	-118.05	0.54
1978	21904.00	692.37	22287	22596.37	309.37	1.39
1979	22287.00	599.56	22003	22886.55	883.55	4.02
1980	22003.00	334.49	22490	22337.49	-152.51	0.68
1981	22490.00	380.24	22709	22870.24	161.24	0.71
1982	22709.00	331.87	23053	23040.87	-12.13	0.05
1983	23053.00	335.51	22366	23388.51	1022.51	4.57
1984	22366.00	28.76	21449	22394.75	945.75	4.41
1985	21449.00	-254.97	20901	21194.03	293.03	1.40
1986	20901.00	-342.88	20634	20558.12	-75.88	0.37
1987	20634.00	-320.12	20116	20313.88	197.88	0.98
1988	20116.00	-379.48		19736.52		

ALPH = 1.0 BETA = 0.3 MAPE = 2.35 MSE = 351799.19

TABLE 52

HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING
FORECASTS FOR TOTAL ENROLLMENTS WITH
ALPHA 1.0 AND BETA = 0.4

YEAR	SMOOTH	TREND	TOTAL ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962			11795			
1963	11795.00	99.60	11961	11894.60	-66.40	0.56
1964	11961.00	126.16	13214	12087.16	-1126.84	8.53
1965	13214.00	576.30	15079	13790.89	-1288.11	8.54
1966	15079.00	1092.14	16010	16171.14	161.14	1.01
1967	16010.00	1027.68	16546	17037.68	491.68	2.97
1968	16546.00	831.01	16841	17377.01	536.01	3.18
1969	16841.00	616.60	17492	17457.60	-34.40	0.20
1970	17492.00	630.36	18444	18122.36	-321.64	1.74
1971	18444.00	759.02	18655	19203.02	548.02	2.94
1972	18655.00	539.81	18080	19194.81	1114.81	6.17
1973	18080.00	93.89	18560	18173.88	-386.12	2.08
1974	18560.00	248.33	19280	18808.33	-471.67	2.45
1975	19280.00	437.00	20490	19717.00	-773.00	3.77
1976	20490.00	746.20	21129	21236.20	107.20	0.51
1977	21129.00	703.32	21904	21832.32	-71.68	0.33
1978	21904.00	731.99	22287	22635.99	348.99	1.57
1979	22287.00	592.39	22003	22879.39	876.39	3.98
1980	22003.00	241.84	22490	22244.84	-245.16	1.09
1981	22490.00	339.90	22709	22829.90	120.90	0.53
1982	22709.00	291.54	23053	23000.54	-52.46	0.23
1983	23053.00	312.52	22366	23365.52	999.52	4.47
1984	22366.00	-87.29	21449	22278.71	829.71	3.87
1985	21449.00	-419.17	20901	21029.83	128.83	0.62
1986	20901.00	-470.70	20634	20430.30	-203.70	0.99
1987	20634.00	-389.22	20116	20244.78	128.78	0.64
1988	20116.00	-440.73		19675.27		

ALPH = 1.0 BETA = 0.4 MAPE = 2.42 MSE = 340437.19

TABLE 53

HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING
FORECASTS FOR TOTAL ENROLLMENTS WITH
ALPHA 1.0 AND BETA = 0.2

YEAR	SMOOTH	TREND	TOTAL ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962			11795			
1963	11795.00	132.80	11961	11927.80	-33.20	0.28
1964	11961.00	139.44	13214	12100.44	-1113.56	8.43
1965	13214.00	362.15	15079	13576.15	-1502.85	9.97
1966	15079.00	662.72	16010	15741.72	-268.28	1.68
1967	16010.00	716.38	16546	16726.37	180.37	1.09
1968	16546.00	680.30	16841	17226.30	385.30	2.29
1969	16841.00	603.24	17492	17444.24	-47.76	0.27
1970	17492.00	612.79	18444	18104.79	-339.21	1.84
1971	18444.00	680.63	18655	19124.63	469.63	2.52
1972	18655.00	586.71	18080	19241.70	1161.70	6.43
1973	18080.00	354.36	18560	18434.36	-125.64	0.68
1974	18560.00	379.49	19280	18939.49	-340.51	1.77
1975	19280.00	447.59	20490	19727.59	-762.41	3.72
1976	20490.00	600.07	21129	21090.07	-38.93	0.18
1977	21129.00	607.86	21904	21736.86	-167.14	0.76
1978	21904.00	641.29	22287	22545.29	258.29	1.16
1979	22287.00	589.63	22003	22876.63	873.63	3.97
1980	22003.00	414.90	22490	22417.90	-72.10	0.32
1981	22490.00	429.32	22709	22919.32	210.32	0.93
1982	22709.00	387.26	23053	23096.25	43.25	0.19
1983	23053.00	378.61	22366	23431.61	1065.61	4.76
1984	22366.00	165.48	21449	22531.48	1082.48	5.05
1985	21449.00	-51.01	20901	21397.98	496.98	2.38
1986	20901.00	-150.41	20634	20750.59	116.59	0.57
1987	20634.00	-173.73	20116	20460.27	344.27	1.71
1988	20116.00	-242.58		19873.41		

ALPH = 1.0 BETA = 0.2 MAPE = 2.42 MSE = 375007.19

TABLE 54

HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING FORECASTS FOR UNDERGRADUATE ENROLLMENTS WITH ALPHA = 1.0 AND BETA = 0.3

YEAR	SMOOTH	TREND	UNDERGRADUATE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962			10006			
1963	10006.00	70.70	10107	10076.70	-30.30	0.30
1964	10107.00	79.79	11065	10186.79	-878.21	7.94
1965	11065.00	343.25	12877	11408.25	-1468.75	11.41
1966	12877.00	783.88	13596	13660.87	64.88	0.48
1967	13596.00	764.41	14120	14360.41	240.41	1.70
1968	14120.00	692.29	14366	14812.29	446.29	3.11
1969	14366.00	558.40	14763	14924.40	161.40	1.09
1970	14763.00	509.98	15395	15272.98	-122.02	0.79
1971	15395.00	546.59	15472	15941.59	469.59	3.04
1972	15472.00	405.71	14889	15877.71	988.71	6.64
1973	14889.00	109.10	15065	14998.09	-66.91	0.44
1974	15065.00	129.17	15631	15194.16	-436.84	2.79
1975	15631.00	260.22	16599	15891.21	-707.79	4.26
1976	16599.00	472.55	17313	17071.55	-241.45	1.39
1977	17313.00	544.99	18015	17857.98	-157.02	0.87
1978	18015.00	592.09	18521	18607.09	86.09	0.46
1979	18521.00	566.26	18218	19087.26	869.26	4.77
1980	18218.00	305.48	18602	18523.48	-78.52	0.42
1981	18602.00	329.04	18916	18931.04	15.04	0.08
1982	18916.00	324.53	19120	19240.52	120.52	0.63
1983	19120.00	288.37	18410	19408.37	998.37	5.42
1984	18410.00	-11.14	17779	18398.86	619.86	3.49
1985	17779.00	-197.10	17240	17581.90	341.90	1.98
1986	17240.00	-299.67	16845	16940.33	95.33	0.57
1987	16845.00	-328.27	16115	16516.73	401.73	2.49
1988	16115.00	-448.79		15666.21		

ALPH = 1.0 BETA = 0.3 MAPE = 2.56 MSE = 294655.37

TABLE 55

HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING FORECASTS FOR UNDERGRADUATE ENROLLMENTS WITH ALPHA = 1.0 AND BETA = 0.4

YEAR	SMOOTH	TREND	UNDERGRADUATE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962			10006			
1963	10006.00	60.60	10107	10066.60	-40.40	0.40
1964	10107.00	76.76	11065	10183.76	-881.24	7.96
1965	11065.00	429.26	12877	11494.25	-1382.75	10.74
1966	12877.00	982.35	13596	13859.35	263.35	1.94
1967	13596.00	877.01	14120	14473.01	353.01	2.50
1968	14120.00	735.81	14366	14855.80	489.80	3.41
1969	14366.00	539.88	14763	14905.88	142.88	0.97
1970	14763.00	482.73	15395	15245.73	-149.27	0.97
1971	15395.00	542.44	15472	15937.44	465.44	3.01
1972	15472.00	356.26	14889	15828.26	939.26	6.31
1973	14889.00	-19.44	15065	14869.55	-195.45	1.30
1974	15065.00	58.73	15631	15123.73	-507.27	3.25
1975	15631.00	261.64	16599	15892.64	-706.36	4.26
1976	16599.00	544.18	17313	17143.18	-169.82	0.98
1977	17313.00	612.11	18015	17925.11	-89.89	0.50
1978	18015.00	648.07	18521	18663.06	142.06	0.77
1979	18521.00	591.24	18218	19112.24	894.24	4.91
1980	18218.00	233.54	18602	18451.54	-150.46	0.81
1981	18602.00	293.73	18916	18895.72	-20.28	0.11
1982	18916.00	301.84	19120	19217.83	97.83	0.51
1983	19120.00	262.70	18410	19382.70	972.70	5.28
1984	18410.00	-126.38	17779	18283.62	504.62	2.84
1985	17779.00	-328.23	17240	17450.77	210.77	1.22
1986	17240.00	-412.54	16845	16827.46	-17.54	0.10
1987	16845.00	-405.52	16115	16439.48	324.48	2.01
1988	16115.00	-535.31		15579.68		

ALPH = 1.0 BETA = 0.4 MAPE = 2.58 MSE = 280779.19

TABLE 56

HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING
FORECASTS FOR UNDERGRADUATE ENROLLMENTS
WITH ALPHA = 1.0 AND BETA = 0.6

YEAR	SMOOTH	TREND	UNDERGRADUATE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962			10006			
1963	10006.00	40.40	10107	10046.40	-60.60	0.60
1964	10107.00	76.76	11065	10183.76	-881.24	7.96
1965	11065.00	605.50	12877	11670.50	-1206.50	9.37
1966	12877.00	1329.40	13596	14206.40	610.40	4.49
1967	13596.00	963.16	14120	14559.16	439.16	3.11
1968	14120.00	699.66	14366	14819.66	453.66	3.16
1969	14366.00	427.47	14763	14793.46	30.46	0.21
1970	14763.00	409.19	15395	15172.18	-222.82	1.45
1971	15395.00	542.87	15472	15937.87	465.87	3.01
1972	15472.00	263.35	14889	15735.35	846.35	5.68
1973	14889.00	-244.46	15065	14644.54	-420.46	2.79
1974	15065.00	7.82	15631	15072.81	-558.19	3.57
1975	15631.00	342.73	16599	15973.72	-625.28	3.77
1976	16599.00	717.89	17313	17316.89	3.89	0.02
1977	17313.00	715.56	18015	18028.55	13.55	0.08
1978	18015.00	707.42	18521	18722.42	201.42	1.09
1979	18521.00	586.57	18218	19107.57	889.57	4.88
1980	18218.00	52.83	18602	18270.82	-331.18	1.78
1981	18602.00	251.53	18916	18853.53	-62.47	0.33
1982	18916.00	289.01	19120	19205.01	85.01	0.44
1983	19120.00	238.00	18410	19358.00	948.00	5.15
1984	18410.00	-330.80	17779	18079.20	300.20	1.69
1985	17779.00	-510.92	17240	17268.08	28.08	0.16
1986	17240.00	-527.77	16845	16712.23	-132.77	0.79
1987	16845.00	-448.11	16115	16396.89	281.89	1.75
1988	16115.00	-617.24		15497.75		

ALPH = 1.0 BETA = 0.6 MAPE = 2.59 MSE = 265769.19

TABLE 57

HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING FORECASTS FOR MALE ENROLLMENTS WITH ALPHA = 1.0 AND BETA = 0.2

YEAR	SMOOTH	TREND	MALE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962			8236			
1963	8236.00	25.60	8268	8261.60	-6.40	0.08
1964	8268.00	26.88	9072	8294.88	-777.12	8.57
1965	9072.00	182.30	10123	9254.30	-868.70	8.58
1966	10123.00	356.04	10376	10479.04	103.04	0.99
1967	10376.00	335.43	10658	10711.43	53.43	0.50
1968	10658.00	324.75	10799	10982.75	183.75	1.70
1969	10799.00	288.00	11279	11087.00	-192.00	1.70
1970	11279.00	326.40	11860	11605.39	-254.61	2.15
1971	11860.00	377.32	11899	12237.32	338.32	2.84
1972	11899.00	309.65	11397	12208.65	811.65	7.12
1973	11397.00	147.32	11619	11544.32	-74.68	0.64
1974	11619.00	162.26	11799	11781.26	-17.74	0.15
1975	11799.00	165.81	12435	11964.80	-470.20	3.78
1976	12435.00	259.85	12677	12694.84	17.84	0.14
1977	12677.00	256.28	12966	12933.27	-32.73	0.25
1978	12966.00	262.82	13067	13228.82	161.82	1.24
1979	13067.00	230.46	12649	13297.45	648.45	5.13
1980	12649.00	100.77	12948	12749.76	-198.24	1.53
1981	12948.00	140.41	13144	13088.41	-55.59	0.42
1982	13144.00	151.53	13476	13295.53	-180.47	1.34
1983	13476.00	187.62	12979	13663.62	684.62	5.27
1984	12979.00	50.70	12382	13029.70	647.70	5.23
1985	12382.00	-78.84	12029	12303.16	274.16	2.28
1986	12029.00	-133.67	11751	11895.32	144.32	1.23
1987	11751.00	-162.54	11280	11588.46	308.46	2.73
1988	11280.00	-224.23		11055.77		

ALPH = 1.0   BETA = 0.2   MAPE = 2.52   MSE = 158080.87

TABLE 58

HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING FORECASTS FOR MALE ENROLLMENTS WITH ALPHA = 1.0 AND BETA = 0.3

YEAR	SMOOTH	TREND	MALE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962			8236			
1963	8236.00	22.40	8268	8258.40	-9.60	0.12
1964	8268.00	25.28	9072	8293.28	-778.72	8.58
1965	9072.00	258.30	10123	9330.89	-792.11	7.82
1966	10123.00	496.53	10376	10619.52	243.52	2.35
1967	10376.00	423.47	10658	10799.47	141.47	1.33
1968	10658.00	381.03	10799	11039.03	240.03	2.22
1969	10799.00	309.02	11279	11108.02	-170.98	1.52
1970	11279.00	360.31	11860	11639.31	-220.69	1.86
1971	11860.00	426.52	11899	12286.52	387.52	3.26
1972	11899.00	310.26	11397	12209.26	812.26	7.13
1973	11397.00	66.58	11619	11463.58	-155.42	1.34
1974	11619.00	113.21	11799	11732.21	-66.79	0.57
1975	11799.00	133.25	12435	11932.25	-502.75	4.04
1976	12435.00	284.07	12677	12719.07	42.07	0.33
1977	12677.00	271.45	12966	12948.45	-17.55	0.14
1978	12966.00	276.72	13067	13242.71	175.71	1.34
1979	13067.00	224.00	12649	13291.00	642.00	5.08
1980	12649.00	31.40	12948	12680.40	-267.60	2.07
1981	12948.00	111.68	13144	13059.68	-84.32	0.64
1982	13144.00	136.98	13476	13280.97	-195.03	1.45
1983	13476.00	195.48	12979	13671.48	692.48	5.34
1984	12979.00	-12.26	12382	12966.74	584.74	4.72
1985	12382.00	-187.68	12029	12194.32	165.32	1.37
1986	12029.00	-237.28	11751	11791.72	40.72	0.35
1987	11751.00	-249.49	11280	11501.50	221.50	1.96
1988	11280.00	-315.95		10964.05		

ALPH = 1.0   BETA = 0.3   MAPE = 2.57   MSE = 153903.00

TABLE 59

HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING
FORECASTS FOR MALE ENROLLMENTS WITH
ALPHA = 0.9 AND BETA = 0.2

YEAR	SMOOTH	TREND	MALE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962			8236			
1963	8239.20	26.24	8268	8265.43	-2.57	0.03
1964	8267.74	26.70	9072	8294.44	-777.56	8.57
1965	8994.24	166.66	10123	9160.90	-962.10	9.50
1966	10026.79	339.84	10376	10366.62	-9.38	0.09
1967	10375.05	341.52	10658	10716.57	58.57	0.55
1968	10663.85	330.98	10799	10994.83	195.83	1.81
1969	10818.58	295.73	11279	11114.30	-164.70	1.46
1970	11262.53	325.37	11860	11587.90	-272.10	2.29
1971	11832.79	374.35	11899	12207.13	308.13	2.59
1972	11929.81	318.88	11397	12248.69	851.69	7.47
1973	11482.16	165.58	11619	11647.74	28.74	0.25
1974	11621.87	160.40	11799	11782.27	-16.73	0.14
1975	11797.32	163.41	12435	11960.73	-474.27	3.81
1976	12387.57	248.78	12677	12636.35	-40.65	0.32
1977	12672.93	256.10	12966	12929.02	-36.98	0.29
1978	12962.30	262.75	13067	13225.05	158.05	1.21
1979	13082.80	234.30	12649	13317.10	668.10	5.28
1980	12715.80	114.04	12948	12829.84	-118.16	0.91
1981	12936.18	135.31	13144	13071.48	-72.52	0.55
1982	13136.75	148.36	13476	13285.11	-190.89	1.42
1983	13456.91	182.72	12979	13639.62	660.62	5.09
1984	13045.06	63.81	12382	13108.86	726.86	5.87
1985	12454.68	-67.03	12029	12387.65	358.65	2.98
1986	12064.86	-131.59	11751	11933.27	182.27	1.55
1987	11769.23	-164.40	11280	11604.83	324.83	2.88
1988	11312.48	-222.87		11089.61		

ALPH = 0.9 BETA = 0.2 MAPE = 2.57 MSE = 172375.19

TABLE 60

HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING FORECASTS FOR FEMALE ENROLLMENTS WITH ALPHA = 1.0 AND BETA = 1.0

YEAR	SMOOTH	TREND	FEMALE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962			3559			
1963	3559.00	0.00	3693	3559.00	-134.00	3.63
1964	3693.00	134.00	4142	3827.00	-315.00	7.61
1965	4142.00	449.00	4956	4591.00	-365.00	7.36
1966	4956.00	814.00	5634	5770.00	136.00	2.41
1967	5634.00	678.00	5888	6312.00	424.00	7.20
1968	5888.00	254.00	6042	6142.00	100.00	1.66
1969	6042.00	154.00	6213	6196.00	-17.00	0.27
1970	6213.00	171.00	6584	6384.00	-200.00	3.04
1971	6584.00	371.00	6756	6955.00	199.00	2.95
1972	6756.00	172.00	6683	6928.00	245.00	3.67
1973	6683.00	-73.00	6941	6610.00	-331.00	4.77
1974	6941.00	258.00	7482	7199.00	-283.00	3.78
1975	7482.00	541.00	8055	8023.00	-32.00	0.40
1976	8055.00	573.00	8452	8628.00	176.00	2.08
1977	8452.00	397.00	8995	8849.00	-146.00	1.62
1978	8995.00	543.00	9220	9538.00	318.00	3.45
1979	9220.00	225.00	9354	9445.00	91.00	0.97
1980	9354.00	134.00	9542	9488.00	-54.00	0.57
1981	9542.00	188.00	9685	9730.00	45.00	0.46
1982	9685.00	143.00	9577	9828.00	251.00	2.62
1983	9577.00	-108.00	9387	9469.00	82.00	0.87
1984	9387.00	-190.00	9067	9197.00	130.00	1.43
1985	9067.00	-320.00	8872	8747.00	-125.00	1.41
1986	8872.00	-195.00	8883	8677.00	-206.00	2.32
1987	8883.00	11.00	8836	8894.00	58.00	0.66
1988	8836.00	-47.00		8789.00		

ALPH = 1.0 BETA = 1.0 MAPE = 2.58 MSE = 42459.80

TABLE 61

HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING FORECASTS FOR FEMALE ENROLLMENTS WITH ALPHA = 1.0 AND BETA = 0.9

YEAR	SMOOTH	TREND	FEMALE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962			3559			
1963	3559.00	13.40	3693	3572.40	-120.60	3.27
1964	3693.00	121.94	4142	3814.94	-327.06	7.90
1965	4142.00	416.29	4956	4558.29	-397.71	8.02
1966	4956.00	774.23	5634	5730.23	96.23	1.71
1967	5634.00	687.62	5888	6321.62	433.62	7.36
1968	5888.00	297.36	6042	6185.36	143.36	2.37
1969	6042.00	168.34	6213	6210.34	-2.66	0.04
1970	6213.00	170.73	6584	6383.73	-200.27	3.04
1971	6584.00	350.97	6756	6934.97	178.97	2.65
1972	6756.00	189.90	6683	6945.89	262.89	3.93
1973	6683.00	-46.71	6941	6636.29	-304.71	4.39
1974	6941.00	227.53	7482	7168.53	-313.47	4.19
1975	7482.00	509.65	8055	7991.65	-63.35	0.79
1976	8055.00	566.67	8452	8621.66	169.66	2.01
1977	8452.00	413.97	8995	8865.96	-129.04	1.43
1978	8995.00	530.10	9220	9525.09	305.09	3.31
1979	9220.00	255.51	9354	9475.51	121.51	1.30
1980	9354.00	146.15	9542	9500.15	-41.85	0.44
1981	9542.00	183.82	9685	9725.81	40.81	0.42
1982	9685.00	147.08	9577	9832.08	255.08	2.66
1983	9577.00	-82.49	9387	9494.51	107.51	1.15
1984	9387.00	-179.25	9067	9207.75	140.75	1.55
1985	9067.00	-305.92	8872	8761.07	-110.93	1.25
1986	8872.00	-206.09	8883	8665.91	-217.09	2.44
1987	8883.00	-10.71	8836	8872.29	36.29	0.41
1988	8836.00	-43.37		8792.63		

ALPH = 1.0 BETA = 0.9 MAPE = 2.62 MSE = 44145.69

TABLE 62

HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING FORECASTS FOR FEMALE ENROLLMENTS WITH ALPHA = 1.0 AND BETA = 0.8

YEAR	SMOOTH	TREND	FEMALE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962			3559			
1963	3559.00	26.80	3693	3585.80	-107.20	2.90
1964	3693.00	112.56	4142	3805.56	-336.44	8.12
1965	4142.00	381.71	4956	4523.71	-432.29	8.72
1966	4956.00	727.54	5634	5683.54	49.54	0.88
1967	5634.00	687.91	5868	6321.91	433.91	7.37
1968	5868.00	340.78	6042	6228.78	186.78	3.09
1969	6042.00	191.36	6213	6233.36	20.36	0.33
1970	6213.00	175.07	6584	6388.07	-195.93	2.98
1971	6584.00	331.81	6756	6915.81	159.81	2.37
1972	6756.00	203.96	6683	6959.96	276.96	4.14
1973	6683.00	-17.61	6941	6665.39	-275.61	3.97
1974	6941.00	202.88	7482	7143.87	-338.12	4.52
1975	7482.00	473.38	8055	7955.37	-99.63	1.24
1976	8055.00	553.07	8452	8608.07	156.07	1.85
1977	8452.00	428.21	8995	8880.21	-114.79	1.28
1978	8995.00	520.04	9220	9515.04	295.04	3.20
1979	9220.00	284.01	9354	9504.01	150.01	1.60
1980	9354.00	164.00	9542	9518.00	-24.00	0.25
1981	9542.00	183.20	9685	9725.20	40.20	0.42
1982	9685.00	151.04	9577	9836.04	259.04	2.70
1983	9577.00	-56.19	9387	9520.80	133.80	1.43
1984	9387.00	-163.24	9067	9223.76	156.76	1.73
1985	9067.00	-288.65	8872	8778.35	-93.65	1.06
1986	8872.00	-213.73	8883	8658.27	-224.73	2.53
1987	8883.00	-33.95	8836	8849.05	13.05	0.15
1988	8836.00	-44.39		8791.61		

ALPH = 1.0 BETA = 0.8 MAPE = 2.65 MSE = 46028.30

TABLE 63

HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING FORECASTS FOR GRADUATE ENROLLMENTS WITH ALPHA = 1.0 AND BETA = 0.1

YEAR	SMOOTH	TREND	GRADUATE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962			1502			
1963	1502.00	48.60	1556	1550.60	-5.40	0.35
1964	1556.00	49.14	1827	1605.14	-221.86	12.14
1965	1827 00	71.33	1885	1898.33	13.33	0.71
1966	1885.00	69.39	2071	1954.99	-116.01	5.60
1967	2071.00	81.59	2076	2152.59	76.59	3.69
1968	2076.00	73.93	2163	2149.93	-13.07	0.60
1969	2163.00	75.24	2433	2238.24	-194.76	8.00
1970	2433.00	94.72	2734	2527.72	-206.28	7.55
1971	2734.00	115.35	2869	2849.35	-19.65	0.69
1972	2869.00	117.31	2864	2986.31	122.31	4.27
1973	2864.00	105.08	3087	2969.08	-117.92	3.82
1974	3087.00	116.87	3252	3203.87	-48.13	1.48
1975	3252.00	121.68	3355	3373.68	18.68	0.56
1976	3355.00	119.82	3242	3474.82	232.82	7.18
1977	3242.00	96.53	3338	3338.53	0.53	0.02
1978	3338.00	96.48	3234	3434.48	200.48	6.20
1979	3234.00	76.43	3289	3310.43	21.43	0.65
1980	3289.00	74.29	3433	3363.29	-69.71	2.03
1981	3433.00	81.26	3372	3514.26	142.26	4.22
1982	3372.00	67.03	3580	3439.03	-140.97	3.94
1983	3580.00	81.13	3629	3661.13	32.13	0.89
1984	3629.00	77.92	3363	3706.92	343.92	10.23
1985	3363.00	43.53	3376	3406.53	30.53	0.90
1986	3376.00	40.47	3507	3416.47	-90.53	2.58
1987	3507.00	49.53	3625	3556.53	-68.47	1.89
1988	3625.00	56.37		3681.37		

ALPH = 1.0 BETA = 0.1 MAPE = 3.47 MSE = 17472.12

TABLE 64

HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING FORECASTS FOR GRADUATE ENROLLMENTS WITH ALPHA = 0.9 AND BETA = 0.2

YEAR	SMOOTH	TREND	GRADUATE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962			1502			
1963	1507.40	44.28	1556	1551.68	-4.32	0.28
1964	1555.57	45.06	1827	1600.62	-226.37	12.39
1965	1804.36	85.80	1885	1890.17	5.17	0.27
1966	1885.52	84.87	2071	1970.39	-100.61	4.86
1967	2060.94	102.98	2076	2163.92	87.92	4.24
1968	2084.79	87.16	2163	2171.95	8.95	0.41
1969	2163.89	85.55	2433	2249.44	-183.56	7.54
1970	2414.64	118.59	2734	2533.23	-200.77	7.34
1971	2713.92	154.73	2869	2868.65	-0.35	0.01
1972	2868.96	154.79	2864	3023.75	159.75	5.58
1973	2879.98	126.03	3087	3006.01	-80.99	2.62
1974	3078.90	140.61	3252	3219.51	-32.49	1.00
1975	3248.75	146.46	3355	3395.21	40.21	1.20
1976	3359.02	139.22	3242	3498.24	256.24	7.90
1977	3267.62	93.10	3338	3360.72	22.72	0.68
1978	3340.27	89.01	3234	3429.28	195.28	6.04
1979	3253.53	53.86	3289	3307.38	18.38	0.56
1980	3290.84	50.55	3433	3341.39	-91.61	2.67
1981	3423.84	67.04	3372	3490.88	118.88	3.53
1982	3383.89	45.64	3580	3429.53	-150.47	4.20
1983	3564.95	72.73	3629	3637.68	8.68	0.24
1984	3629.87	71.16	3363	3701.03	338.03	10.05
1985	3396.80	10.32	3376	3407.12	31.12	0.92
1986	3379.11	4.72	3507	3383.83	-123.17	3.51
1987	3494.68	26.89	3625	3521.57	-103.43	2.85
1988	3614.66	45.50		3660.16		

ALPH = 0.9 BETA = 0.2 MAPE = 3.50 MSE = 18037.34

TABLE 65

HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING FORECASTS FOR GRADUATE ENROLLMENTS WITH ALPHA = 0.9 AND BETA = 0.1

YEAR	SMOOTH	TREND	GRADUATE ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962			1502			
1963	1507.40	49.14	1556	1556.54	0.54	0.03
1964	1556.05	49.09	1827	1605.15	-221.85	12.14
1965	1804.81	69.06	1885	1873.87	-11.13	0.59
1966	1883.89	70.06	2071	1953.95	-117.05	5.65
1967	2059.29	80.59	2076	2139.89	63.89	3.08
1968	2082.39	74.84	2163	2157.23	-5.77	0.27
1969	2162.42	75.36	2433	2237.79	-195.21	8.02
1970	2413.48	92.93	2734	2506.41	-227.59	8.32
1971	2711.24	113.42	2869	2824.66	-44.34	1.55
1972	2864.57	117.41	2864	2981.97	117.97	4.12
1973	2875.80	106.79	3087	2982.59	-104.41	3.38
1974	3076.56	116.19	3252	3192.74	-59.26	1.82
1975	3246.07	121.52	3355	3367.59	12.59	0.38
1976	3356.26	120.39	3242	3476.64	234.64	7.24
1977	3265.46	99.27	3338	3364.73	26.73	0.80
1978	3340.67	96.86	3234	3437.53	203.53	6.29
1979	3254.35	78.54	3289	3332.90	43.90	1.33
1980	3293.39	74.59	3433	3367.98	-65.02	1.89
1981	3426.50	80.44	3372	3506.94	134.94	4.00
1982	3385.49	68.30	3580	3453.79	-126.21	3.53
1983	3567.38	79.66	3629	3647.04	18.04	0.50
1984	3630.80	78.03	3363	3708.84	345.84	10.28
1985	3397.58	46.91	3376	3444.49	68.49	2.03
1986	3382.85	40.74	3507	3423.59	-83.41	2.38
1987	3498.66	48.25	3625	3546.91	-78.09	2.15
1988	3617.19	55.28		3672.47		

ALPH = 0.9 BETA = 0.1 MAPE = 3.53 MSE = 17795.64

TABLE 66

HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING FORECASTS FOR FRESHMAN ENROLLMENTS WITH ALPHA = 1.0 AND BETA = 0.1

YEAR	SMOOTH	TREND	FRESHMAN ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962			3115			
1963	3115.00	-196.20	2897	2918.80	21.80	0.75
1964	2897.00	-198.38	3680	2698.62	-981.38	26.67
1965	3680.00	-100.24	4658	3579.76	-1078.24	23.15
1966	4658.00	7.58	4490	4665.58	175.58	3.91
1967	4490.00	-9.98	4236	4480.02	244.02	5.76
1968	4236.00	-34.38	3929	4201.62	272.62	6.94
1969	3929.00	-61.64	4208	3867.36	-340.64	8.10
1970	4208.00	-27.58	4347	4180.42	-166.58	3.83
1971	4347.00	-10.92	4211	4336.08	125.08	2.97
1972	4211.00	-23.43	3608	4187.57	579.57	16.06
1973	3608.00	-81.38	4064	3526.62	-537.38	13.22
1974	4064.00	-27.65	4340	4036.35	-303.65	7.00
1975	4340.00	2.72	5047	4342.72	-704.28	13.95
1976	5047.00	73.15	5328	5120.14	-207.86	3.90
1977	5328.00	93.93	5409	5421.93	12.93	0.24
1978	5409.00	92.64	5444	5501.64	57.64	1.06
1979	5444.00	86.88	5257	5530.87	273.87	5.21
1980	5257.00	59.49	5499	5316.48	-182.52	3.32
1981	5499.00	77.74	5326	5576.74	250.74	4.71
1982	5326.00	52.66	5165	5378.66	213.66	4.14
1983	5165.00	31.30	4672	5196.30	524.30	11.22
1984	4672.00	-21.13	4433	4650.87	217.87	4.91
1985	4433.00	-42.92	4471	4390.08	-80.92	1.81
1986	4471.00	-34.83	4560	4436.17	-123.83	2.72
1987	4560.00	-22.44	4177	4537.55	360.55	8.63
1988	4177.00	-58.50		4118.50		

ALPH = 1.0 BETA = 0.1 MAPE = 7.08 MSE = 169268.06

TABLE 67

HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING FORECASTS FOR FRESHMAN ENROLLMENTS WITH ALPHA = 0.9 AND BETA = 0.1

YEAR	SMOOTH	TREND	FRESHMAN ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962			3115			
1963	3093.20	-198.38	2897	2894.82	-2.18	0.08
1964	2896.78	-198.18	3680	2698.60	-981.40	26.67
1965	3581.86	-109.86	4658	3472.00	-1186.00	25.46
1966	4539.40	-3.12	4490	4536.28	46.28	1.03
1967	4494.62	-7.28	4236	4487.34	251.34	5.93
1968	4261.13	-29.90	3929	4231.23	302.23	7.69
1969	3959.22	-57.10	4208	3902.12	-305.88	7.27
1970	4177.41	-29.58	4347	4147.83	-199.17	4.58
1971	4327.08	-11.65	4211	4315.43	104.43	2.48
1972	4221.44	-21.05	3608	4200.39	592.39	16.42
1973	3667.24	-74.37	4064	3592.87	-471.13	11.59
1974	4016.89	-31.96	4340	3984.92	-355.08	8.18
1975	4304.49	-0.01	5047	4304.48	-742.52	14.71
1976	4972.75	66.82	5328	5039.56	-288.44	5.41
1977	5299.15	92.78	5409	5391.93	-17.07	0.32
1978	5407.29	94.31	5444	5501.60	57.60	1.06
1979	5449.75	89.13	5257	5538.88	281.88	5.36
1980	5285.18	63.76	5499	5348.94	-150.06	2.73
1981	5483.99	77.26	5326	5561.25	235.25	4.42
1982	5349.52	56.09	5165	5405.61	240.61	4.66
1983	5189.06	34.44	4672	5223.49	551.49	11.80
1984	4727.15	-15.20	4433	4711.95	278.95	6.29
1985	4460.89	-40.30	4471	4420.59	-50.41	1.13
1986	4465.96	-35.77	4560	4430.19	-129.81	2.85
1987	4547.02	-24.09	4177	4522.93	345.93	8.28
1988	4211.59	-55.22		4156.37		

ALPH = 0.9 BETA = 0.1 MAPE = 7.17 MSE = 182455.75

TABLE 68

HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING FORECASTS FOR FRESHMAN ENROLLMENTS WITH ALPHA = 0.8 AND BETA = 0.1

YEAR	SMOOTH	TREND	FRESHMAN ENROLLMENT	FORECAST	ERROR	ABSOLUTE % ERROR
1962			3115			
1963	3071.40	-200.56	2897	2870.84	-26.16	0.90
1964	2891.77	-198.47	3680	2693.30	-986.70	26.81
1965	3482.66	-119.53	4658	3363.13	-1294.87	27.80
1966	4399.02	-15.94	4490	4383.08	-106.92	2.38
1967	4468.61	-7.39	4236	4461.22	225.22	5.32
1968	4281.04	-25.41	3929	4255.63	326.63	8.31
1969	3994.33	-51.54	4208	3942.79	-265.21	6.30
1970	4154.96	-30.32	4347	4124.63	-222.37	5.12
1971	4302.52	-12.53	4211	4289.99	78.99	1.88
1972	4226.80	-18.85	3608	4207.95	599.95	16.63
1973	3727.99	-66.85	4064	3661.14	-402.86	9.91
1974	3983.43	-34.62	4340	3948.81	-391.19	9.01
1975	4261.76	-3.32	5047	4258.44	-788.56	15.62
1976	4889.29	59.76	5328	4949.04	-378.96	7.11
1977	5252.20	90.08	5409	5342.28	-66.72	1.23
1978	5395.65	95.41	5444	5491.07	47.07	0.86
1979	5453.41	91.65	5257	5545.06	288.06	5.48
1980	5314.61	68.60	5499	5383.21	-115.79	2.11
1981	5475.84	77.87	5326	5553.70	227.70	4.28
1982	5371.54	59.65	5165	5431.19	266.19	5.15
1983	5218.23	38.35	4672	5256.59	584.59	12.51
1984	4788.91	-8.41	4433	4780.50	347.50	7.84
1985	4502.50	-36.21	4471	4466.28	-4.72	0.11
1986	4470.05	-35.84	4560	4434.21	-125.79	2.76
1987	4534.84	-25.77	4177	4509.06	332.06	7.95
1988	4243.41	-52.34		4191.07		

ALPH = 0.8 BETA = 0.1 MAPE = 7.44 MSE = 200033.50

APPENDIX D

BOX-JENKINS ARIMA FORECASTS

TABLE 69

BOX-JENKINS ARIMA (1,0,0) FOR TOTAL ENROLLMENTS - YEARS 1948 THROUGH 1985 TO FORECAST 1986

MODEL: D=0, P=1

RESULTS OF ENROLLMENT FORECAST

YEAR	ACTUAL TOTAL ENROLLMENTS	FORECAST TOTAL ENROLLMENTS	FORECAST ERRORS	ABSOLUTE PERCENT ERRORS
1948	10265	10611	346	3.37%
1949	9993	10587	594	5.94%
1950	8517	10334	1817	21.33%
1951	7697	8948.1	1251.1	16.25%
1952	8236	8168.1	-67.9	0.82%
1953	7790	8681.7	891.7	11.45%
1954	8403	8256.9	-146.1	1.74%
1955	9113	8840.1	-272.9	2.99%
1956	9328	9510.4	182.4	1.96%
1957	9342	9712.3	370.3	3.96%
1958	9693	9725.4	32.4	0.33%
1959	10298	10054	-244	2.37%
1960	10854	10618	-236	2.17%
1961	11301	11133	-168	1.49%
1962	11795	11545	-250	2.12%
1963	11961	11999	38	0.32%
1964	13214	12151	-1063	8.04%
1965	15079	13292	-1787	11.85%
1966	16010	14971	-1039	6.49%
1967	16546	15802	-744	4.50%
1968	16841	16277	-564	3.35%
1969	17492	16539	-953	5.45%
1970	18444	17114	-1330	7.21%
1971	18655	17951	-704	3.77%
1972	18080	18135	55	0.30%
1973	18560	17631	-929	5.01%
1974	19280	18052	-1228	6.37%
1975	20490	18682	-1808	8.82%
1976	21129	19735	-1394	6.60%
1977	21904	20289	-1615	7.37%
1978	22287	20958	-1329	5.96%
1979	22003	21288	-715	3.25%
1980	22490	21044	-1446	6.43%
1981	22709	21463	-1246	5.49%
1982	23053	21651	-1402	6.08%
1983	22366	21946	-420	1.88%
1984	21449	21356	-93	0.43%
1985	20901	20566	-335	1.60%

AVERAGE % ERROR = 5.13%

YEAR	ACTUAL	FORECAST	DIFFERENCE	ABSOLUTE % ERROR
1986	20634	20092	-542	2.63%

TABLE 70

BOX-JENKINS ARIMA (1,0,0) FOR TOTAL ENROLLMENTS - YEARS 1948 THROUGH 1986 TO FORECAST 1987

MODEL: D=0, P=1

RESULTS OF ENROLLMENT FORECAST

YEAR	ACTUAL TOTAL ENROLLMENTS	FORECAST TOTAL ENROLLMENTS	FORECAST ERRORS	ABSOLUTE PERCENT ERRORS
1948	10265	10611	346	3.37%
1949	9993	10587	594	5.94%
1950	8517	10334	1817	21.33%
1951	9697	8948.1	-748.9	7.72%
1952	8236	8168.1	-67.9	0.82%
1953	7790	8681.7	891.7	11.45%
1954	8403	8256.9	-146.1	1.74%
1955	9113	8840.1	-272.9	2.99%
1956	9328	9510.4	182.4	1.96%
1957	9342	9712.3	370.3	3.96%
1958	9693	9725.4	32.4	0.33%
1959	10298	10054	-244	2.37%
1960	10854	10618	-236	2.17%
1961	11301	11133	-168	1.49%
1962	11795	11545	-250	2.12%
1963	11961	11999	38	0.32%
1964	13214	12151	-1063	8.04%
1965	15079	13292	-1787	11.85%
1966	16010	14971	-1039	6.49%
1967	16546	15802	-744	4.50%
1968	16841	16277	-564	3.35%
1969	17492	16539	-953	5.45%
1970	18444	17114	-1330	7.21%
1971	18655	17951	-704	3.77%
1972	18080	18135	55	0.30%
1973	18560	17631	-929	5.01%
1974	19280	18052	-1228	6.37%
1975	20490	18682	-1808	8.82%
1976	21129	19735	-1394	6.60%
1977	21904	20289	-1615	7.37%
1978	22287	20958	-1329	5.96%
1979	22003	21288	-715	3.25%
1980	22490	21044	-1446	6.43%
1981	22709	21463	-1246	5.49%
1982	23053	21651	-1402	6.08%
1983	22366	21946	-420	1.88%
1984	21449	21356	-93	0.43%
1985	20901	20566	-335	1.60%
1986	20634	20092	-542	2.63%

AVERAGE % ERROR = 4.85%

YEAR	ACTUAL	FORECAST	DIFFERENCE	ABSOLUTE % ERROR
1987	20116	19860	-256	1.27%

TABLE 71

BOX-JENKINS ARIMA (1,0,0) FOR TOTAL ENROLLMENTS - YEARS 1948 THROUGH 1987 TO FORECAST 1988 AND 1989

MODEL: D=0, P=1

RESULTS OF ENROLLMENT FORECAST

YEAR	ACTUAL TOTAL ENROLLMENTS	FORECAST TOTAL ENROLLMENTS	FORECAST ERRORS	ABSOLUTE PERCENT ERRORS
1948	10265	10611	346	3.37%
1949	9993	10587	594	5.94%
1950	8517	10334	1817	21.33%
1951	9697	8948.1	-748.9	7.72%
1952	8236	8168.1	-67.9	0.82%
1953	7790	8681.7	891.7	11.45%
1954	8403	8256.9	-146.1	1.74%
1955	9113	8840.1	-272.9	2.99%
1956	9328	9510.4	182.4	1.96%
1957	9342	9712.3	370.3	3.96%
1958	9693	9725.4	32.4	0.33%
1959	10298	10054	-244	2.37%
1960	10854	10618	-236	2.17%
1961	11301	11133	-168	1.49%
1962	11795	11545	-250	2.12%
1963	11961	11999	38	0.32%
1964	13214	12151	-1063	8.04%
1965	15079	13292	-1787	11.85%
1966	16010	14971	-1039	6.49%
1967	16546	15802	-744	4.50%
1968	16841	16277	-564	3.35%
1969	17492	16539	-953	5.45%
1970	18444	17114	-1330	7.21%
1971	18655	17951	-704	3.77%
1972	18080	18135	55	0.30%
1973	18560	17631	-929	5.01%
1974	19280	18052	-1228	6.37%
1975	20490	18682	-1808	8.82%
1976	21129	19735	-1394	6.60%
1977	21904	20289	-1615	7.37%
1978	22287	20958	-1329	5.96%
1979	22003	21288	-715	3.25%
1980	22490	21044	-1446	6.43%
1981	22709	21463	-1246	5.49%
1982	23053	21651	-1402	6.08%
1983	22366	21946	-420	1.88%
1984	21449	21356	-93	0.43%
1985	20901	20566	-335	1.60%
1986	20634	20092	-542	2.63%
1987	20116	19860	-256	1.27%

AVERAGE % ERROR = 4.76%

YEAR	ACTUAL	FORECAST	DIFFERENCE	ABSOLUTE % ERROR
1988	NOT AVAILABLE	19410	UNKNOWN	UNKNOWN
1989	NOT AVAILABLE	18796	UNKNOWN	UNKNOWN

TABLE 72

BOX-JENKINS ARIMA (1,0,1) FOR TOTAL ENROLLMENTS - YEARS 1948 THROUGH 1985 TO FORECAST 1986

MODEL: D=0, P=1, Q=1

RESULTS OF ENROLLMENT FORECAST

YEAR	ACTUAL TOTAL ENROLLMENTS	FORECAST TOTAL ENROLLMENTS	FORECAST ERRORS	ABSOLUTE PERCENT ERRORS
1948	10265	11626	1361	13.26%
1949	9993	9709.6	-283.4	2.84%
1950	8517	10727	2210	25.95%
1951	9697	7611	-2086	21.51%
1952	8236	8472.5	236.5	2.87%
1953	7790	8695.1	905.1	11.62%
1954	8403	7769.7	-633.3	7.54%
1955	9113	9631.6	518.6	5.69%
1956	9328	9273.5	-54.5	0.58%
1957	9342	9933.2	591.2	6.33%
1958	9693	9425.8	-267.2	2.76%
1959	10298	10445	147	1.43%
1960	10854	10633	-221	2.04%
1961	11301	11432	131	1.16%
1962	11795	11531	-264	2.24%
1963	11961	12289	328	2.74%
1964	13214	11952	-1262	9.55%
1965	15079	14403	-676	4.48%
1966	16010	15427	-583	3.64%
1967	16546	16119	-427	2.58%
1968	16841	16432	-409	2.43%
1969	17492	16660	-832	4.76%
1970	18444	17541	-903	4.90%
1971	18655	18371	-284	1.52%
1972	18080	18040	-40	0.22%
1973	18560	17383	-1177	6.34%
1974	19280	18697	-583	3.02%
1975	20490	18782	-1708	8.34%
1976	21129	20690	-439	2.08%
1977	21904	20145	-1759	8.03%
1978	22287	21839	-448	2.01%
1979	22003	21069	-934	4.24%
1980	22490	21228	-1262	5.61%
1981	22709	21876	-833	3.67%
1982	23053	21701	-1352	5.86%
1983	22366	22389	23	0.10%
1984	21449	20775	-674	3.14%
1985	20901	20584	-317	1.52%

AVERAGE % ERROR = 5.23%

YEAR	ACTUAL	FORECAST	DIFFERENCE	ABSOLUTE % ERROR
1986	20116	19870	-246	1.22%

TABLE 73

BOX-JENKINS ARIMA (1,0,1) FOR TOTAL ENROLLMENTS - YEARS 1948 THROUGH 1986 TO FORECAST 1987

MODEL: D=0, P=1, Q=1

RESULTS OF ENROLLMENT FORECAST

YEAR	ACTUAL TOTAL ENROLLMENTS	FORECAST TOTAL ENROLLMENTS	FORECAST ERRORS	ABSOLUTE PERCENT ERRORS
1948	10265	11568	1303	12.69%
1949	9993	9718.5	-274.5	2.75%
1950	8517	10563	2046	24.02%
1951	9697	7673.2	-2023.8	20.87%
1952	8236	8218.9	-17.1	0.21%
1953	7790	8724	934	11.99%
1954	8403	7632.7	-770.3	9.17%
1955	9113	9511.3	398.3	4.37%
1956	9328	9241.5	-86.5	0.93%
1957	9342	9800.6	458.6	4.91%
1958	9693	9413.1	-279.9	2.89%
1959	10298	10291	-7	0.07%
1960	10854	10638	-216	1.99%
1961	11301	11307	6	0.05%
1962	11795	11547	-248	2.10%
1963	11961	12188	227	1.90%
1964	13214	11986	-1228	9.29%
1965	15079	14259	-820	5.44%
1966	16010	15563	-447	2.79%
1967	16546	16091	-455	2.75%
1968	16841	16565	-276	1.64%
1969	17492	16689	-803	4.59%
1970	18444	17651	-793	4.30%
1971	18655	18465	-190	1.02%
1972	18080	18201	121	0.67%
1973	18560	17483	-1077	5.80%
1974	19280	18784	-496	2.57%
1975	20490	18961	-1529	7.46%
1976	21129	20784	-345	1.63%
1977	21904	20432	-1472	6.72%
1978	22287	21931	-356	1.60%
1979	22003	21423	-580	2.64%
1980	22490	21344	-1146	5.10%
1981	22709	22174	-535	2.36%
1982	23053	21908	-1145	4.97%
1983	22366	22646	280	1.25%
1984	21449	21048	-401	1.87%
1985	20901	20744	-157	0.75%
1986	20634	20104	-530	2.57%

AVERAGE % ERROR = 4.63%

YEAR	ACTUAL	FORECAST	DIFFERENCE	ABSOLUTE % ERROR
1987	20116	20144	28	0.14%

TABLE 74

BOX-JENKINS ARIMA (1,0,1) FOR TOTAL ENROLLMENTS - YEARS 1948 THROUGH 1987 TO FORECAST 1988 AND 1989

MODEL: D=0, P=1, Q=1

RESULTS OF ENROLLMENT FORECAST

YEAR	ACTUAL TOTAL ENROLLMENTS	FORECAST TOTAL ENROLLMENTS	FORECAST ERRORS	ABSOLUTE PERCENT ERRORS
1948	10265	11627	1362	13.27%
1949	9993	9718.1	-274.9	2.75%
1950	8517	10729	2212	25.97%
1951	9697	7617.7	-2079.3	21.44%
1952	8236	8474.1	238.1	2.89%
1953	7790	8701.7	911.7	11.70%
1954	8403	7772.4	-630.6	7.50%
1955	9113	9637.1	524.1	5.75%
1956	9328	9277.9	-50.1	0.54%
1957	9342	9938.4	596.4	6.38%
1958	9693	9430.7	-262.3	2.71%
1959	10298	10450	152	1.48%
1960	10854	10638	-216	1.99%
1961	11301	11438	137	1.21%
1962	11795	11537	-258	2.19%
1963	11961	12295	334	2.79%
1964	13214	11959	-1255	9.50%
1965	15079	14409	-670	4.44%
1966	16010	15435	-575	3.59%
1967	16546	16126	-420	2.54%
1968	16841	16441	-400	2.38%
1969	17492	16668	-824	4.71%
1970	18444	17550	-894	4.85%
1971	18655	18380	-275	1.47%
1972	18080	18049	-31	0.17%
1973	18560	17391	-1169	6.30%
1974	19280	18706	-574	2.98%
1975	20490	18791	-1699	8.29%
1976	21129	20699	-430	2.04%
1977	21904	20156	-1748	7.98%
1978	22287	21848	-439	1.97%
1979	22003	21080	-923	4.19%
1980	22490	21237	-1253	5.57%
1981	22709	21887	-822	3.62%
1982	23053	21711	-1342	5.82%
1983	22366	22400	34	0.15%
1984	21449	20785	-664	3.10%
1985	20901	20593	-308	1.47%
1986	20634	19880	-754	3.65%
1987	20116	20019	-97	0.48%

AVERAGE % ERROR = 5.05%

TABLE 74 (Continued)

MODEL: D=0, P=1, Q=1

RESULTS OF ENROLLMENT FORECAST

YEAR	ACTUAL TOTAL ENROLLMENTS	FORECAST TOTAL ENROLLMENTS	FORECAST ERRORS	ABSOLUTE PERCENT ERRORS
1988	NOT AVAILABLE	19091	UNKNOWN	UNKNOWN
1989	NOT AVAILABLE	18190	UNKNOWN	UNKNOWN

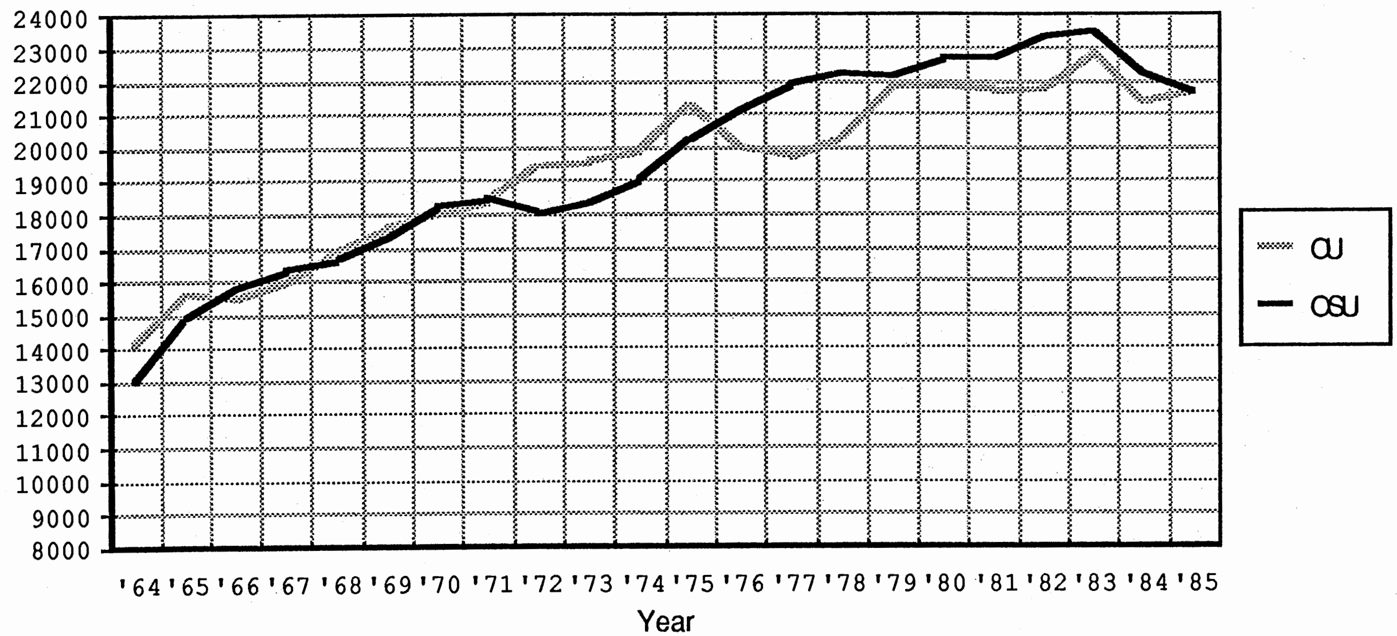


Figure 11. OSU and OU Main Campus Enrollments

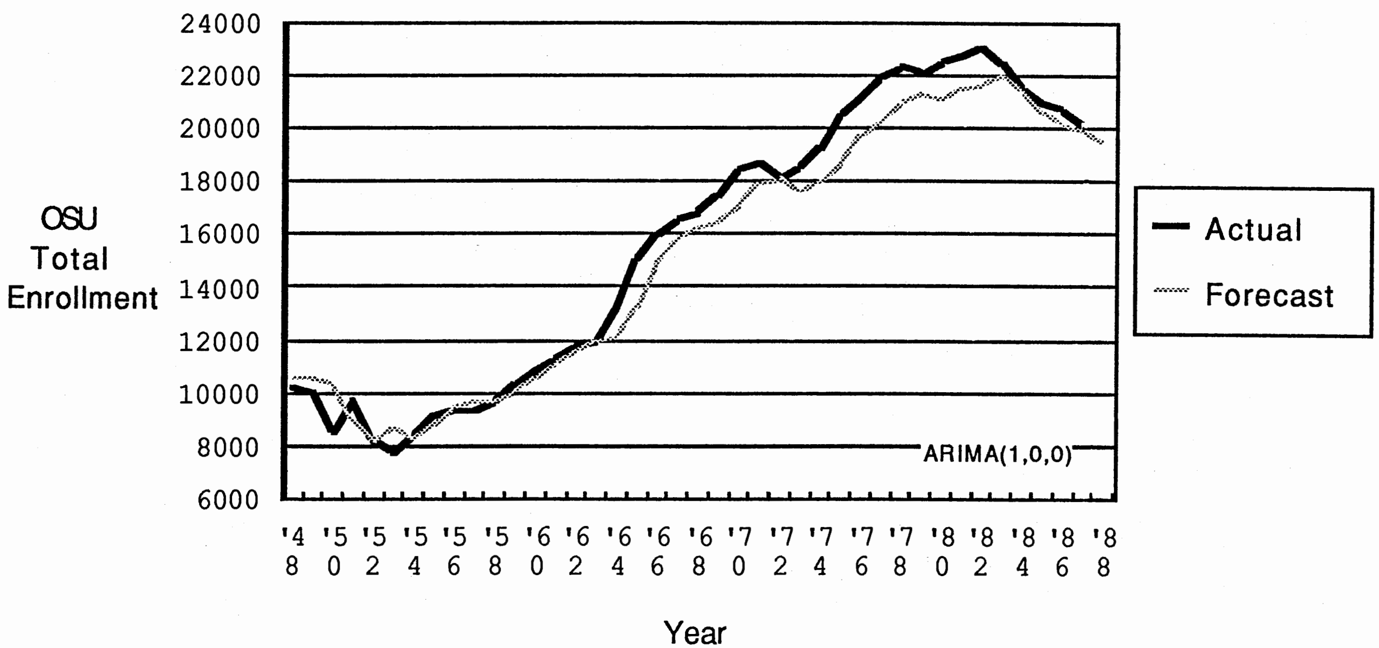


Figure 12. Results of Box-Jenkins Enrollment Forecasts

DATA - *
MEAN - .

OBS.	DATA
1	8711.00
2	10291.0
3	10265.0
4	9993.00
5	8517.00
6	7697.00
7	8236.00
8	7790.00
9	8403.00
10	9113.00
11	9328.00
12	9342.00
13	9693.00
14	10298.0
15	10854.0
16	11301.0
17	11795.0
18	11961.0
19	13214.0
20	15079.0
21	16010.0
22	16546.0
23	16841.0
24	17492.0
25	18444.0
26	18655.0
27	18080.0
28	18560.0
29	19280.0
30	20490.0
31	21129.0
32	21904.0
33	22287.0
34	22003.0
35	22490.0
36	22709.0
37	23053.0
38	22366.0
39	21449.0
40	20901.0
41	20634.0
42	20116.0

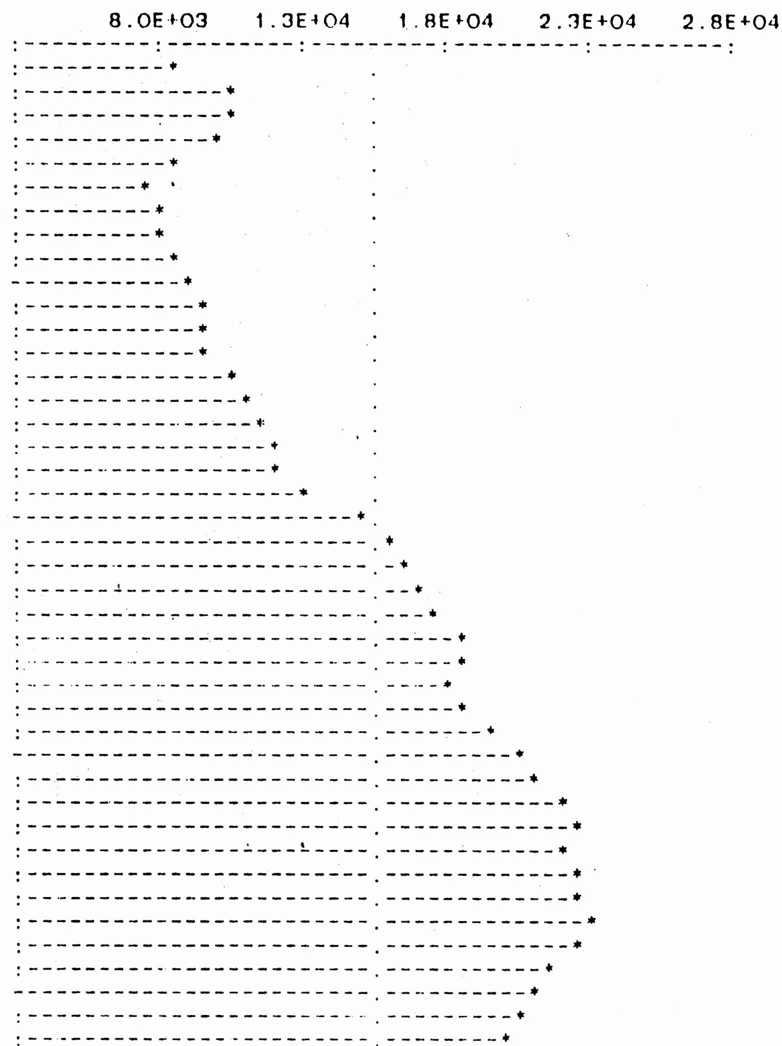
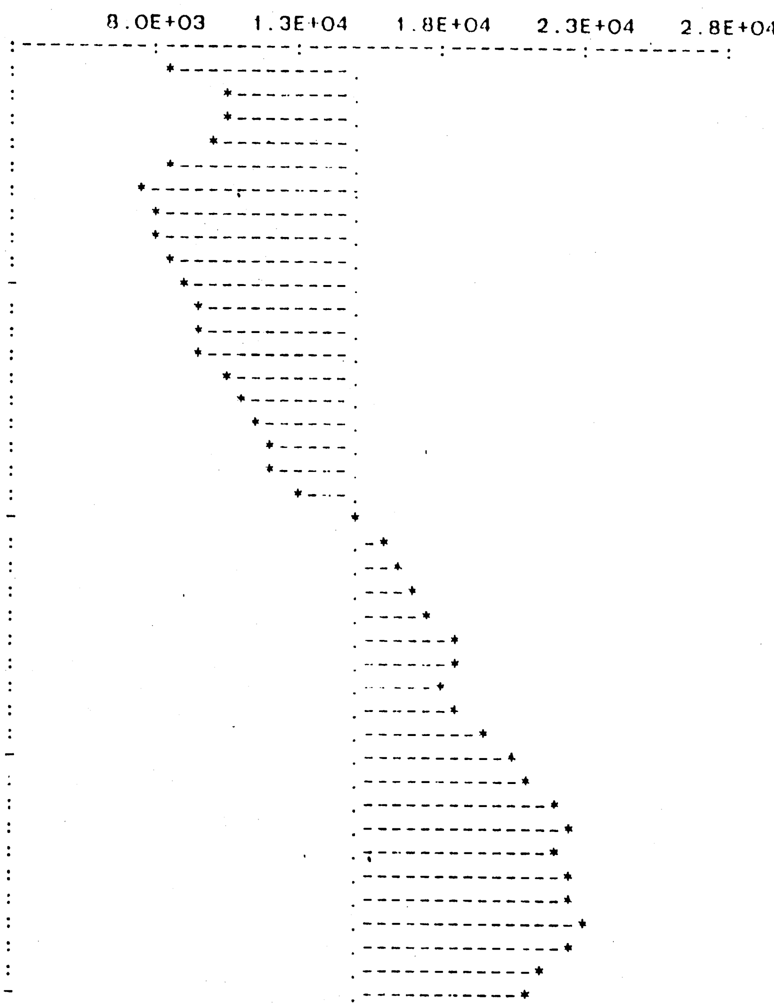


Figure 13. Enrollment Series - Years 1945 Through 1987

DATA - *
MEAN - .

OBS.	DATA
1	8711.00
2	10291.0
3	10265.0
4	9993.00
5	8517.00
6	7697.00
7	8236.00
8	7790.00
9	8403.00
10	9113.00
11	9328.00
12	9342.00
13	9693.00
14	10298.0
15	10854.0
16	11301.0
17	11795.0
18	11961.0
19	13214.0
20	15079.0
21	16010.0
22	16546.0
23	16841.0
24	17492.0
25	18444.0
26	18655.0
27	18080.0
28	18560.0
29	19280.0
30	20490.0
31	21129.0
32	21904.0
33	22287.0
34	22003.0
35	22490.0
36	22709.0
37	23053.0
38	22366.0
39	21449.0
40	20901.0



MEAN VALUE OF THE PROCESS
0.15064E+05

STANDARD DEVIATION OF THE PROCESS
0.53750E+04

Figure 14. OSU Enrollment Series (with d=0) - Years 1945 Through 1985

```
AUTOCORRELATIONS *
TWO STANDARD ERROR LIMITS .

     AUTO.  STAND.
LAG  CORR.    ERR   -1  -.75  -.5 -.25   0   .25  .5   .75   1
                     :----:----:----:----:----:----:----:----:
  1  0.958  0.150                    .   :*****.*************
  2  0.913  0.148                    .   :*****.************
  3  0.857  0.146                    .   :*****.***********
  4  0.794  0.144                    .   :*****.**********
  5  0.721  0.142                    .   :*****.********
  6  0.637  0.140                    .   :*****.*******
  7  0.555  0.138                    .   :*****.*****
  8  0.465  0.136                     .  :****.****
  9  0.378  0.131                     .  :****.***
 10  0.295  0.131                     .  :****.*
 11  0.213  0.129                     .  :****.
 12  0.132  0.127                     .  :***  .
 13  0.053  0.124                     .  :*    .
 14 -0.024  0.122                     .  *     .
 15 -0.100  0.120                     . **:    .
 16 -0.172  0.117                     .***:    .
 17 -0.237  0.114                     *****:   .
 18 -0.298  0.112                   **.***:   .
 19 -0.353  0.109                  ***.***:   .
 20 -0.394  0.106                 ****.***:   .
 21 -0.423  0.104                 ****.***:   .
 22 -0.441  0.101                *****.***:   .
 23 -0.453  0.098                *****.***:   .
 24 -0.460  0.094                *****.***:   .
 25 -0.458  0.091                *****.***:   .
 26 -0.448  0.088                *****.***:   .
 27 -0.439  0.085                ******.**:  .
 28 -0.422  0.081                 *****.**:  .
 29 -0.401  0.077                 *****.**:  .
 30 -0.373  0.073                  ****.**:  .
```

Figure 15. SAC for Enrollment Series (with d=0) - Years 1945 Through 1985

```
PARTIAL AUTOCORRELATIONS *
TWO STANDARD ERROR LIMITS .

     PR-AUT STAND.
LAG  CORR.    ERR.  -1  -.75  -.5 -.25   0   .25  .5   .75   1
                     :----:----:----:----:----:----:----:----:
  1  0.958  0.158                    .   :*****.*************
  2 -0.071  0.158                    .  *:    .
  3 -0.144  0.158                    . ***:    .
  4 -0.119  0.158                    .  **:    .
  5 -0.147  0.158                    . ***:    .
  6 -0.148  0.158                    . ***:    .
  7 -0.007  0.158                    .    *    .
  8 -0.123  0.158                    .  **:    .
  9 -0.010  0.158                    .    *    .
 10  0.032  0.158                    .    :*   .
 11 -0.055  0.158                    .   *:    .
 12 -0.058  0.158                    .   *:    .
 13 -0.057  0.158                    .   *:    .
 14 -0.072  0.158                    .   *:    .
 15 -0.080  0.158                    .  **:    .
 16 -0.047  0.158                    .   *:    .
 17 -0.012  0.158                    .    *    .
 18 -0.052  0.158                    .   *:    .
 19 -0.006  0.158                    .    *    .
 20  0.087  0.158                    .    :**  .
 21  0.045  0.158                    .    :*   .
 22  0.045  0.158                    .    :*   .
 23 -0.027  0.158                    .   *:    .
 24 -0.097  0.158                    .  **:    .
 25  0.007  0.158                    .    *    .
 26 -0.002  0.158                    .    *    .
 27 -0.102  0.158                    .  **:    .
 28  0.022  0.158                    .    *    .
 29  0.025  0.158                    .    *    .
 30  0.045  0.158                    .    :*   .
```

Figure 16. SPAC for OSU Enrollment Series (with d=0) - Years 1945 Through 1985

DATA - *
MEAN - .

OBS	DATA
1	1580.00
2	-26.0000
3	-272.000
4	-1476.00
5	-820.000
6	539.000
7	-446.000
8	613.000
9	710.000
10	215.000
11	14.0000
12	351.000
13	605.000
14	556.000
15	447.000
16	494.000
17	166.000
18	1253.00
19	1865.00
20	931.000
21	536.000
22	295.000
23	651.000
24	952.000
25	211.000
26	-575.000
27	480.000
28	720.000
29	1210.00
30	639.000
31	775.000
32	383.000
33	-284.000
34	487.000
35	219.000
36	344.000
37	-687.000
38	-917.000
39	-548.000

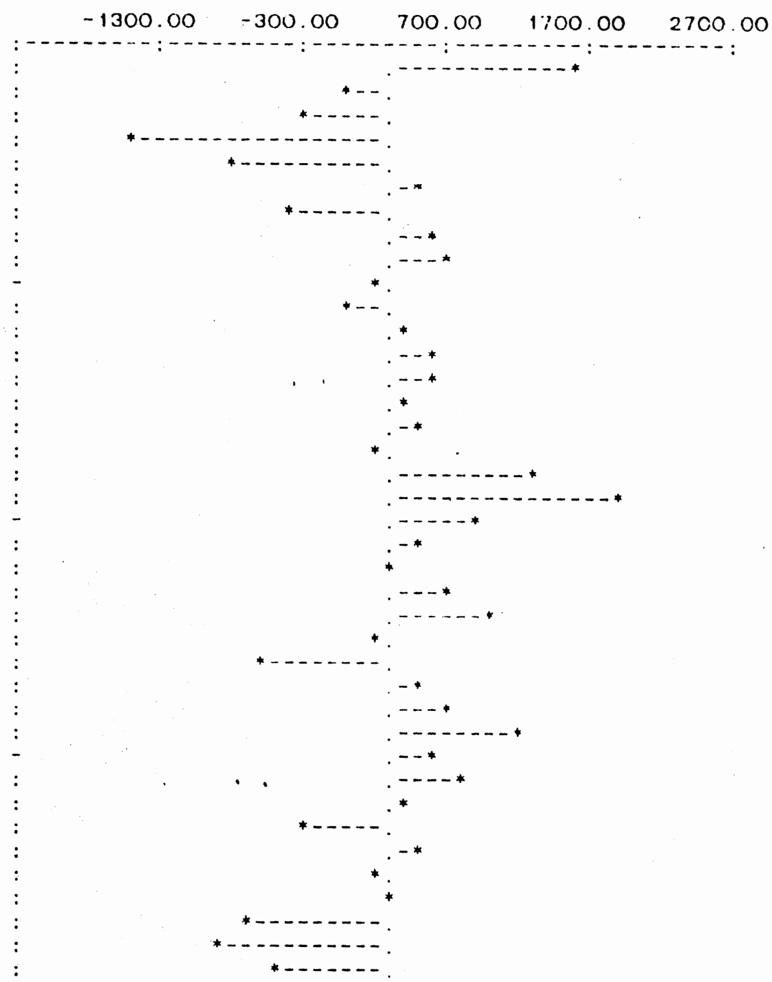


Figure 17. OSU Enrollment Series (with d=1) - Years 1945 Through 1985

AUTOCORRELATIONS *
TWO STANDARD ERROR LIMITS .

LAG	AUTO. CORR.	STAND. ERR.
1	0.445	0.152
2	0.110	0.150
3	-0.061	0.148
4	-0.024	0.146
5	0.129	0.144
6	-0.002	0.141
7	-0.029	0.139
8	-0.099	0.137
9	-0.076	0.135
10	0.020	0.132
11	0.075	0.130
12	0.055	0.128
13	-0.028	0.125
14	-0.268	0.123
15	-0.219	0.120
16	-0.156	0.117
17	-0.102	0.115
18	-0.076	0.112
19	-0.193	0.109
20	-0.194	0.106
21	-0.004	0.103
22	0.073	0.100
23	0.010	0.097
24	-0.161	0.094
25	-0.229	0.090
26	-0.061	0.087
27	-0.041	0.083
28	0.079	0.079
29	0.019	0.075
30	0.043	0.071

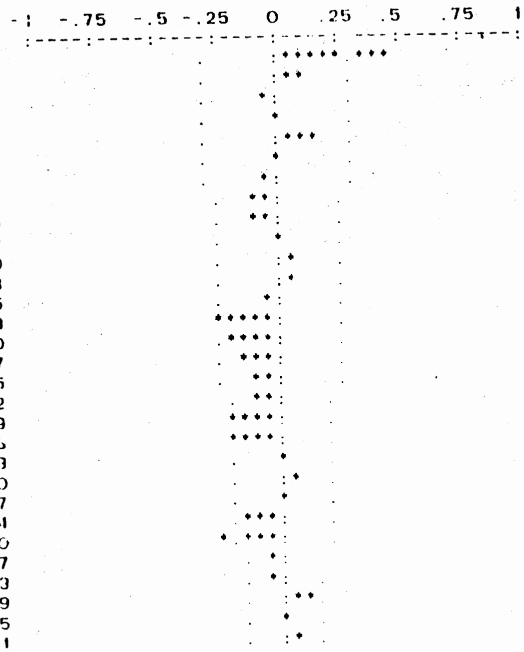


Figure 18. SAC for OSU Enrollment Series (with d=1) - Years 1945 Through 1985

PARTIAL AUTOCORRELATIONS *
TWO STANDARD ERROR LIMITS .

LAG	PR-AUT CORR.	STAND. ERR.
1	0.445	0.160
2	-0.109	0.160
3	-0.085	0.160
4	0.064	0.160
5	0.155	0.160
6	-0.182	0.160
7	0.038	0.160
8	-0.064	0.160
9	-0.015	0.160
10	0.012	0.160
11	0.080	0.160
12	-0.046	0.160
13	-0.027	0.160
14	-0.299	0.160
15	0.036	0.160
16	-0.093	0.160
17	-0.064	0.160
18	-0.045	0.160
19	-0.083	0.160
20	-0.149	0.160
21	0.219	0.160
22	-0.106	0.160
23	-0.118	0.160
24	-0.145	0.160
25	-0.056	0.160
26	0.029	0.160
27	-0.072	0.160
28	0.011	0.160
29	-0.033	0.160
30	0.043	0.160

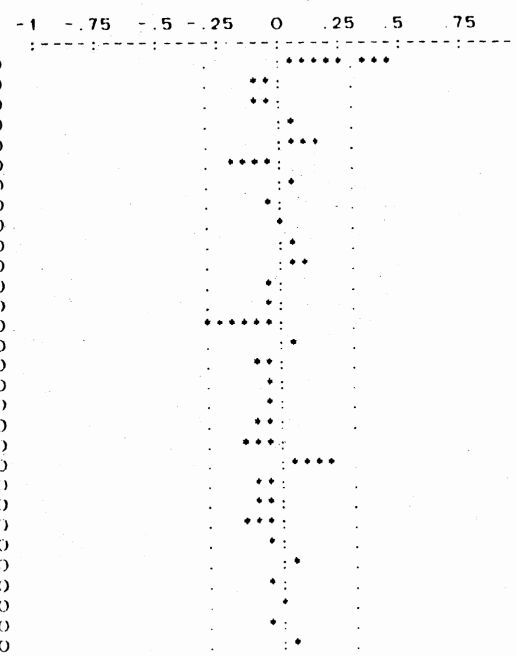


Figure 19. SPAC for OSU Enrollment Series (with d=1) - Years 1945 Through 1985

DEGREE OF NONSEASONAL DIFFERENCING - 2 DEGREE OF SEASONAL DIFFERENCING - 0
DATA - *
MEAN - .

OBS	DATA
1	-1606.00
2	-246.000
3	-1204.00
4	656.000
5	1359.00
6	-985.000
7	1059.00
8	97.0000
9	-495.000
10	-201.000
11	337.000
12	254.000
13	-49.0000
14	-109.000
15	47.0000
16	-328.000
17	1087.00
18	612.000
19	-934.000
20	-395.000
21	-241.000
22	356.000
23	301.000
24	-741.000
25	-786.000
26	1055.00
27	240.000
28	490.000
29	-571.000
30	136.000
31	-392.000
32	-667.000
33	771.000
34	-268.000
35	125.000
36	-1031.00
37	-230.000
38	369.000

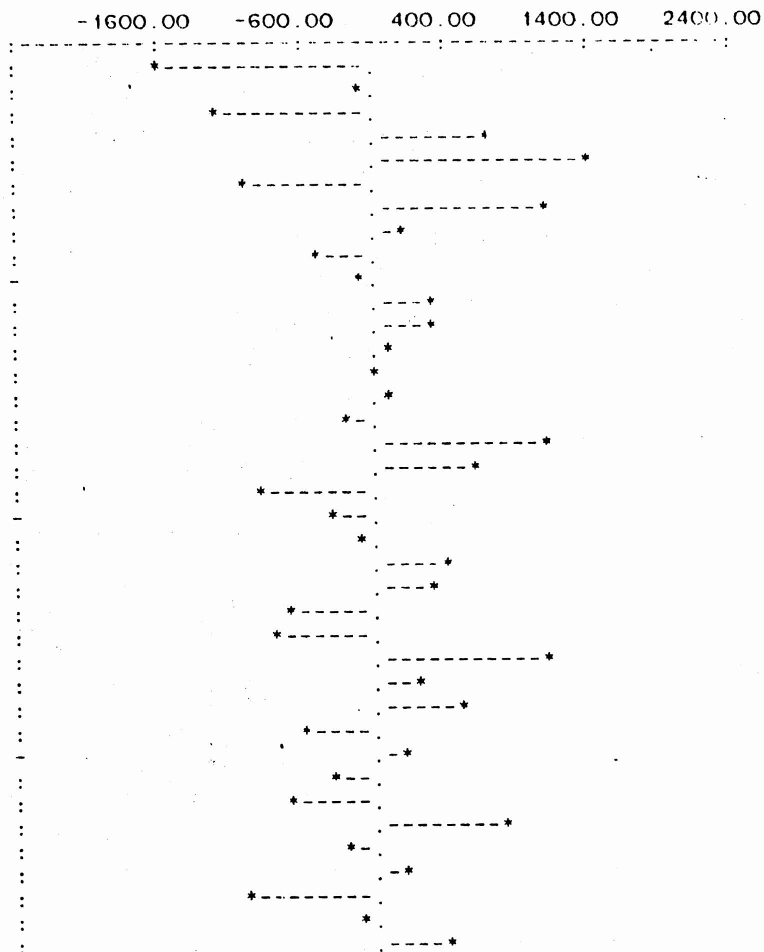


Figure 20. OSU Enrollment Series (with d=2) - Years 1945 Through 1985

AUTOCORRELATIONS *
TWO STANDARD ERROR LIMITS .

LAG	AUTO. CORR.	STAND. ERR.	-1 -.75 -.5 -.25 0 .25 .5 .75 1
1	-0.131	0.151	***:
2	-0.140	0.152	***:
3	-0.070	0.150	*:
4	-0.171	0.147	***:
5	0.206	0.145	:****
6	-0.074	0.143	*:
7	-0.003	0.140	*
8	-0.084	0.138	**:
9	-0.046	0.136	*:
10	0.088	0.133	:**
11	0.026	0.131	:*
12	0.032	0.128	:*
13	0.106	0.126	:**
14	-0.254	0.123	*****:
15	0.019	0.120	*
16	0.015	0.118	*
17	-0.073	0.115	*:
18	0.105	0.112	:**
19	-0.034	0.109	*:
20	-0.120	0.106	**:
21	0.104	0.103	:**
22	0.057	0.099	:*
23	0.100	0.096	:**
24	-0.058	0.092	*:
25	-0.180	0.089	****:
26	0.074	0.085	:*
27	-0.141	0.081	***:
28	0.124	0.077	:**
29	-0.041	0.073	*:
30	0.033	0.068	:*

Figure 21. SAC for OSU Enrollment Series (with d=2) - Years 1945 Through 1985

PARTIAL AUTOCORRELATIONS *
TWO STANDARD ERROR LIMITS .

LAG	PR-AUT CORR.	STAND. ERR.	-1 -.75 -.5 -.25 0 .25 .5 .75 1
1	-0.131	0.162	***:
2	-0.160	0.162	***:
3	-0.117	0.162	**:
4	-0.236	0.162	*****:
5	0.116	0.162	:**
6	-0.110	0.162	**:
7	-0.012	0.162	*
8	-0.140	0.162	***:
9	-0.041	0.162	*:
10	-0.032	0.162	*:
11	0.029	0.162	:*
12	-0.003	0.162	*
13	0.172	0.162	:***
14	-0.235	0.162	*****:
15	0.017	0.162	*
16	-0.086	0.162	**:
17	0.078	0.162	**:
18	-0.064	0.162	*:
19	0.067	0.162	:*
20	-0.241	0.162	*****:
21	0.130	0.162	:***
22	-0.050	0.162	*:
23	0.156	0.162	:***
24	-0.138	0.162	***:
25	-0.023	0.162	*
26	-0.082	0.162	**:
27	-0.061	0.162	*:
28	-0.125	0.162	***:
29	-0.024	0.162	*
30	0.034	0.162	:*

Figure 22. SPAC for OSU Enrollment Series (with d=2) - Years 1945 Through 1985

DEGREE OF NONSEASONAL DIFFERENCING - 0 DEGREE OF SEASONAL DIFFERENCING - 0
DATA - *
MEAN - .

OBS.	DATA
1	8711.00
2	10291.0
3	10265.0
4	9993.00
5	8517.00
6	7697.00
7	8236.00
8	7790.00
9	8403.00
10	9113.00
11	9328.00
12	9342.00
13	9693.00
14	10298.0
15	10854.0
16	11301.0
17	11795.0
18	11961.0
19	13214.0
20	15079.0
21	16010.0
22	16546.0
23	16841.0
24	17492.0
25	18444.0
26	18655.0
27	18080.0
28	18560.0
29	19280.0
30	20490.0
31	21129.0
32	21904.0
33	22287.0
34	22003.0
35	22490.0
36	22709.0
37	23053.0
38	22366.0
39	21449.0
40	20901.0
41	20634.0

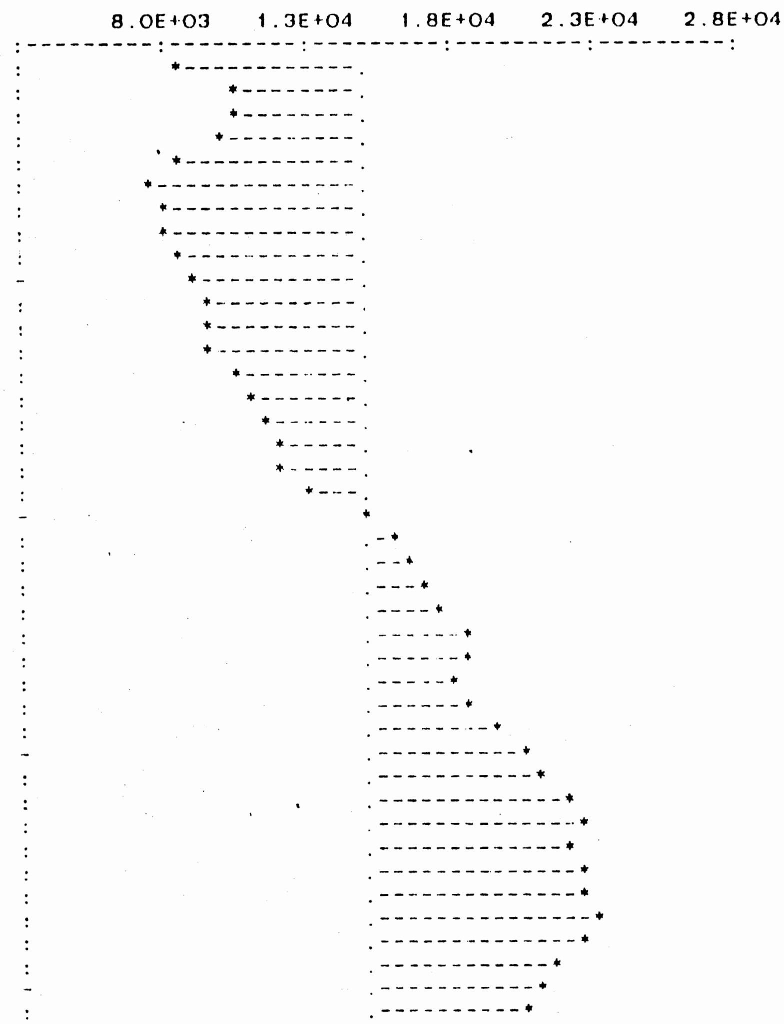


Figure 23. OSU Enrollment Series (with d=0) - Years 1945 Through 1986

AUTOCORRELATIONS *
TWO STANDARD ERROR LIMITS .

LAG	AUTO. CORR.	STAND. ERR.
1	0.961	0.149
2	0.919	0.147
3	0.869	0.145
4	0.811	0.143
5	0.738	0.141
6	0.656	0.139
7	0.574	0.137
8	0.487	0.135
9	0.400	0.133
10	0.316	0.130
11	0.233	0.128
12	0.149	0.126
13	0.067	0.124
14	-0.010	0.121
15	-0.081	0.119
16	-0.152	0.117
17	-0.220	0.114
18	-0.283	0.112
19	-0.338	0.109
20	-0.380	0.107
21	-0.413	0.104
22	-0.439	0.101
23	-0.456	0.098
24	-0.464	0.095
25	-0.464	0.092
26	-0.457	0.089
27	-0.450	0.086
28	-0.437	0.083
29	-0.418	0.079
30	-0.391	0.075

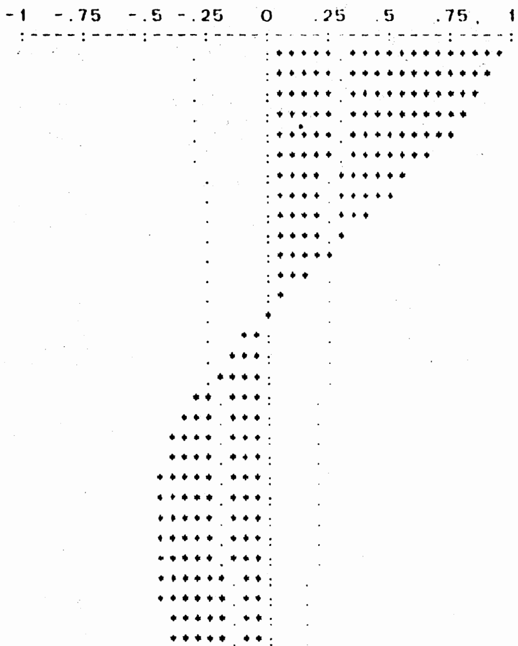


Figure 24. SAC for OSU Enrollment Series (with d=0) - Years 1945 Through 1986

PARTIAL AUTOCORRELATIONS *
TWO STANDARD ERROR LIMITS .

LAG	PR-AUT CORR.	STAND. ERR.
1	0.961	0.156
2	-0.051	0.156
3	-0.123	0.156
4	-0.135	0.156
5	-0.219	0.156
6	-0.155	0.156
7	-0.021	0.156
8	-0.065	0.156
9	-0.021	0.156
10	0.019	0.156
11	-0.042	0.156
12	-0.092	0.156
13	-0.010	0.156
14	-0.046	0.156
15	-0.010	0.156
16	-0.078	0.156
17	-0.063	0.156
18	-0.059	0.156
19	0.010	0.156
20	0.090	0.156
21	0.054	0.156
22	-0.007	0.156
23	0.002	0.156
24	-0.025	0.156
25	0.022	0.156
26	-0.009	0.156
27	-0.101	0.156
28	-0.016	0.156
29	0.022	0.156
30	0.068	0.156

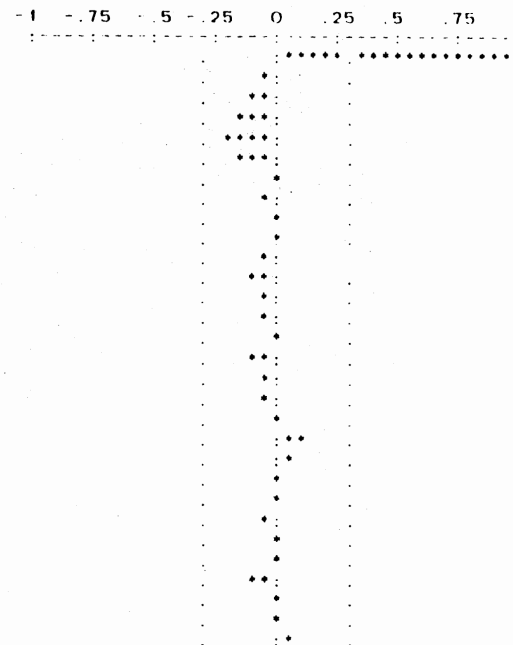


Figure 25. SPAC for OSU Enrollment Series (with d=0) - Years 1945 Through 1986

DEGREE OF NONSEASONAL DIFFERENCING - 1 DEGREE OF SEASONAL DIFFERENCING - 0
DATA - *
MEAN - .

OBS	DATA
1	1580.00
2	-26.0000
3	-272.000
4	-1476.00
5	-820.000
6	539.000
7	-446.000
8	613.000
9	710.000
10	215.000
11	14.0000
12	351.000
13	605.000
14	556.000
15	447.000
16	494.000
17	166.000
18	1253.00
19	1865.00
20	931.000
21	536.000
22	295.000
23	651.000
24	952.000
25	211.000
26	-575.000
27	480.000
28	720.000
29	1210.00
30	639.000
31	775.000
32	383.000
33	-284.000
34	487.000
35	219.000
36	344.000
37	-687.000
38	-917.000
39	-548.000
40	-267.000

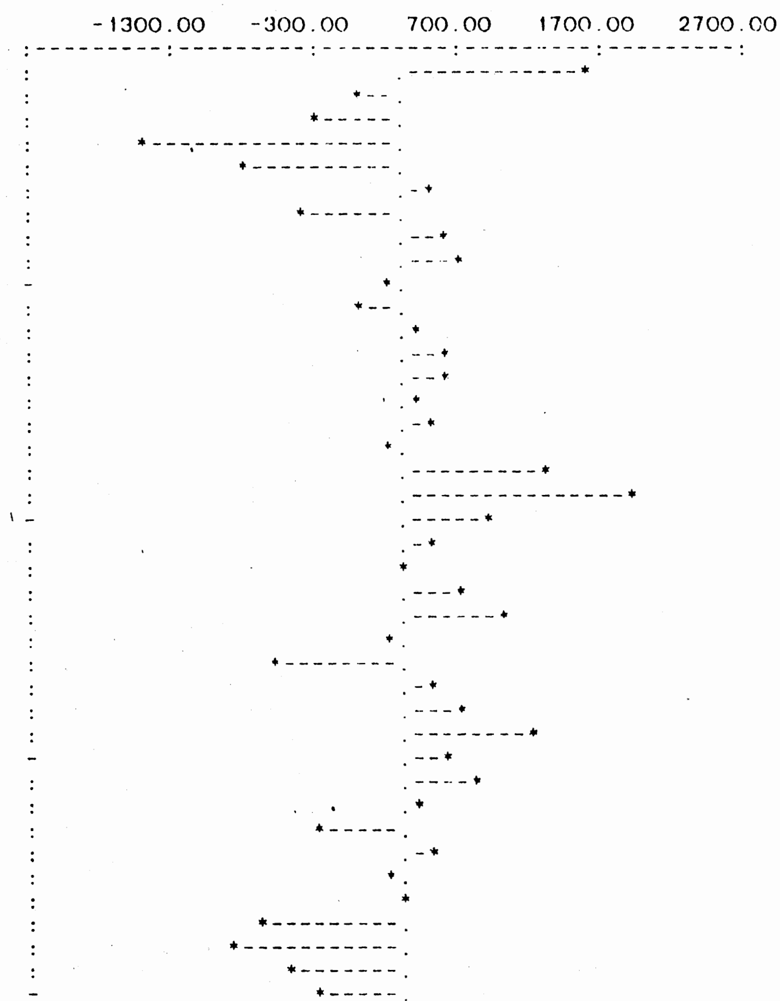


Figure 26. OSU Enrollment Series (with d=1) - Years 1945 Through 1986

AUTOCORRELATIONS *
TWO STANDARD ERROR LIMITS .

LAG	AUTO. CORR.	STAND. ERR.
1	0.463	0.150
2	0.148	0.148
3	-0.027	0.146
4	-0.021	0.144
5	0.135	0.142
6	-0.003	0.140
7	-0.005	0.138
8	-0.094	0.136
9	-0.084	0.134
10	0.014	0.131
11	0.049	0.129
12	0.044	0.127
13	-0.030	0.124
14	-0.232	0.122
15	-0.208	0.120
16	-0.171	0.117
17	-0.108	0.114
18	-0.073	0.112
19	-0.196	0.109
20	-0.210	0.106
21	-0.054	0.104
22	0.039	0.101
23	0.011	0.098
24	-0.168	0.094
25	-0.233	0.091
26	-0.070	0.088
27	-0.054	0.085
28	0.073	0.081
29	0.023	0.077
30	0.040	0.073

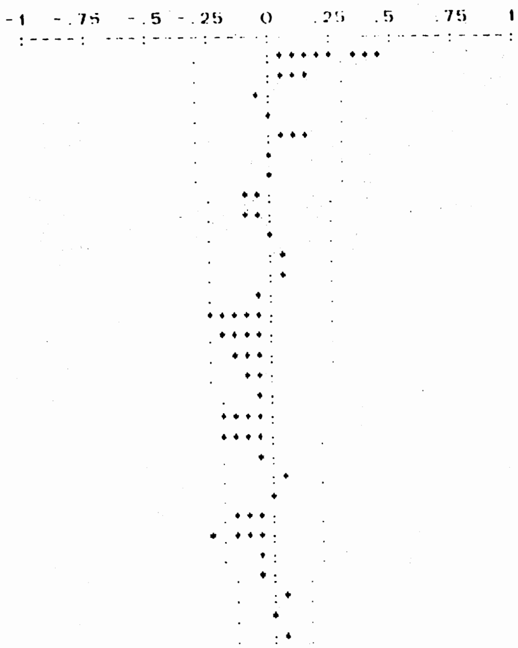


Figure 27. SAC for OSU Enrollment Series (with d=1) - Years 1945 Through 1986

PARTIAL AUTOCORRELATIONS *
TWO STANDARD ERROR LIMITS .

LAG	PR-AUT CORR.	STAND. ERR.
1	0.463	0.158
2	-0.085	0.158
3	-0.079	0.158
4	0.046	0.158
5	0.178	0.158
6	-0.198	0.158
7	0.068	0.158
8	-0.094	0.158
9	-0.003	0.158
10	0.042	0.158
11	0.063	0.158
12	-0.058	0.158
13	-0.006	0.158
14	-0.273	0.158
15	0.023	0.158
16	0.093	0.158
17	0.030	0.158
18	0.055	0.158
19	-0.100	0.158
20	-0.147	0.158
21	0.206	0.158
22	0.104	0.158
23	-0.089	0.158
24	-0.191	0.158
25	-0.037	0.158
26	0.051	0.158
27	-0.087	0.158
28	.0.012	0.158
29	-0.018	0.158
30	0.028	0.158

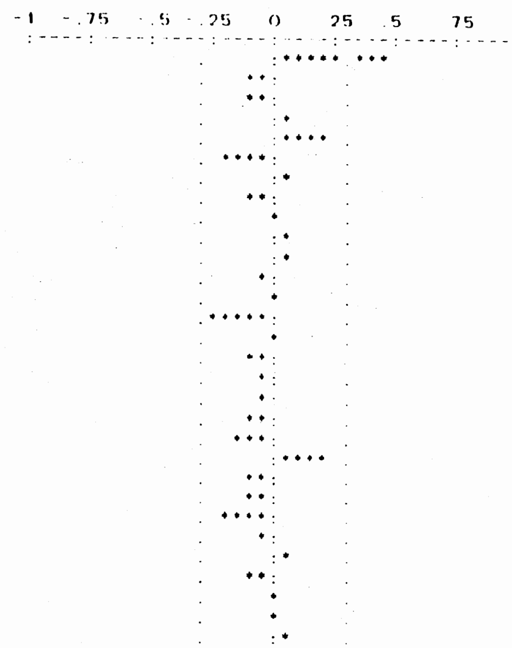


Figure 28. SPAC for OSU Enrollment Series (with d=1) - Years 1945 Through 1986

DEGREE OF NONSEASONAL DIFFERENCING - 2 DEGREE OF SEASONAL DIFFERENCING - 0
DATA - *
MEAN - .

OBS	DATA
1	-1606.00
2	-246.000
3	-1204.00
4	656.000
5	1359.00
6	-985.000
7	1059.00
8	97.0000
9	-495.000
10	-201.000
11	337.000
12	254.000
13	-49.0000
14	-109.000
15	47.0000
16	-328.000
17	1087.00
18	612.000
19	-934.000
20	-395.000
21	-241.000
22	356.000
23	301.000
24	-741.000
25	-786.000
26	1055.00
27	240.000
28	490.000
29	-571.000
30	136.000
31	-392.000
32	-667.000
33	771.000
34	-268.000
35	125.000
36	-1031.00
37	-230.000
38	369.000
39	281.000

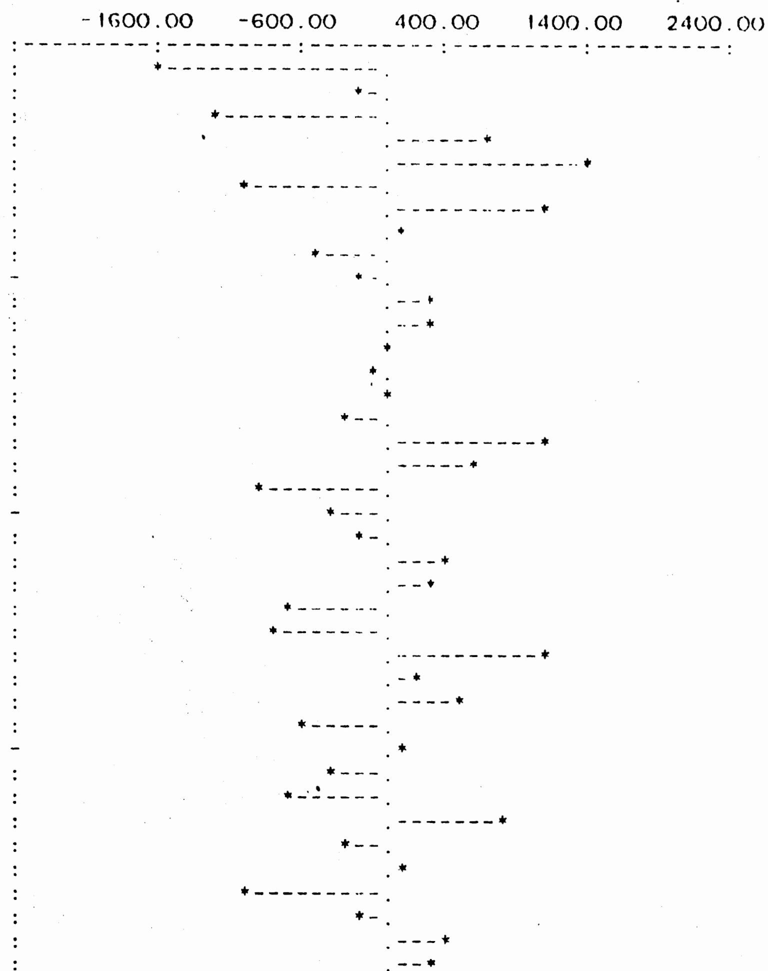


Figure 29. OSU Enrollment Series (with d=2) - Years 1945 Through 1986

AUTOCORRELATIONS *
TWO STANDARD ERROR LIMITS .

LAG	AUTO. CORR.	STAND. ERR.	-1 -.75 -.5 -.25 0 .25 .5 .75 1
1	-0.122	0.152	. **: .
2	-0.143	0.150	. ***: .
3	-0.089	0.148	. **: .
4	-0.168	0.146	. ***: .
5	0.200	0.144	. :**** .
6	-0.059	0.141	. *: .
7	-0.015	0.139	. * .
8	-0.091	0.137	. **: .
9	-0.042	0.135	. *: .
10	0.077	0.132	. :** .
11	0.036	0.130	. :* .
12	0.037	0.128	. :* .
13	0.127	0.125	. :*** .
14	-0.266	0.123	*****: .
15	0.006	0.120	. * .
16	0.021	0.117	. * .
17	-0.065	0.115	. *: .
18	0.102	0.112	. :** .
19	-0.040	0.109	. *: .
20	-0.137	0.106	.***: .
21	0.115	0.103	. :** .
22	0.079	0.100	. :** .
23	0.094	0.097	. :** .
24	-0.055	0.094	. *: .
25	-0.180	0.090	****: .
26	0.074	0.087	. :* .
27	-0.134	0.083	***: .
28	0.132	0.079	. :***
29	-0.043	0.075	. *: .
30	0.025	0.071	. :* .

Figure 30. SAC for OSU Enrollment Series (with d=2) - Years 1945 Through 1986

PARTIAL AUTOCORRELATIONS *
TWO STANDARD ERROR LIMITS .

LAG	PR-AUT CORR.	STAND. ERR.	-1 -.75 -.5 -.25 0 .25 .5 .75 1
1	-0.122	0.160	. **: .
2	-0.160	0.160	. ***: .
3	-0.135	0.160	. ***: .
4	-0.239	0.160	.*****: .
5	0.104	0.160	. :** .
6	-0.103	0.160	. **: .
7	-0.033	0.160	. *: .
8	-0.144	0.160	. ***: .
9	-0.052	0.160	. *: .
10	-0.046	0.160	. *: .
11	0.014	0.160	. * .
12	-0.002	0.160	. * .
13	0.190	0.160	. :**** .
14	-0.241	0.160	.*****: .
15	0.006	0.160	. * .
16	-0.074	0.160	. *: .
17	-0.081	0.160	. **: .
18	-0.077	0.160	. **: .
19	0.054	0.160	. :* .
20	-0.255	0.160	.*****: .
21	0.124	0.160	. :** .
22	-0.035	0.160	. *: .
23	0.137	0.160	. :*** .
24	-0.128	0.160	. ***: .
25	-0.031	0.160	. *: .
26	-0.066	0.160	. *: .
27	-0.066	0.160	. *: .
28	-0.105	0.160	. **: .
29	-0.033	0.160	. *: .
30	0.044	0.160	. :* .

Figure 31. SPAC for OSU Enrollment Series (with d=2) - Years 1945 Through 1986

DEGREE OF NONSEASONAL DIFFERENCING = 0 DEGREE OF SEASONAL DIFFERENCING = 0
DATA - *
MEAN - .

OBS.	DATA
1	8711.00
2	10291.0
3	10265.0
4	9993.00
5	8517.00
6	7697.00
7	8236.00
8	7790.00
9	8403.00
10	9113.00
11	9328.00
12	9342.00
13	9693.00
14	10298.0
15	10854.0
16	11301.0
17	11795.0
18	11961.0
19	13214.0
20	15079.0
21	16010.0
22	16546.0
23	16841.0
24	17492.0
25	18444.0
26	18655.0
27	18080.0
28	18560.0
29	19280.0
30	20490.0
31	21129.0
32	21904.0
33	22287.0
34	22003.0
35	22490.0
36	22709.0
37	23053.0
38	22366.0
39	21449.0
40	20901.0
41	20634.0
42	20116.0

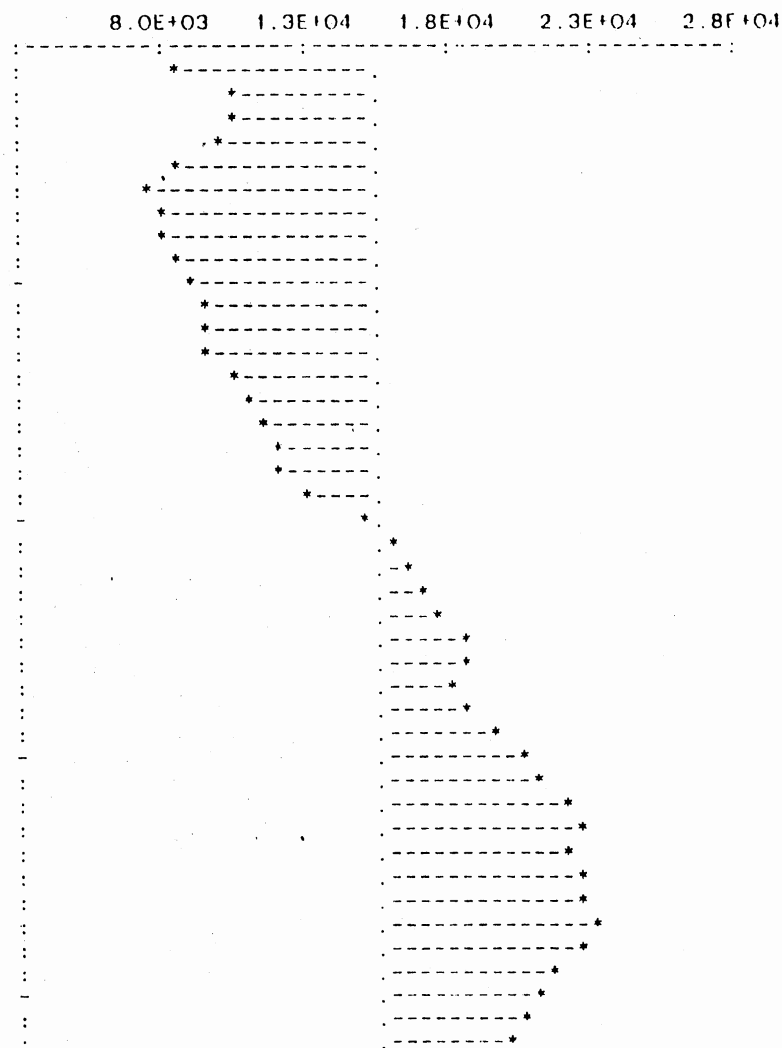


Figure 32. OSU Enrollment Series (with d=0) - Years 1945 Through 1987

AUTOCORRELATIONS *
TWO STANDARD ERROR LIMITS .

LAG	AUTO. CORR.	STAND. ERR.
1	0.963	0.147
2	0.924	0.145
3	0.877	0.143
4	0.824	0.141
5	0.755	0.140
6	0.673	0.138
7	0.592	0.136
8	0.505	0.134
9	0.421	0.132
10	0.337	0.130
11	0.252	0.127
12	0.167	0.125
13	0.082	0.123
14	0.004	0.121
15	-0.068	0.119
16	-0.135	0.116
17	-0.203	0.114
18	-0.269	0.112
19	-0.325	0.109
20	-0.367	0.107
21	-0.402	0.104
22	-0.431	0.101
23	-0.455	0.099
24	-0.468	0.096
25	-0.469	0.093
26	-0.464	0.090
27	-0.459	0.087
28	-0.449	0.084
29	-0.433	0.081
30	-0.407	0.077

Figure 33. SAC for OSU Enrollment Series (with d=0) - Years 1945 Through 1987

PARTIAL AUTOCORRELATIONS *
TWO STANDARD ERROR LIMITS .

LAG	PR AUT CORR.	STAND. ERR.
1	0.963	0.154
2	-0.063	0.154
3	-0.110	0.154
4	-0.116	0.154
5	-0.239	0.154
6	-0.221	0.154
7	-0.019	0.154
8	-0.087	0.154
9	0.039	0.154
10	0.023	0.154
11	-0.054	0.154
12	-0.087	0.154
13	-0.082	0.154
14	-0.037	0.154
15	0.024	0.154
16	-0.002	0.154
17	0.080	0.154
18	-0.111	0.154
19	-0.009	0.154
20	0.094	0.154
21	0.056	0.154
22	0.014	0.154
23	-0.047	0.154
24	-0.014	0.154
25	0.037	0.154
26	-0.028	0.154
27	0.100	0.154
28	-0.007	0.154
29	-0.013	0.154
30	0.069	0.154

Figure 34. SPAC for OSU Enrollment Series (with d=0) - Years 1945 Through 1987

DEGREE OF NONSEASONAL DIFFERENCING - 1 DEGREE OF SEASONAL DIFFERENCING - 0
DATA - *
MEAN - .

OBS	DATA
1	1580.00
2	-26.0000
3	-272.000
4	-1476.00
5	-820.000
6	539.000
7	-446.000
8	613.000
9	710.000
10	215.000
11	14.0000
12	351.000
13	605.000
14	556.000
15	447.000
16	494.000
17	166.000
18	1253.00
19	1865.00
20	931.000
21	536.000
22	295.000
23	651.000
24	952.000
25	211.000
26	-575.000
27	480.000
28	720.000
29	1210.00
30	639.000
31	775.000
32	383.000
33	-284.000
34	487.000
35	219.000
36	344.000
37	-687.000
38	-917.000
39	-548.000
40	-267.000
41	-518.000

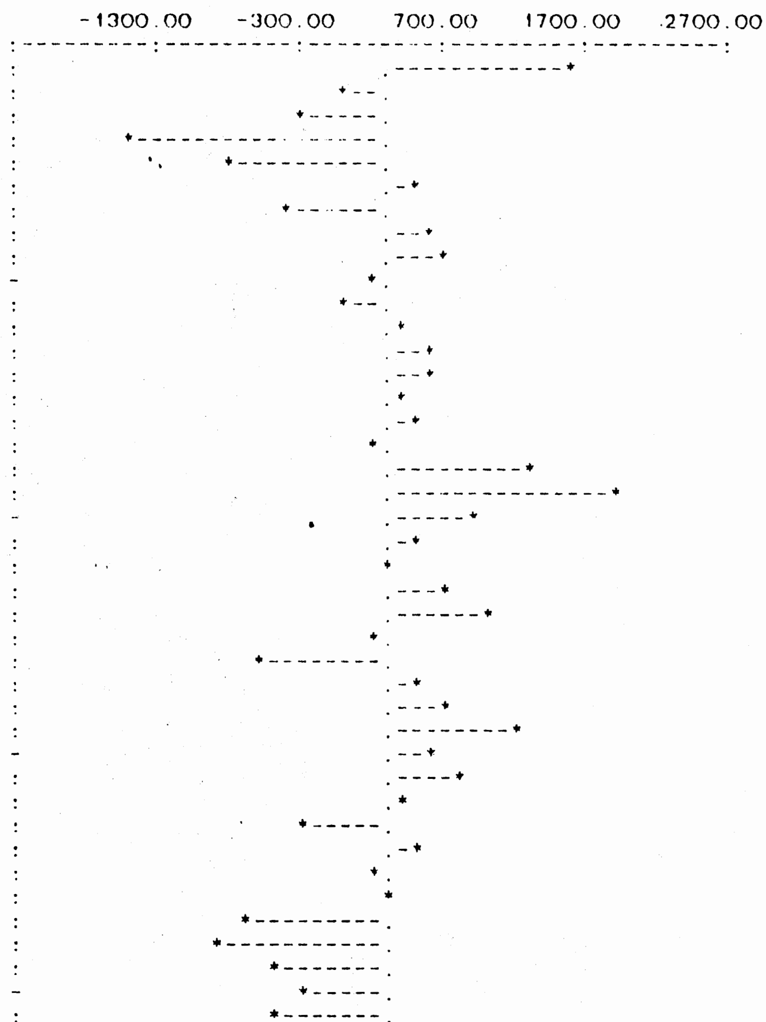


Figure 35. OSU Enrollment Series (with d=1) - Years 1945 Through 1987

AUTOCORRELATIONS *
TWO STANDARD ERROR LIMITS .

LAG	AUTO. CORR.	STAND. ERR.	-1 -.75 -.5 -.25 0 .25 .5 .75 1
1	0.470	0.149	:*****.***
2	0.179	0.147	:****
3	0.028	0.145	:*
4	0.027	0.143	:*
5	0.134	0.141	:***
6	0.006	0.139	*
7	-0.006	0.137	*
8	-0.059	0.135	*:
9	-0.079	0.133	**:
10	-0.001	0.130	*
11	0.039	0.128	:*
12	0.009	0.126	*
13	-0.043	0.124	*:
14	-0.228	0.121	*****:
15	-0.159	0.119	***:
16	-0.157	0.117	***:
17	-0.128	0.114	***:
18	-0.083	0.112	**:
19	-0.188	0.109	****:
20	-0.213	0.107	****:
21	-0.081	0.101	**:
22	-0.032	0.101	*:
23	-0.034	0.098	*:
24	-0.161	0.095	***:
25	-0.238	0.092	*.***:
26	-0.079	0.089	**:
27	-0.068	0.086	*:
28	0.051	0.083	:*
29	0.014	0.079	*
30	0.044	0.075	:*

Figure 36. SAC for OSU Enrollment Series (with d=1) - Years 1945 Through 1987

PARTIAL AUTOCORRELATIONS *
TWO STANDARD ERROR LIMITS .

LAG	PR-AUT CORR.	STAND. ERR.	-1 -.75 -.5 -.25 0 .25 .5 .75 1
1	0.470	0.156	:*****.***
2	-0.054	0.156	*:
3	-0.045	0.156	*:
4	0.051	0.156	:*
5	0.143	0.156	:***
6	-0.159	0.156	***:
7	0.043	0.156	:*
8	-0.054	0.156	*:
9	-0.045	0.156	*:
10	0.051	0.156	:*
11	0.058	0.156	:*
12	-0.073	0.156	*:
13	-0.019	0.156	*
14	-0.234	0.156	.*****:
15	0.053	0.156	:*
16	-0.117	0.156	**:
17	-0.029	0.156	*:
18	-0.013	0.156	*
19	-0.110	0.156	**:
20	-0.153	0.156	***:
21	0.174	0.156	:***
22	-0.113	0.156	**:
23	-0.071	0.156	*:
24	-0.137	0.156	***:
25	-0.103	0.156	**:
26	0.063	0.156	:*
27	-0.065	0.156	*:
28	-0.012	0.156	*
29	-0.015	0.156	*
30	0.041	0.156	:*

Figure 37. SPAC for OSU Enrollment Series (with d=1) - Years 1945 Through 1987

DEGREE OF NONSEASONAL DIFFERENCING - 2 DEGREE OF SEASONAL DIFFERENCING - 0
DATA - *
MEAN - .

OBS	DATA
1	-1606.00
2	-246.000
3	-1204.00
4	656.000
5	1359.00
6	-985.000
7	1059.00
8	97.0000
9	-495.000
10	-201.000
11	337.000
12	254.000
13	-49.0000
14	-109.000
15	47.0000
16	-328.000
17	1087.00
18	612.000
19	-934.000
20	-395.000
21	-241.000
22	356.000
23	301.000
24	-741.000
25	-786.000
26	1055.00
27	240.000
28	490.000
29	-571.000
30	136.000
31	-392.000
32	-667.000
33	771.000
34	-268.000
35	125.000
36	-1031.00
37	-230.000
38	369.000
39	281.000
40	-251.000

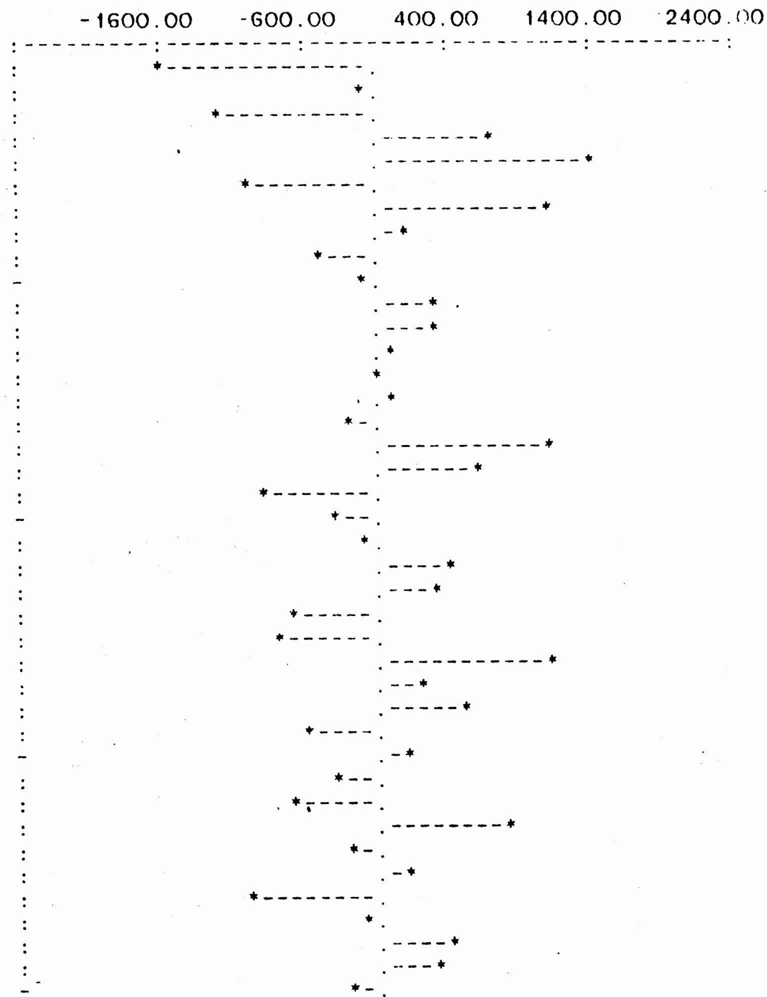


Figure 38. OSU Enrollment Series (with d=2) - Years 1945 Through 1987

AUTOCORRELATIONS *
TWO STANDARD ERROR LIMITS .

LAG	AUTO. CORR.	STAND. ERR.	-1 -.75 -.5 -.25 0 .25 .5 .75 1
1	-0.125	0.150	***:
2	-0.147	0.148	***:
3	-0.086	0.146	**:
4	-0.156	0.144	***:
5	0.197	0.142	:****
6	-0.055	0.140	*:
7	-0.025	0.138	*
8	-0.083	0.136	**:
9	-0.038	0.134	*:
10	0.075	0.131	:*
11	0.042	0.129	:*
12	0.031	0.127	:*
13	0.123	0.124	:**
14	-0.279	0.122	*.****:
15	0.014	0.120	*
16	0.030	0.117	:*
17	-0.069	0.114	*:
18	0.096	0.112	:**
19	-0.038	0.109	*:
20	-0.133	0.106	***:
21	0.125	0.101	:***
22	0.071	0.101	:*
23	0.081	0.098	:**
24	-0.052	0.094	*:
25	-0.181	0.091	****:
26	0.074	0.088	:*
27	-0.134	0.085	***:
28	0.128	0.081	:***
29	-0.048	0.077	*:
30	0.026	0.073	:*

Figure 39. SAC for OSU Enrollment Series (with d=2) - Years 1945 Through 1987

PARTIAL AUTOCORRELATIONS *
TWO STANDARD ERROR LIMITS .

LAG	PR-AUT CORR.	STAND. ERR.	-1 -.75 -.5 -.25 0 .25 .5 .75 1
1	-0.125	0.158	***:
2	-0.166	0.158	***:
3	-0.134	0.158	***:
4	-0.228	0.158	*****:
5	0.104	0.158	:**
6	-0.095	0.158	**:
7	-0.037	0.158	*:
8	-0.132	0.158	***:
9	-0.050	0.158	*:
10	-0.040	0.158	*:
11	0.022	0.158	*
12	0.007	0.158	*
13	0.188	0.158	:****
14	-0.249	0.158	*****:
15	0.008	0.158	*
16	-0.070	0.158	*:
17	-0.087	0.158	**:
18	-0.074	0.158	*:
19	0.060	0.158	:*
20	-0.243	0.158	*****:
21	0.127	0.158	:***
22	-0.028	0.158	*:
23	0.126	0.158	:***
24	-0.111	0.158	**:
25	-0.040	0.158	*:
26	-0.059	0.158	*:
27	-0.079	0.158	**:
28	-0.098	0.158	**:
29	-0.049	0.158	*:
30	0.050	0.158	:*

Figure 40. SPAC for OSU Enrollment Series (with d=2) - Years 1945 Through 1987

APPENDIX E

MULTIPLE REGRESSION ANALYSIS

TABLE 75

THE POSSIBLE FACTORS AFFECTING OKLAHOMA STATE UNIVERSITY ENROLLMENTS

Independent Variables										
Year	Oklahoma Unemployment Rates (1)	Oklahoma Per Capita Incomes (2)	Oklahoma Drilling Rig Activities (3)	United States GNP (1982$) (4)	United States Consumer Price Indices (5)	Oklahoma Other Institution Enrollments (6)	OSU Tuitions (7)	Year	OSU Student Aids (8)	Oklahoma High School Graduates (9)
1962	5.1	1.928	174	1799.4	33.85	38549	23	61/62	1441086	27052
1963	5.1	1.986	158	1873.3	34.44	41876	23	62/63	1441086	26249
1964	4.7	2.122	159	1973.3	34.97	47139	23	63/64	1441086	29939
1965	4.3	2.293	163	2087.6	35.64	54185	23	64/65	1441086	35663
1966	3.6	2.441	141	2208.3	36.75	55972	23	65/66	1596588	34580
1967	3.5	2.627	101	2271.4	37.65	60018	28.5	66/67	1439387	34028
1968	3.5	2.856	106	2365.6	39.3	64514	28.5	67/68	1484425	34645
1969	3.3	3.085	120	2423.3	41.04	66429	28.5	68/69	1579285	35809
1970	4	3.338	98	2416.2	42.9	73512	34.25	69/70	1707131	36293
1971	3.7	3.498	90	2484.8	44.94	79486	38.25	70/71	1770262	37896
1972	3.9	3.773	90	2608.5	46.71	83302	38.25	71/72	1506648	38318
1973	3	4.284	115	2744.1	49.55	86930	38.25	72/73	1475266	37349
1974	4.4	4.739	146	2729.3	54.75	91305	38.25	73/74	1321543	37544
1975	7.2	5.193	177	2695	59.16	104261	38.25	74/75	1548047	37856
1976	5.6	5.695	186	2826.7	62.6	106407	49.83	75/76	2645355	37663
1977	5	6.306	233	2958.6	66.74	109463	49.83	76/77	3377126	38523
1978	3.9	6.972	258	3115.2	71.57	108070	49.83	77/78	3406427	39005
1979	3.4	8.028	247	3192.4	78.17	111537	49.83	78/79	3813742	39225
1980	4.8	9.066	397	3187.1	86.61	118309	56.42	79/80	4133122	39305
1981	3.6	10.329	698	3248.8	94.61	120010	56.42	80/81	4452501	38823
1982	5.7	11.061	622	3166	100	125963	64.02	81/82	4688396	38347
1983	9	10.877	285	3277.7	103.89	132103	72.67	82/83	4150544	36799
1984	7	11.613	319	3492	108.17	127020	82.53	83/84	4782917	35254
1985	7.1	12.214	252	3570	111.62	128383	82.53	84/85	8005961	34626
1986	8.2	12.368	142	3675.3	114.4	128211	92.53	85/86	8610141	34452
1987	7.3	12.875	169	3768	117.7	135382	116.6	86/87	9228405	35514

Source:

(1) UNEMPLY - Oklahoma Employment Security Commision
(2) PINCOME - U.S. Bureau of Economic Analysis
(3) OILRIG - Hudges Tool Company, Dallas, Texas
(4) USGNP - U.S. Department of Commerce
(5) PINDEX - U.S. Department of Commerce
(6) COMPFIG - Oklahoma Regents for Higher Education
(7) TUITION - OSU Office of Registrar
(8) FINAID - Oklahoma Regents for Higher Education
(9) HIGHSCH - Oklahoma State Department of Education

TABLE 76

MULTIPLE REGRESSION (BACKWARD) PROCEDURE FOR UNDERGRADUATE ENROLLMENTS - YEARS 1962 THROUGH 1985

STEP	MULTIPLE R	R SQUARE	F	SIGNIFICANT R	R SQUARE CHANGE	SIGNIFICANT CHANGE	IN/OUT	VARIABLE
1							IN	HIGHSCH
2							IN	UNEMPLY
3							IN	OILRIG
4							IN	FINAID
5							IN	TUITION
6	0.9823	0.965	78.1	.000	0.965	.000	IN	USGNP
7	0.9823	0.965	99.213	.000	.000	0.956	OUT	FINAID
8	0.9823	0.9648	130.383	.000	-0.0001	0.795	OUT	TUITION
9	0.9805	0.9614	165.913	.000	-0.0035	0.186	OUT	UNEMPLY

ANOVA TABLE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFICANT F
REGRESSION	3	164867513.31868	54955837.773	165.91337	.0000
RESIDUAL	20	6624642.63965	331232.13198		

B COFFICIENTS AND CONFIDENCE LIMITS

VARIABLE	B	SE B	95% CONFIDENCE INTERVAL B LOWER	UPPER	T	SIGNIFICANT T
HIGHSCH	0.338009	0.046556	0.240896	0.435122	7.26	.0000
OILRIG	2.370619	0.965583	0.35645	4.384788	2.455	0.0234
USGNP	2.880564	0.379936	2.088031	3.673096	7.582	.0000
(CONSTANT)	-4747.168979	1245.282374	-7344.781059	-2149.5569	-3.812	0.0011

RESULTS OF ENROLLMENT FORECAST

YEAR	ACTUAL UNDERGRADUATE ENROLLMENTS	FORECAST UNDERGRADUATE ENROLLMENTS	FORECAST ERRORS	ABSOLUTE PERCENT ERRORS
1962	10006	9992.4299	13.5701	0.14%
1963	10107	9895.9523	211.0477	2.09%
1964	11065	11433.6332	-368.6332	3.33%
1965	12877	13707.1288	-830.1288	6.45%
1966	13596	13636.5953	-40.5953	0.30%
1967	14120	13536.953	583.047	4.13%
1968	14366	14028.7068	337.2932	2.35%
1969	14763	14621.5467	141.4533	0.96%
1970	15395	14712.5376	682.4624	4.43%
1971	15472	15433.0081	38.9919	0.25%
1972	14889	15931.9736	-1042.9736	7.00%
1973	15065	16054.3126	-989.3126	6.57%
1974	15631	16151.0812	-520.0812	3.33%
1975	16599	16231.226	367.774	2.22%
1976	17313	16566.696	746.304	4.31%
1977	18015	17348.7493	666.2507	3.70%
1978	18521	18022.0315	498.9685	2.69%
1979	18218	18292.6962	-74.6962	0.41%
1980	18602	18660.0628	-58.0628	0.31%
1981	18916	19388.4295	-472.4295	2.50%
1982	19120	18808.8594	311.1406	1.63%
1983	18410	17808.4815	601.5185	3.27%
1984	17779	17984.163	-205.163	1.15%
1985	17240	17837.7457	-597.7457	3.47%

AVERAGE % ERROR = 2.79%

TOTAL CASES = 24
DURBIN-WATSON TEST = 1.02189

OF VARIABLES = 3
NO SERIAL CORRELATION

TABLE 77

MULTIPLE REGRESSION (BACKWARD) PROCEDURE FOR UNDERGRADUATE ENROLLMENTS - YEARS 1962 THROUGH 1986

STEP	MULTIPLE R	R SQUARE	F	SIGNIFICANT R	R SQUARE CHANGE	SIGNIFICANT CHANGE	IN/OUT	VARIABLE
1							IN	HIGHSCH
2							IN	UNEMPLY
3							IN	OILRIG
4							IN	FINAID
5							IN	USGNP
6	0.9813	0.963	77.993	.000	0.963	.000	IN	TUITION
7	0.9812	0.9628	98.359	.000	-0.0002	0.786	OUT	TUITION
8	0.9806	0.9616	125.265	.000	-0.0012	0.446	OUT	FINAID
9	0.979	0.9584	161.251	.000	-0.0032	0.21	OUT	UNEMPLY

ANOVA TABLE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFICANT F
REGRESSION	3	165627124.82303	55209041.608	161.2512	.0000
RESIDUAL	21	7189961.17697	342379.10367		

B COFFICIENTS AND CONFIDENCE LIMITS

VARIABLE	B	SE B	95 % CONFIDENCE INTERVAL B LOWER	UPPER	T	SIGNIFICANT T
HIGHSCH	0.363978	0.042801	0.274968	0.452988	8.504	.0000
OILRIG	2.863338	0.903711	0.98397	4.742707	3.168	0.0046
USGNP	2.577	0.305613	1.941444	3.212556	8.432	.0000
(CONSTANT)	-4993.676467	1251.44424	-7596.194648	-2391.1583	-3.99	0.0007

RESULTS OF ENROLLMENT FORECAST

YEAR	ACTUAL UNDERGRADUATE ENROLLMENTS	FORECAST UNDERGRADUATE ENROLLMENTS	FORECAST ERRORS	ABSOLUTE PERCENT ERRORS
1962	10006	9987.9275	18.0725	0.18%
1963	10107	9840.2801	266.7199	2.64%
1964	11065	11443.9218	-378.9218	3.42%
1965	12877	13833.3357	-956.3357	7.43%
1966	13596	13687.1981	-91.1981	0.67%
1967	14120	13534.3574	585.6426	4.15%
1968	14366	14016.0018	349.9982	2.44%
1969	14763	14628.4517	134.5483	0.91%
1970	15395	14723.3269	671.6731	4.36%
1971	15472	15460.6589	11.3411	0.07%
1972	14889	15933.0324	-1044.0324	7.01%
1973	15065	16001.3625	-936.3625	6.22%
1974	15631	16122.962	-491.962	3.15%
1975	16599	16236.8955	362.1045	2.18%
1976	17313	16531.8087	781.1913	4.51%
1977	18015	17319.3128	695.6872	3.86%
1978	18521	17969.8918	551.1082	2.98%
1979	18218	18217.4146	0.5854	0.00%
1980	18602	18662.3754	-60.3754	0.32%
1981	18916	19507.8037	-591.8037	3.13%
1982	19120	18903.561	216.439	1.13%
1983	18410	17663.0291	746.9709	4.06%
1984	17779	17750.2878	28.7122	0.16%
1985	17240	17530.872	-290.872	1.69%
1986	16845	17423.9307	-578.9307	3.44%

AVERAGE % ERROR = 2.67%

TOTAL CASES = 25
DURBIN-WATSON TEST = 1.01896

OF VARIABLES = 3
NO SERIAL CORRELATION

TABLE 78

MULTIPLE REGRESSION (BACKWARD) PROCEDURE FOR UNDERGRADUATE ENROLLMENTS - YEARS 1962 THROUGH 1987

STEP	MULTIPLE R	R SQUARE	F	SIGNIFICANT R	R SQUARE CHANGE	SIGNIFICANT CHANGE	IN/OUT	VARIABLE
1							IN	HIGHSCH
2							IN	UNEMPLY
3							IN	OILRIG
4							IN	FINAID
5							IN	USGNP
6	0.9798	0.9601	76.2	.000	0.9601	.000	IN	TUITION
7	0.9795	0.9595	94.65	.000	-0.0006	0.585	OUT	FINAID

ANOVA TABLE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFICANT F
REGRESSION	3	165955789.16853	33191157.834	94.64994	.0000
RESIDUAL	20	7013455.33147	350672.76657		

B COFFICIENTS AND CONFIDENCE LIMITS

VARIABLE	B	SE B	95% CONFIDENCE INTERVAL B LOWER	UPPER	T	SIGNIFICANT T
HIGHSCH	0.343445	0.064859	0.208151	0.478739	5.295	.0000
UNEMPLY	262.601794	112.507554	27.91528	497.288309	2.334	0.0301
OILRIG	3.155138	0.9147	1.247108	5.063168	3.449	0.0025
USGNP	4.101154	1.023571	1.966023	6.236285	4.007	0.0007
TUITION	-54.043886	21.284444	-98.442434	-9.645338	-2.539	0.0195
(CONSTANT)	-7345.30512	1557.050131	-10593.25299	-4097.3573	-4.717	0.0001

RESULTS OF ENROLLMENT FORECAST

YEAR	ACTUAL UNDERGRADUATE ENROLLMENTS	FORECAST UNDERGRADUATE ENROLLMENTS	FORECAST ERRORS	ABSOLUTE PERCENT ERRORS
1962	10006	9970.4429	35.5571	0.36%
1963	10107	9947.2495	159.7505	1.58%
1964	11065	11522.7919	-457.7919	4.14%
1965	12877	13865.0135	-988.0135	7.67%
1966	13596	13734.8375	-138.8375	1.02%
1967	14120	13354.3315	765.6685	5.42%
1968	14366	13968.3416	397.6584	2.77%
1969	14763	14596.3998	166.6002	1.13%
1970	15395	14537.165	857.835	5.57%
1971	15472	15048.8495	423.1505	2.73%
1972	14889	15753.6165	-864.6165	5.81%
1973	15065	15819.4715	-754.4715	5.01%
1974	15631	16291.198	-660.198	4.22%
1975	16599	17090.7776	-491.7776	2.96%
1976	17313	16547.0198	765.9802	4.42%
1977	18015	17374.0552	640.9448	3.56%
1978	18521	17971.853	549.147	2.96%
1979	18218	18198.0126	19.9874	0.11%
1980	18602	18688.5161	-86.5161	0.47%
1981	18916	19410.5911	-494.5911	2.61%
1982	19120	18808.4754	311.5246	1.63%
1983	18410	18070.7461	339.2539	1.84%
1984	17779	17468.1991	310.8009	1.75%
1985	17240	17387.2715	-147.2715	0.85%
1986	16845	17160.7216	-315.7216	1.87%
1987	16845	16459.0524	385.9476	2.29%
1988	UNKNOWN	16381.7843		

AVERAGE % ERROR = 2.88%
OF VARIABLES = 5
NO SERIAL CORRELATION

TOTAL CASES 26
DURBIN-WATSON TEST = 1.10285

TABLE 79

MULTIPLE REGRESSION (BACKWARD) PROCEDURE FOR TOTAL ENROLLMENTS - YEARS 1962 THROUGH 1985

STEP	MULTIPLE R	R SQUARE	F	SIGNIFICANT R	R SQUARE CHANGE	SIGNIFICANT CHANGE	IN/OUT	VARIABLE
1							IN	HIGHSCH
2							IN	UNEMPLY
3							IN	OILRIG
4							IN	FINAID
5							IN	TUITION
6	0.9858	0.9718	97.703	0.000	0.9718	.000	IN	USGNP
7	0.9856	0.9714	122.233	0.000	-0.0004	.624	OUT	TUITION
8	0.9851	0.9704	155.845	0.000	-0.001	0.442	OUT	FINAID

ANOVA TABLE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFICANT F
REGRESSION	4	263591602.61312	65897900.65328	155.84468	0.0000
RESIDUAL	19	8034025.22021	422843.43264		

B COFFICIENTS AND CONFIDENCE LIMITS

VARIABLE	B	SE B	95 % CONFIDENCE INTERVAL B LOWER	UPPER	T	SIGNIFICANT T
HIGHSCH	0.489064	0.062489	0.358273	0.619856	7.826	0.0000
UNEMPLY	238.934029	116.435253	-4.767447	482.635504	2.052	0.054
OILRIG	2.589032	1.097805	0.291303	4.886761	2.358	0.029
USGNP	3.137439	0.53539	2.016857	4.258021	5.86	0.0000
(CONSTANT)	-8851.205391	1686.256837	-12380.57702	-5321.833758	-5.249	0.0000

RESULTS OF ENROLLMENT FORECAST

YEAR	ACTUAL TOTAL ENROLLMENTS	FORECAST TOTAL ENROLLMENTS	FORECAST ERRORS	ABSOLUTE PERCENT ERRORS
1962	11795	11693.5292	101.4708	0.86%
1963	11961	11491.2426	469.7574	3.93%
1964	13214	13516.6498	-302.6498	2.29%
1965	15079	16589.4466	-1510.4466	10.02%
1966	16010	16214.2661	-204.2661	1.28%
1967	16546	16014.8202	531.1798	3.21%
1968	16841	16625.0649	215.9351	1.28%
1969	17492	17363.8258	128.1742	0.73%
1970	18444	17688.5523	755.4477	4.10%
1971	18655	18595.3585	59.6415	0.32%
1972	18080	19237.6317	-1157.6317	6.40%
1973	18560	19038.8501	-478.8501	2.58%
1974	19280	19502.5512	-222.5512	1.15%
1975	20490	20296.8004	193.1996	0.94%
1976	21129	20256.6185	872.3815	4.13%
1977	21904	21069.3662	834.6338	3.81%
1978	22287	21598.3165	688.6835	3.09%
1979	22003	21800.1746	202.8254	0.92%
1980	22490	22545.5338	-55.5338	0.25%
1981	22709	22995.9625	-286.9625	1.26%
1982	23053	22808.3829	244.6171	1.06%
1983	22366	22317.7415	48.2585	0.22%
1984	21449	21844.649	-395.649	1.84%
1985	20901	21632.665	-731.665	3.50%

AVERAGE % ERROR = 2.47%

TOTAL CASES = 24
DURBIN-WATSON TEST = 1.12960

OF VARIABLES = 4
NO SERIAL CORRELATION

TABLE 80

MULTIPLE REGRESSION (BACKWARD) PROCEDURE FOR TOTAL ENROLLMENTS - YEARS 1962 THROUGH 1986

STEP	MULTIPLE R	R SQUARE	F	SIGNIFICANT R	R SQUARE CHANGE	SIGNIFICANT CHANGE	IN/OUT	VARIABLE
1							IN	HIGHSCH
2							IN	UNEMPLY
3							IN	OILRIG
4							IN	FINAID
5							IN	USGNP
6	0.9854	0.971	100.597	0.000	0.971	.000	IN	TUITION
7	0.9852	0.9706	125.31	0.000	-0.0005	.594	OUT	TUITION
8	0.9836	0.9675	148.972	0.000	-0.003	0.177	OUT	FINAID

ANOVA TABLE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFICANT F
REGRESSION	4	265714662.86758	66428665.7169	148.97216	0.0000
RESIDUAL	20	8918265.77242	445913.28862		

B COFFICIENTS AND CONFIDENCE LIMITS

VARIABLE	B	SE B	95% CONFIDENCE INTERVAL B LOWER	95% CONFIDENCE INTERVAL B UPPER	T	SIGNIFICANT T
HIGHSCH	0.519846	0.060334	0.393992	0.6457	8.616	0.0000
UNEMPLY	233.146241	119.498698	-16.123538	482.416019	1.951	0.065
OILRIG	3.198811	1.040874	1.027583	5.370035	3.073	0.006
USGNP	2.773912	0.485426	1.761332	3.786493	5.714	0.0000
(CONSTANT)	-9113.119549	1721.628415	-12704.37151	-5521.867588	-5.293	0.0000

RESULTS OF ENROLLMENT FORECAST

YEAR	ACTUAL TOTAL ENROLLMENTS	FORECAST TOTAL ENROLLMENTS	FORECAST ERRORS	ABSOLUTE PERCENT ERRORS
1962	11795	11686.78	108.22	0.92%
1963	11961	11423.1546	537.8454	4.50%
1964	13214	13528.7191	-314.7191	2.38%
1965	15079	16740.9143	-1661.9143	11.02%
1966	16010	16279.1558	-269.1558	1.68%
1967	16546	16015.9674	530.0326	3.20%
1968	16841	16614.0092	226.9908	1.35%
1969	17492	17377.3192	114.6808	0.66%
1970	18444	17702.0585	741.9415	4.02%
1971	18655	18630.1282	24.8718	0.13%
1972	18080	19239.2655	-1159.2655	6.41%
1973	18560	18981.8157	-421.8157	2.27%
1974	19280	19467.6997	-187.6997	0.97%
1975	20490	20286.7192	203.2808	0.99%
1976	21129	20207.4684	921.5316	4.36%
1977	21904	21030.8717	873.1283	3.99%
1978	22287	21539.3417	747.6583	3.35%
1979	22003	21716.0939	286.9061	1.30%
1980	22490	22549.2063	-59.2063	0.26%
1981	22709	23152.8575	-443.8575	1.95%
1982	23053	22922.2281	130.7719	0.57%
1983	22366	22118.7352	247.2648	1.11%
1984	21449	21552.4892	-103.4892	0.48%
1985	20901	21251.3852	-350.3852	1.68%
1986	20634	21357.6165	-723.6165	3.51%

AVERAGE % ERROR = 2.52%

TOTAL CASES = 25
DURBIN-WATSON TEST = 1.13831

OF VARIABLES = 4
NO SERIAL CORRELATION

TABLE 81

MULTIPLE REGRESSION (BACKWARD) PROCEDURE FOR TOTAL ENROLLMENTS - YEARS 1962 THROUGH 1987

STEP	MULTIPLE R	R SQUARE	F	SIGNIFICANT R	R SQUARE CHANGE	SIGNIFICANT CHANGE	IN/OUT	VARIABLE
1							IN	HIGHSCH
2							IN	UNEMPLY
3							IN	OILRIG
4							IN	FINAID
5							IN	USGNP
6	0.9851	0.9705	104.131	0.000	0.9705	.000	IN	TUITION
7	0.9842	0.9687	123.802	0.000	-0.0018	0.297	OUT	FINAID

ANOVA TABLE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFICANT F
REGRESSION	5	267336767.53374	53467353.5068	123.80213	0.0000
RESIDUAL	20	8637550.00472	431877.50024		

B COFFICIENTS AND CONFIDENCE LIMITS

VARIABLE	B	SE B	LOWER	UPPER	T	SIGNIFICANT T
HIGHSCH	0.445878	0.071978	0.295734	0.596022	6.195	0.0000
UNEMPLY	376.206047	124.856441	115.760219	636.651875	3.013	0.0069
OILRIG	3.25861	1.015098	1.141154	5.376067	3.21	0.0044
USGNP	5.008987	1.135919	2.639503	7.378471	4.41	0.0003
TUITION	-61.576131	23.620636	-110.847886	-12.304376	-2.607	0.0169
(CONSTANT)	-10512.1728	1727.952759	-14116.6171	-6907.728493	-6.084	0.0000

RESULTS OF ENROLLMENT FORECAST

YEAR	ACTUAL TOTAL ENROLLMENTS	FORECAST TOTAL ENROLLMENTS	FORECAST ERRORS	ABSOLUTE PERCENT ERRORS
1962	11795	11632.2897	162.7103	1.38%
1963	11961	11592.2759	368.7241	3.08%
1964	13214	13591.2409	-377.2409	2.85%
1965	15079	16578.5261	-1499.5261	9.94%
1966	16010	16365.1913	-355.1913	2.22%
1967	16546	15928.4999	617.5001	3.73%
1968	16841	16691.7463	149.2537	0.89%
1969	17492	17470.1462	21.8538	0.12%
1970	18444	17487.9795	956.0205	5.18%
1971	18655	18161.1033	493.8967	2.65%
1972	18080	19044.1167	-964.1167	5.33%
1973	18560	19034.1593	-474.1593	2.55%
1974	19280	19674.6779	-394.6779	2.05%
1975	20490	20796.3775	-306.3775	1.50%
1976	21129	20084.3528	1044.6472	4.94%
1977	21904	21055.9244	848.0756	3.87%
1978	22287	21722.8836	564.1164	2.53%
1979	22003	21983.7228	19.2772	0.09%
1980	22490	22602.5387	-112.5387	0.50%
1981	22709	23226.0745	-517.0745	2.28%
1982	23053	22673.4921	379.5079	1.65%
1983	22366	22153.4715	212.5285	0.95%
1984	21449	21289.2558	159.7442	0.74%
1985	20901	21219.239	-318.239	1.52%
1986	20634	21108.7208	-474.7208	2.30%
1987	20116	20319.9935	-203.9935	1.01%
1988	UNKNOWN	20157.4513		

TOTAL CASES = 26
DURBIN-WATSON TEST = 1.3197

AVERAGE % ERROR = 2.53%
OF VARIABLES = 5
NO SERIAL CORRELATION

TABLE 82

MULTIPLE REGRESSION (BACKWARD) PROCEDURE FOR OU ENROLLMENTS - YEARS 1962 THROUGH 1987

EP	MULTIPLE R	R SQUARE	F	SIGNIFICANT R	R SQUARE CHANGE	SIGNIFICANT CHANGE	IN/OUT	VARIABL
							IN	HIGHSCI
							IN	UNEMPL
							IN	CLFIG
							IN	FINAID
							IN	TUITION
	0.9891	0.9783	143.053	0.000	0.9783	.000	IN	USGNP
	0.989	0.9781	178.606	0.000	-0.0002	.646	OUT	CLFIG
	0.9875	0.9751	205.379	0.000	-0.003	0.112	OUT	FINAID

ANOVA TABLE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFICANT F
REGRESSION	4	227481206.20886	56870301.55222	205.37862	0.0000
RESIDUAL	21	5814998.44498	276904.68786		

B COFFICIENTS AND CONFIDENCE LIMITS

VARIABLE	B	SE B	LOWER	UPPER	T	SIGNIFICANT T
HIGHSCH	0.343076	0.05706	0.224414	0.461739	6.013	0.0000
UNEMPLY	474.909955	99.956539	267.039159	682.78075	4.751	0.0001
TUITION	-52.741291	18.375567	-90.955337	-14.527245	-2.87	0.0092
USGNP	5.147921	0.855812	3.368165	6.927677	6.015	0.0000
(CONSTANT)	-7370.731356	1374.023169	-10228.16612	-4513.296599	-5.364	0.0000

RESULTS OF ENROLLMENT FORECAST

YEAR	ACTUAL OU ENROLLMENTS	FORECAST OU ENROLLMENTS	FORECAST ERRORS	ABSOLUTE PERCENT ERRORS
1962	12117	12382.3313	-265.3313	2.19%
1963	13064	12487.2723	576.7277	4.41%
1964	14163	14078.0523	84.9477	0.60%
1965	15640	16440.265	-800.265	5.12%
1966	15473	16357.6303	-884.6303	5.72%
1967	15980	16155.5179	-175.5179	1.10%
1968	16930	16852.1302	77.8698	0.46%
1969	17607	17453.5241	153.4759	0.87%
1970	18052	17612.1974	439.8026	2.44%
1971	18441	18161.8581	279.1419	1.51%
1972	19494	19038.4161	455.5839	2.34%
1973	19647	18976.6142	670.3858	3.41%
1974	19932	19632.1988	299.8012	1.50%
1975	21316	20892.4129	423.5871	1.99%
1976	20010	20133.5802	-123.5802	0.62%
1977	19719	20822.6907	-1103.6907	5.60%
1978	20357	21271.817	-914.817	4.49%
1979	21872	21507.2583	364.7417	1.67%
1980	21836	21824.7293	11.2707	0.05%
1981	21681	21407.1013	273.8987	1.26%
1982	21803	21414.0261	388.9739	1.78%
1983	22907	22568.9573	338.0427	1.48%
1984	21365	21672.2547	-307.2547	1.44%
1985	21748	21905.8316	-157.8316	0.73%
1986	22165	22383.2004	-218.2004	0.98%
1987	21646	21533.1321	112.8679	0.52%

AVERAGE % ERROR = 2.09%
\# OF VARIABLES = 4
NO SERIAL CORRELATION

TOTAL CASES = 26
DURBIN-WATSON TEST = 1.09145

APPENDIX F

MULTIPLE DISCRIMINANT ANALYSIS

TABLE 83

SUMMARY RESULTS OF DISCRIMINANT ANALYSIS FOR UNDERGRADUATE ENROLLMENTS

STEP	ACTION ENTERED	ACTION REMOVED	VARS IN	WILKS' LAMBDA	SIG.	LABEL
1	UNEMPLY		1	.54735	.0013	OK UNEMPLOYMENT RATES
2	PINCOME		2	.36090	.0002	OK PER CAPITA INCOMES
3	OILRIG		3	.34320	.0010	OK DRILLING RIG ACTIVITIES
4	USGNP		4	.23714	.0003	US GROSS NATIONAL PRODUCTS
5	PINDEX		5	.23675	.0015	US PRICE INDICES
6	COMPFIG		6	.15898	.0004	OK OTHER INSTI ENROLLMENTS
7	TUITION		7	.12243	.0003	OSU TUITION
8	FINAID		8	.11953	.0014	OSU STUDENT AIDS
9	HIGHSCH		9	.09632	.0016	OK HIGH SCHOOL GRADUATES
10		PINCOME	8	.09741	.0004	OK PER CAPITA INCOMES
11		FINAID	7	.10150	.0001	OSU STUDENT AIDS

CANONICAL DISCRIMINANT FUNCTIONS EVALUATED AT GROUP MEANS

GROUP	FUNC 1	FUNC 2
0	0.40861	-0.74400
1	1.94784	0.40374
2	-4.11585	0.25181

CLASSIFICATION FUNCTION COEFFICIENTS
(FISHER'S LINEAR DISCRIMINANT FUNCTIONS)

STATUS =	0	1	2
UNEMPLY	190.3296	195.4702	182.6081
OILRIG	1.633649	1.673984	1.551268
USGNP	2.159767	2.219545	2.027821
PINDEX	-29.89367	-30.84488	-28.06715
COMPFIG	-0.2146955E-01	-0.2178316E-01	-0.2097944E-01
TUITION	-4.440890	-4.781812	-3.196848
HIGHSCH	0.1655859E-01	0.1597986E-01	0.187202GE-01
(CONSTANT)	-1877.945	-1952.214	-1763.314

TEST OF EQUALITY OF GROUP COVARIANCE MATRICES USING BOX'S M

THE RANKS AND NATURAL LOGARITHMS OF DETERMINANTS PRINTED ARE THOSE OF THE GROUP COVARIANCE MATRICES.

GROUP LABEL	RANK	LOG DETERMINANT
0	7	49.253735
1	7	46.940693
2	< 6	(TOO FEW CASES TO BE NON-SINGULAR)
POOLED WITHIN-GROUPS COVARIANCE MATRIX	7	56.186996

SINCE SOME COVARIANCE MATRICES ARE SINGULAR, THE USUAL PROCEDURE WILL NOT WORK. THE NON-SINGULAR GROUPS WILL BE TESTED AGAINST THEIR OWN POOLED WITHIN-GROUPS COVARIANCE MATRIX. THE LOG OF ITS DETERMINANT IS 58.291799

BOX'S M	APPROXIMATE F	DEGREES OF FREEDOM		SIGNIFICANCE
239.78	4.3867	28,	792.6	0.0000

CANONICAL DISCRIMINANT FUNCTIONS

FUNCTION	EIGENVALUE	PERCENT OF VARIANCE	CUMULATIVE PERCENT	CANONICAL CORRELATION	:	AFTER FUNCTION	WILKS' LAMBDA	CHI-SQUARED	D.F.	SIGNIFICANCE
					:	0	0.1015042	43.465	14	0.0001
1*	6.57782	95.64	95.64	0.9316845	:	1	0.7691807	4.9862	6	0.5456
2*	0.30008	4.36	100.00	0.4804366	:					

* MARKS THE 2 CANONICAL DISCRIMINANT FUNCTIONS REMAINING IN THE ANALYSIS.

TABLE 84

SUMMARY RESULTS OF CLASSIFICATION FOR UNDERGRADUATE ENROLLMENTS

CASE SEQNUM	MIS VAL	SEL	ACTUAL GROUP	HIGHEST PROBABILITY GROUP	P(D/G)	P(G/D)	2ND HIGHEST GROUP	P(G/D)	DISCRIMINANT SCORES...	
1			0	0	0.5610	0.6409	1	0.3590	0.4280	0.3310
2			1	1	0.9516	0.9185	0	0.0815	2.2440	0.5108
3			1	1	0.8956	0.9371	0	0.0629	2.2192	0.7869
4			1 **	0	0.4417	0.5428	1	0.4572	0.5469	0.5269
5			1	1	0.8242	0.8275	0	0.1725	2.1947	-0.1669
6			0	0	0.7705	0.6149	1	0.3851	1.0370	-0.3883
7			1	1	0.7451	0.8837	0	0.1163	2.4800	-0.1487
8			1	1	0.6594	0.8894	0	0.1106	2.5890	-0.2456
9			0	0	0.6899	0.8649	1	0.1347	-0.1132	-0.0584
10			2	2	0.1168	0.7906	0	0.2087	-2.2253	-0.5973
11			0	0	0.5983	0.6061	1	0.3939	0.5615	0.2547
12			1	1	0.4791	0.6853	0	0.3147	2.1482	-0.7927
13			1	1	0.9289	0.8710	0	0.1290	2.2043	0.1177
14			1	1	0.0202	0.9991	0	0.0009	3.7473	2.5399
15			1 **	0	0.2424	0.6691	1	0.3303	-0.0585	0.8735
16			1	1	0.7042	0.6448	0	0.3552	1.1111	0.4394
17			0 **	1	0.6463	0.7058	0	0.2942	2.0137	-0.5283
18			0	0	0.1660	0.9933	1	0.0066	-0.3621	-2.4754
19			0	0	0.3105	0.9766	2	0.0129	-1.0818	-1.0874
20			0	0	0.4264	0.9391	1	0.0609	0.7657	-2.0000
21			2	2	0.2877	0.9998	0	0.0002	-3.9825	-1.3211
22			2	2	0.4626	1.0000	0	0.0000	-4.4972	1.4334
23			2	2	0.9433	1.0000	0	0.0000	-4.4161	0.4152
24			2	2	0.8352	1.0000	0	0.0000	-4.5566	-0.1555
25			2	2	0.2213	1.0000	0	0.0000	-5.0175	1.7361

CLASSIFICATION RESULTS -

ACTUAL GROUP		NO. OF CASES	PREDICTED GROUP MEMBERSHIP 0	1	2
GROUP	0	8	7 87.5%	1 12.5%	0 0.0%
GROUP	1	11	2 18.2%	9 81.8%	0 0.0%
GROUP	2	6	0 0.0%	0 0.0%	6 100.0%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 88.00%

TABLE 85

COMPARISONS OF TOTAL ENROLLMENT FORECASTS

Year	Simple Exponential Smoothing (Alpha = 1.0)	Brown's Double Exponential Smoothing (Alpha = 0.7)	Holt's Two Parameter Exponential Smoothing (Alpha = 1.0, Beta = 0.3)	Box-Jenkins Methodology (P = 1, D = 0, Q = 0)	Multiple Regression Analysis
1963	1.39%	1.39%	0.42%	0.32%	3.09%
1964	9.48%	8.98%	8.49%	8.04%	2.85%
1965	12.37%	8.68%	9.26%	11.85%	9.95%
1966	5.82%	1.59%	0.27%	6.49%	2.22%
1967	3.24%	4.03%	2.20%	4.50%	3.74%
1968	1.75%	3.67%	2.95%	3.35%	0.88%
1969	3.72%	0.26%	0.05%	5.45%	0.13%
1970	5.16%	2.08%	1.66%	7.21%	5.18%
1971	1.13%	2.76%	2.82%	3.77%	2.65%
1972	3.18%	6.24%	6.38%	-0.30%	5.33%
1973	2.59%	2.28%	1.33%	5.01%	2.55%
1974	3.73%	3.09%	2.14%	6.37%	2.05%
1975	5.91%	3.95%	3.80%	8.82%	1.49%
1976	3.02%	0.66%	0.12%	6.60%	4.95%
1977	3.54%	0.09%	0.54%	7.37%	3.87%
1978	1.72%	1.76%	1.39%	5.96%	2.53%
1979	1.29%	4.09%	4.02%	3.25%	0.09%
1980	2.17%	1.18%	0.68%	6.43%	0.50%
1981	0.96%	0.12%	0.71%	5.49%	2.28%
1982	1.49%	0.37%	0.05%	6.08%	1.65%
1983	3.07%	4.37%	4.57%	1.83%	0.95%
1984	4.28%	3.84%	4.41%	0.43%	0.74%
1985	2.62%	0.18%	1.40%	1.60%	1.52%
1986	1.29%	1.61%	0.37%	2.63%	2.30%
1987	2.58%	0.24%	0.98%	1.27%	1.01%
1963-87 MAPE	3.37%	2.60%	2.35%	4.61%	2.48%
1980-87 MAPE	2.31%	1.49%	1.65%	3.22%	1.37%
1985-87 MAPE	2.16%	0.68%	0.92%	1.83%	1.61%
1988 FORECAST	20116	19657	19737	19410	20157
1989 FORECAST	N.A.	19193	19357	18796	N.A.
BEST MODEL (MARK *)	*	*	* *	*	*

APPENDIX G

COMPUTER PROGRAMS

SIMPLE EXPONENTIAL SMOOTHING FORECAST PROGRAM

```
      INTEGER OBS,X(100),X1,TOP4,L
      REAL A(10),MSE
      REAL AVGE(100),ALPH(100),AVGEE(100)
      DATA NOBS/100/,NA/10/
      DO 30 I=1,NOBS
      OBS=I
      READ(5,20,END=40) X(I)
20    FORMAT(I5)
30    CONTINUE
40    OBS=OBS-1
      IOBS=OBS
      K=1
      DO 200 M=1,NA
      A(M)=M*0.1
      ALPH(K)=A(M)
      ETOTAL=0.0
      S1=FLOAT(X(1))
      DO 300 I=1,OBS
      S=A(M)*X(I)+(1-A(M))*S1
      F=S
      IF (IOBS .EQ. I) GO TO 300
      D=F-X(I+1)
      E=(D/FLOAT(X(I+1)))*100.0
      ETOTAL=ETOTAL+ABS(E)
      ABSE=ABS(E)
      S1=S
300   CONTINUE
      AVGE(K)=ETOTAL/FLOAT(OBS)
      K=K+1
200   CONTINUE
      DO 500 I=1,9
      DO 400 J=I+1,10
      IF (AVGE(I) .LT. AVGE(J)) GO TO 400
      TEMP=AVGE(I)
      AVGE(I)=AVGE(J)
      AVGE(J)=TEMP
      ATEMP=ALPH(I)
      ALPH(I)=ALPH(J)
      ALPH(J)=ATEMP
400   CONTINUE
500   CONTINUE
      TOP3=4
      DO 2000 K=1,4
      IF (AVGE(K) .EQ. 0.0) GO TO 2000
      ETOT=0.0
      TDDSQ=0.0
      SS1=FLOAT(X(1))
      WRITE(6,600)
600   FORMAT('1',28X,'SIMPLE EXPONENTIAL SMOOTHING FORECAST')
      WRITE(6,650)
650   FORMAT('0',16X,'        TOTAL                               ABSOLUTE'
     *)
      WRITE(6,700)
700   FORMAT(16X,'YEAR  ENROLLMENT   FORECAST       ERROR    % ERROR')
      WRITE(6,750)
750   FORMAT(16X,'--------------------------------------------------')
      IYEAR=1962
      WRITE(6,800) IYEAR,X(1)
800   FORMAT(16X,I4,5X,I5)
      DO 1000 I=1,OBS
      SS=ALPH(K)*X(I)+(1-ALPH(K))*SS1
      FF=SS
      IF (IOBS .EQ. I) GO TO 850
      DD=FF-X(I+1)
      EE=(DD/FLOAT(X(I+1)))*100.0
      ABSEE=ABS(EE)
      ETOT=ETOT+ABS(EE)
      DDSQ=DD**2
      TDDSQ=TDDSQ+DDSQ
850   IYEAR=IYEAR+1
      IF (IOBS .NE. I) WRITE(6,900) IYEAR,X(I+1),FF,DD,ABSEE
900   FORMAT(16X,I4,5X,I5,5X,F8.2,5X,F8.2,5X,F5.2)
      IF (IOBS .EQ. I) WRITE(6,950) IYEAR,FF
950   FORMAT(16X,I4,15X,F8.2)
      SS1=SS
1000  CONTINUE
      AVGEE(K)=ETOT/FLOAT(OBS)
      MSE=TDDSQ/FLOAT(OBS)
      WRITE(6,1100)
1100  FORMAT(16X,'--------------------------------------------------')
      WRITE(6,1200) ALPH(K),AVGEE(K),MSE
1200  FORMAT(17X,'ALPH = ',F3.1,5X,'MAPE =',F6.2,5X,'MSE = ',F10.2)
2000  CONTINUE
      STOP
      END
```

BROWN'S DOUBLE EXPONENTIAL SMOOTHING FORECAST PROGRAM

```
      DIMENSION S(10,100),DS(10,100),AA(10,100),BB(10,100)
      DIMENSION DD(10,100),ABSEE(10,100),FF(10,100)
      INTEGER OBS,X(100),X1,TOP4,L,INDEX(10)
      REAL AVGE(10),ALPH(10),A(10),MSE(10),MTEMP
      DATA NOBS/100/,NA/10/
      DO 30 I=1,NOBS
      OBS=I
      READ(5,20,END=40) X(I)
20    FORMAT(I5)
30    CONTINUE
40    OBS=OBS-1
      IOBS=OBS
      K=1
      DO 100 M=1,NA
      A(M)=M*0.1
      ALPH(K)=A(M)
      S1=FLOAT(X(1))
      DO 50 I=1,OBS
      S(K,I)=A(M)*X(I)+(1-A(M))*S1
      S1=S(K,I)
50    CONTINUE
      K=K+1
100   CONTINUE
      AVGE(10)=0.0
      DO 300 J=1,NA
      INDEX(J)=J
      ETOTAL=0.0
      TDDSQ=0.0
      DS1=FLOAT(X(1))
      DO 200 I=1,OBS
      DS(J,I)=ALPH(J)*S(J,I)+(1-ALPH(J))*DS1
      AA(J,I)=2.0*S(J,I)-DS(J,I)
      IF (ALPH(J) .EQ. 1.0) GO TO 300
      BB(J,I)=(ALPH(J)/(1-ALPH(J)))*(S(J,I)-DS(J,I))
      MM=1
      FF(J,I)=AA(J,I)+BB(J,I)*MM
      IF (IOBS .EQ. I) GO TO 200
      DD(J,I)=FF(J,I)-X(I+1)
      ABSEE(J,I)=ABS(DD(J,I)/X(I+1))*100.0
      ETOTAL=ETOTAL+ABS(ABSEE(J,I))
      DDSQ=DD(J,I)**2
      TDDSQ=TDDSQ+DDSQ
      DS1=DS(J,I)
200   CONTINUE
      AVGE(J)=ETOTAL/FLOAT(OBS)
      MSE(J)=TDDSQ/FLOAT(OBS)
300   CONTINUE
      DO 500 I=1,9
      DO 400 J=I+1,10
      IF (AVGE(I) .LT. AVGE(J)) GO TO 400
      TEMP=AVGE(I)
      AVGE(I)=AVGE(J)
      AVGE(J)=TEMP
      ATEMP=ALPH(I)
      ALPH(I)=ALPH(J)
      ALPH(J)=ATEMP
      ITEMP=INDEX(I)
      INDEX(I)=INDEX(J)
      INDEX(J)=ITEMP
      MTEMP=MSE(I)
      MSE(I)=MSE(J)
      MSE(J)=MTEMP
400   CONTINUE
500   CONTINUE
      TOP3=4
      DO 2000 K=1,4
      IF (ALPH(K) .EQ. 1.0) GO TO 2000
      WRITE(6,600)
600   FORMAT('1',20X,'BROWN''S DOUBLE EXPONENTIAL SMOOTHING FORECAST')
      WRITE(6,650)
650   FORMAT('0',1X,'             TOTAL                                A              B
     *                ABSOLUTE')
      WRITE(6,700)
700   FORMAT(1X,'YEAR  ENROLLMENT    FORECAST     COEFFICIENT  COEFFICIENT
     *      ERROR         % ERROR')
      WRITE(6,750)
750   FORMAT(1X,'---------------------------------------------------------------
     *-------------------------')
      IYEAR=1962
      WRITE(6,800) IYEAR,X(1)
800   FORMAT(1X,I4,5X,I5)
      DO 1000 I=1,OBS
      IYEAR=IYEAR+1
      IF (IOBS .NE. I) WRITE(6,850) IYEAR,X(I+1),FF(INDEX(K),I),AA(INDEX
     *(K),I),BB(INDEX(K),I),DD(INDEX(K),I),ABSEE(INDEX(K),I)
850   FORMAT(1X,I4,5X,I5,5X,F8.2,5X,F8.2,5X,F8.2,5X,F8.2,5X,F8.2)
      IF (IOBS .EQ. I) WRITE(6,900) IYEAR,FF(INDEX(K),I),AA(INDEX(K
     *),I),BB(INDEX(K),I)
900   FORMAT(1X,I4,15X,F8.2,5X,F8.2,5X,F8.2)
1000  CONTINUE
      WRITE(6,1100)
1100  FORMAT(1X,'---------------------------------------------------------------
     *-------------------------')
      WRITE(6,1500) ALPH(K),AVGE(K),MSE(K)
1500  FORMAT(10X,'ALPH = ',F3.1,15X,'MAPE = ',F8.2,10X,'MSE = ',F10.2)
2000  CONTINUE
      STOP
      END
```

HOLT'S TWO PARAMETER EXPONENTIAL SMOOTHING FORECAST PROGRAM

```
      INTEGER OBS,X(100),X1,TOP5,L
      REAL A(10),B(10),MSE
      REAL AVGE(100),ALPH(100),BETA(100),AVGEE(100)
      DATA NOBS/100/,NA/10/,NB/10/
      DO 30 I=1,NOBS
      OBS=I
      READ(5,20,END=40) X(I)
20    FORMAT(I5)
30    CONTINUE
40    OBS=OBS-1
      IOBS=OBS
      K=1
      DO 200 M=1,NA
      A(M)=M*0.1
      DO 100 N=1,NB
      B(N)=N*0.1
      ALPH(K)=A(M)
      BETA(K)=B(N)
      S1=FLOAT(X(1))
      T1=X(2)-X(1)
      ETOTAL=0.0
      DO 300 I=1,OBS
      S=A(M)*X(I)+(1-A(M))*(S1+T1)
      T=B(N)*(S-S1)+(1-B(N))*T1
      L=1
      F=S+T*L
      IF (IOBS .EQ. I) GO TO 300
      D=F-X(I+1)
      E=(D/FLOAT(X(I+1)))*100.0
      ETOTAL=ETOTAL+ABS(E)
      ABSE=ABS(E)
      S1=S
      T1=T
300   CONTINUE
      AVGE(K)=ETOTAL/FLOAT(OBS)
      K=K+1
100   CONTINUE
200   CONTINUE
      DO 500 I=1,99
      DO 400 J=I+1,100
      IF (AVGE(I) .LT. AVGE(J)) GO TO 400
      TEMP=AVGE(I)
      AVGE(I)=AVGE(J)
      AVGE(J)=TEMP
      ATEMP=ALPH(I)
      ALPH(I)=ALPH(J)
      ALPH(J)=ATEMP
      BTEMP=BETA(I)
      BETA(I)=BETA(J)
      BETA(J)=BTEMP
400   CONTINUE
500   CONTINUE
      TOP5=3
      DO 2000 K=1,3
      WRITE(6,600)
600   FORMAT('1',13X,'HOTL''S TWO PARAMETER EXPONENTIAL SMOOTHING FORECA
     *ST')
      WRITE(6,650)
650   FORMAT('0',1X,'                                            TOTAL
     *                     ABSOLUTE')
      WRITE(6,700)
700   FORMAT(1X,' YEAR       SMOOTH         TREND    ENROLLMENT   FORECAST
     *       ERROR       % ERROR')
      WRITE(6,750)
750   FORMAT(1X,'------------------------------------------------------
     *------------------------')
      ETOT=0.0
      TDDSQ=0.0
      SS1=FLOAT(X(1))
      TT1=X(2)-X(1)
      IYEAR=1962
      WRITE(6,800) IYEAR,X(1)
800   FORMAT(2X,I4,30X,I5)
      DO 1000 I=1,OBS
      SS=ALPH(K)*X(I)+(1-ALPH(K))*(SS1+TT1)
      TT=BETA(K)*(SS-SS1)+(1-BETA(K))*TT1
      FF=SS+TT*L
      IF (IOBS .EQ. I) GO TO 850
      DD=FF-X(I+1)
      EE=(DD/FLOAT(X(I+1)))*100.0
      ABSEE=ABS(EE)
      ETOT=ETOT+ABS(EE)
      DDSQ=DD**2
      TDDSQ=TDDSQ+DDSQ
850   IYEAR=IYEAR+1
      IF (IOBS .NE. I) WRITE(6,900) IYEAR,SS,TT,X(I+1),FF,DD,ABSEE
900   FORMAT(2X,I4,4X,F8.2,5X,F8.2,5X,I5,5X,F8.2,5X,F8.2,7X,F5.2)
      IF (IOBS .EQ. I) WRITE(6,950) IYEAR,SS,TT,FF
950   FORMAT(2X,I4,4X,F8.2,5X,F8.2,5X,10X,F8.2)
      SS1=SS
      TT1=TT
1000  CONTINUE
      AVGEE(K)=ETOT/FLOAT(OBS)
      MSE=TDDSQ/FLOAT(OBS)
      WRITE(6,1200)
1200  FORMAT(1X,'------------------------------------------------------
     *------------------------')
      WRITE(6,1300) ALPH(K),BETA(K),AVGEE(K),MSE
1300  FORMAT(10X,'ALPH = ',F3.1,6X,'BETA = ',F3.1,5X,'MAPE = ',F6.2,5X,'
     *MSE = ',F10.2)
2000  CONTINUE
      STOP
      END
```

BOX-JENKINS METHODOLOGY PROGRAM

```
DATA LIST RECORD=1
   /YEAR 1-4 ENROLL 7-11

BOX-JENKINS  VARIABLE=ENROLL/LOG/DIFFERENCE=0 THRU 2/
             LAG=30/PLOT=SER,DSER,ACF,PACF/IDENTIFY

BOX-JENKINS  VARIABLE=ENROLL/LOG/DIFFERENCE=0/P=1/Q=1/LAG=30/
             BFR=13/PLOT=RAC,RES/ESTIMATE

BOX-JENKINS  VARIABLE=ENROLL/LOG/DIFFERENCE=0/P=1/Q=1/
             FCON=(1.4302)/
             FP=(.85)/
             FQ=(-.79844)/
             ORIGIN=-54/LEAD=2/PLOT=FCF,FLF,CIN/FORECAST
```

MULTIPLE REGRESSION ANALYSIS PROGRAM

```
DATA LIST RECORD=1
   /YEAR 1-4 ENROLL 7-11 UNEMPLY 13-15 (1) PINCOME 17-22 (3)
    OILRIG 24-26  USGNP 28-33 (1) PINDEX 35-40 (2) COMPFIG 42-47
    TUITION 49-54 (2) FINAID 56-62 HIGHSCH 64-68

VAR LABELS
        ENROLL  'OSU TOTAL ENROLLMENTS'
        UNEMPLY 'OK UNEMPLOYMENT RATES'
        PINCOME 'OK PER CAPITA INCOMES'
        OILRIG  'OK DRILLING RIG ACTIVITIES'
        USGNP   'US GROSS NATIONAL PRODUCTS'
        PINDEX  'US PRICE INDICES'
        COMPFIG 'OK OTHER INSTI ENROLLMENTS'
        TUITION 'OSU TUITION'
        FINAID  'OSU STUDENT AIDS'
        HIGHSCH 'OK HIGH SCHOOL GRADUATES'
LIST

REGRESSION DESCRIPTIVES=CORR/
        VARS=ENROLL UNEMPLY TO HIGHSCH/
        STATISTICS=ALL/
        DEPENDENT=ENROLL/
        METHOD=BACKWARD/
        RESIDUALS=DEFAULT ID(YEAR)/
        SCAT5ERPLOT(*RES,*PRE)/PARTIALPLOT/
        CASEWISE=ALL DEPENDENT PRED RESID SEPRED
```

MULTIPLE DISCRIMINANT ANALYSIS PROGRAM

```
DATA LIST RECORD=1
   /YEAR 1-4 ENROLL 7-11 UNEMPLY 13-15 (1) PINCOME 17-22 (3)
    OILRIG 24-26  USGNP 28-33 (1) PINDEX 35-40 (2) COMPFIG 42-47
    TUITION 49-54 (2) FINAID 56-62 HIGHSCH 64-68 STATUS 71

VAR LABELS
        ENROLL  'OSU TOTAL ENROLLMENTS'
        UNEMPLY 'OK UNEMPLOYMENT RATES'
        PINCOME 'OK PER CAPITA INCOMES'
        OILRIG  'OK DRILLING RIG ACTIVITIES'
        USGNP   'US GROSS NATIONAL PRODUCTS'
        PINDEX  'US PRICE INDICES'
        COMPFIG 'OK OTHER INSTI ENROLLMENTS'
        TUITION 'OSU TUITION'
        FINAID  'OSU STUDENT AIDS'
        HIGHSCH 'OK HIGH SCHOOL GRADUATES'
        STATUS  '1=INCR, 2=DECR, O=UNCHNG'
LIST

DISCRIMINANT GROUPS=STATUS(O,2)/
        VARIABLE=UNEMPLY TO HIGHSCH/
        ANALYSIS UNEMPLY TO HIGHSCH(2)
                 UNEMPLY TO HIGHSCH(1)
                 UNEMPLY TO HIGHSCH(O)/
        METHOD=WILKS/
STATISTICS 10 12 13 14 15
```

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