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A STUDENT ENROLLMENT FORECASTING MODEL FOR LANSING COMMUNITY COLLEGE (MICHIGAN)

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A STUDENT ENROLLMENT FORECASTING MODEL FOR LANSING COMMUNITY COLLEGE (MICHIGAN)

By

Walter Boyd Lingo

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ABSTRACT

A STUDENT ENROLLMENT FORECASTING MODEL

FOR LANSING COMMUNITY COLLEGE (MICHIGAN)

By

Walter B. Lingo

This study was designed to develop a useful student enrollment forecasting model for Lansing Community College. From the descriptive data collected hypotheses regarding the forecasting of student enrollment are suggested for subsequent experimental study.

Eight calculation methods: simple average, moving average, double moving average, exponential smoothing, double exponential smoothing, ratio method, simple correlation and regression analysis, and multiple correlation and regression analysis, were selected to forecast the 1979 student enrollment at Lansing Community College. From these eight calculation methods fifty-one 1979 student enrollment forecasts were generated.

Each calculation method required at least one influencing factor to compute a student enrollment forecast. The calculation methods of simple average, moving average, double moving average, exponential smoothing, and double exponential smoothing required only the influencing factor of past Lansing Community College student enrollment data. The ratio method incorporated two influencing factors: past student enrollment and tri-county (Clinton, Eaton, and Ingham) census data. The final two calculation methods, simple and multiple correlation and regression analysis, produced forecasts

through the application of twenty-two selected influencing factors/ independent variables.

Each of the fifty-one forecasts resulting from the eight listed calculation methods, and the selected influencing factors, were ranked by its accuracy in forecasting the Lansing Community College 1979 fulltime equated student enrollment. The ranking was based on the percentage of error of each forecast.

The calculation method that produced the most accurate forecast, based on the percentage of error, was the ratio method/18-20 year olds with a percentage of error of -0.4. The above fact revealed that the tested mathematical function methods did not produce a more accurate forecast than a non-mathematical function calculation method.

The range of the percentage of error produced by the eight calculation methods (fifty one scores) tested was 512.6. This indicated that the selection of a calculation method in forecasting student enrollment can produce diverse scores.

In addition, the influencing factors that produced the highest correlation coefficients did not produce a correspondingly high accuracy rate in forecasting student enrollment.

The major finding of this study was that the model that most accurately forecasted the 1979 fulltime equated student enrollment was able to forecast the 1980 student enrollment within an equal percentage of error.

DEDICATION

I wish to dedicate this completed dissertation to my wife, Ruth Ann, whose love and industriousness has been an unending source of inspiration.

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Chapter I

Statement of the Problem

Need

College administrators need information to effectively plan. Student enrollment which translates to fiscal income is one of the most fundamental elements in planning, and therefore the need for insight regarding future student enrollment is of paramount importance.

The impact of unforseen increases or decreases in student enrollment at a community college can create great institution-wide problems. Normally, the problems of unexpected increases in student enrollment, which require immediate administrative response, are generally more palatable inasmuch as additional revenue is usually generated; however, this revenue is not always commensurate with the required encumberance of dollars created by increased student enrollment. The problems which accompany unforeseen decreases in student enrollment are far more distasteful, for this situation nearly always results in fewer dollars than projected in the budget. Compounding the problem, a decrease in student enrollment often creates a very vicious spiral: decreased student enrollment is followed by a reduction in fiscal support; reduced fiscal support forces cutbacks in personnel and programs; fewer programs often result in even fewer students and in turn yet fewer dollars, et cetera.

The ability to accurately predict changes in student enrollment can permit administrative decision-making that will minimize the impact of decreased student enrollment and maximize the advantages of increased student enrollment. Given the many ailments within the present economic climate, coupled with the resulting uncertainties, it is a risky and complex undertaking to forecast student enrollment at a specific institution. The risk and complexity of forecasting a community college's student enrollment is great but the need for the positive adaptibility the knowledge of an accurate forecast can produce is equally great.

The Lansing State Journal in its September 2, 1979, edition quoted the president of Lansing Community College: "Trying to predict Lansing Community College's fulltime enrollment for the upcoming schoolyear is like guessing the number of waves that will hit the beach."[1] This statement emphasizes the complexity of developing a student enrollment forecasting model at Lansing Community College. The development of a reliable student enrollment forecasting model for Lansing Community College will provide an instrument that can produce valuable information from which administrative level decisions can be made without guessing.

If the application of the product and by-products of this research was restricted to the provincial needs of one institution, its value would be extremely limited. It is proposed that the commonality existing between a great many community colleges throughout the United States and Lansing Community College will permit a more limitless sharing of the product and by-products of this research. The primary contribution of this research will directly benefit Lansing Community College, and Lansing Community College will thus profit from the potential adaptability produced by the information in meeting its needs.

Purpose

The primary purpose of this study is to develop an applicable model that produces an accurate student enrollment forecast for Lansing Community College. As a by-product (secondary purpose) of the development of "the model" noteworthy facts relative to the influencing factors and the demographics of student enrollment at Lansing Community College are expected to be discovered. It is further expected that these noteworthy facts might also be applicable to comparable community colleges. In addition it is anticipated that the fulfillment of the primary purpose (the model) will enable other institutions to apply that model to the forecasting of their student enrollment(s).

Hypothesis

Numerous methods could be applied to the forecasting of student enrollment, each having inherent strengths and weaknesses. It is expected that one and only one of the selected calculation methods will most accurately forecast student enrollment at Lansing Community College.

In addition to the calculation method, the identification of major influencing factors, such as, economics, enrollment, and demographics may potentially contribute to accurate student enrollment forecasting. Further it is expected from the analysis of the major influencing factors and the applied and resulting models that:

H_{1a}: The calculation methods which employ the mathematical functions of both simple and multiple regression will produce more accurate forecasts than the other applied, in this study, calculation methods.

H_{1b}: The influencing factors that produce the highest simple correlation coefficient scores (measured against Lansing Community College's fulltime equated enrollment) will provide the most descriminating student enrollment forecasting data when applied to multiple regression analysis.

H_{1c}: The model that most accurately retrospectively "forecast" the 1979 Lansing Community College fulltime equated student enrollment will forecast the 1980 fulltime equated student enrollment within an equal percentage of error.

Theory

There is no existing consensus on the most reliable student enrollment influencing factor(s) nor the most applicable calculation method to accurately forecast student enrollment at a given institution. The available calculation methods and the numerous potential influencing factors together provide researchers the challenge of exercising the scientific method of trial and error. It was stated by Granger in his inaugural address (1977) at the University of Nottingham that, "The current trend in forecasting is towards model building."[2] A model for the purpose of this research shall be defined as a technique (calculation method/influencing factors) which when imitated can produce a fulltime equated student enrollment forecast for Lansing Community College.

It is my belief that a reliable model can be developed through a system of trial and error. This belief is based on the expectation I theorize that a model developed through trial and error, which most accurately forecasted the 1979 fulltime equated student enrollment (a known quantity) at Lansing Community College will be an effective model in forecasting 1980 and future fulltime equated student enrollments at Lansing Community College.

Overview

Though the primary purpose of this research is the development of a useful student enrollment forecasting model, it should be noted that numerous other related purposes might be served as well. Potential purposes related to the primary purpose are demographic descriptions, manpower studies, planning data, resource needs, latent demands, and, of course, policy recommendations. This overview of the setting within which this study exist should enhance one's appreciation of the potential value of this study.

In order to maximize the acceptance of the research and the subsequent conclusions the design of this research is detailed in Chapter III. The design is based to a large extent on the experiences and results of other researchers whose work is reviewed at length in Chapter II.

Chapter II

REVIEW OF LITERATURE

Introduction

Although many college administrators are interested in information related to student enrollment trends, a commensurate amount of contemporary literature on the subject of forecasting student enrollment has not been written. This is not to imply that the available literature is inferior. It should be noted that many heretofore unreported studies may become public as the pressure of inflation demands greater refinement in institutional planning and subsequent desire for more accurate student enrollment forecast models emerge. In the absence of a voluminous bibliography of related literature my review will reflect the most representative literature available.

There are four works which warrant special attention inasmuch as each specifically addresses the topic of forecasting student enrollment. They are: Statewide Planning in Higher Education (Chapter VII - "Meeting Area Educational Program and Capacity Needs")[1]; Methodology of Enrollment Projections for Colleges and Universities[2]; Projecting College and University Enrollments[3]; and Higher Education Enrollment Forecasting[4]. Following a review of the above cited works will be a detailed review of selected representative student enrollment forecast studies.

D. Kent Halstead who authored Statewide Planning in Higher Education included a chapter (VII) entitled "Meeting Area Educational Program and Capacity Needs," in which he specifically addresses problems related to student enrollment forecasting. Halstead maintains that, ". . . the fundamental purpose of higher education planning at the state level is to provide information and recommendations for the development of a total statewide system of postsecondary education that residents expect and society requires."[5]

In fulfilling the fundamental purpose stated above Halstead suggests that studies must be conducted and those studies should involve the following three objectives:

> . . . to provide within the State an enrollment capacity for anticipated student attendance in each area of recognized program need, to encourage institutional development and growth consistent with assigned differential functions, and to expand existing facilities and initiate new programs in such a way as to enhance geographical accessibility and effective program clustering.[6]

No statewide planning in higher education can be complete without the application of projection methodology. Halstead notes that, "Even with the most exacting techniques, however, predicting college enrollments is a hazardous undertaking because of the number, variety, and uncertainty of the variables involved."[7]

The variables Halstead is concerned about and which he devotes considerable space and data compilation to include:

> . . . state population growth and economic development; high school retention rates and geographic distribution of graduates; future anticipated admission policies, curriculums, . . . overall college entrance rates, patterns of student residence, attendance rates at individual institutions and the ability of institutions to accomodate everyone who would enroll. . . .[8]

We should be cautioned that the above listed variables are applicable to statewide planning but may not apply carte blanche to the forecasting of student enrollment at individual institutions.

Methodology of Enrollment Projections for Colleges and Universities by L.V. Lins, ". . . is an attempt to assist the many individuals throughout the country who have need for making institutional and/or statewide estimates of future college enrollments."[9] Lins notes that in forecasting student enrollment, "All factors related to enrollment of a particular institution must be considered."[10] Factors submitted by Lins to consider in the development of a student enrollment forecast model include: admission policy, housing, instructional facilities, staff, programs, high school graduates, post-baccalaureate students, related economic structure, international situations, birth rates, veteran enrollments, educational benefits and/or loan and scholarship programs, migration, mortality rates, and Selective Service drafts and deferments. The above list suggest the complexity and riskiness inherent in the forecasting of student enrollment. Lins sums up this section, "Good forecasts will call for logically integrated, analytical techniques."[11]

The remaining contents of his publication are divided into four chapters: (1) "Enrollment Projection Techniques", (2) "Short-Range Estimates of Enrollment", (3) "Long-Range Projections of Enrollment", and (4) "Data Presentation".

A review of the chapter on enrollment projection techniques will be omitted in favor of authors who treat the topic in a more statistical form. In Lins' discussion of short-range estimates of enrollment he suggest that in institutions, ". . . with large evening and/or part-time programs, total enrollment is a quite unsatisfactory basis on which to estimate. . . . a better index. . . may be facultyload data and number of credits. . . ."[12] Inasmuch as Lansing Community College possesses a disproportionate percentage of parttime students/evening programs this suggestion is noteworthy.

Lins in this writing indicated that he represents an institution without a limited enrollment policy. Lansing Community is also without a limited enrollment policy. Lins, based on forecasting results at his institution, ". . .has found that a combined ratio, cohort-survival method yields the best short-range estimates of enrollment."[13]

Under the heading of long range projections of enrollment Lins' maintains that, "Enrollment projections can be made as far as 17 years into the future without estimating births."[14] This of course is based on the fact that nearly all the students who will attend school within seventeen years are born and can be relatively accurately counted.

<u>Projecting College and University Enrollments: Analyzing the Past and Focusing the Future</u> by Wayne L. Mangelson, Donald M. Norris, Nick L. Poulton, and John A. Seeley, is a subjective approach to the topic of student enrollment forecasting and lacks documentation. In spite of this weakness the work merits review in that it presents a unique perspective. The text is presented in three parts: (1) Major Findings, (2) Review and Analysis of Past Projections, and (3) Means of Improving Enrollment Projections.

The major findings submitted by Mangelson resulted from an analysis of several enrollment studies. The major findings included:

1. The underlying assumptions in existing enrollment studies have been inadequate for projecting college enrollments.
    a. The usage of only the 18-21 year old age cohort as the basis for projection is misleading.

Broader cohort populations must be utilized in order to reflect the extension of the period of education and the participation of older learners.

b. Although it is necessary to utilize birth rate assumptions in predicting the size of traditional college cohort populations beyond 1990, it must be recognized that birth rate trends are currently in a state of flux.

c. Most projection studies assume implicitly that trends in underlying factors influencing attendance patterns will continue along established lines. Many of such assumptions seem unlikely.

d. Projection studies have assumed that the institutional composition of higher education will not change. The emergence of the notion of postsecondary education suggests that different institutional forms and enrollment patterns should be considered for the future.

2. Existing projection studies are not easily compared.
   a. Definitions of terms vary among the individual studies.
   b. The actual factors projected as well as their levels of disaggregation vary from study to study.
   c. Overly aggregated data may mask significant trends in certain enrollment categories.
3. The use of extrapolation assumes that the future will reflect the past along certain important dimensions. To be confident of the results of extrapolation, the factors selected for extrapolation must be appropriate and trend relationships must be understood.
   a. The enrollment projections of the early sixities, which were based on enrollment trends of the fifties, underestimated consistently the actual enrollments of the early sixties.
   b. The enrollment projections of the early seventies, however, based on the enrollment trends of the sixties, overestimated consistently the actual enrollment figures of the past several years.
   c. Existing projections fall short of the mark by extrapolating enrollments, rather than by the influencing factors that actually determine enrollments.
4. By extrapolating enrollments rather than the underlying factors actually influencing enrollments, existing projections fail to incorporate mechanisms for explaining why enrollments are changing. Therefore, existing studies are unable to predict what changes in enrollment trends will occur.
5. It is recommended that new projection techniques be developed, grounded on an understanding of the relationships between enrollments and underlying social values (e.g., credentialism), social

conditions (e.g., demographic factors), diffusion of communications technology (e.g., cable television), public policy (e.g., financial aid), and educational systems factors (e.g., new institutions).

   a. The incorporation of underlying factors into enrollment projections will improve the quality of actual enrollment projections.
   b. Also, the educator can utilize both the improved projection and the predictions of key factors to develop educational and institutional policy.

6. Although a number of the influencing factors are not measured currently, they are regularly monitorable.
7. The future states of the underlying factors may be predicted utilizing a combination of the following three techniques: extrapolation of reasonable trends, alteration of trends based on changes in relevant moderating factors, and the recognition of floors and ceilings that may operate to restrict variations in trends to within certain limits.
8. Considering the mechanisms for monitoring and predicting the factors influencing postsecondary educational enrollments, it is recommended that a framework be developed for describing the relationships among the key underlying factors and potential learners, educational aspirants, and actual enrollments, appropriately disaggregated.[15]

In examining the intended purpose of an enrollment projection study Mangelson states that the purpose, ". . . determines in most cases the definition of quantities used, many of the assumptions made, the types of output categories projected, and to some degree the methodological approach used."[16] The purpose(s) of a study according to Mangelson serve to create conceptual bases which he, ". . . groups under three headings: limits to comparison, methodological limitations, and the limitation of underlying assumptions."[17]

Issues discussed under the heading of limits to comparison included: definition of terms vary among individual studies, actual factors projected, as well as their levels of disaggregation, vary from study to study, and the masking of significant trends through over aggregation. Methodological limitations of course vary from method to method. The following three statements regarding methodological limitations are worthy of note:

(1) The use of extrapolation assumes that the future will reflect the past and often ignores the fact the linear growth along traditional lines is questional given the uncertainties of current enrollment trends.18
(2) The selection of the factors to be extrapolated determines largely the utility of the projection.19
(3) Projection studies that suggest policy alternatives do not develop fully the linkage between the enrollment figures and those policy alternatives.20

Given that each study is built on underlying assumptions, it should be noted that those assumptions create limitations. Generally assumptions are based on extrapolations from available data. These assumptions do not permit an examination of the underlying factors actually influencing enrollments. Mangelson maintains that, ". . . until studies incorporate mechanisms for explaining why enrollments are changing we will be unable to predict that changes in enrollment trends will occur."[21]

In the final chapter Mangelson outlines factors which he feels influence postsecondary educational enrollments. They are classified as social values, social conditions, diffusion of communications technology, public policy, and educational systems factors.

Under the heading of social values he suggest that values placed on knowledge, self-improvement, and formal education combined to create an attitude. Attitude along with other factors affect an individual's behavior and postsecondary enrollment.

Social conditions are described as those conditions which are objectively measurable, such as demographics, economics, and leisure time. The advantage of this kind of data is the statistical manageability it possesses.

The diffussion of technology into educational endeavors addressed the impact of such innovations as computer-assissted instruction, aduio-visual cassettes, and a host of similar technologies. Mangelson states that, "The effects of such technologies must be assessed with considerable prudence, the distinction being drawn clearly between window dressing and programs of substantive importance."[22]

Public policy (the level of public financial support) and the educational system (available opportunities) are the final two concerns expressed by Mangelson. He concludes, "By expanding the basis for the projection of postsecondary education's enrollments, the potential exists for expanding the uses of such projections as well."[23]

The final work is the Paul Wing publication, Higher Education Forecasting, which was released for limited distribution by the Board of Directors of the National Center for Higher Education Management Systems (NCHEMS) at the Western Interstate Commission for Higher Education (WICHE) in Boulder, Colorado. The author proposes in his preface that this publication ". . . provides a comprehensive treatment of the subject (enrollment forecasting) which will be of value to enrollment forecasting practitioners at higher education institutions and national agencies, as well as those at state agencies."[24] Though a good deal of the topics within this writing are technical, much of the discussion is nontechnical and thus provides a fine source for the establishment of a general understanding of the problems involved in forecasting higher education student enrollment.

Wing addresses the topic of student enrollment forecasting under the following headings: general consideration, alternative enrollment techniques, constructing an enrollment forecasting procedure, and a summary with conclusions.

The principal concern of forecasting higher education student enrollments according to Wing is ". . . the accurate prediction of future enrollments in specific higher education programs and/or institutions."[25] In an attempt to identify some of the subtleties and difficulties inherent in student enrollment forecasting, he introduced some general considerations such as federal financing plans, student attitudes, and judicial decisions which influence student enrollment.

The uses of student enrollment forecasts can be classified under one of two general headings according to Wing. Those two classifications are:

> (1) Short and medium-range forecasts which can be used as a partial basis for a variety of planning and management activities (for example - budgeting)
>
> (2) Long-term forecasts which provide a means for altering or reinforcing general expectations for the future, which if properly followed-up enable policy makers to adjust their priorities and frames of reference gradually, over a period of years.[26]

Additional uses of student enrollment forecasts suggested by Wing included:

> (1) Capital planning and budgeting. Contrasting projected enrollments with the current and projected capacity of physical facilities can provide a basis for capital investment decisions.

(2) Operating budgets for institutions or programs. Projected enrollments can serve as a basis for short- and medium-range budgetary estimates.

(3) Support for other management systems. Enrollment projections can be applied in analysis of such things as intersegmental student flows (for example, junior college transfers), unit costs of instruction, student access to higher education, impact of instructional programs on labor markets, different strategies for allocating resources, and funding requirements.27

Wing concluded that forecasting techniques and procedures have been under development for several decades by analysts and researchers in a number of fields and that the application of the various forecasting techniques to the specific problems of higher education enrollment forecasting have lagged far behind the technical developments.

Inasmuch as a presentation of selected calculation methods (extracted from more technical treatise) are included in Chapter III in detail I will review here only Wing's suggested classes of alternative enrollment forecasting calculation methods. Wing's four broad classes of enrollment forecasting calculation methods are:

(1) Curve Fitting: Techniques and models that produce forecasts based primarily on historical enrollment data.
(2) Causal Models: Tecniques and models that produce forecasts based on historical relationships between enrollments and other parameter(s) or variable(s) (for example, high school graudates).
(3) Intention Surveys: Techniques based on surveys of the intentions of potential students, producing forecasts or other techniques.
(4) Subjective Judgment: Those elements and aspects of forecasting procedures based on the judgment of the forecaster rather than some quantitative technique or procedure.28

In a succeeding chapter Wing concludes that, "In practice, causal models have proven to be better than curve-fitting models in most forecasting situations, particularly when enrollment patterns are changing.[29]

Guidelines for constructing a forecasting procedure are submitted by Wing in five steps:

> (1) Partition the population of students. . .
> (2) Identify the most appropriate forecasting techniques. . .
> (3) perform the calculations. . .
> (4) . . . compute the total enrollment figure by summing the estimates for each of the individual categories.
> (5) . . . validation of the results.30

As a cautionary submission Wing notes that there is a tendency for administrators to take forecasting too seriously in some situations. He suggest that a means of making more evident the risk of over reliance on a specific student enrollment forecasts ". . . is to provide explicit estimates of 'maximum likely' enrollments along with the 'preferred' estimates."[31] The most significant contribution of this publication is its practical approach to the goal of the development of a functional student enrollment forecasting model.

Review of Specific Studies

Besides the review presented above, a number of specific enrollment forecasting studies are important, highly relevant to this study, and merit mention. The importance and relevance of these studies rest on the introduction of selected student enrollment influencing factors and the resulting accuracy of the application of previously completed studies related to other institutions that have forecasted enrollment employing factors such as: past enrollments Coffman[32], Committee on Enrollment[33], Lins[34], Meier[35], Newton[36], and Tatham[37]; high school graduates Banks[38], Educational Research[39], Springer[40], and Thompson[41]; work force Gold[42], Johnston[43], Martinko[44], and Smith[45]; participation of high school graduates in higher education Degan[46] and Hassell[47]; population pool Prestiage[48] and U.S. Bureau of Census[49]; cohort survival Oliver[50] and Zimmer[51]; migration Petersen[52] and Purves[53]; economic indicators Gell[54]; land use Tatham[56]; square footage Duncan[57]; new programs New York State[58]; and S.A.T. scores Jewett[59].

An equally important ingredient in the development of an efficient student enrollment forecast model is the selection of the "most applicable" calculation method(s). Examples of methods and the resulting degree(s) of accuracy include: New York State[60] reported a range of 0.4 to 3.5 percent error using ratio methods and student surveys to predict statewide college enrollment; Evans[61] utilized cohort survival and subjective judgement to achieve accuracy within 1 percent in predicting freshmen enrollment in the California state college system; Zimmer[62] reported an error range of -6.12% to 6.88% in predicting total enrollment in the Minnesota college system applying cohort survival, multiple correlation and regression, Markov transition model, polynomial model, and ratio methods; and finally a one year department forecast, Orwig[63] yielded a 1-6% error range using cohort survival, moving averages, the Markov transition model, and the simple averages method. There are numerous calculation methods available and careful review of the literature must be made to determine which method is most applicable to the fulfillment of the purpose of a particular model. This review of specific studies provided information that significantly contributed to the selection of both the student enrollment influencing factors and calculation methods applied in this study.

Summary

As can be seen from the literature, although research in student enrollment forecasting is sketchy, there is every indication that the calculation methods known and the potentially applicable student enrollment influencing factors might well be sufficient to produce accurate student enrollment forecasts.

Quite likely, further research will generate more specific information regarding the calculation methods and influencing factors that facilitate accurate student enrollment forecasting.

Chapter III

Design of the Study

Introduction

This chapter contains a graphic presentation (tables 3.1 - 3.13) of student enrollment influencing factors (independent variables), a description of selected calculation methods, the operational measures to be applied in this study, the design of the study, its testable hypotheses, a description of the analysis to be used, and finally a summary.

Influencing Factors (independent variables)

Prior to detailing the design of this research the items to be considered as potential influencing factors of student enrollment at Lansing Community College are presented. The factors will be introduced under the following headings:

1. Economic (Tables 3.1 - 3.4)

   3.1 Consumer Price Index (all items)
   3.2 Employment Data (Clinton-Eaton-Ingham-Ionia)
   3.3 United States Gross National Product (1976 Dollars)
   3.4 Lansing Community College Tuition Rate Data

2. Enrollment (Tables 3.5 - 3.8)

   3.5 Lansing Community College Fall Term Enrollment Data
   3.6 Michigan Selected Public Community College Fall Enrollment Data
   3.7 Michigan Higher Education Fall Term Enrollment Data
   3.8 Michigan State University Fall Enrollment Data

3. Lansing Community College Demographics (Tables 3.9 - 3.12)

   3.9 Lansing Community College General Student Data (State Count Data)
   3.10 Lansing Community College Fall Term Student Age Data
   3.11 Lansing Community College Data of Students by High School
   3.12 Lansing Community College Divisional Credit Generation Data (Percent of Total College Credits)

Table 3.1

Consumer Price Index (all items)

Year	Index	Index (minus one year)	Index (minus two years)
1957	84.3	81.4	80.2
1958	86.6	84.3	81.4
1959	87.3	86.6	84.3
1960	88.7	87.3	86.6
1961	89.6	88.7	87.3
1962	90.6	89.6	88.7
1963	91.7	90.6	89.6
1964	92.9	91.7	90.6
1965	94.5	92.9	91.7
1966	97.2	94.5	92.9
1967	100.0	97.2	94.5
1968	104.2	100.0	97.2
1969	109.8	104.2	100.0
1970	116.3	109.8	104.2
1971	121.3	116.3	109.8
1972	125.3	121.3	116.3
1973	133.1	125.3	121.3
1974	147.7	133.1	125.3
1975	161.2	147.7	133.1
1976	170.5	161.2	147.7
1977	181.5	170.5	161.2
1978	195.3	181.5	170.5
1979	219.4	195.3	181.5
1980	---	219.4	195.3

Source: Economic Report of the President, 1979 (Washington: G.P.O. 1979), Table B-43. United States Department of Labor Bureau of Labor Statistics, Washington 25, D.C.

Table 3.2

Employment Data
(Clinton-Eaton-Ingham-Ionia)

Year	Civilian Labor Force	Unemployment Rate	Number of Unemployed
1970	177,600	6.5	11,500
1971	183,500	6.4	11,800
1972	190,500	6.2	11,800
1973	194,100	5.0	9,700
1974	197,300	7.7	15,200
1975	200,300	11.9	23,900
1976	208,100	8.6	18,000
1977	221,500	7.7	17,000
1978	227,500	6.3	14,400
1979	235,000	6.7	15,700

Source: Michigan Employment Security Commission, Lansing, Michigan

Table 3.3

United States
Gross National Product (1976 Dollars)

Year	G.N.P.	Year	G.N.P.
1957	442.8	1969	935.5
1958	448.9	1970	982.4
1959	486.5	1971	1,063.4
1960	506.0	1972	1,171.1
1961	523.3	1973	1,306.6
1962	563.8	1974	1,413.2
1963	594.7	1975	1,516.3
1964	635.7	1976	1,691.6
1965	688.1	1977	1,887.4
1966	753.0	1978	2,128.3
1967	796.3	1979	2,327.1
1968	868.5		

Source: Economic Report of the President
Washington: G.P.O., 1979

Table 3.4

Lansing Community College
Tuition Rate Data

Year	Resident	Non-Resident	Out-of-State
1957	3.11	4.33	4.33
1958	3.11	4.33	4.33
1959	3.11	4.33	4.33
1960	3.11	4.33	4.33
1961	3.11	4.33	4.33
1962	3.50	5.00	5.00
1963	3.50	5.00	5.00
1964	4.12	5.63	5.63
1965	4.12	5.63	5.63
1966	5.00	7.00	7.00
1967	6.00	8.50	8.50
1968	6.20	8.80	8.80
1969	6.80	9.60	9.60
1970	7.00	11.00	31.00
1971	7.00	13.00	31.00
1972	7.00	13.00	31.00
1973	7.00	13.00	31.00
1974	7.00	13.00	22.50
1975	8.50	14.50	24.00
1976	8.50	14.50	24.00
1977	8.50	14.50	24.00
1978	11.00	17.00	27.00
1979	11.00	17.00	27.00

Source: Lansing Community College
Office of the Registrar

Table 3.5

Lansing Community College
Fall Term Enrollment Data

Year	Fulltime Equated	Headcount	Fulltime	Parttime
1957	166	425	62	363
1958	310	678	205	473
1959	401	857	265	592
1960	561	1297	334	963
1961	774	1604	549	1055
1962	1037	2124	720	1404
1963	1136	2320	719	1601
1964	1457	3021	1029	1992
1965	2114	3842	1526	2316
1966	2748	4166	1975	2191
1967	2880	4946	2038	2908
1968	3481	6047	2438	3609
1969	4019	7130	2754	4376
1970	4244	7230	2970	4260
1971	4435	7951	2983	4968
1972	4654	8773	2988	5785
1973	5334	10640	3208	7432
1974	6699	13280	3998	9282
1975	8357	15901	5476	10425
1976	8399	17102	5181	11921
1977	8750	19042	4815	14227
1978	8048	18313	4420	13893
1979	9019	21000	4718	16282

Source: Lansing Community College
Office of the Registrar

Table 3.6

Michigan Selected Public Community College
Fall Enrollment Data*

Year	Delta	G.R.J.C.	Henry Ford	Macomb	Mott	Oakland	Schoolcraft
1965	2122	3543	2880	4406	3877	2469	1772
1966	2272	3836	5069	5929	4264	2754	2273
1967	2872	3889	5138	6324	4793	4080	2645
1968	3506	4132	5229	7414	4986	6801	3077
1969	3987	4040	5991	8930	4370	8870	3395
1970	4438	4331	5854	10007	4757	9807	3649
1971	4606	4283	5269	10196	5041	9514	3705
1972	4638	4011	5614	9518	5199	8717	3725
1973	4678	4161	6159	10103	5182	8913	3873
1974	5509	4881	7064	11561	6489	9871	4681
1975	6123	5751	7530	13714	7774	11383	5085
1976	5929	5367	7548	12594	5724	10572	4729
1977	5842	5469	8048	12288	4577	10495	4671
1978	6074	5694	7906	12434	5513	10555	4929
1979	5516	7203	11153	12167	5090	10661	3794

Table 3.6 (cont'd.)

Delta - Delta College, University Center, Michigan

G.R.J.C. - Grand Rapids Junior College, Grand Rapids, Michigan

Henry Ford - Henry Ford Community College, Dearborn, MIchigan

Macomb - Macomb County Community College, Warren, Michigan

Mott - Mott Community College, Flint, Michigan

Oakland - Oakland Community College, Union Lake, Michigan

Schoolcraft - Schoolcraft Community College, Livonia, Michigan

Source: Senate Fiscal Agency Office
Lansing, Michigan
"Historical Enrollment Summary" (unpublished)

*The enrollment data is fulltime equated student enrollment

Table 3.7

Michigan Higher Education
Fall Term Enrollment Data*

Year	Public Four Year Colleges	Public Community Colleges	Independent Colleges	Total Higher Education Enrollment
1966	174,010	45,380	38,065	257,455
1967	185,197	51,972	42,609	279,778
1968	198,478	61,852	41,923	302,253
1969	208,224	70,422	42,727	321,373
1970	217,547	77,343	42,845	337,744
1971	220,341	79,507	42,599	342,447
1972	219,235	79,849	43,198	342,282
1973	222,398	82,848	44,008	349,245
1974	230,885	98,853	48,364	378,102
1975	242,061	115,861	52,543	410,465
1976	236,942	109,750	50,773	397,465
1977	236,618	108,365	51,014	395,997
1978	236,035	106,649	50,647	393,331
1979	196,751	111,564	53,177	361,492

Source: Senate Fiscal Agency Office, Lansing, Michigan "Historical Ernollment Summary" (unpublished)
*The enrollment data is fulltime equated student enrollment.

Table 3.8

Michigan State University
Fall Enrollment Data

Year	Headcount	F.Y.E.S.
1964	34,487	
1965	38,802	35,499
1966	41,474	37,946
1967	42,053	39,497
1968	44,421	41,061
1969	44,173	41,782
1970	43,569	41,253
1971	44,887	41,124
1972	44,909	40,349
1973	45,195	40,623
1974	47,367	42,732
1975	48,670	42,839
1976	46,921	42,839
1977	47,034	41,095
1978	46,567	40,730
1979	47,355	41,374

Source: Senate Fiscal Agency Office
Lansing, Michigan
"Historical Enrollment Summary" (unpublished)

Table 3.9

Lansing Community College
General Student Data
(State Count Data)

Year	Total Students	Freshmen (-40 credits)	Sophomores (40+ credits)	Men	Women	Married Men	Married Women
1969	7181	5873	1308	4893	2288	2002	747
1970	7396	5645	1751	4868	2528	1891	837
1971	7951	6023	1928	4988	2963	1978	1038
1972	8773	6679	2094	5207	3566	2280	1374
1973	10,640	8208	2432	5971	4669	2765	1836
1974	13,280	10,380	2900	7319	5961	3380	2307
1975	15,901	12,120	3781	8385	7084	3687	2774
1976	17,102	12,773	4329	8709	8393	3725	3356
1977	19,042	14,154	4888	9267	9775	3868	3977
1978	18,313	13,582	4731	8558	9755	3658	4384
1979	18,826	13,857	4969	8600	10,226	2835	3836

Source: Lansing Community College
Office of the Dean of Student Personnel Services

Table 3.9 (cont'd.)

Lansing Community College
General Student Data
(State Count Data)

Year	New Students	Re-Admissions	Returning	Transfers	Resident	Out of District	Out of State	Foreign
1969	2943	674	3564	374	5230	1871	50	30
1970	2811	1049	3536	464	5603	1738	43	12
1971	3145	1169	3637	459	6253	1676	18	4
1972	3568	1528	3677	581	6981	1764	28	0
1973	4393	4433	1814	542	8471	2128	38	3
1974	5221	5720	2339	375	10,508	2699	30	43
1975	6866	4392	4643	632	12,466	3305	46	84
1976	5653	8654	2795	883	13,073	3820	36	173
1977	6317	3302	9423	860	14,486	4206	95	255
1978	6278	3638	8924	597	13,496	4505	57	255
1979	5417	4272	9173	772	14,354	4169	53	250

Souce: Lansing Community College
Office of the Dean of Student Personnel Services

Table 3.10

Lansing Community College
Fall Term Student Age Data
Percent of Total Enrollment

Age	1971	1972	1973	1974	1975	1976	1977	1973	1979
-21	39.0	35.9	31.5	30.4	29.3	28.1	26.2	25.8	26.4
21-25	29.8	29.1	28.1	27.5	27.7	27.8	26.4	25.5	27.1
26-30	13.0	14.0	15.5	16.1	18.6	20.2	19.4	18.6	17.8
31-35	5.8	7.1	8.5	9.0	9.4	9.1	10.3	10.6	10.7
36-40	4.3	4.3	4.9	5.0	5.2	5.0	5.6	6.5	6.2
41-45	3.4	3.7	3.8	4.1	3.7	3.8	4.0	4.3	4.0
46-50	2.0	2.6	3.1	3.3	2.6	2.4	2.9	2.9	2.7
51-55	1.2	1.4	2.0	1.8	1.6	1.6	2.0	2.0	2.0
56-60	.4	.7	.9	1.0	.7	.7	.9	1.1	.9
61+	.3	.3	.3	.5	.5	.4	1.0	1.2	1.2
Mean Age	25.0	25.5	26.2	26.8	26.0	26.5	20.3	27.6	27.5
Median Age	21.0	23.0	22.5	23.0	24.0	24.0	25.0	25.0	25.0
Mode Age	19.0	19.0	19.0	19.0	18.0	19.0	19.0	19.0	19.0

Source: Lansing Community College, Office of the Dean of Student Personnel Services

Table 3.11

Lansing Community College
Data of Students by High School

Year	High School Graduates Lansing Community College Area	Lansing Community College District
1972	7877	4491
1973	8247	4721
1974	7839	4445
1975	8211	4510
1976	8107	4493
1977	8460	4707
1978	7947	4382
1979	8208	4405

Source: Lansing Community College
Office of Admissions

Table 3.12

Fall Term
Lansing Community College
Divisional Credit Generation Data
(Percent of Total College Credits)

	DIVISIONS				
Year	A & S	Business	L.R.	S.P.S.	Tech./H.C.
1970	39737 (60.4)	12840 (19.4)	72 (0.1)	691 (1.0)	12436 (18.9)
1971	39249 (57.1)	13357 (19.4)	156 (0.2)	316 (1.1)	15168 (22.0)
1972	38145 (52.8)	14939 (20.7)	207 (0.2)	932 (1.2)	17918 (24.8)
1973	38954 (46.9)	20034 (24.2)	475 (0.5)	983 (1.1)	22234 (26.8)
1974	45832 (44.1)	26588 (25.6)	1413 (1.3)	1481 (1.4)	28528 (27.4)
1975	56383 (43.5)	32694 (25.2)	2547 (1.9)	2227 (1.7)	35685 (27.5)
1976	54811 (42.1)	32910 (25.2)	2624 (2.0)	3308 (2.5)	36534 (28.0)
1977	52845 (38.9)	36963 (27.2)	2898 (2.1)	3998 (2.9)	38923 (28.7)
1978	47370 (42.1)	34375 (25.2)	2642 (2.0)	4245 (2.5)	36112 (28.0)
1979	51148 (38.9)	38987 (27.2)	3089 (2.1)	4407 (2.9)	42160 (28.7)

Table 3.12 (cont'd.)

A & S - Division of Liberal Arts and Science

Business - Division of Business

L.R. - Division of Learning Resources

S.P.S. - Division of Student Personnel Services

Tech./H.C. - Division of Technology and Health Careers

Source: Lansing Community College
Office of the Registrar

4. Population Pool (Table 3.13)

3.13 Tri-County Census Data By Age (Clinton-Eaton-Ingham)

These factors will be evaluated for application in the forecasting model whose function is the accurate forecast of Lansing Community College's fulltime equated student enrollment.

Calculation Methods

All student enrollment forecasts must be calculated via a predetermined method. "As with all forecasting," states Centra, "the assumption behind most of the projections presented is that there will not be any drastic changes in the nation."[1] This assumption permits researchers the liberty to select from a body of calculation methods the method which is most applicable to the forecasting at an individual institution or other population segment.

The following calculation methods will be applied in this study to the forecasting of the 1979 Lansing Community College fulltime equated enrollment:

1. Simple Average
2. Moving Average
3. Double Moving Average
4. Exponential Smoothing
5. Double Exponential Smoothing
6. Ratio Method
7. Simple Regression and Correlation (Y - a + bx)
8. Multiple Regression and Correlation ($Y = a + b_1x_1 + \ldots b_nx_n$)

The method of simple average is nothing more than the calculation of the mean ($\bar{x}$). The mean is defined as:

$\bar{x} = \frac{x_1 + x_2 + \ldots x_N}{N}$. Glass adds, "The value of the mean is especially affected by what might be called outliers, i.e., scores shich lie far from the center of the group of scores. Whether

Table 3.13

Tri-County Census Data By Age
(Clinton-Eaton-Ingham)

		AGE					
Year	TOTAL	TOTAL 18-20	TOTAL 21-25	TOTAL 26-30	FEMALE 18-30	MALE 18-30	TOTAL 18-30
1970	378,000	34,625	40,994	27,711	51,924	51,133	103,057
1971	382,000	36,239	43,612	27,847	53,949	53,504	107,453
1972	386,000	37,853	46,230	27,984	55,975	53,256	114,231
1973	390,000	39,467	48,848	28,120	58,000	60,618	118,618
1974	394,000	41,082	51,467	28,257	60,026	62,990	123,016
1975	398,000	42,696	54,085	28,394	62,052	65,361	127,413
1976	401,800	44,310	56,703	28,530	64,253	67,733	131,986
1977	405,600	45,925	59,322	28,667	66,279	70,104	136,383
1978	409,400	47,539	61,940	28,803	68,304	72,475	130,779
1979	413,200	49,153	64,558	28,940	70,330	74,346	145,176

Source: "Population Projections for Michigan to the Year 2000"
Information Systems Division, Office of the Budget
Department of Management and Budget
Lansing, Michigan

this is an advantage depends upon the particular questions you are asking of the data."[2]

The moving average calculation method offers the advantage of placing greater weight on more current data than on more dated data. Mathematically a moving average is computed:

$$1979^{F} = \frac{1978^{A} + 1977^{A} + 1976^{A} + \ldots}{N}$$

where: A = actual
F = forecast
N = number of actual years applied

It can be seen in the above formula that a reduction in N places greater weight on more recent data and an increase in N places less weight on recent data. As stated by Brown, "The process of computing the moving average is quite simple and straight forward. It is accurate: the average minimizes the sum of squares of the differences between the most recent N observations and the estimate of the coefficient in the model."[3] This advantage should be considered in the light of the fact, ". . . that when there are changes in the basic pattern of the variable being forecast moving averages may not adapt rapidly to the changes." Wheelright goes on, "This limitation of simple moving averages to adapt to trend, seasonal and cyclical patterns can be overcome at least in part by using higher order smoothing techniques."[4]

Exponential smoothing is a higher order smoothing technique. As defined by Brown, "Exponential smoothing is quite a common sort of averaging. In the field of systems engineering, this is the simplest case of proportional control. The estimate is corrected with each new observation in proportion to the difference between the previous estimate and the new observation."[5]

The formula for the calculation of exponential smoothing is:

$$1979^{F} = 1978^{A} + \alpha(1978^{F} - 1978^{A})$$

where: A = actual
V = forecast
α = constant

The value of alpha (α) must be between 0 and 1. Thus the effect of a large and small alpha is completely analogous to the effect of including a small number of observations in computing a moving average versus including a large number of observations in a moving average.

Two obvious limitations in the moving average calculation, that is, the need to store the last N observations and the fact of equal weight to all N observations, are removed in the exponential smoothing method. According to Wheelwright, "What we should like is a weighting sceme that would apply the most weight to the most recent observed values and decreasing weights to the older values."[6] Exponential smoothing does just that plus it eliminates the need for storing all past observations.

The limitations of exponential smoothing are much the same as moving averages: (1) not effective in handling trends, (2) they are nonstatistical methods and thus difficult to evaluate in any exact terms.

It is interesting to note that the simple average and the moving average have the inherent weakness that a forecast will always fall below or above the actual data if a trend exist. The <u>double</u>

moving average is an attempt to eliminate the phenomenon. This is done by ". . . taking the difference between the single moving average and the double moving average and adding it back to the single moving average."[7] Unfortunately the same two limitations, that is, storage of data and equal weight for all observations, exist in the method of double moving averages as in moving averages.

Double exponential smoothing as with single exponential smoothing is able to eliminate the two limitations cited above. In applying double exponential smoothing the same concluding steps as described in the double moving averages are executed, that is, we add to the single exponential smoothed value the difference between itself and the double smoothing and then adjust.

The ratio method produces student enrollment forecasts based on trends in ratios of enrollment to selected variables. Once the ratio is established, here a decision must be made whether to use the median, mean, or most recent ratio and which calculation method to apply, it is then possible to make a forecast by multiplying the calculated ratio by the projected variable.

This method has been used widely and is based on the assumption that "the habit" reflected in the calculated ratio will continue.

It should be noted that all of the above calcualtion methods discussed heretofore are "non-statistical". A non-statistical model is defined by Wheelwright as, ". . . models that do not follow the general rules of statistical analysis and probability theory . . . , based much more on intuition . . . than on fundamental statistics."[8] The intent of including the above models is that required statistical wizardry is minimal and thus; if one of the above models "proves efficient," the appeal to apply that model woul- be greater. A measure of efficiency for each of the applied models will be detailed later in this chapter.

Simple correlation and regression analysis is a statistical method which attempts to determine the relationship between enrollment (dependent variable) and an "influencing factor" (independent variable). In forecasting work simple correlation and regression analysis is considered to have the following strengths and weaknesses:

Strengths:

1. A greater range of forecasting situations can be handled with regression analysis than with smoothing techniques (non-statistical models).

2. It is a statistical model and thus its accuracy can be closely evaluated in terms of statistical measures.

Weaknesses:

1. It is suitable only for linear relationships.

2. It requires a considerable amount of data to produce statistically significant results.

3. It treats all observations of the data as being equal.

Multiple Correlation and Regression Analysis applies the same principle as the simple correlation and regression analysis. The difference in practice is that there are situations in which more than one independent variable (influencing factor) can be used and then simple correlation and analysis is not adequate and should be replaced by multiple correlation and regression analysis. In addition to the above mentioned advantage we can compute the individual coefficient of correlation for each of the pairs of independent variables.

As a statistical model there are tests of significance which can evaluate the model. The application of the above tests will produce a better understanding of each equation and the reliability which might be placed on each equation. Of course the chief interest in the value of multiple correlation and regression analysis is its applicability to the forecasting of student enrollment. Before this interest can be realized, the influencing factors (independent variables) must be statistically examined.

Operational Measures

Past Lansing Community College fulltime equated enrollment data will be the only influencing factor applied to the following student enrollment forecasting methods:

1. Simple Average
2. Moving Average
3. Double Moving Average
4. Exponential Smoothing
5. Double Exponential Smooth

The ratio method of forecasting Lansing Community College's fulltime equated enrollment will employ only census data. The census data will include the population pool of Clinton, Eaton, and Ingham counties and will incorporate the following age ranges:

1. 18 - 20 Year Olds
2. 21 - 25 Year Olds
3. 26 - 30 Year Olds
4. 18 - 30 Year Olds
5. Total Population

The simple correlation and regression analysis calculation method will be applied to all included influencing factors and will serve two purposes. The first is to produce data which will allow the application of the $Y = a + bx$ formula to the forecasting of the 1979 Lansing Community College fulltime equated student enrollment. The second purpose is to evaluate each of the influencing factors via statistical methods (which will be detailed later in this chapter). That evaluation will be followed by the application of the multiple correlation and regression analysis calculation method to the statistically evaluated and selected influencing factors. The simple correlation and regression analysis will be applied to the following dependent variables (Lansing Community College enrollments) and influencing factors (independent variables):

I. Fulltime Equated Enrollment (dependent variable)

A. Independent Variables
1. Lansing Community College Headcount Enrollment
2. Lansing Community College Fulltime Enrollment
3. Lansing Community College Parttime Enrollment
4. Lansing Community College Area/High School Graduates
5. Lansing Community College District/High School Graduates
6. United States Gross National Product
7. Michigan Public Community Colleges Enrollment
8. Michigan Independent Colleges Enrollment
9. Michigan Total Higher Education Enrollment
10. Michigan Public Four Year Colleges Enrollment (Headcount)
11. Michigan Public Four Year Colleges Enrollment (FTE)
12. Michigan State University (Headcount)
13. Michigan State University (FYES)
14. Lansing Community College Tuition (out of state)
15. Lansing Community College Tuition (resident)
16. Lansing Community College Tuition (non-resident)
17. Consumers Price Index (all items)
18. Consumers Price Index (all items) minus one year
19. Consumers Price Index (all items) minus two years
20. Delta College
21. Grand Rapids Junior College

22. Schoolcraft College
23. Macomb County Community College
24. Henry Ford Community College
25. C.S. Mott Community College
26. Oakland County Community College
27. Lansing Community College - Division of Arts & Sciences
28. Lansing Community College - Division of Student Personnel Services
29. Lansing Community College - Division of Technical Health Careers
30. Lansing Community College - Division of Business
31. Lansing Community College - Division of Learning Resources
32. Tri-County Census Data (18-30/male)
33. Tri-County Census Data (18-30/female)
34. Tri-County Census Data (18-20)
35. Tri-County Census Data (21-25)
36. Tri-County Census Data (26-30)
37. Tri-County Census Data (18-30)
38. Civilian Work Force
39. Number of Unemployed
40. Unemployed Rate

II. Fulltime Enrollment (dependent variable)

A. Independent Variables
1. Michigan State University Enrollment (headcount)
2. Consumers Price Index (all items)
3. Consumers Price Index (all items) minus one year
4. Consumers Price Index (all items) minus two years
5. United States Gross National Product

III. Parttime Enrollment (dependent variable)

A. Independent Variables
1. Michigan State University Enrollment (headcount)
2. Consumers Price Index (all items)
3. Consumers Price Index (all items) minus 1 year
4. Consumers Price Index (all itmes) minus 2 years
5. United States Gross National Product

IV. Headcount Enrollment (dependent variable)

A. Independent Variables
1. Michigan State University Enrollment (headcount)
2. Consumers Price Index (all items)
3. Consumers Price Index (all items) minus 1 year
4. Consumers Price Index (all items) minus 2 years
5. United States Gross National Product

The resulting data from the simple correlation and regression analysis will be evaluated to determine which independent variables will be employed in the multiple correlation and regression analysis. The methods of evaluation for the data from each of the forty independent variables tested will include:

1. Ranking by correlation coefficient.
2. Ranking by coefficient of determination.
3. Eliminate independent variables (R) which do not permit rejection of Ho: P = 0 at 95% confidence level.
4. Accept only regression equations which are significant at the 95% confidence level (F - statistic).
5. Subjective judgment.

The application of multiple regression and correlation analysis will encompass six runs of separate combinations of selected independent variables tested. These combinations will be determined by the collective influence of the above stated methods of evaluation. The data produced by these six runs will be tested by the following measurement devices:

1. Examine correlation coefficient.
2. Examine coefficient of determination.
3. Reject models which do not produce a large enough R to permit rejection of Ho: P = 0 at the 95% confidence level.
4. Accept only regression equations which are significant at the 95% confidence level (F - statistic).

Design

The framework around which this study is built is quite straight forward. The design of the study or plan is predictive. It is the goal of this study, through the application of several selected models, to discover a model which accurately "predicts" the 1979 full-time equated student enrollment at Lansing Community College. The basic design then requires the thoughtful selection of the factors most influential to student enrollment and the subsequent application of those factors to calculation methods which mathematically/statistically possess the power to effectuate reliable results. This design will allow a conclusion regarding the relative accuracy of the models tested to the prediction of the 1979 fulltime equated student enrollment at Lansing Community College.

Testable Hypotheses

Null hypotheses: No difference will be found in the 1979 forecasting accuracy (Lansing Community College fulltime equated student enrollment) of the selected calculation methods as measured by the percentage of error.

Symbolically: Ho: $M_1 = M_x$

Legend: M_1 = the difference from 9019 generated by the simple average calculation method's forecast of the Lansing Community College fulltime equated student enrollment.

M_x = the forecasted student enrollments $\pm$ 9019 generated by each of the selected calculation methods.

Alternate hypothesis H_{1a}: The calculation methods which employ the mathematical functions of simple and multiple regression produce more accurate forecasts than the other applied calculation methods in this study.

Alternate hypothesis H_{1b}: The influencing factors (independent variables) which possess the highest correlation coefficient (measured against the dependent variable) will produce the most accurate student enrollment forecast.

Alternate hypothesis H_{1c}: The model which most accurately forecast the 1979 fulltime equated student enrollment at Lansing Community College will forecast the 1980 enrollment within an equal percentage of error.

Analysis

The null hypothesis and the alternate hypothesis a and b will be tested by comparing the accuracy of their respective forecast. This will be done by computing the percentage of error. This computation is specifically only a matter of subtracting the forecasted enrollment (s) from the actual enrollment (9019) and dividing the difference by the actual enrollment (9019) thus producing the percentage of error.

Alternate hypothesis 1c must be tested by determining which of the applied models produces the most accurate 1979 fulltime equated student enrollment. This will be done by comparing the percentage of error of each model. Upon determining which model has the lowest percentage of error that model will be used to forecast the 1980 Lansing Community College fulltime equated enrollment. The resulting percentage of error can then be compared to the percentage of error of the selected model in predicting the 1979's enrollment and the test for hypothesis 1c will be complete.

Summary

The design of this study is such that from collected data useful information will be generated relative to the accurate forecasting of student enrollment at Lansing Community College. The testing of the above described hypotheses are expected to respectively reveal:

A. The relative accuracy of selected calculation methods to forecast the 1979 fulltime equated student enrollment of Lansing Community College.

B. The relative impact of the selected influencing factors upon the accurate forecasting of the fulltime equated student enrollment at Lansing Community College.

C. The relative accuracy of the applied calculation methods to forecast the 1979 fulltime equated student enrollment of Lansing Community College.

D. A recommended model to forecast the 1980 fulltime equated student enrollment at Lansing Community College.

Chapter IV

Analysis of Results

Introduction

The accumulated data of this study will be analyzed, discussed, and interpreted in this chapter. The above task will be achieved by directly presenting the results of the four stated hypotheses.

Null Hypothesis

The null hypothesis: No difference will be found in the 1979 forecasting accuracy (Lansing Community College fulltime equated student enrollment) of the selected calculation methods as measured by the percentage of error.

Symbolically: Ho: $M_1 = Mx$

Legend: M_1 = the difference from 9019 generated by the simple average calculation method's forecast of the Lansing Community College fulltime equated student enrollment.

Mx = the forecasted student enrollments $\pm$ 9019 generated by each of the selected calculation methods.

The selected calculation methods which were used to forecast the 1979 fulltime equated student enrollment of Lansing Community College included:

1. Simple Average (Table 4.1)
2. Moving Average (Table 4.2)
3. Double Moving Average (Table 4.3)
4. Exponential Smoothing (Table 4.4)
5. Double Exponential Smoothing (Table 4.5)
6. Ratio Method (Tables 4.6 - 4.10)

Table 4.1

Forecasts of the Succeeding Year's
Lansing Community College
Fulltime Equated Student Enrollment
Calculation Method: Simple Average

Year	Running Total	Divisor	Simple Average	Forecasted Enrollment	Actual Enrollment (Year)	Percentage of Error
1957	166	1	166.0	166	310 (1958)	-46.4
1958	476	2	238.0	238	401 (1959)	-40.6
1959	877	3	292.3	292	561 (1960)	-47.9
1960	1438	4	359.5	359	774 (1961)	-53.6
1961	2212	5	442.4	442	1037 (1962)	-57.3
1962	3249	6	541.5	541	1136 (1963)	-52.3
1963	4385	7	626.4	626	1457 (1964)	-57.0
1964	5842	8	730.2	730	2114 (1965)	-65.4
1965	7956	9	884.0	884	2748 (1966)	-67.8
1966	10704	10	1070.4	1070	2880 (1967)	-62.8
1967	13584	11	1234.9	1234	3481 (1968)	-64.5

Table 4.1 (cont'd.)

Year	Running Total	Divisor	Simple Average	Forecasted Enrollment	Actual Enrollment (Year)	Percentage of Error
1968	17065	12	1422.0	1422	4019 (1969)	-64.6
1969	21084	13	1621.8	1621	4244 (1970)	-61.8
1970	25328	14	1809.1	1809	4435 (1971)	-59.2
1971	29763	15	1984.2	1984	4654 (1972)	-57.3
1972	34417	16	2151.0	2151	5334 (1973)	-59.6
1973	39751	17	2338.2	2338	6699 (1974)	-65.0
1974	46450	18	2580.5	2580	8357 (1975)	-69.1
1975	54807	19	2884.5	2884	8399 (1976)	-65.6
1976	63206	20	3160.3	3160	8750 (1977)	-63.8
1977	71956	21	3426.4	3426	8048 (1978)	-57.4
1978	80004	22	3636.5	3636	9019 (1979)	-59.6

Table 4.2

Forecasts of the 1979
Lansing Community College
Fulltime Equated Student Enrollment
Calculation Method: Moving Averages

Years	Total Enrollment (Schoolyears)	1979^F (Moving Average)	1979^A	Percentage of Error
1969-78	62939 (10)	6293.9	9019	-30.2
1970-78	58920 (9)	6546.6	9019	-27.4
1971-78	54676 (8)	6834.5	9019	-24.2
1972-78	50241 (7)	7177.2	9019	-20.4
1973-78	45587 (6)	7597.8	9019	-15.7
1974-78	40253 (5)	8050.6	9019	-10.7
1975-78	33554 (4)	8388.5	9019	- 6.9
1976-78	25197 (3)	8399.0	9019	- 6.8
1977-78	16798 (2)	8399.0	9019	- 6.8
1978	8048 (1)	8048.0	9019	-10.7

F = Forecasted Enrollment   A = Actual Enrollment

Table 4.3

Forecasts of the 1964 through 1979
Lansing Community College
Fulltime Equated Student Enrollment
Calculation Mehtod: Double Moving Average

Year	Actual Enrollment	Four Year Running Average	Four Year Moving Average of Col. 3	Value of A*	Value of B**	Forecast (A + B)	Percentage of Error
1957	166						
1958	310						
1959	401						
1960	561						
1961	774	360					
1962	1037	512					
1963	1136	693					
1964	1457	877	607	1147	179.8	1327	- 8.9
1965	2114	1101	796	1406	203.1	1609	-23.9
1966	2748	1436	1027	1845	272.4	2117	-23.0
1967	2880	1864	1320	2408	362.3	2770	- 3.8
1968	3481	2300	1675	2925	416.3	3341	- 4.0
1969	4019	2806	2102	3510	468.9	3979	- 1.0

Table 4.3 (cont'd.)

Year	Actual Enrollment	Four Year Running Average	Four Year Moving Average of Col. 3	Value of A*	Value of B**	Forecast (A + B)	Percentage of Error
1970	4244	3282	2563	4001	478.9	4480	5.6
1971	4435	3656	3011	4301	429.6	4731	6.7
1972	4654	4045	3447	4643	398.3	5041	8.3
1973	5334	4338	3830	4846	338.3	5184	- 2.8
1974	6699	4667	4177	5157	326.3	5483	-18.2
1975	8357	5281	4583	5979	464.9	6444	-22.9
1976	8399	6261	5137	7385	748.6	8134	- 3.2
1977	8750	7197	5852	8542	895.8	9438	7.9
1978	8048	8051	6698	9404	901.1	10305	28.0
1979	9019	8389	7475	9303	608.7	9912	9.9
1980	—	8554	8048	9060	337.0	9397	—

*A is the result of the difference between columns 3 and 4 added back to column 3.

**B is column 3 minus column 4 multiplied by .666 ($\frac{2}{n - 1}$).

Table 4.4

Forecasts of the Succeeding Year's
Lansing Community College
Fulltime Equated Student Enrollment
Calculation Mehtod: Exponential Smoothing

Year	Actual Enrollment	Exponentially Smoothed Values and Percentage of Error*					
		$\alpha = .1$	P.E.	$\alpha = .5$	P.E.	$\alpha = .9$	Percentage of Error
1970	4244						
1971	4435	4244	- 4.3	4244	- 4.3	4244	- 4.3
1972	4654	4263	- 8.4	4340	- 6.7	4416	- 5.1
1973	5334	4302	-19.3	4497	-15.7	4630	-13.2
1974	6699	4542	-32.2	5598	-16.4	6492	- 3.1
1975	8357	4758	-43.1	6149	-26.4	6678	-20.1
1976	8399	5118	-39.1	7253	-13.6	8189	- 2.5
1977	8750	5446	-37.8	7846	-10.3	8378	- 4.3
1978	8048	5776	-28.2	8298	+ 3.1	8713	+ 8.3
1979	9019	6003	-33.4	8173	- 9.3	8115	-10.0

Table 4.5

Forecasts of the Succeeding Year's
Lansing Community College
Fulltime Equated Student Enrollment
(1972 through 1979)
Calculation Method: Double Exponential Smoothing (α = .1)

Year	Actual Enrollment	Single Exponential Smoothing	Double Exponential Smoothing	Value of A	Value of B	Forecast of A+BM	Percentage of Error
1970	4244	—	—	—	—	—	—
1971	4435	4244	4244	—	—	—	—
1972	4654	4263	4244	4282	2.10	4284.1	-7.9
1973	5334	4302	4250	4354	5.77	4359.8	-18.2
1974	6699	4542	4278	4806	29.30	4835.3	-27.8
1975	8357	4758	4326	5190	47.95	5238.0	-37.3
1976	8399	5118	4405	5831	79.14	5910.1	-29.6
1977	87.50	5446	4509	6383	104.00	6487.0	-25.9
1978	8048	5776	4636	6916	126.54	7042.5	-12.5
1979	9019	6003	4778	7228	135.97	7363.9	-18.3

Table 4.5 (cont'd.)

$A = 1.2\,(x'+1) - (x''+1)$

$B = \dfrac{\alpha}{1-\alpha}\,(x'+1 - x''+1)$

$M = 1$ (or the number of years ahead we want to forecast)

Single Exponential Smooth = $x'+1 = x+\alpha\,(x^F - x)$, where x equals previous year's known enrollment and F equals forecasts for previous year.

Double Exponential Smoothing = $x''+1 = \alpha\,(x'+1) + (1-\alpha)\,(x''+1)$

Table 4.6

Forecasting 1979 Fulltime Equated Student Enrollment
Applying Tri-County Census Data (18 - 20 Year Olds)
Calculation Method: Ratio Method

Year	Census Data 18 - 20 Year Olds	Enrollment	Percentage of Population
1970	34,625	4244	.122
1971	36,239	4435	.122
1972	37,853	4654	.122
1973	39,467	5334	.135
1974	41,082	6699	.163
1975	42,696	8357	.195
1976	44,310	8399	.189
1977	45,925	8750	.190
1978	47,539	8048	.169
1979	49,153	1979 Forecast=8975.33*	.1826**

*Forecast based on the ratio trend percentage multiplied by the projected population.

**The percentage figure was calculated with the moving average method (1976-1977-1978/N=3).

Table 4.7

Forecasting 1979 Fulltime Equated Student Enrollment
Applying Tri-County Census Data (21 - 25 Year Olds)
Calculation Method: Ratio Method

Year	Census Data 21 - 25 Year Olds	Enrollment	Percentage of Population
1970	40,994	4244	.103
1971	43,612	4435	.101
1972	46,230	4654	.100
1973	48,848	5334	.109
1974	51,467	6699	.130
1975	54,085	8357	.154
1976	56,703	8399	.148
1977	59,332	8750	.147
1978	61,940	8048	.129
1979	64,558	1979 Forecast=9122.04*	.1413**

*Forecast based on the ratio trend percentage multiplied by the projected population.

**The percentage figure was calculated with the moving average method (1976-1977-1978/N = 3).

Table 4.8

Forecasting 1979 Fulltime Equated Student Enrollment
Applying Tri-County Census Data (26 - 30 Year Olds)
Calculation Method: Ratio Method

Year	Census Data 26 - 30 Year Olds	Enrollment	Percentage of Population
1970	27,438	4244	.154
1971	27,603	4435	.160
1972	27,768	4654	.167
1973	27,933	5334	.190
1974	28,098	6699	.238
1975	28,263	8357	.295
1976	28,604	8399	.293
1977	28,769	8750	.304
1978	28,934	8048	.278
1979	29,099	1979 Forecast=8485.3*	.2916**

*Forecast based on the ratio trend percentage multiplied by the projected population.

**The percentage figure was calculated with the moving average method (1976-1977-1978/N = 3).

Table 4.9

Forecasting 1979 Fulltime Equated Student Enrollment
Applying Tri-County Census Data (18 - 30 Year Olds)
Calculation Method: Ratio Method

Year	Census Data 18 - 30 Year Olds	Enrollment	Percentage of Population
1970	103,057	4244	.041
1971	107,453	4435	.041
1972	114,231	4654	.040
1973	118,618	5334	.044
1974	123,016	6699	.054
1975	127,413	8357	.065
1976	131,986	8399	.063
1977	136,383	8750	.064
1978	140,799	8048	.057
1979	145,176	1979 Forecast=8899.28*	.613**

*Forecast based on the ratio trend percentage multiplied by the projected population.

**The percentage figure was calculated with the moving average method (1976-1977-1978/N = 3).

Table 4.10

Forecasting The 1979 Fulltime Equated Student Enrollment
Applying Tri-County Total Census Data
Calculation Method: Ratio Method

Year	Total Census Data	Enrollment	Percentage of Population
1970	378,000	4244	.011
1971	382,000	4435	.012
1972	386,000	4654	.012
1973	390,000	5334	.014
1974	394,000	6699	.017
1975	398,000	8357	.021
1976	401,800	8399	.021
1977	405,600	8750	.022
1978	409,400	8048	.020
1979	413,200	1979 Forecast=8677.20*	.021**

*Forecast based on the ratio trend percentage multiplied by the projected population.

**The percentage figure was calculated with the moving average method (1976-1977-1978/N = 3).

7. Simple Correlation and Regression Analysis (Table 4.11)

8. Multiple Correlation and Regression Analysis (Table 4.12)

All of the above listed calculation methods produced at least a single forecast of the 1979 Lansing Community College fulltime equated student enrollment. In addition the moving average calculation method produced ten forecasts; the ratio calculation method produced five forecasts; the simple correlation and analysis calculation method produced twenty two forecasts; and finally the multiple correlation and regression analysis calculation method produced six forecasts.

A concise system to compare the results of the selected calculation methods was used. That system is the percentage of error. Simply stated the percentage of error is the actual fulltime equated student enrollment (9,019 in 1979) of Lansing Community College minus the forecasted Lansing Community College fulltime equated student enrollment divided by the actual 1979 fulltime equated student enrollment at Lansing Community College. Table 4.13 presents the results of all the 1979 Lansing Community College fulltime equated student enrollment forecasts that were calculated in this study including the enrollment forecast and the percentage of error.

The summary presented in Table 4.13 reflects, with no need for statistical justification, the conspicuous evidence that requires the rejection of the null hypothesis. The percentage of error range is so great (-62.0 to 512.2) that there is just no doubt the 1979 results of fulltime equated student enrollment forecasting at Lansing Community College is affected by the selection of a calculation method.

Table 4.11

Forecasts of the 1979
Lansing Community College
Fulltime Equated Student Enrollment
Calculation Method: Simple Correlation and Regression Analysis (formula: Y = a+bx)

	Independent Variable (x)	a	b	Forecast (Y)	Percentage of Error
1.	Michigan Independent Colleges Enrollment (53,177)	-14,946.1	.449	8,930.4	- .98
2.	Lansing Community College Headcount (21,000)	337.6	.457	9,934.6	10.15
3.	Michigan Public Community College Enrollment (111,564)	-1,862.6	.089	8,066.6	-10.56
4.	Lansing Community College Fulltime Enrollment (4,718)	-266.1	1.718	7,839.4	-13.08
5.	Lansing Community College Area/High School Graduates (8,208)	-22,581.9	3.697	7,763.1	-13.92
6.	Lansing Community College District/High School Graduates (4,405)	20,883.7	-2.982	7,748.0	-14.09
7.	Lansing Community College Parttime Enrollment (16,282)	690.4	.598	10,427.0	15.61
8.	Michigan Public 4 Year Colleges (Headcount) Enrollment (240,600)	10,313.3	.074	7,491.1	-16.94

Table 4.11 (cont'd.)

	Independent Variable (x)	a	b	Forecast (Y)	Percentage of Error
9.	Consumers Price Index - Minus 1 Year (195.3)	-6,004.5	85.677	10,728.2	18.95
10.	Consumers Price Indes - Minus 2 Years (818.5)	-6,765.9	96.470	10,743.4	19.11
11.	Macomb C.C.C. (12,167)	-2,230.3	.778	7,235.6	-19.77
12.	Delta College (5,516)	-1,863.4	1.602	6,973.2	-22.68
13.	Oakland C.C. (10,661)	47.4	.640	6,870.4	-23.82
14.	Michigan Total Higher Education Enrollment (361,492)	-7,812.6	.040	6,647.1	-26.30
15.	Michigan State University Enrollment (47,355)	5,656.7	-0.009	6,072.2	-32.68
16.	Consumers Price Index (219.4)	-6,015.8	82.637	12,114.8	34.32
17.	Schoolcraft C.C. (3,794)	-2,676.3	2.138	5,435.3	-39.74
18.	Michigan Public 4 Year Colleges (F.T.E.) (196,751)	-9,206.5	.073	5,156.3	-42.82
19.	Mott C.C. (5,090)	-2,663.9	1.536	5,154.3	-42.85
20.	Henry Ford C.C. (11,153)	-4,108.4	1.529	12,944.5	43.52
21.	United State/Gross National Product (2,327.4)	-2,694.5	6.734	12,978.2	43.90
22.	Grand Rapids J.C. (7,203)	-8,195.6	2.980	13,269.3	47.13

Table 4.12

Forecasts of the 1979
Lansing Community College
Fulltime Equated Student Enrollment
Calculation Method: Multiple Correlation and Regression Analysis
(formula: $Y = a+b_1x_1+b_2x_2 \ldots b_nx_n$)

		1979 Forecast	Percentage of Error
Run I	a = -1396.353	3,424.894	-62.02
X1	United States/Gross National Product (2327.4) (b=1.499)		
X2	Michigan Public Community College Enrollment (111,564) (b=.067)		
X3	Consumers Price Index (219.4) (b=24,743)		
X4	Grand Rapids Junior College Enrollment (7,203) (b=-.345)		
X5	Lansing Community College Tuition (resident) (11.00) (b=-260.367)		
X6	Tri-County Census Data (18-30) (49,153) (b=.16)		
X7	Michigan Total Higher Education Enrollment (361,492) (b=.000)		
X8	Civilian Labor Force (253,000) (b=-.036)		
Run II	a = 1321.161	13,283.752	47.28
X1	United States Gross/National Product (2,327.4) (b=4.515)		
X2	Michigan Public Community College Enrollment (111,564) (b=.248)		
X3	Consumers Price Index (219.4) (b=-37.518)		
X4	Grand Rapids Junior College (7,203) (b=-0.738)		
X5	Michigan Independent College Enrollment (53,177) (b=-0.013)		
X6	Lansing Community College Tuition (resident) (11.00) (b=114.105)		
X7	Tri-County Census Data (18-30) (49,153) (b=-0.009)		

Table 4.12 (cont'd.)

		1979 Forecast	Percentage of Error
X8 Delta College (5,516) (b=-3.158)			
X9 Schoolcraft College (3,794) (b=0.790)			
X10 Michigan Total Higher Education Enrollment (361,492) (b=-.004)			
X11 Macomb Community College (12,167) (b=-0.097)			
Run III	a = 2101.647	55,217.189	512.23
X1 United States/Gross National Product (2,327.4) (b=4.046)			
X2 Michigan Public Community College Enrollment (111,564) (b=.210)			
X3 Consumers Price Index (219.4) (b=-29.956)			
X4 Grand Rapids Junior College (7,203) (b=-.912)			
X5 Michigan Independent College Enrollment (53,177) (b=.135)			
X6 Lansing Community College Tuition (resident) (11.00) (b=250.994)			
X7 Tri-County Census Data (18-30) (49,153) (b=-.015)			
X8 Delta College (5,516) (b=-.689)			
X9 Schoolcraft College (3,794) (b=-1.066)			
X10 Michigan Total Higher Education Enrollment (361,492) (b=-0.023)			
Run IV	a = 1082.792	24,063.653	166.81
X1 United States/Gross National Product (2,327.4) (b=4.594)			
X2 Michigan Public Community College Enrollment (111,564) (b=.235)			
X3 Consumers Price Index (219.4) (b=-33.989)			
X4 Grand Rapids Junior College (7,203) (b=-.683)			
X5 Michigan Independent College Enrollment (53,177) (b=-.035)			
X6 Lansing Community College Tuition (resident) (11.00) (b=77.269)			
X7 Tri-County Census Data (18-30) (49,153) (b=-.011)			
X8 Delta College (5,516) (b=-3.342)			
X9 Schoolcraft College (3,794) (b=.922)			

Table 4.12 (cont'd.)

		1979 Forecast	Percentage of Error
Run V	a = 1744.461	3,535.296	-60.80
X1	United States/Gross National Product (2,327.4) (b=5.177)		
X2	Michigan Public Community College Enrollment (111,564) (b=.229)		
X3	Consumers Price Index (219.4) (b=-41.160)		
X4	Grand Rapids Junior College (7,203) (=-.735)		
X5	Michigan Independent College Enrollment (53,177) (b=-.276)		
X6	Lansing Community College Tuition (resident) (11.00) (b=-20.983)		
X7	Tri-County Census Data (18-30) (49,153) (b=-.019)		
X8	Delta College (5,516) (b=-.2.388)		
Run VI	a = -2100.6848	9,074.160	.61
X1	United States/Gross National Product (2,327.4) (b=1.184)		
X2	Michigan Public Community College Enrollment (111,564) (b=.074)		
X3	Consumers Price Index (219.4) (b=37.124)		
X4	Grand Rapids Junior College (7,203) (b=-.412)		
X5	Michigan Independent College Enrollment (53,177) (b=-.002)		
X6	Lansing Community College Tuition (resident) (11.00) (b=-329.961)		
X7	Tri-County Census Data (18-30) (49,153) (b=-.026)		

Table 4.13

A Summary of the Results of the
Application of the Selected Calculation Methods
Forecasts of Lansing Community College
Fulltime Equated Student Enrollment

Calculation Method	1979 Forecast	Percentage of Error
I. Simple Average (Table 4.1)		
1. Simple Average (N = 22)	3,836	-59.6
II. Moving Average (Table 4.2)		
1. 1978 (N = 1)	8,048	-10.7
2. 1977-78 (N = 2)	8,399	- 6.8
3. 1976-78 (N = 3)	8,399	- 6.8
4. 1975-78 (N = 4)	8,388	- 6.9
5. 1974-78 (N = 5)	8,050	-10.7
6. 1973-78 (N = 6)	7,597	-15.7
7. 1972-78 (N = 7)	7,177	-20.4
8. 1971-78 (N = 8)	6,834	-24.2
9. 1970-78 (N = 9)	6,546	-27.4
10. 1969-78 (N = 10)	6,293	-30.2
III. Double Moving Average (Table 4.3)		
1. Double Moving Average	9,911	9.9
IV. Exponential Smoothing (Table 4.4)		
1. $\alpha = .1$	6,003	-33.4
2. $\alpha = .5$	8,173	- 9.3
3. $\alpha = .9$	8,115	-10.0

Table 4.13 (cont'd.)

Calculation Method	1979 Forecast	Percentage of Error
V. Double Exponential Smoothing (Table 4.5)		
1. $\alpha = .1$	7,363	-18.3
2. $\alpha = .5$	8,631	- 4.3
3. $\alpha = .9$	7,555	-16.2
VI. Ratio Method/Tri-County Census Data		
1. 18 - 20 Year Olds (Table 4.6)	8,975	- 0.4
2. 21 - 25 Year Olds (Table 4.7)	9,122	1.1
3. 26 - 30 Year Olds (Table 4.8)	8,485	- 5.9
4. 18 - 30 Year Olds (Table 4.9)	8,899	- 1.3
5. Total Population (Table 4.10)	8,677	- 3.8
VII. Simple Correlation and Regression Analysis (Table 4.11)		
1. Consumers Price Index	12,114	34.32
2. Consumers Price Index - Minus 1 Year	10,728	18.95
3. Consumers Price Index - Minus 2 Years	10,743	19.11
4. Delta College	6,973	-22.68
5. Grand Rapids Junior College	13,269	47.13
6. Henry Ford Community College	12,944	43.52
7. Lansing Community College Area/High School Graduates	7,763	-13.92
8. Lansing Community College District/High School Graduates	7,748	-14.09
9. Lansing Community College Fulltime Enrollment	7,839	-13.08
10. Lansing Community College Headcount	9,934	10.15
11. Lansing Community College Parttime Enrollment	10,427	15.61
12. Macomb County Community College	7,235	-19.77
13. Michigan Independent Colleges Enrollment	8,930	- 0.98
14. Michigan Public Community College Enrollment	8,066	-10.56
15. Michigan Public 4 Year Colleges (F.T.E.)	5,156	-42.82
16. Michigan Public 4 Year Colleges (Headcount) Enrollment	7,491	-16.94

Table 4.13 (cont'd.)

Calculation Method	1979 Forecast	Percentage of Error
17. Michigan State University Enrollment	6,072	-32.68
18. Michigan Total Higher Education Enrollment	6,647	-26.30
19. Mott Community College	5,154	-42.85
20. Oakland Community College	6,870	-23.82
21. Schoolcraft Community College	5,435	-39.74
22. United States/Gross National Product	12,978	43.90
VIII. Multiple Correlation and Regression Analysis (Table 4.12)		
1. Run I	3,424	-62.0
2. Run II	13,283	47.2
3. Run III	55,217	512.2
4. Run IV	24,063	166.8
5. Run V	3,535	-60.8
6. Run VI	9,074	0.6

It should be noted that the simple and multiple correlation and regression analysis calculation methods were the only two statistical models, and thus it is possible to make statistical statements about the accuracy and significance of these regressions. The independent variables that were included in the forecasting of the 1979 fulltime equated student enrollment at Lansing Community College survived the following statistical evaluations:

1. F Statistic Test
   A. Simple Correlation and Regression Analysis (Table 4.14)
   B. Multiple Correlation and Regression Analysis (Table 4.15)
2. Coefficient of Determination (Table 4.16)
3. Correlation Coefficient (Table 4.17)
4. Correlation of Coefficient/Ho: p = 0
   A. Simple Correlation and Regression Analysis (Table 4.18)
   B. Multiple Correlation and Regression Analysis (Table 4.19)

In order to execute the two formulae, $Y = a + bx$ and $Y = a + b, x, + \ldots b_n x_n$ it was necessary to extract both the a and b from each of the simple and multiple correlation and regression analysis program runs. "Mini-Regression: A Small Computer Program for Performing Multiple Regression-Analysis" from Mini-Tab was the program that produced the bulk of this study's statistical data and it was this program from which a and b were extracted.

Inasmuch as the possibility of a miscalculation existed a cross check was conducted to verify the value of each a and b. The cross check of each linear regression (only the simple correlation and regression) was conducted. Using Texas Instruments 59 Program:

Table 4.14

Results of the F Statistic Test*
On Selected Independent Variables
In the Simple Correlation and Regression Analysis

Independent Variable	F Statistic	Degrees of Freedom	95% Confidence Level Accept/Reject
Lansing Community College Area/High School Graduates	1.75	6	Reject
Lansing Community College District/High School Graduates	0.34	6	Reject
Lansing Community College Enrollment (Headcount)	1,004.13	21	Accept
Lansing Community College Enrollment (Parttime)	334.22	21	Accept
Lansing Community College Enrollment (Fulltime)	885.46	21	Accept
Tri-County Census Data (18 - 30 Year Olds) Male	56.16	8	Accept
Tri-County Census Data (18 - 30 Year Olds) Female	58.36	8	Accept
Tri-County Census Data (18 - 20 Year Olds)	58.73	8	Accept
Tri-County Census Data (21 - 25 Year Olds)	59.73	8	Accept
Tri-County Census Data (26 - 30 Year Olds)	58.87	8	Accept
Tri-County Census Data (18 - 30 Year Olds)	73.76	8	Accept
Civilian Labor Force (Clinton-Eaton-Ingham-Ionia)	25.98	8	Accept
Number of Unemployed (Clinton-Eaton-Ingham-Ionia)	10.39	8	Accept
Unemployment Rate (Clinton-Eaton-Ingham-Ionia)	2.92	8	Reject
Lansing Community College Tuition (resident)	211.11	21	Accept
Lansing Community College Tuition (non-resident)	285.31	21	Accept
Lansing Community College-Division of Arts & Sciences	51.04	8	Accept
Lansing Community College-Division of Student Personnel Services (Total Credits)	38.54	8	Accept
Lansing Community College-Division of Technical Health Careers (Total Credits)	582.55	8	Accept

Table 4.14 (cont'd.)

Independent Variable	F Statistic	Degrees of Freedom	95% Confidence Level Accept/Reject
Lansing Community College-Division of Business	580.98	8	Accept
Lansing Community College-Division of Learning Resources	896.88	8	Accept
Lansing Community College Tuition (out of state)	39.05	21	Accept
Michigan State University (FYES)	14.38	9	Accept
Michigan State University (Headcount)	0.02	14	Reject
Consumers Price Index (all items)	259.07	20	Accept
Consumers Price Index (all items) minus 1 year	202.50	21	Accept
Consumers Price Index (all items) minus 2 years	165.59	21	Accept
Delta College Enrollment	105.69	12	Accept
Grand Rapids Junior College Enrollment	153.41	12	Accept
Henry Ford Community College Enrollment (fulltime equated)	84.07	12	Accept
Schoolcraft Community College Enrollment	104.88	12	Accept
Oakland Community College Enrollment	25.51	12	Accept
Mott Community College Enrollment	9.08	12	Accept
Macomb Community College Enrollment	89.75	12	Accept
United States Gross National Product (1976 dollars)	932.83	18	Accept
Michigan Public Four Year Colleges Enrollment (headcount)	57.74	14	Accept
Michigan Total Higher Education Enrollment (FYES/FTE)	66.85	8	Accept
Michigan Public Community Colleges Enrollment (FYES/FTE)	197.11	12	Accept
Michigan Independent Colleges Enrollment (FYES/FTE)	198.52	9	Accept
Michigan Public Four Year Colleges Enrollment (FTE)	25.91	9	Accept

*This test indicates the significance (or lack of significance) of the total regression equation at the 95% confidence level.

Table 4.15

Results of the F Statistic Test*
On Selected Runs
In the Multiple Correlation and Regression Analysis

Run	F Statistic	Degrees of Freedom	95% Confidence Level Accept/Reject
Run I	221.47	14	Accept
United States Gross National Product			
Michigan Public Community College Enrollment			
Consumers Price Index			
Grand Rapids Junior College			
Lansing Community College Tuition (resident)			
Tri-County Census Data (18 - 30)			
Michigan Total Higher Education Enrollment			
Civilian Labor Force			
Run II	253.64	11	Accept
United States Gross National Product			
Michigan Public Community College Enrollment			
Consumers Price Index			
Grand Rapids Junior College			
Michigan Independent College Enrollment			
Lansing Community College Tuition (resident)			
Tri-County Census Data (18 - 30)			
Delta College			

Table 4.15 (cont'd.)

Run	F Statistic	Degrees of Freedom	95% Confidence Level Accept/Reject
Schoolcraft College			
Michigan Total Higher Education Enrollment			
Macomb Community College			
Run III	174.45	12	Accept
United States Gross National Product			
Michigan Public Community College Enrollment			
Consumers Price Index			
Grand Rapids Junior College			
Michigan Independent College Enrollment			
Lansing Community College Tuition (resident)			
Tri-County Census Data (18 - 30)			
Delta College			
Schoolcraft College			
Michigan Total Higher Education Enrollment			
Run IV	366.94	13	Accept
United States Gross National Product			
Michigan Public Community College Enrollment			
Consumers Price Index			
Grand Rapids Junior College			
Michigan Independent College Enrollment			
Lansing Community College Tuition (resident)			
Tri-County Census Data (18 - 30)			
Delta College			
Schoolcraft College			

Table 4.15 (cont'd.)

Run	F Statistic	Degrees of Freedom	95% Confidence Level Accept/Reject
Run V	354.24	14	Accept
United States Gross National Product Michigan Public Community College Enrollment Consumers Price Index Grand Rapids Junior College Michigan Independent College Enrollment Lansing Community College Tuition (resident) Tri-County Census Data (18 - 30) Delta College			
Run VI	255.91	15	Accept
United States Gross National Product Michigan Public Community College Enrollment Consumers Price Index Grand Rapids Junior College Michigan Independent College Enrollment Lansing Community College Tuition (resident) Tri-County Census Data (18 - 30)			

Table 4.16

Independent Variables Ranked By Resulting
Coefficient of Determination from the
Simple Correlation and Regression Analysis

Independent Variable vs Lansing Community College (FTE)	Coefficient of Determination
Lansing Community College - Division of Learning Resources	.991
Lansing Community College - Division of Technical Health Careers	.986
Lansing Community College - Division of Business	.986
United States Gross National Product	.981
Lansing Community College Headcount Enrollment	.980
Lansing Community College Fulltime Enrollment	.977
Michigan Public Community Colleges Enrollment	.943
Lansing Community College Parttime Enrollment	.941
Lansing Community College Tuition (non-resident)	.931
Consumers Price Index (all items)	.928
Grand Rapids Junior College	.927
Michigan Independent Colleges Enrollment	.923

Table 4.16 (cont'd.)

Independent Variable vs Lansing Community College (FTE)	Coefficient of Determination
Lansing Community College (resident)	.910
Consumers Price Index (all items) minus 1 year	.906
Tri-County Census Data (18 - 30)	.902
Delta College	.898
Schoolcraft College	.897
Michigan Total Higher Education Enrollment	.893
Consumers Price Index (all items) minus 2 years	.887
Macomb County Community College	.882
Tri-County Census Data (18 - 20)	.880
Tri-County Census Data (21 - 25)	.880
Tri-County Census Data (25 - 30)	.880
Tri-County Census Data (18 - 30)	.879
Henry Ford Community College	.875
Tri County Census Data (18 - 30) male	.875
Lansing Community College - Division of Arts & Sciences	.865

Table 4.16 (cont'd.)

Independent Variable vs Lansing Community College (FTE)	Coefficient of Determination
Lansing Community College - Division of Student Personnel Services	.828
Michigan Public Four Year Colleges Enrollment	.805
Civilian Work Force	.765
Michigan Public Four Year Colleges Enrollment (FTE)	.742
Oakland County Community College	.680
Lansing Community College Tuition (out of state)	.650
Michigan State University (FYES)	.615
Number of Unemployed	.565
Mott Community College	.431
Unemployment Rate	.270
Lansing Community College Area/High School Graduates	.226
Lansing Community College District/High School Graduates	.054
Michigan State University Enrollment (Headcount)	.001

Table 4.17

Independent Variable Ranked By
Correlation Coefficient from
Simple Correlation and Regression Analysis

Independent Variable vs Lansing Community College (FTE)	Correlation Coefficient
Lansing Community College - Division of Learning Resources	.996
United States Gross National Product	.993
Lansing Community College Headcount Enrollment	.993
Lansing Community College - Division of Business	.990
Lansing Community College - Division of Technical Health Careers	.990
Lansing Community College Fulltime Enrollment	.998
Michigan Public Community Colleges Enrollment	.971
Lansing Community College Tuition (non-resident)	.970
Consumers Price Index (all items)	.965
Grand Rapids Junior College	.964
Michigan Independent Colleges Enrollment	.963
Lansing Community Colleges Parttime Enrollment	.961

Table 4.17 (cont'd.)

Independent Variable vs Lansing Community College (FTE)	Correlation Coefficient
Lansing Community College Tuition (resident)	.954
Consumers Price Index (all items) minus 1 year	.952
Tri-County Census Data (18 - 30)	.950
Delta College	.948
Schoolcraft College	.947
Michigan Total Higher Education Enrollment	.945
Tri-County Census Data (18 - 30) female	.942
Tri-County Census Data (18 - 20)	.939
Tri-County Census Data (21 - 25)	.938
Tri-County Census Data (26 - 30)	.938
Macomb County Community College	.938
Consumers Price Index (all items) minus 2 years	.938
Henry Ford Community College	.936
Tri-County Census Data (18 - 30) male	.935
Lansing Community College - Division of Arts & Sciences	.930

Table 4.17 (cont'd.)

Independent Variable vs Lansing Community College (FTE)	Correlation Coefficient
Lansing Community College - Division of Student Personnel Services	.910
Michigan Public Four Year Colleges Enrollment	.897
Civilian Work Force	.874
Michigan Public Four Year Colleges Enrollment (FTE)	.862
Oakland County Community College	.825
Lansing Community College Tuition (out of state)	.806
Michigan State University (FYES)	.784
Number of Unemployed	.752
Mott Community College	.656
Unemployment Rate	.520
Lansing Community College Area/High School Graduates	.475
Lansing Community College District/High School Graduates	-.231
Michigan State University Enrollment (Headcount)	-.035

Table 4.18

Simple Correlation and Regression Analysis
Values of the Correlation Coefficient Required for
95% Level of Significance When Ho: P = 0
Items (x) Versus Lansing Community College Fulltime Equated Enrollment (y)

	Item (x)	.95% Confidence Interval	Degrees of Freedom	Coefficient of Correlation Score
1.	Lansing Community College Headcount	.413	21	.990
2.	United State/Gross National Product	.444	18	.990
3.	Lansing Community College Fulltime Enrollment	.413	21	.988
4.	Michigan Public Community College Enrollment	.532	12	.971
5.	Lansing Community College Parttime Enrollment	.413	21	.970
6.	Consumers Price Index	.423	20	.964
7.	Grand Rapids J. C.	.532	12	.963
8.	Michigan Independent Colleges Enrollment	.602	9	.961
9.	Consumers Price Index-Minus 1 Year	.413	21	.952
10.	Delta College	.532	12	.948
11.	Schoolcraft C. C.	.532	12	.947

Table 4.18 (cont'd.)

12. Michigan Total Higher Education Enrollment	.632	8	.945
13. Consumers Price Index-Minus 2 Years	.413	21	.942
14. Macomb C. C. C.	.532	12	.939
15. Henry Ford C. C.	.532	12	.935
16. Michigan Public 4 Year Colleges	.497	14	.897
17. Michigan Public 4 Year Colleges Enrollment	.602	9	.862
18. Oakland C. C.	.532	12	.825
19. Mott C. C.	.532	12	.656
20. Lansing Community College Area/High School Graduates	.707	6	.475*
21. Lansing Community College District/High School Graduates	.707	6	-.231*
22. Michigan State University Enrollment	.497	14	-.035*

*Falls outside the 95% confidence interval

Table 4.19

Multiple Correlation and Regression Analysis
Values of Correlation Coefficient Required for 95% Level of Significance
When Ho: p = o

Runs*	95% Confidence Interval	Degrees of Freedom	Coefficient of Correlation Score
Run I	.497	14	.996
Run II	.553	11	.998
Run III	.532	12	.997
Run IV	.514	13	.998
Run V	.497	14	.998
Run VI	.482	15	.996

*See Table 4.15 for more detailed information relative to a specific multiple correlation and regression analysis run.

{(2nd) (Pgm) 01, (SBR) (CLR), (RST) and enter data} the a and b of the applied formulae, $Y = a + bx$ and $Y = a + b, x, + b_n x_n$, were deemed to be acceptable.

Alternate hypothesis H_{1a}: The calculation methods that employ the mathematical functions of simple and multiple regression produce more accurate forecasts than the other applied calculation methods in this study.

Table 4.20 presents a ranking of the applied calculation methods of this study based solely on the percentage of error in forecasting the 1979 fulltime equated student enrollment at Lansing Community College. Based on the information reflected in Table 4.20 alternate hypothesis H_{1a} must be rejected. The most accurate forecast was not the result of a mathematical function calculation method. The least accurate forecast was the product of a calculation method of the mathematical function derivation. The range in the percentage of error resulting from the mathematical function based calculation methods was 547.2. The above three facts alone dictate the rejection of the alternate hypothesis H_{1a}.

Alternate hypothesis H_{1b}: The influencing factors (independent variables) that possess the highest correlation coefficient measured against the dependent variable) will produce the most accurate student enrollment forecast.

The test of this hypothesis is presented in Table 4.21. Table 4.21 exhibits a ranking of the independent variables. This ranking is based on the correlation coefficient resulting from the simple correlation and regression analysis of the independent variable versus the Lansing Community College fulltime equated student

Table 4.20

A Ranking of the Lansing Community College
Fulltime Equated Student Enrollment Forecast
By Calculation Method
Based on the Percentage of Error

	Calculation Method	Percentage of Error
1.	Ratio Method/Tri-County Census Data - 18 - 20 Year Olds	-0.4
2.	Multiple Correlation and Regression Analysis - Run VI	0.6
3.	Simple Correlation and Regression Analysis - Michigan Independent Colleges Enrollment	-0.9
4.	Ratio Method/Tri-County Census Data - 21 - 25 Year Olds	1.1
5.	Ratio Method/Tri-County Census Data - 18 - 30 Year Olds	-1.3
6.	Ratio Method/Tri-County Census Data - Total Population	-3.8
7.	Double Exponential Smoothing - $\alpha = .5$	-4.3
8.	Ratio Method/Tri-County Census Data - 26 - 30 Year Olds	-5.9
9.	Moving Average - 1977-78 (N = 2)	-6.8
	Moving Average - 1976-78 (N = 3)	-6.8
11.	Moving Average - 1975-78 (N = 4)	-6.9
12.	Exponential Smoothing - $\alpha = .5$	-9.3
13.	Double Moving Average - Double Moving Average	9.9
14.	Exponential Smoothing - $\alpha = .9$	-10.0
15.	Simple Correlation and Regression Analysis - Lansing Community College Headcount	10.1
16.	Simple Correlation and Regression Analysis - Michigan Public Community College Enrollment	10.5
17.	Moving Average - 1978 (N = 1)	-10.7
	Moving Average - 1974-78 (N = 5)	-10.7
19.	Simple Correlation and Regression Analysis - Lansing Community College Fulltime Enrollment	-13.0
20.	Simple Correlation and Regression Analysis - Lansing Community College Area/High School Graduates	-13.9

Table 4.20 (cont'd.)

	Calculation Method	Percentage of Error
21.	Simple Correlation and Regression Analysis - Lansing Community College District/High School Graduates	-14.0
22.	Simple Correlation and Regression Analysis - Lansing Community College Parttime Enrollment	15.6
23.	Moving Average - 1973-78 (N = 6)	15.7
24.	Double Exponential Smoothing - α = .9	16.2
25.	Simple Correlation and Regression Analysis - Michigan Public 4 Year Colleges (Headcount) Enrollment	16.9
26.	Double Exponential Smoothing - α = .1	-18.3
27.	Simple Correlation and Regression Analysis - Consumers Price Index - Minus 1 Year	18.9
28.	Simple Correlation and Regression Analysis - Consumers Price Index - Minus 2 Years	19.1
29.	Simple Correlation and Regression Analysis - Macomb County Community College	-19.7
30.	Moving Avérage - 1972-78 (N = 7)	-20.4
31.	Simple Correlation and Regression Analysis - Delta College	-22.6
32.	Simple Correlation and Regression Analysis - Oakland Community College	-23.8
33.	Moving Average - 1971-78 (N = 8)	-24.2
34.	Simple Correlation and Regression Analysis - Michigan Total Higher Education Enrollment	-26.3
35.	Moving Average - 1970-78 (N = 9)	-27.4
36.	Moving Average - 1969-78 (N = 10)	-30.2
37.	Simple Correlation and Regression Analysis - Michigan State	-32.6
38.	Exponential Smoothing - α = .1	-33.4
39.	Simple Correlation and Regression Analysis - Consumers Price Index	34.3
40.	Simple Correlation and Regression Analysis - Schoolcraft Community College	-39.7
41.	Simple Correlation and Regression Analysis - Michigan Public 4 Year Colleges (F.T.E.)	-42.82
42.	Simple Correlation and Regression Analysis - Mott Community College	-42.85
43.	Simple Correlation and Regression Analysis - Henry Ford Community College	43.5
44.	Simple Correlation and Regression Analysis - United States Gross National Product	43.9
45.	Simple Correlation and Regression Analysis - Grand Rapids Junior College	47.1
46.	Multiple Correlation and Regression Analysis - Run II	47.2

Table 4.20 (cont'd.)

	Calculation Method	Percentage of Error
47.	Simple Average - Simple Average	-59.6
48.	Multiple Correlation and Regression Analysis - Run V	-60.8
49.	Multiple Correlation and Regression Analysis - Run I	-62.0
50.	Multiple Correlation and Regression Analysis - Run IV	166.8
51.	Multiple Correlation and Regression Analysis - Run III	512.2

Table 4.21

A Comparison of the
Independent Variables'
Correlation Coefficient Versus The
1979 Lansing Community College
Fulltime Equated Student Enrollment
Forecasting Accuracy (Percentage of Error)

	Independent Variable	Correlation Coefficient	Percentage of Error
1.	Lansing Community College Fulltime Enrollment	.998	-13.08
2.	Lansing Community College Headcount	.993	10.15
	United States/Gross National Product	.993	43.90
4.	Michigan Public Community College Enrollment	.971	-10.56
5.	Consumers Price Index	.965	34.32
6.	Grand Rapids Junior College	.964	47.13
7.	Michigan Independent Colleges Enrollment	.963	- 0.98
8.	Lansing Community College Parttime Enrollment	.961	15.61
9.	Consumers Price Index - Minus 1 Year	.952	18.95
10.	Delta College	.948	-22.68

Table 4.21 (cont'd.)

	Independent Variable	Correlation Coefficient	Percentage of Error
11.	Schoolcraft Community College	.947	-39.74
12.	Michigan Total Higher Education Enrollment	.945	-26.30
13.	Consumers Price Index - Minus 2 Years	.938	19.11
	Macomb County Community College	.938	-19.77
15.	Henry Ford Community College	.936	43.52
16.	Michigan 4 Year Colleges (Headcount) Enrollment	.897	- 7.32
17.	Michigan Public 4 Year Colleges (F.T.E.)	.862	-42.82
18.	Oakland Community College	.825	-23.82
19.	Mott Community College	.656	-42.85
20.	Lansing Community College Area/High School Graduates	.475	-13.92
21.	Lansing Community College District/High School Graduates	-.231	-14.09
22.	Michigan State University Enrollment	-.035	-32.68

enrollment. The acceptance of alternate hypothesis H_{1b} then is dependent upon the percentage of error column in Table 4.21 reflecting a descending percentage of error trend. As a consequence of the fact that there is not even a hint of descending values in the percentage of error column, alternate hypothesis H_{1b} is rejected.

Alternate hypothesis H_{1c}: The model that most accurately forecast the 1979 fulltime equated student enrollment at Lansing Community College will forecast the 1980 enrollment within an equal percentage of error.

Table 4.13 reveals that the model that produced the most accurate forecast of the 1979 Lansing Community College fulltime equated student enrollment was the Ratio Method/Tri-County Census Data (18 - 20 Year Olds). The percentage of error was -000.48785. The acceptance of alternate hypothesis H_{1c} requires that a forecast of the 1980 Lansing Community College fulltime equated student enrollment, applying the Ratio Method/Tri-County Census Data (18 - 20 Year Olds) produce a percentage of error figure within $\pm$ 000.48785.

The forecast of the Lansing Community College 1980 fulltime equated student enrollment presented in Table 4.22 produced a percentage of error equal to 0.37. This figure dictates that the alternate hypothesis H_{1c} be accepted.

Table 4.23 presents a summary of the results of the four hypotheses tested in this study.

Table 4.22

Forecasting 1980 Fulltime Equated Enrollment
Applying Tri-County Census Data (18 - 20 Year Olds)
Calculation Method: Ratio Method

Year	Census Data 18 - 20 Year Olds	Enrollment	Percentage of Population
1970	34,625	4,244	.122
1971	36,239	4,435	.122
1972	37,853	4,654	.122
1973	39,467	5,334	.135
1974	41,082	6,699	.163
1975	42,696	8,357	.195
1976	4,310	8,399	.189
1977	45,925	8,750	.190
1978	47,539	8,048	.169
1979	49,153	9,019	.183
1980	50,767	1980 Forecast=9,168.52*	.1806**

The 1980 Lansing Community College fulltime equated enrollment was 9134 . The forecasted enrollment of 9,168.52 produces a percentage of error equal to .3779.

*Forecast based on the ratio trend percentage multiplied by the projected population.

**This percentage of population figure was calculated with the moving average method (1977-1978-1979/3).

Table 4.23

A Summary of the Results of the Tested Hypotheses in this Study

Hypothesis		Result
Null:	No difference will be found in the 1979 forecasting accuracy (Lansing Community College fulltime equated student enrollment) of the selected calculation methods as measured by the percentage of error.	Reject
H_1a:	The calculation methods which employ the mathematical functions of simple and multiple regression produce more accurate forecasts than the other applied calculation methods in this study.	Reject
H_1b:	The influencing factors (independent variables) that possess the highest correlation coefficient (measured against the dependent variable) will produce the most accurate student enrollment forecast.	Reject
H_1c:	The model which most accurately forecast the 1979 fulltime equated student enrollment at Lansing Community College will forecast the 1980 enrollment within an equal percentage of error.	Accept

CHAPTER V

SUMMARY AND DISCUSSION

Summary

This study was designed to develop a useful student enrollment forecasting model for Lansing Community College. From the descriptive data collected hypotheses regarding the forecasting of student enrollment can be generated and subsequently tested by the Division of Student Personnel Services/Lansing Community College.

Eight calculation methods: simple average, moving average, double moving average, exponential smoothing, double exponential smoothing, ratio method, simple correlation and regression analysis, and multiple correlation and regression analysis, were selected to forecast the 1979 student enrollment at Lansing Community College. From these eight calculation methods fifty-one 1979 student enrollment forecasts were generated.

Each calculation method required at least one influencing factor to compute a student enrollment forecast. The calculation methods of simple average, moving average, double moving average, exponential smoothing, and double exponential smoothing required only the influencing factor of past Lansing Community College student enrollment data. The ratio method incorporated two influencing factors: past student enrollment and tri-county (Clinton, Eaton, and Ingham) census data. The final two calculation methods, simple and multiple correlation and regression analysis, produced forecasts through the application of twenty-two selected influencing factors/independent variables.

The resulting data from the simple correlation and regression analysis were statistically evaluated to screen the independent variables for application in the multiple correlation and regression analysis. The evaluation of the data from each of the forty independent variables tested included: ranking by correlation coefficient of determination, testing of Ho: P=0 at 95% confidence level, F-Test, and subjective judgment.

The application of the multiple correlation and regression analysis in this study included six runs of separate combinations of test-determined independent variables. The six test-determined combinations were the result of the collective influence of the methods of evaluation listed in the above paragraph. The subsequent data produced by the six runs were then tested by the statistical evaluations of correlation coefficient, coefficient of determination, testing of Ho: P=0 at the 95% confidence level, and the F-Test.

Each of the fifty-one forecasts resulting from the eight listed calculation methods, and the selected influencing factors, was ranked by its accuracy in forecasting the Lansing Community College 1979 fulltime equated student enrollment. The ranking was based on the percentage of error of each forecast. The percentage of error was calculated by subtracting the forecasted fulltime equated student enrollment from the actual 1979 fulltime equated student enrollment and then dividing the difference by the actual 1979 fulltime equated student enrollment.

The calculation method that produced the most accurate forecast, based on the percentage of error, was the ratio method/18-20 year olds with a percentage of error of -0.4. This forecast was only slightly more accurate (by 0.2) than the 0.6 produced by Run Six of the multiple correlation and regression calculation method. The above fact reveals that the tested mathematical function methods did not produce a more accurate forecast than a non-mathematical function calculation method.

The range of the percentage of error produced by the eight calculation methods (fifty one scores) tested was 574.2. This indicates that the selection of a calculation method in forecasting student enrollment can produce diverse scores. It is important to realize that the selection of the most appropriate calculation method is extremely important in the development of a student enrollment forecasting model.

In addition, the influencing factors that produced the highest correlation coefficients did not produce a correspondingly high accuracy rate in forecasting student enrollment.

The major finding of the study was that the model that most accurately forecasted the 1979 fulltime equated student enrollment was able to forecast the 1980 student enrollment within an equal percentage of error. The most accurate model produced a -0.4 percentage of error in forecasting the 1979 fulltime equated student enrollment at Lansing Community College. The same model was used to forecast the 1980 enrollment. The resulting percentage of error was 0.37792.

Conclusions

1. Mathematical function calculation methods do not produce forecasts with lower percentages of error than the non-mathematical

function calculation methods.

2. Accuracy in forecasting student enrollment is significantly dependent upon the selected calculation method.
3. The percentages of error produced by the forecasts of the simple correlation and regression analysis calculation method were not proportionately reflected in the correlation coefficient they generated.
4. The percentage of error resulting from the most accurate calculation method applied to the 1979 student enrollment forecast produced a forecast with greater accuracy in 1980.

Discussion

Certainly the challenges of developing an accurate student enrollment forecasting model for Lansing Community College are worthy of exploration. It should be apparent to even the most uninvolved administrator, faculty member, or staff person that it is extremely advantageous for both the students affected and the college to know as nearly as possible the student enrollment to be expected in succeeding years.

Calculation Methods

There are numerous calculation methods that could be applied to student enrollment forecasting. The eight calculation methods selected for application in this study were determined to be most appropriate as a result of a review of the literature available on the subject of student enrollment forecasting. The appropriateness was determined by their forecasting postulates, projection techniques, and the type of data they required. In the literature a good deal is written explaining and evaluating various calculation methods, but few studies have applied more than one calculation method to the same set of data as was done in this study.

As an increased volume of research becomes available in the topic area of student forecasting studies which apply numerous calculation methods to the same data will emerge. This emerging data will then provide necessary information as to the calculation methods that are most efficiently applicable to specific student enrollment settings.

Influencing Factors

Inasmuch as the actual influencing factors in the problem of accurately forecasting student enrollment are critical, it is of paramount importance that those factors be identified. The forty influencing factors evaluated in this study were not quantifiably labelled regarding their actual influence on the fulltime equated student enrollment at Lansing Community College. The evaluation did reveal significantly high correlation coefficients that suggest the value of pursuing an actual influence coefficient, that is, cause and effect. The inability to more accurately forecast student enrollment from extremely high correlation coefficient scores suggest the possibility that there are more discriminating influencing factors than were included in this study.

Implications for Further Research

This study concludes that there is a difference in the forecasting accuracy of student enrollment as a result of the selected calculation method. Given this fact it is important that extensive research be conducted to refine the understanding of the strengths and weaknesses of tested calculation methods. The knowledge of a calculation method's strengths and weaknesses would enable a forecaster to apply the calculation method whose characteristics are best matched to the character of the enrollment setting to be forecast.

Another conclusion reached in this study was that the calculation methods that employed the mathematical functions of simple and multiple regression do not produce the most accurate forecasts. The importance of this conclusion can be seen in the extreme complexity, greater clerical demands, and implied superiority of the simple and multiple regression calculation method as compared to the greater ease in the application of alternate calculation methods. Additional research could be applied to test this conclusion on a longitudinal basis or at a large number of institutions during the same forecast period. This kind of a study could produce a more definitive response to the question of the superiority of the mathematical function versus non-mathematical function calculation methods.

The importance of selecting the most discriminating influencing factor(s) for the right calculation method in the forecasting of student enrollment cannot be overstated. It is important to evaluate as many factors that potentially influence student enrollment as can be evaluated. Only those factors that influence student enrollment should be applied to a calculation method. Based on the results of this study it is apparent that a high correlation coefficient score is not sufficient to establish the discriminating power of a specific factor in the influentialness of student enrollment.

Further research should be designed to specifically identify those factors that influence student enrollment.

Specific recommendations for further research include:

1. Pursue at all cost the identification of at least one influencing factor with a defined cause and effect ratio.
2. Investigate in great detail the effect of unemployment upon student enrollment.
3. Apply the ratio method (enrollment/18-20 year olds) to a number of comparable institutions to test its applicability value at other institutions.

Hypotheses for Experimental Study

1. A null hypothesis: No difference will be found in the 1980 through 1990 forecast accuracy (Lansing Community College fulltime equated student enrollment) of ten selected calculation methods as measured by the percentage of error.
2. A null hypothesis: No difference will be found in the 1980 forecasting accuracy (Lansing Community College and nineteen comparable community colleges) of ten selected calculation methods as measured by the percentage of error.
3. The independent variables that produce the most accurate student enrollment forecast using simple correlation and regression analysis data collectively will produce the most accurate student enrollment forecast using multiple correlation and regression analysis data.
4. The most influential factors in the forecasting of student enrollment will produce the most accurate forecast using simple correlation and regression analysis.

Approach to the Future

Increasing fiscal pressure from local, state, and federal levels is placing great demands on higher education. Indeed, many institutions cannot survive these demands. Threats upon higher education in the form of such legislation as Michigan's 1980 Proposal D and local millage defeats must be met with responses emanating from as great a base of objective data as possible. Of course only one element of a necessary data base for effective higher education administration is represented by student enrollment forecasting data. A data base must include numerous compilations similar to the data presented in this study. This data base can be interpolated into information that will enable the fulfillment of the goals and objectives of an institution.

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