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ABSTRACT

Two quantitative enrollment projection techniques and the methods used by researchers at the Ohio Board of Regents (OBR) are discussed. Two quantitative approaches that are typically used for enrollment projections are curve-fitting techniques and causal models. Many state forecasters use curve-fitting techniques, a popular approach because only historical data are required. If enrollment trends are unstable, however, curve-fitting techniques are less useful and may be inappropriate. Causal models look at cause and effect relationships between independent factors and enrollment patterns. In Ohio, enrollment projection through 1992 for public higher education institutions is based on a dual approach. One, based on demographic information, is the Demographic Simulation of Ohio (DS), and the other, the Regents Enrollment Forecasting System (REFS), is based on high school graduate pools by county, matriculation rates, institutional market shares, and historical enrollment patterns in public postsecondary institutions in Ohio. A description of these methods and their advantages and disadvantages are provided. Comparison of full-time and part-time projections is also discussed. (SW)

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METHODOLOGY AND LIMITATIONS OF OHIO ENROLLMENT PROJECTIONS[1]

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Enrollment projections are made at various levels, including national, regional, state, school division, and institutional.

When statisticians, economists, or mathematicians design enrollment projection models for postsecondary education, certain historical information about enrollment patterns at the elementary, secondary, and postsecondary levels is necessary at the onset of the project. Researchers must also know the current milieu. political issues, economic trends, institutional missions. These same researchers then must select appropriate analytical techniques, scrutinize available information and data, make subjective judgments about enrollment predictions, and incorporate national and statewide demographic trends, including fertility, migratory, and mortality rates.

The selected techniques may vary depending on the use of the prediction (e.g., planning or budgetary analyses), level of the projections (e.g., national, state, or institutional), the expertise of the researchers (and their users), and, finally, the kind, quantity, and quality of available data.

Enrollment projections are also the basis for additional predictions, as illustrated below.

Postsecondary enrollment assumptions

- Number of full- and part-time students in postsecondary institutions
- Number of associate, bachelor, and advance degrees to be granted
- Number of female and male students enrolled in higher education institutions
- Number of students enrolled in two- and four-year postsecondary programs.

Staffing assumptions

- Number of persons available to teach in elementary, secondary, and specialty areas (e.g., special education, speech therapy, occupational therapy)
- Number of full-time professional faculty and personnel needed.

Fiscal assumptions

- Total general fund expenditures
- Current fund expenditures by programs.

Researchers have created an entire hierarchy of predictions based upon enrollment forecasts. Each level of prediction is built upon earlier assumptions and estimations, which may or may not be reliable. Consequently, state and institutional planners need to understand the basis for enrollment forecasting if they are to interpret projected data accurately and outline future needs and goals adequately.

[1] Condensed from Appendix in "A Strategic Approach to the maintenance of Institutional Financial Stability and Flexibility in the Face of Enrollment Instability or Decline" (The Ohio Board of Regents Management Studies Task Force Series) by John D. Millett. Published by the Academy for Educational Development, Inc., Washington, D.C., June 1979.

Enrollment Projection Techniques

Two quantitative approaches are typically used for enrollment projections. curve-fitting techniques and causal models. Many state forecasters use curve-fitting techniques, a popular approach because only historical data are required. If enrollment trends are unstable, however, curve-fitting techniques are less useful and may be inappropriate, unless these instabilities are predictable and necessary adjustments can be calculated. Causal models are usually preferable because they tend to be more accurate than curve-fitting techniques. Causal models look at cause and effect relationships between independent factors and enrollment patterns, such as graduating high school seniors and entering college freshmen.

It should be noted, however, that one method may be appropriate for national enrollment projections but unacceptable for a local institutional projection. The appropriateness of a projection technique may vary from state to state, region to locality, or locality to school. Consequently, it is impossible to prescribe a single methodology. Moreover, the availability of data may be the real determinant of which technique or combination of techniques is selected. As any model becomes more sophisticated, the historical data become more exacting and extensive. The accuracy of any projection is dependent upon the accuracy and completeness of historical data, the theoretical model used (including the assumptions), and the continuation of a relationship from the past to the future. The use of sophisticated methodologies must be balanced against the practical realities of modeling costs and future uncertainties.

Curve-fitting techniques. Trend analysts assume that political, social, and economic trends that have influenced student enrollment in the past will continue to affect future enrollment patterns. Mathematical techniques are employed to determine the effects of these trends on future enrollments. Simple linear regression models fit the "best" straight line to the given data points by minimizing the squared deviations of the actual points from the straight line. In enrollment projections, regression lines are fitted to the data, using years as independent variables and percentage(s) as the dependent variable(s). Linear regression techniques, such as moving averages, frequently cause overestimation of expected enrollments.

Several types of curve-fitting techniques are used in enrollment projections, including simple averages, moving averages, exponential smoothing, polynomial models, exponential models, and spectral analysis. Each of these curve-fitting techniques is summarized with limitations and assumptions in Table 1.

Causal models. Although it is mathematically possible to view enrollment as a function of time alone, curve-fitting techniques do not account for any other effects on enrollment because certain variables, such as per capita income, tuition rates, and other socioeconomic factors, may have been considered but not incorporated into enrollment factors. Moreover, predictions based on these variables are themselves difficult, as described in Table 2.

The most frequently used and historically satisfactory variable, in addition to time, has been the relationship of the college-age population to enrollment. The college-age population can be determined from the following data bases: (a) birth data or fertility rates for the appropriate time period, (b) number of high school graduates, and (c) population data, including mortality and migratory rates. Estimates of future high school graduates and future population groups are dependent upon the extension of birth data from earlier years.

At the onset of enrollment projections, certain considerations are essential in causal model development. Investigators need to ascertain what causal relationships exist between independent factors and enrollment. For example, does the number of high school graduates relate directly to the number of entering freshmen? Does the number of nontraditional students correspond to the divorce rate? In order to rely on these causal relationships, the actual relationship between the independent variables and enrollments must be recognizable, stable, and predictable, and not be primarily speculative.

Among existing causal models, the most common are cohort-survival techniques, ratio methods, the Markov Transition Model, multiple correlation and regression methods, path-analytical models, and systems of equations. It should be noted that the Markov Transition Model is also a curve-fitting technique because it relies on previous enrollment data.

Qualitative Judgments

When selecting projection techniques, researchers must consider available data, accuracy of information, use of projections, and other known variables and, on this basis, choose the approach to be used. Wheelwright and Makridakis (1973) noted:

> In any modeling effort there is a choice. We can either construct a single model which may not completely duplicate reality or we can build a highly sophisticated and complex model which can be accurate but which also requires a large amount of effort and resources to be developed and manipulated. Even if the most sophisticated model could be developed, there would still be some part of reality that could not be explained by the model. The number of factors in real life phenomena is infinite. (pp. 80-81)

With these words of caution, subjective judgment becomes essential during enrollment projections, especially when data are missing or certain variables are immeasurable. Intuition frequently is coupled with quantitative results in order to ensure realistic and logical projections. The selection of the forecasting methodology may be based on certain known information, but the final selection is usually rooted in some subjective decision. Two types of qualitative methods popularly complement enrollment projections: intention surveys and Delphi surveys. Intention surveys, as used by the Denver Public Schools, Florida Board of Regents, and the Virginia Department of Education, are usually follow-up questionnaires distributed to high school graduates to determine their postsecondary school plans. A Delphi survey consists of a "panel of experts" who interpret the enrollment projections in light of possible future changes; the National Center for Higher Education Management Systems used this approach in 1972 to determine future trends in higher education.

Enrollment Projection Methods in Ohio

Researchers at the Ohio Board of Regents (OBR) employ a dual approach in projecting enrollments through 1992 for public higher education institutions in Ohio. One, based on demographic information, is the Demographic Simulation of Ohio (DSO). The other, the Regents Enrollment Forecasting System (REFS), is based on high school graduate pools by county, matriculation rates, institutional market shares, and historical enrollment patterns in public postsecondary institutions in Ohio.

DSO, using an interactive computer program, combines the numbers of future Ohioans with anticipated college-going rates by age and sex to project enrollment to the year 2000. In the initial phase of the DSO program, the number of men and women in 1970 between the ages of birth and 84 years are placed in a 2 × 84 matrix (sex = 2 rows and ages = 84 columns), making 168 cells. Submodel programs incorporate the mortality, fertility, and migration rates specific to Ohio by comparing Ohio's experiences with national norms.

- *Mortality forecasts.* Based on the national mortality tables, OBR demographic researchers can estimate the

TABLE 1
Curve-Fitting Techniques

Technique	Description	Limitations and Assumptions
Simple averages	Uses the mean of past enrollments as the enrollment forecast for the next time period. Depending on the availability of past enrollment data, the average can be based on long or short time periods.	Generally not a good choice because enrollment is not consistent from year to year.
Moving averages	Is similar to simple averages technique, except that a fixed number of past enrollment figures are used to estimate future enrollments.	Appropriate for short-range forecasting; less rigid than simple averages. As enrollment trends become more pronounced, fewer data points should be included. In times of continued expansion (or contraction) of enrollments, moving-average technique is inappropriate.
Exponential smoothing	Is a variation of averaging techniques; most recent historical enrollment figure is weighted most heavily and each successively earlier data point is weighted less than the previous one.	Appropriate for short-range forecasting; similar difficulties as averaging techniques during periods of continued expansion (or contraction) of enrollments.
Polynomial models	Uses a standard least squares estimation for three orders of polynomials: linear, quadratic, or some more complex order.	No guarantee that the curve will not change shape substantially for the forecast years. Number of data points must be at least equal to the number of parameters to be estimated. Difficult to determine beforehand appropriate polynomial order.
Exponential models	Parameters are multiplied together rather than added.	Reflects more accurately some situations in which rate of growth or shrinkage of enrollment is constant.
Spectral analysis	Is a special form of the polynomial model using trigonometric functions (sine and cosine) to replace "t".	Usually inappropriate for enrollment projections because it requires a minimum of approximately 25 historical data points.

Source: Descriptions and limitations adapted from Wing, P., *Higher Education Enrollment Forecasting: A Manual for State-Level Agencies*. Boulder, CO: National Center for Higher Education Management Systems, 1974.

probable death rate by age and sex in Ohio.

- *Fertility forecasts*. The Census Bureau presently uses three fertility models, labeled as Models I, II, and III, for predicting birth rates. When demographic researchers superimpose the national trends on Ohio data, the results are more optimistic than considered reasonable, especially for Models I and II. In contrast, Model III is too pessimistic. To balance these extremes, the OBR researchers have developed a model which lies between Models II and III.
- *Migration forecasts*. To complete the migration estimates (by age cohort), chronological ages are grouped into five-year increments from birth to age 85 years. These seventeen age groups are further divided by sex; a migration rate is specified for each age-sex cohort.

Given this information, the computer can add and subtract the predicted number of Ohioans who might be born, move, or die in Ohio each year.

To develop postsecondary enrollment projections, OBR researchers rely on trends from the 1960s and 1970s. They divide the potential college-bound population into nine age groups:

18–19 years	25–29 years	40–44 years
20–21 years	30–34 years	45–49 years
22–24 years	35–39 years	50+ years

Each age group is divided further by sex and full- or part-time status. The entire matrix, by age group, sex, and enrollment status, makes a 9 × 2 × 2, or three-tier, matrix of 36 cells. Enrollment figures for this 9 × 2 × 2 matrix are available for the last eight years (1971 through 1978) and thus permit eight data points in time for each of the 36 cells. A similar matrix is developed with participation rates in the cells, calculated by dividing the number of students in a particular age-sex cohort by the number of Ohioans in that cohort. Currently, the DSO data are being further subdivided among public and private two- and four-year institutions, which makes a new five-tier matrix (i.e., 9 × 2 × 2 × 2 × 2), including age group, sex, full-/part-time, public/private, and two-/four-year status.

Each cell becomes a homogeneous information sector for a particular age-sex cohort. For example, the data show the percentage (or participation rate) of eighteen-/nineteen-year-old Ohio women who attended college on a full-time basis during 1971 through 1978. OBR researchers assume that recent data are more reliable and more indicative of future enrollment trends than earlier data. Consequently, the researchers apply weighted least squares ($.8^n$) with each year's value weighted according to its proximity to the current year. For example, the 1978 participation rate is weighted with a value of 1; 1977 as .8; 1976 as .64; 1975 as .512; and so forth.

A Coefficient of Determination (r^2) is calculated for each time series in each cell in the 9 × 2 × 2 matrix. A linear model is applied using the described weighting ($.8^n$). Whenever the Coefficient of Determination is at or greater than eighty percent, the OBR researchers assume that the future college attendance rate is predictable by a statistical extrapolation technique (i.e., weighted least squares) for the next four years. In Ohio, the majority of the cells (approximately 24 or 25 cells) are at or greater than the eighty percent cut-off point, indicating stability and consistency from 1971 through 1978. Estimates of forecasted participation rates for the remaining cells (approximately 12 cells) are made by using various statistical techniques, such as weighted least squares, linear regressions, exponential smoothing, weighted averages, and straight averages. From these analyses, the OBR researchers establish optimistic and pessimistic sets of enrollment projections. Finally, the participation rate data in the 36 cells (i.e., the 9 × 2 × 2 matrix) are combined with Ohio population data divided by sex and the nine age groups (i.e., 2 × 9 = 18 cells) in order to develop enrollment forecasts.

REFS uses (1) information regarding the historical and forecasted number of high school graduates in each of the 88 counties in Ohio and (2) the participation rates (or college-going rates) for each county in Ohio (e.g., the number of full-time freshmen at public postsecondary institutions as compared to the number of high school graduates). Currently, these participation rates range from a high of seventy percent in Montgomery County to a low of fifteen percent in Gallia County. Weighted least square projections are made for each county in order to forecast the future participation rates by county.

Historical market shares indicate the percentage by institution of full-time freshmen from a particular county who attend any of Ohio's public postsecondary institutions. These data show the proportion of the "potential college market" from high school graduating classes that each public postsecondary institution attracts.

With these estimated market shares, institutional planners can determine their share of a certain county's college market, such as the number of students from Cuyahoga County who

TABLE 2
Causal Models

Model	Description	Limitations and Assumptions
Cohort-survival techniques	Identifies a group of individuals with common traits, such as grade level or year of birth. This group is aged through the educational system by the: grade-progression or class-succession method; or age-survival method.	Net migration, mortality, and school attendance patterns will remain stable over time.
Ratio methods	Uses time series data to calculate the ratio between the total population by age groups. These extrapolated values of ratios are then used for enrollment projections.	Less accurate than cohort-survival techniques because the ratios are insensitive to recent changes which are compiled with historical data.
Markov transition model	Uses a transition matrix to estimate numbers of students enrolled at each level in the next time period. Model is applied successively for forecasting purposes.	Assumes that enrollments in one year are dependent only on enrollments of the previous year. Can design student flow models.
Multiple correlation and regression methods	Determines relationship between enrollments (dependent variable) and one or more independent variables, such as high school graduates, per capita income, ethnic background, and student demand estimation. Includes autocorrelation and multicollinearity techniques.	Permits development of econometric models of student behavior patterns (e.g., income, tuition, draft laws).
Path-analytical models	Extension of multiple correlation and regression models, except uses *a priori* identification of causal relationships.	Best suited for student demand, and not direct enrollment projections.
Systems of equations	Uses a series of equations to link different parameters of interest, such as optimization, simulation, or student flow models.	Few models developed.

Source: Descriptions and limitations adapted from Wing, P. *Higher Education Enrollment Forecasting: A Manual for State Level Agencies*. Boulder, CO: National Center for Higher Education Management Systems, 1974.

attended University of Akron in 1974. These market shares are calculated for the 88 counties and for the 66 public postsecondary institutions in Ohio, thus making an 88 × 66 matrix of 5,808 cells for each year in a seven-year period. By applying weighted least squares, forecasts are made for the next decade. After these initial forecasts are made, the data are normalized so all county totals equal 100 percent. The number of college-bound freshmen is calculated for each county from the following formula:

Forecasted county participation rate	×	Number of forecasted high school graduates	=	Forecasted number of college-bound freshmen

These forecasted market share numbers are then used to allocate college-bound freshmen among the public postsecondary institutions in Ohio.

The projected number of out-of-state freshmen by institution is also calculated based on the percentage of out-of-state freshmen during the last eight years. Only one institution, Central State, has more than twenty percent of its students from out of state; seven institutions draw more than ten percent; and approximately 39 institutions have more than one percent from out of state. The out-of-state freshmen projections are added to the in-state projections to determine the size of freshman classes.

Forecasts are then made for the sophomore, junior, and senior years by using the historical attrition patterns between college classes at individual institutions. The attrition rates are analyzed for the past seven years by comparing changes in enrollment between the sophomore and freshman years, junior and sophomore years, and senior and junior years. Approximately 41 percent of the full-time students attending public postsecondary institutions in Ohio are freshmen. These attrition trends are projected by college class and by institution, making enrollment projections institution-specific. Similarly, graduate and professional school enrollments are compared with each institution's undergraduate enrollment. These manipulations are unnecessary with certain professional school enrollments (e.g., medical, dental, veterinary medicine) because of fixed enrollment figures that are set by institutional policy.

These REFS forecasts at the institutional level are summed and compared with the results of the DSO program. If the REFS and DSO differ, the OBR researchers adjust the county-specific participation rate data in REFS to ensure agreement and consistency. The full-time estimates are summed by institution and compared with state-level DSO projections. In general, full-time projections are strongly dependent on high school enrollment projections, which are generally stable because they are based on known birth, migration, and mortality rates.

In contrast, part-time projections are not easily derived from state-level projections because part-time enrollment is dependent on regional events, especially the local economy. Frequently, part-time enrollment is determined by uncontrollable and unpredictable variables, such as unemployment rates, as when a plant shuts down or a new shopping mall opens. In order to refine further the part-time enrollment projections, OBR researchers have analyzed characteristics of part-time students at each public postsecondary institution in Ohio for the last seven years. Certain part-time student characteristics, summarized in an institutional part-time profile document, include (a) student ages, (b) student ranks, (c) number of credits taken, (d) number of day or evening classes, and (e) county of origin.

Based on historical data, the OBR researchers determine, through exponential smoothing, a set of part-time enrollment forecasts based on part-time historical enrollment patterns. These part-time forecasts, together with the institutional part-time student profiles, are then disseminated to Ohio public postsecondary institutional administrators with questionnaires to determine the efficacy of these projections. Using the questionnaires, institutional planners can submit additional information, such as new advertising campaigns or increased safety in the parking lots, which might stimulate increased part-time enrollments. In the final analysis, however, the OBR researchers must speculate about the impact of recruitment activities, program expansions, or facility improvements on future part-time enrollment trends. Finally, part-time enrollment projections by institution are readjusted to agree with part-time totals from the DSO data.

OBR researchers are concerned that the process may become too mechanized and overly quantified. Consequently, senior OBR staff members are also asked to study the enrollment projections to lend a statewide perspective to the analyses. Furthermore, whenever there are deviations from the enrollment projections, OBR researchers scrutinize the economic, social, and political trends in order to pinpoint causes for unexpected fluctuations in the enrollment projections.

Advantages of the Ohio Enrollment Projection Methods

Although other states have conceptualized sophisticated models and have written complex computer programs for projecting enrollment figures, few states have coupled these efforts with the detailed data base as Ohio has. Because of limited data bases, other states must rely on highly aggregated estimates. In Ohio for the last fifteen years, every student who enrolled in any public postsecondary institution in the state completed a computer card with personal background information, listing age, sex, credit hours attempted, credit hours achieved, place of origin, etc. These information computer cards were then entered into the OBR data base. Therefore, during the last decade, OBR researchers have acquired a sizable data pool on degree students in public postsecondary institutions.

By using five to ten years of accumulated historical data, unique occurrences, which deviate statistically but lack impact on overall trends, can be filtered. At the same time, consistent trends can be identified and incorporated into enrollment projection procedures. Moreover, by distributing data among small cells (e.g., an 88 × 66 matrix), wherein homogeneity is increased, stability and reliability are also made possible. (Unfortunately, as there is no similar systematic means for collecting like data for private higher education institutions, only limited and incomplete information is currently available for Ohio's independent colleges and universities.)

In a national survey on enrollment projection techniques during the 1950s, Lins (1960) found that in states where the majority of universities and colleges were private, statewide projections were not made because of the differences between public and private postsecondary institutional concerns. Since then, nearly every state has made enrollment projections for postsecondary institutions, using a variety of methods. Many states are hindered, however, by the difficulty of obtaining accurate historical high school information, especially for private high schools. Population data gathered for other purposes frequently do not contain appropriate ages for the college-age group and are usually only estimates. In contrast, most states maintain accurate birth records which are available for projecting at least eighteen years of college enrollments. Consequently, the use of birth data in a forecast model is the most reliable variable for determining the college-age population.

Limitations of Enrollment Projections

The most persistent problem that researchers confront is the lack of other appropriate data. Local data can only result in generalizations to a particular locale. Few state-level data collection agencies have the degree of accuracy and consistency necessary for empirical research or enrollment predictions. Consequently, many researchers turn to the Census Bureau and Department of Labor in order to look at nationwide patterns.

Although the largest and most comprehensive data collection is the national census, conducted each decade, these data become less useful for predictions as time passes. For example, during 1979, researchers must use 1970 census data in order to make predictions for the 1980s because the next decade's census has not yet begun and will not be fully compiled until 1983. In the interim, many economic, political, and sociological events have occurred that have altered the American way of life from the early to the late 1970s.

While the sample size of the monthly Current Population Reports (CPR) looks impressive (N = approximately 55,000), in actuality, it is not large enough for some national or most single state studies. In national studies, the National Center for Education Statistics (NCES) discovered that when CPR data were distributed among cells in matrices, there were not enough data points for detailed analyses. These problems would become magnified if the data were distributed among the fifty states in order to study Ohio alone.

State and institutional administrators must weigh the advantages and limitations of enrollment projections when planning postsecondary programs, budgets, and capital needs. One advantage is that enrollment projections can provide statistical information to guide decision making.

Enrollment projections are not sacred, however, and are dependent upon many internal and external factors. Has a college expanded its program offerings? Has the military draft been reinstated? Has a major manufacturer shut its plant? Much depends upon assumptions, definitions, unemployment rates, migration, admission policies, part-time estimates, and other influencing factors.

For any given year, the actual enrollment counts may fall above or below the enrollment projection line but, theoretically, if the differences (positive and negative errors) were totaled for several years, actual counts would equal projection estimates. The most pervasive limitation, however, of any enrollment projection analysis is the fact that researchers become locked into basic assumptions that may or may not apply in the future. The following list (Lins, 1960, pp. 31–32) is illustrative of common assumptions which may be necessary when making enrollment projections.

- Counties (or parishes) in which a high proportion of youth attend high school will continue to graduate a higher proportion of high-school-age youth than will the remainder of the state.
- There will be no major changes in academic or admission requirements during the period covered.
- Facilities and staff will be provided to meet the needs of the projected student body.
- Tuition and fees will not change markedly in relation to the value of the consumer dollar.
- The various forms of financial benefits available to students will be expanded at a rate roughly commensurate to the increase in enrollment. Financial benefits will continue to include scholarships, fellowships, assistantships, loan funds, and job opportunities while attending college.
- There will be no major war or other major catastrophe and no major change in the requirements and practices relative to compulsory military training.
- The federal or the state government will not provide new forms of subsidics for men discharged from the armed forces.
- There will be no great change in mortality and migration patterns.
- Economic conditions will remain substantially the same as at the present time.
- The retention rate and transfer rate from class to class will remain about the same as during the past few years.
- No new major curricular programs will be added or dropped.

For example, in Ohio, in order to complete projections through 1992, based on collected data and enrollment trends from 1971 through 1978, OBR researchers assumed that the market shares and county participation rates, in terms of absolute numbers, would remain constant after 1982; consequently, enrollment projections were less reliable as projected farther beyond the current year. The range between the optimistic and pessimistic enrollment projections is marginal during the first few years of estimations. After a few years, the range increases for each succeeding year. When higher education institutional planners review enrollment projections, they should consider the impact of this increased error range in the later years.

Moreover, most enrollment projection models are not structured for corrections. If an assumption needs alteration, the computer program requires modifications and new computer runs are necessary for adjusting enrollment projections. In Ohio, certain assumptions are made from a statewide perspective and historical perception of enrollment trends for all sixty-six institutions. In reality, there may be true differences among urban institutions and other education facilities or among four- and two-year colleges or technical schools. For example, how do enrollment projections accommodate increased nontraditional enrollees in urban areas? How do enrollment projections adjust for economic recessions or inflation? How does a lower unemployment rate affect postsecondary enrollments in rural areas?

The flexibility of these assumptions is essential, especially in consideration of the enrollment patterns of the last decade. The composition and distribution of the postsecondary student body have changed by age, race, and sex groupings. The number of persons aged 35 years or older has increased 66 percent from 1972 (the first year data were collected on this age group) through 1978. (The Census Bureau estimated that approximately 850,000 women and 460,000 men 35 years and older were enrolled in colleges and universities during 1978.) Since 1975, approximately one million blacks, comprising ten percent of the 1978 student body, have enrolled in colleges and universities. In contrast, only six percent of the college-enrolled student body was black in 1968, showing a 135 percent increase in the size of black enrollment during the last decade. Similar changes have occurred in the number of females enrolled in college. Between 1968 and 1978, the number of college-enrolled females under the age of 35 years increased by 76 percent, but the enrollments of their male counterparts increased only 24 percent. Women comprised 39 percent of the college student body in 1968 and 48 percent by 1978.

Attrition patterns have also varied during the last decade, especially because of these shifts in age, race, and sex distributions. According to a recent Bureau of the Census report (1979), "although the proportion of 18- and 19-year-olds enrolled in college was as large for women as for men in 1978, the proportion of women 20- and 21-years-old in college remained significantly lower than that for men in the same ages (26 percent for women compared to 31 percent for men). . . . This suggests that, in 1978, women were as likely as men to enter college but were not as likely to continue on to graduation." (p. 2)

Another major problem in enrollment projections at the national, state, and local levels is the inconsistency in defining terms. Moreover, institutions may have defined terms, such as full- or part-time status, but subsequently have changed the criteria. The following list is illustrative of terms requiring uniform definitions for enrollment information.

- *Institutions* (e.g., public, private, four-year, two-year, regional, extension)
- *Students* (e.g., auditors, new students, transfer students, re-entering students, advanced-standing students, continuing students)
- *Degree Credit Programs* (e.g., associate, baccalaureate, first professional, graduate, doctorate)
- *Student Classification* (e.g., undergraduate, professional, graduate, other)

Problems persist because of inconsistent terminology and imprecise definitions at the state levels. The problem becomes further complicated because little information is available on private and out-of-state students. In addition to the use of different terminology, there is little cooperative effort to share information about students who are enrolled in out-of-state postsecondary schools or even in private institutions within the home state.

Recently, researchers have begun studying the relationship between unemployment rates and participation rates. An individual who is laid off a job may then enroll in a postsecondary program because of expectations that new skills will enhance his or her ability to reenter the labor market or to complete a college education. A depressed economy also tends to encourage persons to attend college immediately after high school as a means of improving their employment prospects, although they may face personal financial hardships. Conversely, a booming economy tends to discourage immediate college entrance after high school because job opportunities are more appealing.

Urban schools are most susceptible to fluctuations in employment rates (a plant closes, an industry expands its product line, promotional opportunities begin, sales hit a record high), especially in heavily industrialized areas. Certain age categories also tend to be more vulnerable to unemployment fluctuations. Consequently, employment rates and college participation rates of the last seven years may or may not reflect the actual trends during the next decade because of unpredictable economic shifts at the local, state, and national levels.

Another problem, especially prevalent in Ohio, is the frequent transfer of students among colleges and universities within a state. (It was interesting and somewhat surprising that when OBR researchers investigated the rate of transfer between two- and four-year institutions, they discovered a reverse migration from four-year universities and colleges to two-year community colleges.) At present, based on ethnic origins, various segments of the Ohio population prefer certain public postsecondary institutions. Certain schools attract urban blacks while other institutions attract rural Appalachians or eastern European suburbanites. Internal migration problems become prevalent when there are many comparable institutions, as in Ohio, a circumstance which enables students to transfer easily. Enrollment projections become inaccurate if there are no available means for tracking these internal migratory habits. For example, because of one university's prestige and selectivity among its fellow Ohio institutions, it attracts transfer students from other, less competitive schools. The most feasible tracking method would be a computer sort of postsecondary students, for the last seven years, based on social security numbers. This type of computer sort would identify the number and segment of the population that is transferring among colleges and universities.

Within the next decade, migratory habits may have an even more dramatic impact on national and certain state enrollment projections, especially those for southwestern states. Some estimations indicate that the actual number of legal immigrants and the estimated number of illegal aliens exceed the U.S. birthrate. During the 1980s, many of these immigrants, including increasing numbers of Spanish-speaking residents, may be students enrolling in postsecondary institutions for the first time. This new influx of students will have the greatest impact on public community colleges in the southwestern United States, especially as English-as-a-second-language programs become widespread. In contrast, Ohio is leading the nation in the rate of outward migration—a dominant factor causing net losses in Ohio's population.

Closed and open admissions policies directly affect potential enrollment. For example, certain professional schools (e.g., medicine or law) determine the number of openings almost exclusively by policy rather than demographic demands. In other selective institutional settings, the number of available openings is fewer than the number of applicants. In these selective instances, the enrollment projection is based on the number of available openings.

In contrast, at universities with open admissions policies, the number of applicants is equal to or less than the number of openings. Because the number of openings exceeds the number of applicants, these institutions must focus on applicants and student demand for admissions. If a school changes its admission policy (e.g., from closed to open admissions or vice versa), this policy change will greatly alter enrollment calculations.

TABLE 3
Potential Internal Factors Influencing Part-Time Enrollment

Potential Internal Factors	Type of Institution: Urban universities and colleges	Non-Urban universities and colleges	Community/junior colleges	Technical colleges	Regional campuses
• Program offerings					
Variety of continuing education programs	●●●	●●●	●●●		●●●
Variety of academic core courses	●●●	●●●	●●		●●
New program offerings	●●	●●	●●	●●	●●
Mini programs	●	●	●●		●●
Job-related offerings	●●	●●	●●	●●●	●●
• Convenience					
Registration	●●	●●	●●	●●	●●
Location	●●●	●●●	●●●	●●●	●●●
Meeting times (evening and weekend)	●●●	●●●	●●●	●●●	●●●
• Cost					
Tuition and fees	●●	●●	●●●	●●●	●●●
Availability of scholarships	●	●	NA	NA	NA
• Location/Facilities					
Off campus offerings	●●●	●●	NA	NA	NA
Expanded facilities	●●	●●	●●	●●	●●
Safety of location	●●●		●●		
• Special services					
Counseling (personal career)	●	●	●		●
Recreation benefits		●	●	NA	●
Access to libraries, labs, etc.	●●	●●			
• Recruitment and advertising efforts	●●	●●	●●	●●	●●

Key

●●● Highly influential
●● Influential
● Possibly influential
NA Not applicable

Comparison of Full- and Part-Time Projections

Reliable causal relationships exist for predicting full-time student enrollment, such as the number of high school graduates and the number of entering freshmen. These figures are predictable because the number of high school graduates is easily estimated using fertility, cohort-survival, migratory, and mortality rates based on elementary and secondary school records. Currently, there is a predicted and observable downward trend at the secondary level. During 1978, there were 16.4 million high school students (aged 14 to 17 years) compared to 16.6 million in 1977. Approximately 94 percent of this age group were enrolled in school. Bureau of the Census researchers (1979) concluded that: ". . . there is no indication from trends of the past few years that enrollment rates at the high school level will increase further . . . Thus, high schools will increasingly experience the decreases in enrollment that have been occurring in elementary schools for several years." (p. 2) Concurrently, colleges and universities will also be affected by this downward trend.

The causal relationships of part-time enrollment are less known and, thus, more abstract and unclear. Although the traditional college-age group (18- to 21-year-old population) is an excellent base for full-time enrollment projections, it is an unreasonable, inappropriate, and inexact base for part-time predictions. Even the character of the traditional college-age group is changing. The Census Bureau reported that in 1970, seventeen percent of the college students were part-time enrollees; by 1978 twenty-four percent were part-time. Because many investigators assume that part-time students seldom travel long distances to take classes, the surrounding areas of postsecondary institutions are usually targeted as concentrations of potential part-time enrollees.

When estimating the number of part-time students, the influential factors, both internal and external variables, are more complex than simple travel distance. Table 3 displays potential internal factors that may influence part-time enrollment. Certain internal factors, such as program offerings and convenience, are considered highly influential while other internal factors, such as personal counseling services, have marginal influence. Major changes in the institutional mission may appeal to a different group of students. Changes in cost may attract or discourage students.

Table 4 shows the potential external factors which may influence part-time enrollments. As an example of influencing external factors, a change in out-of-state charges or student aid will affect the number of out-of-state students attending a postsecondary institution.

At a given point in time, certain factors are relevant; however, because of changes in social, economic, or political trends, these same factors later become irrelevant. For example, because of the selective service draft in the 1960s, enrollment projections based on trends during the 1950s were too conservative. Many male students enrolled in school in the mid- and late sixties to postpone the draft. Similarly, many of the enrollment projections made in the 1960s for the 1970s were too optimistic because the Vietnam War and military draft ceased to be factors. Consequently, influential variables are dynamic and may dramatically influence one time period but have minimal impact on another.

Current Ohio enrollment projections do not include certain identifiers, which may prove troublesome if causal relationships exist between postsecondary enrollment, attrition rates, socioeconomic background, urban environment, and ethnic origin. Other influential variables include changes in tuition, student financial aid, or veterans' benefits. For example, during the 1979-80 academic year, the federal government extended Basic Educational Opportunity Grant (BEOG) funding to middle income families. How will this change in federal financial aid funding affect enrollment projections? At least two unknowns persist: (1) How many middle class families will take advantage of this extension? (2) Will there be enough federal monies for all

TABLE 4
Potential External Factors
Influencing Part-Time Enrollment

Categories	Factors
Job opportunities	Job mobility Job training/staff development Salary incentives Legal, licensing, or certification requirements
Demographic trends	Transfer students Nontraditional students (e.g., female, older, minority students) Migration rates Mortality rates Fertility rates
Economic and political trends	Inflation Unemployment rate State funding formulae Federal financial aid and loan policies Industrial expansion/contraction Military conscription laws
Cost	State/federal financial aid Tuition remission plans Veterans benefits
Societal structure	Attitudes toward higher education Changes in personal lifestyles (e.g., divorce rate)
Public relations	Public awareness Liaison program with industry

qualified applicants? With these two unknowns alone, the impact of this financial aid funding change on postsecondary enrollments is indeterminable and remains only speculative.

There are many other incidental situations or qualitative changes that affect postsecondary enrollments but remain unnoticed, unrealized, or immeasurable. Improved safety and additional spaces in a college's parking lot attract new students. A new postsecondary institution opens and competes for the same students. A neighboring institution closes. Other influential factors include community recreation programs, winning streaks in intercollegiate sports, image changes, or program expansions (or eliminations). Changes in state law, such as residential requirements, and federal law, such as selective service, also affect enrollment trends.

When selecting factors that influence enrollment projections, forecasters must realize that these variables are dynamic and, thus, require periodic review and analysis. As new variables are identified, they need to be incorporated into the enrollment projection model and, as yet other variables become obsolete, they need to be eliminated. For example, minority students with Hispanic surnames currently have the highest attrition rate of all college student subgroups. The federal government, especially the National Institute of Education, is concentrating its efforts, monies, and program thrusts on increasing the college completion rates of Spanish-speaking students. If these efforts are successful, enrollment projections will again be altered, and although some of these projections will therefore appear inaccurate, in reality, they will have served as benchmarks for program effectiveness in changing attrition trends.

Conclusions

Enrollment projections are commonly used for planning capital budgets, operating expenses for instructional programs, and support costs. In order to make these future plans, state and institutional administrators often study estimations, such as future faculty needs and program alterations, which are outgrowths of these enrollment projections. Because of certain predictions, such as declining enrollments, institutional planners may implement new programs which eventually cause a shift in predicted enrollments. Although the original enrollment projections are erroneous, they do serve a useful purpose in the planning process.

The selected enrollment forecast techniques vary depending on whom the predictions are for, where they are being conducted, and what data are available. Most quantitative approaches are either curve-fitting techniques or causal models. Many states select curve-fitting techniques because historical data are necessary. When possible, causal models are preferred because certain influential factors, such as per capita income, tuition rates, and other socioeconomic variables, can be incorporated. Ideally, any quantitative approach should be complemented with subjective judgment.

No matter how sophisticated the projection model or how large the data pool, however, there are definite limitations in enrollment projections. These limitations are essential to know when planning future expectations. Basic to any enrollment projection is the selection of assumptions affecting the predictions. Researchers too easily become locked into a set of assumptions and overlook new conditions or changing trends. State and institutional planners must also be aware that as enrollment predictions are projected beyond the current year, the range between optimistic and pessimistic forecasts increases. Consequently, state enrollment projections for the next four years may have a narrow range of fluctuation (e.g., several hundred students) and, in ten years may have a wide range of potential error (e.g., several thousand students).

Researchers are still uncertain as to how unemployment rates affect college enrollments, especially at urban colleges and universities. In times of unemployment, high school seniors tend to enroll in college upon graduation in hopes of acquiring skills to enter the job market. In times of economic boom, jobs are a stronger enticement than academic pursuits. Migration also has a definite impact on postsecondary participation rates but, because the effects of migration are difficult to identify, most state and national studies assume that it is a marginal factor.

Both observable and unrecognizable changes influence enrollment projections. Such changes include program offerings, admission policies, academic standards, federal and state laws, tuition, financial aid, veterans' benefits, institutional facilities, neighboring schools, and school image. Part-time enrollment is more difficult to forecast than full-time enrollment.

OBR researchers use various quantitative approaches (e.g., weighted least squares, exponential smoothing, cohort-survival rates) when forecasting enrollments. By reconciling differences and incorporating state and institutional expert judgments, the final projections are refined. An added advantage to Ohio enrollment projections is the comprehensive data base which has been compiled during the last fifteen years. Because of the magnitude of the data base and available student information, multi-tier matrices can be analyzed with sufficient data in each cell to create added stability and reliability. Reliability is ensured further by employing a variety of enrollment projection methodologies as counterchecks for precise refinement.

In comparison with other state and national enrollment projections, the OBR approach has several advantages. The historical and market share analyses permit OBR researchers to look at consistent and erratic enrollment trends at the county and institutional levels. Furthermore, for the last ten years, OBR researchers have systematically collected personal background information on every undergraduate and graduate student enrolled in public higher education institutions in Ohio. Data classifications have been defined consistently among public institutions so that like data are compared. Overall, because of the data pool and years of model refinement, enrollment projections for the State of Ohio are as advanced, if not more so, than those in any other state.

Certain investigations are hindered because of the unavailability of precise, comprehensive, and appropriate data, especially for single state studies. Certain data are suspect; other data, such as those from the 1970 national census, are too outdated for predictive purposes. More current national data are inexact for refined analyses and projections, primarily because of the small size of the monthly data pools.

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