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ABSTRACT

Analytical techniques developed by the University of Texas at Austin to deal with problems of forecasting future enrollments, instructional workloads, and funding levels are considered. In order to project university enrollments, Texas public high school graduates were projected. In-migration rates were separated from survival rates, progression/continuation rates were established for each age group in each grade, and a range of enrollment projections for entering freshmen was developed. A method was also developed to estimate transfer enrollments. Once the attrition and retention rates for each group of entering students were determined, the rates were applied against the projected enrollments of first-time freshmen and transfers in order to estimate total undergraduate enrollment for five years. Although comparable methods for projecting graduate enrollment have not been developed, a number of variables have been considered in making this projection. Techniques for forecasting future instructional workload and funding are also examined. (SW)

A COMPREHENSIVE TECHNIQUE FOR FORECASTING UNIVERSITY ENROLLMENT, INSTRUCTIONAL WORKLOADS AND FUNDING LEVELS

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Mary Corcoran
University of Minnesota
(Editor, AIR Forum Publications)

A Comprehensive Technique for Forecasting University Enrollment, Instructional Workloads and Funding Levels

Abstract

It is clear that the unsettled higher education environment of the 80's will call for increased reliance on planning and management techniques in colleges and universities across the country. Changes in demographics, environment, student interest, student mix, notions of faculty tenure, and other factors make it more difficult for all institutions to do the analyses required to develop the planning paramaters required to use these techniques effectively. At major research universities where the institutional objectives are multi-faceted, where enrollments tend to be larger, and where the outlook is state and nation-wide rather than regional, planning and management are even more complex. The purpose of this paper is to describe how one major research university has developed a series of analytical techniques to deal with some of the problems of forecasting future enrollments, instructional workloads, and funding levels.

The nation-wide prospects for higher education enrollment during the coming decade are well-documented. Extensive coverage in the national press has pointed to steep declines in higher education enrollments in the next decade (Magarell, 1980). Predictions that the traditional pool of 18-21 year olds will decline by 25 percent nation-wide by 1994 and that overall enrollment in higher education will decline by similar percentages are commonplace (Reinhardt, 1979).

However, some publications have pointed out that enrollment prospects in some states differ substantially from the national outlook (Henderson, 1977, and Western Interstate Commission for Higher Education, 1980). In Texas, we are experiencing continued demographic and economic growth (Norris, 1977 and WICHE, 1980). Thus, on the one hand the conventional wisdom, and perhaps the assumptions made by those who allocate budgets, is influenced by perceptions of national enrollment declines, while on the other hand University administrators in some states must plan for enrollment increases.

It therefore has become essential for each institution to accurately estimate enrollments, whether up or down, in order to plan within increasingly scarce resources.

Future Enrollments

Of course, enrollment forecasting is not new. An entire series of studies has estimated the costs of various enrollment levels and the resources required to meet these enrollments (Gamso, 1977); developed extensive data bases to project state-wide enrollments (Render, 1977); and used national mortality tables and other variables like migration and attrition rates to make detailed enrollment projections (Kraetsch, 1979). Forecasting techniques have been analyzed extensively (Wing, 1974) along with their results (Richardson, 1977) and their limitations (Kraetsch, 1979). At the University of Texas at Austin, however, we were most concerned with developing flexible techniques with which we could forecast institutional enrollments accurately, with minimal cost in terms of data base development, using straight-forward procedures to insure a high degree of understanding and acceptance by University administrators, in order to provide management information appropriate for an institution of our size and complexity.

The University of Texas at Austin is one of the country's major institutions with a mission which emphasizes research and graduate education in addition to undergraduate teaching. Undergraduate enrollment has grown steadily for the past decade to 35,000 and is made up of students who are largely Texas residents (90%), full-time (88%), and Caucasian (85%). In developing the analytical techniques to forecast the University's future enrollment levels, a fundamental distinction was made at the outset. Methodologies designed to forecast the number of students entering the University (i.e. new freshmen, undergraduate transfers, and graduate students) were developed separately from methodologies designed to measure student progress through the University (i.e. student attrition, retention, graduation, cross-campus enrollment shifts). Once this distinction was made we set about to forecast entering freshmen and undergraduate transfer students.

First-Time Freshmen

Since our first-time freshmen are largely Texas public high school graduates, the first step in projecting enrollments was to project Texas public high school graduates. In developing these forecasts a cohort survival technique was used based on enrollment data from Texas public schools. However, we quickly found that grade-to-grade progression rates derived from gross enrollment figures mixed the effects of at least three important factors: 1) the survival (i.e. mortality) rate of students from one year to the next, 2) actual student progression to the next grade level, and 3) in-migration of students from outside the state's public school system. Survival rate information was available for Texas from the Census Bureau. However, because of a lack of adequate information on the other two variables we were forced to devise our own methods of determining the effects of in-migration and the stability of actual progression rates.

The first step in the process was to separate in-migration rates from survival rates (Fishbeck, 1980). To do this we multiplied survival rates for each age group by the number of students of that age enrolled in a particular year. This represented the number of children in each age group who should have survived to the next year. Next, we subtracted this figure from the actual enrollment of that age group in the next year.

For example, in 1979 there were 237,844 nine-year-old students in the public schools. Of those, 99.963%, or 237,756 should have returned as ten-year-olds in 1972. However, in 1972 there were actually 242,225 ten-year-olds, 4,469 more than expected. These additional students represented an in-migration rate of 1.9% (4,469 ÷ 237,844 = .019). In like fashion an annual migration rate was determined for each student age group.

The next step was to establish progression/continuation rates for each age group in each grade, given survival rates and migration rates. To do this, survival rates were applied to each age group in each grade in a particular year. This gave us the number of students who should have survived to the next year. Then we adjusted the actual second year enrollment in each grade by the migration rate of each age group. Finally we divided this adjusted figure by the "survived" figure to give us the percentage of students who progressed to the next higher grade in the second year.

Returning to our example, we knew from published data that there were 169,593 nine-year-olds in fourth grade in 1971. Of these, 99.963% (169,530) should have become 10-year-olds in 1972. In 1972 there were actually 166,160 ten-year-olds in fifth grade. By applying our in-migration rate (1.9%) we determined that there were 3,221 (i.e. 169,530 x .019) in-migrants in this group of 166,160. Therefore 162,939 (i.e. 166,160 - 3,221) of the original students must have progressed from ninth to tenth grade. Thus, 96.11% (162,939 ÷ 169,530) of the surviving nine-year-olds from the fourth grade in 1971 advanced to the fifth grade in 1972.

This method was applied to students ages 6-14 and grades 1-9. (In Texas, once students reach age 15 or grade 10, they may drop out). In doing so, we found that in-migration is increasing annually at all levels, We also determined that actual progression rates are unstable because of the mainstreaming of special education students in 1975.

In view of the recent acceleration of in-migration to the public school system, we decided to use recent progression rates for projecting high school enrollments and graduates. We did this in several ways: by using the most recent progression rates available (i.e. 1977-78), the average of progression rates over the last five years (excluding 1975 because of the unique situation mentioned previously), using gross progression rates only, or using migration and progression rates separately. These multiple approaches yielded ranges of projections which were always within 3%. Because of this narrow error range, the different forecasts were averaged to present the estimates shown in Table 1. These numbers are very similar to those which were subsequently published by the Western Interstate Commission on Higher Education (1980). Both sets of figures confirm strongly the notion that the demographic situation in Texas is very different from that of the nation as a whole. This is clearly represented in Figure 1.

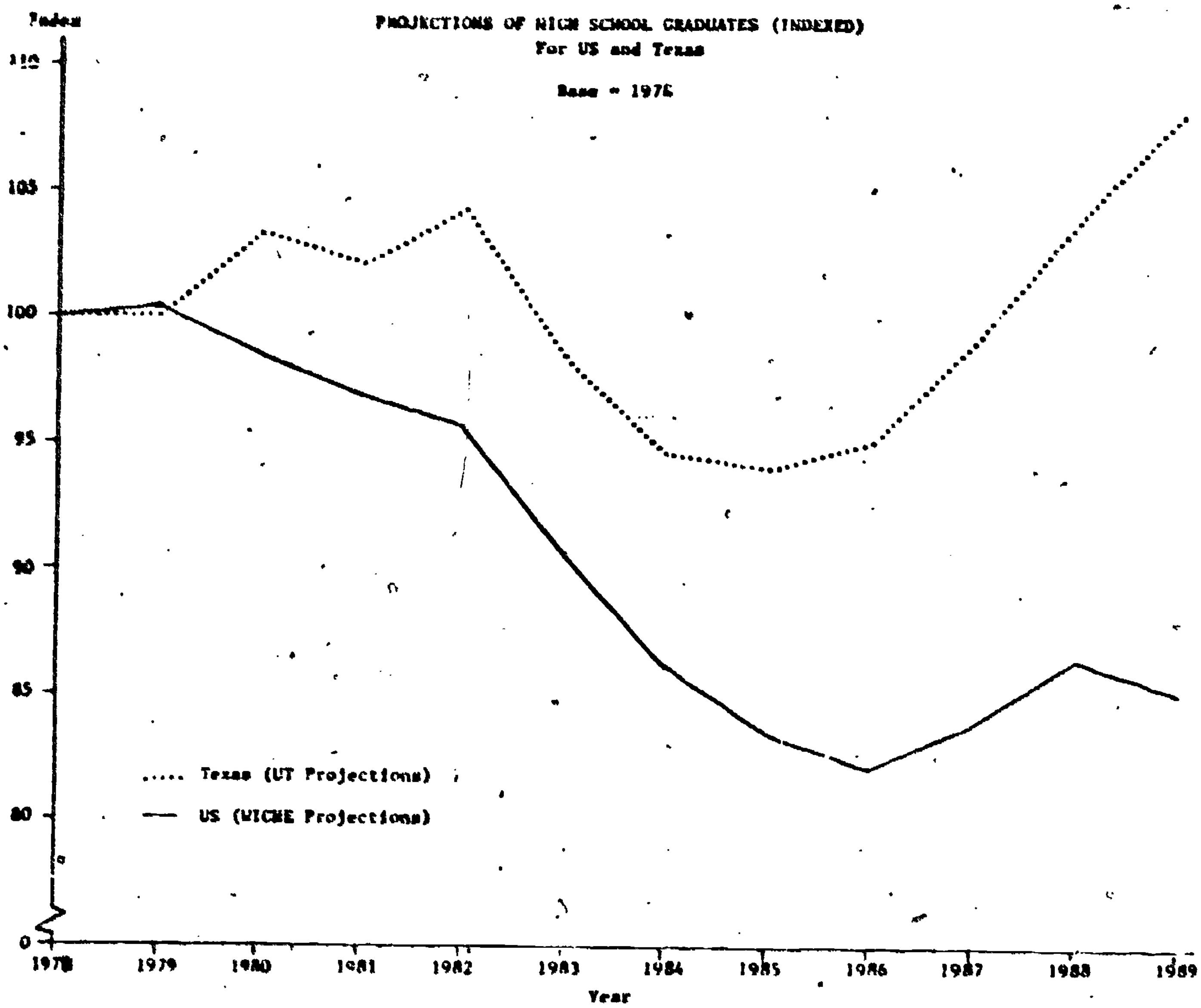
The next step in our methodology involved translating these high school graduate projections into estimates of the number of first-time freshmen for the coming years. Based on other analyses we know that in the last five years between 2.62% and 3.06% of the Texas public high school graduates have enrolled at UT-Austin. Therefore, a range of enrollment

Table 1

PROJECTIONS OF TEXAS PUBLIC HIGH SCHOOL GRADUATES 1980-1989

YEAR	PROJECTIONS
1980	173,470
1981	171,750
1982	175,150
1983	165,510
1984	159,100
1985	157,980
1986	159,978
1987	166,660
1988	174,730
1989	181,770

Figure 1


Index
PROJECTIONS OF HIGH SCHOOL GRADUATES (INDEXED)
For US and Texas
Base = 1978
110
105
100
95
90
85
80
0
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
Year
..... Texas (UT Projections)
— US (WICHE Projections)

projections for entering freshmen was developed. Given that Texas high school graduates consistently comprise 90% of our entering freshmen class (the other 10% being out-of-state and foreign students), these figures were then adjusted to give the forecasts for first-time freshmen shown in Table 2. Based on these figures, we expect relatively large entering freshmen classes for three more years, followed by classes more modest in size. However, by the end of the 80's we may have even large entering classes than we expect in the near term.

Incoming Undergraduate Transfer Students

We have found that students transferring to the University do not exhibit as stable enrollment patterns as do first-time freshmen. For example, the percentage of those enrolling who are residents fluctuates significantly, as does their percentage of the 18-24 year old population. Moreover, once accepted, transfers do not enroll as consistently as freshmen. Thus, projecting transfer enrollments based on these indicators is a tenuous proposition. However, we have found that new freshmen consistently comprise 58% of the undergraduate students who enter the University each fall. Thus, although we have not been able to predict transfer enrollments using the methods applied to first-time freshmen, we can predict them as a consistent percentage of each entering group of undergraduates. Consequently, we project first-time freshman enrollments using the methods described earlier and then estimate transfer enrollments by dividing the freshman projections by .58 to estimate the total number of entering undergraduate students. The difference between the number of freshmen and this total represents the number of transfer students.

Table 2

TOTAL FIRST-TIME FRESHMAN ENROLLMENTS
PROJECTIONS FOR 1980-1989

YEAR	LOW	HIGH
1980	5018	5956
1981	4966	5899
1982	5032	6052
1983	4774	5697
1984	4594	5470
1985	4563	5431
1986	4618	5502
1987	4814	5728
1988	5049	6004
1989	5236	6266

Student Flow

Once students arrive on campus they are affected by a different set of factors than when they were applicants. For example they may change majors, run into academic difficulty, drop out for financial reasons, or speed up their progress for personal reasons. But their rates of progress significantly impact a university's enrollment level. Therefore as the second section of our methods to estimate UT-Austin's future enrollment, we developed a technique designed to track any defined group of students for any defined period of time. Student attrition, retention, major selection and progress are readily monitored. Cross-campus enrollment shifts can also be assessed. Through this technique the impact of any entering student group can be predicted for the length of their stay at the University.

The higher education literature contains many descriptions and evaluations of different student flow methodologies (Evans, 1975). In developing our technique we employed a combination Markov method, to measure student transitions from one "state" to another over time, and Cohort ratio method, to calculate transitional probabilities for individual cohorts of students based both on their current and past status. The basic output is called a "Student Transformation Matrix." This matrix summarizes the results of tracking individual students on the basis of their classification (i. e. freshman, sophomore, etc.) and major) during a preceeding semester and their subsequent status in some later semester. This transformation matrix enables us to determine the rate at which a student who begins at one status achieves a different status at some later time. Figure 2 provides an example of the tracking capabilities of this method. Of the students

Figure 2

TRANSFORMATION MATRIX FOR UNDERGRADUATE STUDENTS
SPRING 1978 TO FALL 1978

MODE OF ADMISSIONS-- FTIC

STATUS OF STUDENTS MAJORING IN ALL MAJORS
SPRING 1978

CLASSIFICATION AND COLLEGE OF MAJOR OF THESE STUDENTS FALL 1978		NUMBER OF UNDERGRADUATES				NUMBER AS A FRACTION OF COLUMN TOTAL			
		FRESHMEN	SOPHOMORES	JUNIORS	SENIORS	FRESHMEN	SOPHOMORES	JUNIORS	SENIORS
HUMANITIES	JUNIORS	2	0	0	0	1.12	0.00	0.00	0.00
	SENIORS	2	0	0	0	1.12	0.00	0.00	0.00
COMMUNICATION	JUNIORS	4	0	0	0	2.23	0.00	0.00	0.00
	SENIORS	1	1	0	0	0.56	20.00	0.00	0.00
SOC & BEHAV SCIENCES	SOPHOMORES	3	0	0	0	1.68	0.00	0.00	0.00
	JUNIORS	5	0	0	0	2.79	0.00	0.00	0.00
	SENIORS	6	0	0	0	3.35	0.00	0.00	0.00
NATURAL SCIENCES	SOPHOMORES	2	0	0	0	1.12	0.00	0.00	0.00
	JUNIORS	9	0	0	0	5.03	0.00	0.00	0.00
	SENIORS	4	0	0	0	2.23	0.00	0.00	0.00
GEN & COMP STUDIES	SOPHOMORES	3	0	0	0	1.68	0.00	0.00	0.00
	JUNIORS	3	0	0	0	1.68	0.00	0.00	0.00
	SENIORS	1	0	0	0	0.56	0.00	0.00	0.00
BUSINESS ADMIN	FRESHMEN	2	0	0	0	1.12	0.00	0.00	0.00
	SOPHOMORES	1	0	0	0	0.56	0.00	0.00	0.00
	JUNIORS	6	0	0	0	3.35	0.00	0.00	0.00
	SENIORS	5	0	0	0	2.79	0.00	0.00	0.00
EDUCATION	FRESHMEN	1	0	0	0	0.56	0.00	0.00	0.00
	SOPHOMORES	1	0	0	0	0.56	0.00	0.00	0.00
	JUNIORS	4	0	0	0	2.23	0.00	0.00	0.00
	SENIORS	4	0	0	0	2.23	0.00	0.00	0.00
ENGINEERING	FRESHMEN	1	0	0	0	0.56	0.00	0.00	0.00
	JUNIORS	8	0	0	0	4.47	0.00	0.00	0.00
	SENIORS	12	1	0	0	6.70	20.00	0.00	0.00
FINE ARTS	FRESHMEN	1	0	0	0	0.56	0.00	0.00	0.00
	SENIORS	1	0	0	0	0.56	0.00	0.00	0.00
ARCHITECTURE	JUNIORS	1	0	0	0	0.56	0.00	0.00	0.00
GRADUATED SOC & BEH SCI		2	0	0	0	1.12	0.00	0.00	0.00
GRADUATED BUSINESS ADM		1	0	0	0	0.56	0.00	0.00	0.00
GRADUATED ENGINEERING		0	1	1	0	0.00	20.00	33.33	0.00
STUDENTS DISMISSED		14	0	1	0	7.82	0.00	33.33	0.00
STUDENTS DROPPED OUT		69	2	1	0	38.55	40.00	33.33	0.00
TOTAL		179	5	3	0	100.00	100.00	100.00	0.00

who entered the University as first-time freshmen in Spring 1976, 69 had dropped out, 14 had been dismissed for academic reasons, and another 14 had progressed to various classifications within our School of Business Administration by Fall 1979.

Because of different progression rates and the lack of cross-college major changes among graduate students, we determined that we should use different approaches to analyze undergraduates as opposed to graduate students. Currently our focus has been concentrated on undergraduate students and their progression rates.

Our primary data source for this technique is known as the 12th Class Day Reporting System. This information system (maintained by the Office of Institutional Studies) is designed to provide a "snap-shot" of the University, especially in terms of enrollment and the instructional function, as of an official census date each semester. It is a basic analytical information system which generates various reports required by external agencies and, more importantly, provides the information to determine from an informational perspective where the University has been, is presently, and will be in the future. Once problems such as matrix size, changes in student identification numbers, improper classification data for special non-degree students, etc., had been solved our student flow technique began to produce results. We now have the capability to summarize rates of progress, retention, attrition, and graduation for any student population we choose to select.

In our initial studies we focused on first-time freshmen and transfer students who entered the University in Fall 1975. Table 3 shows percentages

Table 3

PROGRESSION RATES FOR STUDENTS
ENTERING FALL 1975

FIRST-TIME FRESHMEN

	After 1 year	After 2 yrs	After 3 yrs	After 4 yrs
Continuing	82.5%	70.8%	62.6%	25.4%
Graduates	-	-	3.0	36.5
Dropped Out	14.4	22.6	26.1	28.6
Dismissed	3.1	6.5	8.2	9.5
(Attrition Rate)	17.5	29.1	34.3	38.1

UNDERGRADUATE TRANSFERS

	After 1 year	After 2 yrs	After 3 yrs	After 4 yrs
Continuing	68.5%	43.5%	15.8%	5.6%
Graduated	1.5	20.1	45.6	55.1
Dropped Out	23.0	28.5	30.1	30.3
Dismissed	6.9	8.0	8.5	9.0
(Attrition Rate)	29.9	36.5	38.6	39.3

of students in each of four categories after each of the four years for which the analysis is possible at the present time. The sum of the drop-out rate and the dismissal rate can be considered the attrition rate.

After one year the attrition rate for first-time freshmen was 17.5%. Only 3.1% had been dismissed, but 14.4% had dropped out. Over 82% continued for a second year. After two years, over 29% of the original entering class had departed. Most had dropped out. After three years, the size of the entering class had been reduced by one-third. Some 63% were still enrolled while a small sub-group (3%) had graduated. At the end of four years, roughly the same percentage of the group had departed (38%) as had graduated (37%). About 25% of the original students were still in school. Of these, 85% are seniors who are expected to graduate soon. We have some preliminary evidence that indicates that just over 50% of an entering freshman class graduates after five years. If this remains true, about half of the remaining students will graduate by the end of this term. As we would expect, most of the students who leave the University either drop out or are dismissed by the end of their second year. Our continuation, attrition, retention and graduation rates are similar to those recently published by the American Council on Education (Jackley, 1979).

The progression rates for undergraduate transfer students who entered the University in Fall 1975 are slightly different from those of the first time freshmen. As shown in Table 3, a larger percentage of transfer students drop out or are dismissed after the first, second, and third years than first-time freshmen. After that, the attrition rates are similar. As one would expect, however, a higher percentage of transfer students graduate after two, three, and four years than do freshmen. Of course, transfer students enter the University with credit toward graduation, so we would expect them to graduate sooner.

We have found that these attrition and retention rates for undergraduate students entering the University in Fall 1975 are quite reliable. We have analyzed the progress of students who entered the University in the Falls of 1976, 1977, and 1978 and have found that their progression rates are very consistent with those in Table 3.

In using the student flow technique as an enrollment projection tool, it was necessary to account for new freshmen and transfer students who enter the University in the spring and summer terms in addition to those who enter in the fall. The number of students who enter in the "off terms" is not as large as the number that enter in the fall, but they must be considered in any estimates of future enrollment. We based our forecasts of these individuals on historical patterns which have been quite stable. Then in order to account for the rates at which these people progress through the University, we analyzed the progress of new freshmen and transfer students entering the University in the Spring and Summer terms of 1976, 1977, and 1978.

Once the attrition and retention rates for each group of entering students were determined, then these rates were applied against the projected enrollments of first-time freshmen and transfers in order to estimate total undergraduate enrollment for the next five years. In order to verify these procedures and to determine error rates, we back-tested the method to 1972. In this way we were able to explain the variations caused by students who "stop out" and then are readmitted to the University. Because this group does not reenter the University in any consistent pattern we chose to account for them by slightly adjusting our progression rates. Once again the adjustments required were only minor.

The resulting forecasts are shown in Table 4. The projections are disaggregated by class and by mode of admission to reflect the diversity of the impact of transfer students and to facilitate the assesment of demand for courses at different instructional levels.

The specific figures themselves are less important than the overall pattern they represent. The forecasts of total undergraduate enrollment essentially follow the trends projected for entering freshmen and transfers in Table 1. That is, they peak in 1982 and then begin to decline. However, the decline is smaller than for entering students only since the effects of continuing students tend to smooth the overall enrollment curve.

Projections of Graduate Enrollment

Up to this point, most of our work has centered on estimates of undergraduate enrollment. We have not as yet been able to develop comparable methods for projecting graduate enrollment. Nevertheless we are able to make preliminary estimates based on historical trends, the relationship between graduate and undergraduate enrollment, recruiting practices, the job market for graduate degree holders, and the general economy. As a result we currently expect our graduate enrollment which stands at just under 8,000, to grow in the next few years, but only very slightly. Law School enrollments, which are treated separately at Texas, are expected to remain fairly constant at about 1500 students consistent with School policy.

Table 4

PROJECTED UNDERGRADUATE ENROLLMENT
By Mode of Admission and Classification
Fall Semesters

YEAR	MODE OF ADMISSION	FRESHMEN	SOPHOMORES	JUNIORS	SENIORS	TOTAL
1980	FTIC	5,956				5,956
	Transfer	979	1,786	1,315	242	4,322
	Continuing	2,421	6,420	6,835	10,738	26,414
	Total	9,356	8,206	8,150	10,980	36,692
1981	FTIC	5,899				5,899
	Transfer	970	1,769	1,303	239	4,281
	Continuing	2,491	6,614	7,222	11,386	27,713
	Total	9,360	8,383	8,525	11,625	37,893
1982	FTIC	6,052				6,052
	Transfer	995	1,814	1,337	245	4,391
	Continuing	2,476	6,638	7,377	11,858	23,349
	Total	9,523	8,452	8,714	12,103	38,792
1983	FTIC	5,697				5,697
	Transfer	936	1,708	1,258	231	4,133
	Continuing	2,525	6,736	7,434	12,069	28,764
	Total	9,158	8,444	8,692	12,300	38,594
1984	FTIC	5,470				5,470
	Transfer	899	1,640	1,208	222	3,969
	Continuing	2,429	6,530	7,392	12,035	38,386
	Total	8,798	8,170	8,600	12,257	37,825

FTIC = First-time in college freshmen

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Because graduate plus law enrollments comprise about one-fifth of our total enrollment, we expect the previously discussed changes in undergraduate enrollment will be the primary factor in determining the shape of the University's future enrollment curve.

Future Instructional Workload

These enrollment forecasts are extremely useful in estimating the University's future instructional workload. In order to convert enrollment forecasts in to SCH forecasts we utilized our Report of Instructional Patterns which produces the details of what are more generally known as an Induced Work Load Matrix and an Induced Course Load Matrix.

In developing our Report of Instructional Patterns, it was necessary to determine if our existing information systems contained the data required for such a technique, and if so, was our data accurate enough to utilize for such analytical purposes. Again we determined that our 12th Class Day Reporting System contained the necessary data on students, their majors, and their course work.

In addition, two other problems had to be resolved, both caused by the University's size. First, how could we effectively handle a matrix of approximately 130 majors in over 90 departments? Second, how could we generate detailed reports that were not so large as to be cumbersome and potentially useless. The first problem was solved primarily by sorting the input records in the same order in which the output was to be written. In addition, the decision was made to focus primarily on college and department summaries initially and go into greater detail only when absolutely necessary. The second problem was solved by utilizing a data retrieval package, EASYTRIEVE, to sort and select specific student credit hour and enrollment data required for the report, thus eliminating unnecessary data from consideration. Utilizing EASYTRIEVE capabilities, it is easy to produce a report for any desired combination of majors or departments. Each final report is determined only by the SCH and Enrollment records read into the program. In this way it becomes unnecessary to maintain any Induced Course Load files. These data are produced as needed from the appropriate SCH and Enrollment data.

The output from this technique is conceptualized in Figure 3. The Semester Credit Hour Matrix (the Induced Work Load Matrix) identifies the number of semester credit hours taught by a college or department both to its own majors and to majors from other colleges or departments. The Enrollment Matrix is not an output of the system. It simply provides the enrollment distribution used to divide into the Semester Credit Hour Matrix to produce the Average Credit Hour Matrix (the Induced Course Load Matrix). This final matrix shows the average student credit hour loads taken by majors in a particular college or department and the average loads taken in that college or department by students from elswhere in the University.

We have used this technique in many ways. We have identified in a definitive way the impact of service teaching on the student credit hour production of departments and colleges. By analyzing the information for several years we have been able to explain student credit hour trends in colleges and departments in terms of whether the greatest impact results from changes in the number of majors, changes in their course-taking patterns, changes in the amount of service instruction, or changes in the

FIGURE 3

THE REPORT ON INSTRUCTIONAL PATTERNS

SEMESTER CREDIT HOUR MATRIX

STUDENT MAJOR / STUDENT LEVEL / COURSE LEVEL / DEPARTMENT		Architecture: Lower Division	Architecture: Upper Division	Architecture: U' Grad Total	Architecture: Masters	Architecture: Doctoral	→	Social Work: LD	Social Work: UD	Social Work: U	Social Work: M	Social Work: D
Architecture	Under-Graduate	X,XXX	X,XXX	X,XXX	XX	XX		XXX	XXX	XXX	XX	XX
	Graduate	XX	XX	XX	XXXX	XXXX		XX	XX	XX	XXX	XXX
	Total	X,XXX	X,XXX	X,XXX	X,XXX	X,XXX		XXX	XXX	XXX	XXX	XXX
↓												
Social Work	U' Grad	X,XXX	X,XXX	X,XXX	XXX	XX		XXX	XXX	XXX	XX	XX
	Graduate	XX	XXX	XXX	X,XXX	X,XXX		XX	XX	XX	XXX	XXX
	Total	X,XXX	X,XXX	X,XXX	X,XXX	X,XXX		XXX	XXX	XXX	XXX	XXX

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ENROLLMENT MATRIX

STUDENT MAJOR / STUDENT LEVEL	Architecture: Lower Division	Architecture: Upper Division	Architecture: U' Grad Total	Architecture: Masters	Architecture: Doctoral	→	Social Work: LD	Social Work: UD	Social Work: U	Social Work: M	Social Work: D
	XXX	XXX	XXX	XXX	XXX		XX	XX	XX	XX	XX

AVERAGE CREDIT HOUR MATRIX

STUDENT MAJOR / STUDENT LEVEL / COURSE LEVEL / DEPARTMENT		Architecture: Lower Division	Architecture: Upper Division	Architecture: U' Grad Total	Architecture: Masters	Architecture: Doctoral	→	Social Work: LD	Social Work: UD	Social Work: U	Social Work: M	Social Work: D
Architecture	U' Grad	X.X	X.X	X.X	.X	.X		X.X	X.X	X.X	.X	.X
	Graduate	.X	.X	.X	X.X	X.X		.X	.X	.X	X.X	X.X
	Total	X.X	X.X	X.X	X.X	X.X		X.X	X.X	X.X	X.X	X.X
↓												
Social Work	U' Grad	XX.X	XX.X	X.X	.X	.X		XX.X	XX.X	XX.X	.X	.X
	Graduate	.X	.X	.X	X.X	X.X		.X	.X	.X	X.X	X.X
	Total	XX.X	XX.X	XX.X	X.X	X.X		XX.X	XX.X	XX.X	X.X	X.X

course-taking patterns of nonmajors. Another use, and the most important one in terms of this paper, is in assessing the impact of future enrollment trends on colleges and departments throughout the University.

One particular product in our Report of Instructional Patterns is an array of the average number of credit hours taken by undergraduate and graduate students from a particular college in each of the colleges on campus. It is a routine matter then to generate the instructional workload imposed by a group of students expected to enroll in some future term. We have run the Report of Instructional Patterns for four years. The data have revealed consistent course-taking and average load trends so that we feel we can determine accurate rates to use in forecasting future instructional loads.

When we first proposed this paper last fall we expected that we would by now have completed all the necessary work to finish our comprehensive analysis of future enrollment, workload, and funding patterns. Unfortunately we have run into some technical delays, but more importantly we have been diverted by requests for a number of policy analyses based on our enrollment work. Therefore I must now resort to telling what we plan to do, not what we've already done.

By analyzing trends in student major preference as expressed during the admissions process, we have estimated how our new freshmen and transfer students will distribute themselves across our various schools and colleges. Likewise, by analyzing historical enrollment patterns and trends in how continuing students change their majors, we have estimated how these students will distribute themselves across our schools and colleges. Using these mechanisms with the enrollment projections shown previously in Table 4, we have made preliminary estimates of undergraduate enrollments in each of our schools and colleges. Once we have developed graduate enrollment projections in which we have more confidence it will be a relatively easy matter to estimate the number of SCH which will be taken across campus by all future students.

Funding

Texas was one of the first states to make extensive use of funding formulas to develop appropriations for its public institutions of higher education (Gross, 1979). Over the last 20 years numerous approaches have been tried to expand and develop the formula system. As a result, the Texas formula system is considerably more complicated than those used in most other states. Formulas are now used in the following eleven areas of institutional cost:

General Administration and Student Services (i. e. top-level administration)

General Institutional Expense (i.e. general expenses not related to a specific unit, e.g. commencement, official functions, etc.)

Faculty Salaries

(Academic) Departmental Operating Expense (e.g. support staff salaries, supplies)

Instructional Administration (i.e. school and college administration -dean's offices)

Library

Organized Research (i.e. research administration, seed money to attract outside sponsored research)

Plant Support Services (i.e. physical plant administration, planning)

Building Maintenance (i.e. general building up-keep and repair)

Custodial Services

Grounds Maintenance

These formulas currently account for about 76% of the total appropriations to public senior institutions. Formulas are not used in the areas of purchased utilities, major repair and renovation, and special items.

Texas operates on a biennial funding cycle. The process of evaluating and modifying existing formulas for a particular biennium begins in the first year of the previous biennium. Working with staff members of the Coordinating Board, Texas College and University System, (the agency which coordinates public higher education in the state), committees of institutional representatives and lay people evaluate all existing formulas and recommend revisions. The Coordinating Board then acts on these recommendations and designates formulas for use by the Legislative Budget Board (the legislative fiscal agency), and the Governor's Budget and Planning Office in making appropriations recommendations to the Legislature. These two agencies work together to incorporate these formulas into appropr-ations request instructions which the institutions use to present their requests. This process and subsequent hearings with the two agencies are completed in the latter half of the first year of the biennium and the first half of the second year prior to the beginning of the Legislative Session. Of course, the Legislature has the right to change the formula designations as they wish, but they use the formula structure throughout their deliberations to generate the ultimate higher education apropriation.

Because the formula system is enrollment-driven in many areas, a substantial portion of the University's future appropriations can be estimated by using the enrollment and student credit hour forecasts discussed in the two previous sections of this paper.

For example, the formulas for the 1932-83 biennium have recently been designated by the Coordinating Board. They call generally for a 20.1% increase in most formula categories for 1981-82 and an additional 12.6% increase for 1982-83. Of course one can argue whether the Legislature will actually fund these increases. Nevertheless, we can obtain a preliminary indication of the implied appropriation levels given the University's future enrollment patterns and those formula assumptions. These estimates could then be modified as we learn of other proposals later in the legislative process. In addition since we know the general history of higher education funding during the last several Legislative Sessions, it is also possible to estimate, in a general way, the sort of increase which will be recommended for the 1984-85 biennium.

As I mentioned previously we have not yet had the opportunity to make these funding estimates. But they can easily be calculated for the formula areas of General Administration and Student Services which relies mainly on fall headcount enrollment information; and General Institutional Expense, Faculty Salaries, Departmental Operating Expense, Instructional Administration, and Library which are all based on student credit hour information. Organized Research is calculated from the Faculty Salary formula amount plus a percentage of an institution's outside sponsored research expenditures. By using a rough projection of this figure, this appropriation can be estimated also. These seven categories account for over 71% of our current year appropriation.

The category which generates by far the largest part of our appropriation is Faculty Salaries. It also provides the best example of how student credit hour estimates can be tied to the formula system to estimate future funding. The Faculty Salary formula rates which were recently recommended by the Coordinating Board for Fiscal Year 1982 are shown in Figure 4. An institution's request is determined by multiplying student credit hours by the formula rates contained in that matrix. The list of program areas is used state-wide by the Coordinating Board. Of course no institution has programs or generates student credit hours in all program areas, nor at all levels of instruction. Since U.T. Ausin is not organized specifically like this program list, we must map our student credit hours into this matrix. (This is not really a difficult task since in general we can move the credit hours for whole schools or departments.) Nevertheless, by using our enrollment projections by college (and level, once our graduate enrollments estimates are further refined), by converting these projections to student credit hour estimates using induced course load information from our Report of Instructional Patterns, and by adjusting these results to account for spring and summer term hours (using the relationships we have already identified), we can then apply the results to the Faculty Salary rates in Figure 4 and obtain a clear estimate of a major portion of our future appropriations.

Conclusion

Thus by using analytical techniques whose conceptual frameworks are widely accepted and understood, by modifying these techniques to account for the unique characteristics, and practices of the University, we are

Figure 4

Coordinating Board, Texas College and University System

RECOMMENDED FORMULA
FOR
FACULTY SALARIES
Public Senior Colleges and Universities
1981-83 Biennium

Base period semester credit hours (Summer Session 1980, Fall Semester 1980 and Spring Semester 1981) <u>times</u> the following rates <u>equals</u> dollar request for Faculty Salaries.

	Fiscal Year 1982 Rates Per Base Period Semester Credit Hour				
	Undergraduate				
Program	Four-Year Institutions	Upper-Level Institutions	Masters	Special Professional	Doctoral
Liberal Arts	$29.99	$52.18	$ 80.60	$	$295.18
Science	32.07	61.56	142.07		425.05
Fine Arts	58.01	79.48	129.13		427.98
Teacher Education	28.02	29.70	66.90		253.04
Teacher Education-Practice Teaching ...	62.27	62.27			
Agriculture	41.67		116.46		373.88
Engineering	52.75	63.30	145.74		425.05
Home Economics	39.58		92.57		278.85
Law				64.57	
Social Service	44.47	51.14	132.84		295.18
Library Science	31.50	31.50	93.92		295.18
Veterinary Medicine ...				132.35	514.16
Vocational Training ...	29.53	29.53			
Physical Training	28.42				
Nursing	89.86	89.86	142.38		470.56
Pharmacy	72.04		130.99		427.98
Business Administration	32.01	36.17	88.59		405.41
Optometry				98.79	425.05
Technology	43.72	56.39	142.07		

1/25/80

increasingly able to provide the kind of management information and policy support so needed as the University meets today's challenges and prepares to deal with the higher education environment of the coming decade. As stated before we have not completed all the work we had hoped to regarding this series of analytical techniques. Quite frankly, as of this time I am not sure that we will. Given the enrollment prospects for the University of Texas at Austin, many policy questions concerning the optimum size of the University in general and specific programs in particular are being asked. Academic policies and requirements are being closely analyzed in attempts to plan program capacity more effectively. All of our work on estimating entering students and analyzing student flow patterns has been received enthusiastically across campus; it has answered critical questions and spawned others. Likewise, our work on the Report of Instructional Patterns has had a similar impact. However, it is not as clear at this point whether the information on future funding will be as widely used. Nevertheless, the methodological issues are clear. Because of our funding structure in the state of Texas, we understand what needs to be done to provide these forecasts. The only remaining questions are those of utilization of the results and those of priority.

BIBLIOGRAPHY

1. Bielec, John A. "Planning Strategies for the 1980's Enrollment Disaster." Business Officer. Washington, D.C.: National Association of College and University Business Officers, March 1979.

2. Centra, John A. "College Enrollment in the 1980s: Projections of Possibilities." New York, N.Y.: The College Board, December 1978.

3. Evans, Keith W. "Student Flow Modeling: An Enrollment Projection Tool for Administrators." Planning for Higher Education. New York: Society of College and University Professors, December 1975.

4. Fishbeck, Mickey. "Analysis of Long-Term Projections of Freshmen." Unpublished. Austin, Texas: Office of Institutional Studies, The University of Texas at Austin, January, 1980.

5. Gamso, Gary. The RRPM Guide: A Primer for Using the NCHEMS Resource Requirements Predicion Model (RRPM 1.6). Boulder, Colorado: National Center for Higher Education Management Systems, 1977.

6. Gross, Francis M. "Formula Budgeting and the Financing of Public Higher Education: Panacea or Nemesis for the 1980s?" The AIR Professional File. Tallahassee, Florida: Association for Institutional Research (Fall, 1979).

7. Henderson, Cathy. Changes in Enrollment by 1985. Washington, D. C.: American Council on Education, Vol. 3, No. 1, June 1977.

8. Jackley, Janet P. and Henderson, Cathy. "Retention: Tactic for the Eighties." Washington, D.C.: The American Council on Education, December, 1979.

9. Kraetsch, Gayla A. "Methodology and Limitations of Ohio Enrollment Projections." The AIR Professional File. Tallahassee, Florida: Association for Institutional Research (Winter 1979-80).

10. Magarell, Jack. "The 1980s: Higher Education's 'Not-Me' Decade." The Chronicle of Higher Education, January 1980.

11. Norris, Donald M. "Enrollment Projection Strategies in an Uncertain Environment." Conflicting Pressures in Postsecondary Education, ed. by Robert H. Fenske. Tallahassee, Florida: Association for Institutional Research, 1977.

12. Reinhardt, Hazel H. "The Ups and Downs of Education." American Demographics, June 1979.

13. Render, Barry. "Enrollment Forecasting in a Large State System." Planning for Higher Education. New York: SCUP, August 1977.

14. Richardson, Richard C., Jr., Gardner, Don E. and Pierce, Ann. "The Need for Institutional Planning." Research Currents. Washington, D. C.: American Association for Higher Education, September 1977.

15. Western Interstate Commission for Higher Education. "High School Graduates: Projections for the Fifty States." Boulder, Colorado, November 1979.

16. Wing, Paul. Higher Education Enrollment Forecasting: A Manual for State-Level Agencies. Boulder, Colorado: NCHEMS, 1974.