A computer model for prediction of tenure ratios in higher education

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A COMPUTER MODEL FOR PREDICTION OF TENURE RATIOS IN HIGHER EDUCATION

The dramatic decline in the rate of turnover among faculty members in higher education is a generally observed phenomenon. Its causes have been widely discussed; among the more often-cited reasons have been: the over-production of doctorates in a large number of disciplines, the diminishing number of majors in traditional fields of study, and the projected decline in the number of potential undergraduate students. The slowing of the flow of faculty into and out of faculty ranks has heightened concern that the faculty of a college or school or of an individual department may become 'overtenured,' even to the point of being 'closed' for the forseeable future. Various options have been advanced to forestall or prevent this situation: tenure quotas, conversion of vacant tenure-track positions into term appointments, provision of more creative and favorable early retirement options. Vaupel suggests three basic strategies: making tenure harder to achieve, promoting attrition among tenured faculty, and increasing the length of time untenured faculty stay at a university prior to the granting of tenure.[1] On the second strategy he proposes a variety of extreme measures for increasing the attrition of tenured faculty: holding down salaries of less worthy tenured faculty, assignment to a larger number of less interesting classes, enforcing obligations to fulfill university responsibilities more strictly, buying out faculty with large retirement bonuses, etc.[2]

Prior to sounding the alarm about the advance of overtenuring and before the imposition of quotas or the semi-Draconian devices mentioned above, it is obviously important to gather the accurate personnel information on the faculty in a particular college and then, on the basis of this data, to make informed projections on the future tenure percentages. The model which follows suggests a relatively direct approach to gathering the relevant information and using it in a computer planning model that is within the easy grasp of college administrators with minimal technical knowledge. It employs the Interactive Financial Planning System (IFPS) developed by EXECUCOM. [3]

The IFPS computer simulation system has the very considerable advantage of enabling the typical manager to develop planning models after very limited introduction to the system. It allows the university administrator to translate the problem into a model directly, without the mediation of complicated mathematical formulas or highly technical experts.[4] It is quite possible that this 'direct access' feature may overcome what Gray, in his survey of higher education planning models, identified as the classic 'two cultures' problem which has more often than not prevented the effective use of models in higher education: the analyst and model builder comes from a technological culture while the administrator typically comes from a liberal arts culture.[5] "The modeler doesn't ask the right questions, and the administrator does not know how to translate the modeler's results into operational policy.[6] The model presented below illustrates one approach to the solution of this dilemma by demonstrating how the administrator can <u>become</u> the modeler.

I. INFORMATION REQUIRED

The information required to implement the model should be easily recoverable from personnel files. It is broken into three basic categories: future, current, past.

Future Information - The two most important and recurring events which are the basis for tenure projections are projected tenure decisions and retirements. By reviewing the ages of all faculty, the mandatory retirement date for each person can be established and the number of retirees for each year recorded. Similarly, proximate tenure decisions (usually for the next six years) can be recorded in the appropriate year. It is necessary to provide data only for the first seven years if you make the assumption that in the year following the opening of a tenured position, a tenure-track appointee will begin tenured service, and, in the sixth year following appointment, either be awarded or denied tenure. This assumption can be built into the tenure projection model and the number of tenure decisions after the first seven years can be calculated by the model rather than manually.

In this matter a chart can be compiled showing the number of retirements and tenure decisions each year for the next 20 years.

	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	20
Mandatory Retirement	2	4	6	6	6	7	7	7	7	5	3	10	12	6	8	5	4	7	8
Tenure Decisions	4	8	9	7	11	6	6												

Current Information - The model requires the determination of the total number of permanent tenurable faculty positions for the base year of the projections; this number is divided into tenured and untenured (tenure-track) faculty. If the intention is to apply the model to other organizational subdivisions, (e.g., schools or departments), the total number of tenured positions and division into tenured and untenured for each of these organizational units is also needed.

tenured	55
untenured	110
total tenurable faculty positions	465

Past Information - The information gathered from the previous five years (or longer, if you wish) centers on two areas: tenure decisions concerning untenured faculty and transitions among tenured faculty.

Untenured Faculty - The files on untenured faculty should be reviewed to determine three factors:

1. the number of tenure-track faculty during this period who received positive tenure decisions;
2. the number of tenure-track faculty who did not receive formal tenure decisions (either because they left the university prior to a decision or were not advanced for a formal decision); and
3. the number of tenure-track faculty who received formal negative decisions in the tenure process.

	1977	1978	1979	1980	1981	Totals
positive tenure decisions	12	15	15	13	15	70
negative tenure decisions	7	8	6	7	7	35
tenure-track appointees who did not receive a decision	1	2	3	3	1	10
total tenure-track appointees	20	25	24	23	23	115

Once again, it is possible to gather this information for organizational subunits if more focused projections concerning these units are desired.

Tenured Faculty - Three basic options/events can occur as alternatives to ordinary completion of tenured service to the mandatory retirement age: death, transfer to another university, early retirement. The files on tenured faculty members who left the tenured faculty ranks during the past five years are examined to determine:

1. the number of faculty who died prior to retirement;
2. the number of faculty who retired early; and
3. the number of faculty who resigned their tenured positions for positions at other institutions.

	1977	1978	1979	1980	1981	TOTAL
deaths	0	1	0	1	0	2
early retirements	2	2	3	1	3	11
resignations	2	1	2	1	2	8
Total Number of Tenured Faculty	321	330	334	339	351	1675

* * *

With the past, current, and future data noted above, you will be able to generate tenure probabilities and projections.

II. TENURE DECISION AND TENURED FACULTY TRANSITION PROBABILITIES

Prior to presenting the tenure projection model, the information you have collected concerning the past five years should be converted to a series of probabilities. A short Interactive Financial Planning System computer model can be developed to calculate the probabilities mentioned below. If the intention is to separate the data for different departments or schools in a particular institution, it would be doubly valuable to develop such a model rather than calculate the possibilities by hand. Datafiles can then be created for each subunit and the model solved for each of the datafiles, thus creating probabilities for all subunits. Appendices 3-5 illustrate the model as well as typical datafiles.

1. Positive Decision Probability - the probability that a tenure-track faculty member will receive a positive tenure decision. This probability can be calculated in two ways:

a. by dividing the number of positive decisions by the total number who entered tenure-track positions (the positive decisions + the negative tenure decisions + the tenure-track appointees who left prior to a formal tenure decision),

$$\text{positive tenure decisions (1977-81)} \div \text{total number of tenure-track appointees (1977-81)}$$

$$70 \div 115 = .6087$$

b. by dividing the number of positive tenure decisions by the total number who received either a negative or positive tenure decision (the negative decision + the positive decisions),

$$\text{positive tenure decisions (1977-81)} \div \text{total number of positive and negative tenure decisions (1977-81)}$$

$$70 \div 105 = .6667$$

In the illustration of the model which follows, the second of these two probabilities is used.

2. Early Death Probability - the probability that a faculty member will die prior to the completion of tenured service at the 70 retirement age. This is calculated by dividing the number of faculty who have died in the past five years by the number of tenured faculty in those five years.

$$\text{deaths (1977-81)} \div \text{total number of faculty (sum 1977-81)}$$

$$2 \div 1675 = .0012$$

3. Early Retirement Probability - the probability that tenured faculty will retire early; calculated in the same manner as above.

early retirements (1977-81) ÷ total number of faculty (sum 1977-81)

$$11 \div 1675 = .0066$$

4. Early Resignation Probability - the probability that a faculty member will resign his/her tenured position to accept an appointment at another university. While it is possible to blend this group with the early retirement group, it is useful to maintain separate records and calculate separate probabilities for reasons that will become obvious when presenting the Tenure Projection Model.

early resignations (1977-81) ÷ total number of faculty (sum 1977-81)

$$8 \div 1675 = .0048$$

As mentioned above, all of these probabilities are based on the assumption that the trends of the past five (or more) years will reflect future trends. The probabilities should be subjected to the informed judgment of university administrators in order to determine whether new factors will intervene to modify future trends. If this judgment is made, the probabilities can be adjusted accordingly.

III. TENURE PROJECTION MODEL

After compiling the information concerning mandatory and tenure decisions during the first seven years, and after calculating probabilities concerning positive tenure decisions and transitions among tenured faculty, it is possible to propose a model which will use this data to generate future projections. Each line in the model below will be explained more fully after presentation of the complete model.

TENURE PROJECTION MODEL

number of years of the projection = 1982-2000

UNTENURED FACULTY

tenure decisions = 4, 8, 9, 7, 11, 6, 6, previous 7 difference

difference = total tenure transitions (adjusted mandatory retirements + early retirements + deaths + resignations) + negative tenure decisions + position change

positive tenure decision probability = .6667

number of positive decisions = positive tenure decision probability x the number of tenure decisions

negative tenure decision probability = 1 - positive tenure decision probability

negative tenure decisions = negative tenure decision probability x the number of tenure decisions

total tenure transitions = adjusted mandatory retirements + early retirements + deaths + resignations

mandatory retirements = 2, 4, 6, 6, 6, 7, 7, 7, 7, 5, 3, 10, 12, 6, 8, 5, 4, 7, 8

adjusted mandatory retirements = mandatory retirements for the first five years, then mandatory retirements - previous retiredeath

early retirement probability = .0066

number of early retirements = number of tenured faculty x early retirement probability

death probability = .0012

deaths = number of tenured faculty x death probability

retiredeath = the number of early retirements + the number of deaths

resignation probability = .0048

number of resignations = the number of tenured faculty x resignation probability

RESULTS

total faculty = tenured faculty + untenured faculty

tenured faculty = the base number of tenured faculty (in the first year of projection), then the previous year's base number + the positive tenure decisions in the present year - the adjusted retirements + the number of resignations

untenured faculty = the base number of untenured faculty (in the first year of projection), then (the previous year's base number + the adjusted retirements + the number of resignations + the new positions) - the number of positive decisions

position change = the number of positions added to or subtracted from the total number of tenured positions

tenure percentage = tenured faculty ÷ by the number of tenured faculty + the number of untenured faculty

* * *

The following provides further explanation of this model.

UNTENURED FACULTY - The aim in this section of the model is to calculate the number of tenure-track faculty who receive a positive or decision in a given year. This is done by multiplying the number of decisions that occur in a given year by the positive decision probability and the negative decision probability. These probabilities have been derived from the experience of the previous five (or more) years.

The number of tenure decisions to be made after the first six years (for which you have calculated exact numbers) is equivalent to the number of tenured positions that have become open seven years before the year in which the decisions are to be made. These open positions have been created in five ways in that 7th year previous:

1. mandatory retirements,
2. deaths,
3. early retirements,
4. resignations, and
5. negative tenure decisions.

Each of these events has created a specific number of open positions and resulted in new appointees who will receive tenure decisions in the 6th year after these events. Thus the definition of the term difference is the sum of adjusted mandatory retirements + early retirements + deaths + resignations + negative tenure decisions. This total becomes the number of anticipated tenure decisions in the 7th year following their occurrence. The concept of 'adjusted' mandatory retirement is explained below.

TENURED FACULTY - the goal of this section of the model is to calculate transitions within the tenured faculty group, transitions based on the probabilities derived from the past five years. The number of mandatory retirements in each year has been calculated from a study of the ages of the present faculty. The number of deaths anticipated is calculated by multiplying the probability of death by the number of tenured faculty in a given year; the number of early retirements by multiplying the probability of early retirement by the number of tenured faculty; the number of resignations by multiplying the probability of resignation by the number of tenured faculty.

The number of mandatory retirements in a given year (which you have calculated on the basis of faculty ages) must be adjusted to take into consideration the fact that a percentage of faculty will die or retire early and consequently not reach the mandatory retirement age. In order not to count them twice, their number must be subtracted from future retirements. This is done by assuming that the number of deaths and early retirements in a particular year should be subtracted in the fifth year after they occur. This is obviously arbitrary, but has the advantage of subtracting the number of deaths and early retirements closer to the year when mandatory retirement would have occurred. In this way, an adjusted mandatory retirement figure is calculated. In the first five years, it will be identical to the previously established mandatory retirement figure. However, in the sixth year, it is adjusted by subtracting tenured faculty members who died or retired five years earlier (and who likely would have taken mandatory retirement about five years later).

The concept of total tenure transitions adds all members of the tenured faculty who, for one reason or another, leave tenured ranks in a particular year. It is calculated by adding the adjusted mandatory retirements, early retirements, deaths and resignations. The opening of a tenure slot obviously affects three other parts of the model:

1. by reducing the number of tenured faculty,
2. by adding to the number of untenured faculty, and
3. by creating an opening which will 'come to term' 7 years later in a positive or negative decision.

RESULTS

This section provides the running totals of total faculty, tenured faculty, untenured faculty, and the percentage of tenured faculty as it changes from year to year.

The total faculty figure simply adds the number of tenured and untenured faculty occupying tenure-track positions.

Position change is the number of tenure-track faculty positions which are added to or subtracted from the total number of tenured positions available.

The tenured faculty number is calculated in years following the base year by adding to the total tenured those who receive positive tenure decisions (thus moving from the untenured pool to the tenured group). But the tenured group is also affected by the transitions among tenured faculty, i.e., by total tenure transitions (adjusted mandatory retirements, deaths, early retirements, and resignations). These four groups must also be subtracted each year from the total number of tenured faculty.

The untenured faculty number can be calculated in the years following the base year by adding to the untenured group the total tenure transitions (adjusted mandatory retirements, deaths, early retirements and resignations);

the positions held by the persons in each of these groups move from the tenured to the untenured group. Also added to the untenured group are any position changes, i.e., the addition or elimination of tenure-track positions. The number of previously untenured faculty members who have received a positive decision must be subtracted from the untenured total since these individuals have moved from untenured to tenured status.

The tenure percentage is calculated by simply dividing the total number of faculty into the number of tenured faculty.

ACTUAL PROJECTIONS

The model using the various probabilities and relationships described above is then projected through to the year 2000. The projections below illustrate the model. For purposes of illustration, all elements of the model have been printed in the chart below for the first six years. The second chart prints only the conclusions of the model most useful in decision-making and extends the projections to the year 2000.

TENURE PROJECTION MODEL - COMPLETE VERSION
(for the first six years of the projection)

	1982	1983	1984	1985	1986	1987
UNTENURED FACULTY						
td	4	8	9	7	11	6
dif	7.806	11.10	13.38	12.64	13.94	10.45
posit dec prob two	.6667	.6667	.6667	.6667	.6667	.6667
posit dec	2.667	5.334	6.000	4.667	7.334	4.000
neg dec prob	.3333	.3333	.3333	.3333	.3333	.3333
neg dec	1.333	2.666	3.000	2.333	3.666	2.000
TENURED FACULTY						
tot ten transit	6.473	8.434	10.38	10.31	10.27	8.446
mand retire	2	4	6	6	6	7
adj mand retire	2	4	6	6	6	4.231
early retire prob	.0066	.0066	.0066	.0066	.0066	.0066
early retire	2.343	2.323	2.294	2.256	2.237	2.208
death prob	.0012	.0012	.0012	.0012	.0012	.0012
deaths	.4260	.4223	.4170	.4103	.4067	.4014
retiredeath	2.769	2.745	2.711	2.667	2.644	2.609
resign prob	.0048	.0048	.0048	.0048	.0048	.0048
resign	1.704	1.689	1.668	1.641	1.627	1.606
RESULTS						
tot fac	465	465	465	465	465	465
position change	0	0	0	0	0	0
ten	355	351.9	347.5	341.9	338.9	334.5
unten	110	113.1	117.5	123.1	126.1	130.5
TENPCT	.7634	.7568	.7474	.7352	.7289	.7194

TENURE PROJECTION MODEL - Tenure Percentage Only

	1982	1983	1984	1985	1986	1987
TENPCT	.7634	.7568	.7474	.7352	.7289	.7194
	1988	1989	1990	1991	1992	1993
TENPCT	.7099	.7030	.7007	.7060	.7142	.7093
	1994	1995	1996	1997	1998	1999
TENPCT	.6952	.6940	.6894	.6929	.6967	.6910
	2000					
TENPCT	.6937					

TENURE PROJECTION MODEL - SIMPLIFIED VERSION (TWELVE VARIABLES)
(for all years of the projection)

	1982	1983	1984	1985	1986	1987
td	4	8	9	7	11	6
posit dec	2.667	5.334	6.000	4.667	7.334	4.000
neg dec	1.333	2.666	3.000	2.333	3.666	2.000
tot ten transit	6.473	8.434	10.38	10.31	10.27	8.446
mand retire	2	4	6	6	6	7
early retire	2.343	2.323	2.294	2.256	2.237	2.208
deaths	.4260	.4223	.4170	.4103	.4067	.4014
resign	1.704	1.689	1.668	1.641	1.627	1.606
tot fac	465	465	465	465	465	465
ten	355	351.9	347.5	341.9	338.9	334.5
unten	110	113.1	117.5	123.1	126.1	130.5
TENPCT	.7634	.7568	.7474	.7352	.7289	.7194

	1988	1989	1990	1991	1992	1993
td	6	7.806	11.10	13.38	12.64	13.94
posit dec	4.000	5.204	7.401	8.919	8.428	9.292
neg dec	2.000	2.602	3.700	4.459	4.213	4.645
tot ten transit	8.414	8.408	8.439	6.492	4.576	11.58
mand retire	7	7	7	5	3	10
early retire	2.179	2.157	2.151	2.167	2.192	2.177
deaths	.3961	.3923	.3910	.3939	.3985	.3958
resign	1.584	1.569	1.564	1.576	1.594	1.583
tot fac	465	465	465	465	465	465
ten	330.1	326.9	325.8	328.3	332.1	329.8
unten	134.9	138.1	139.2	136.7	132.9	135.2
TENPCT	.7099	.7030	.7007	.7060	.7142	.7093

	1994	1995	1996	1997	1998	1999
td	10.45	10.41	11.01	12.14	10.95	8.789
posit dec	6.964	6.943	7.340	8.093	7.301	5.860
neg dec	3.481	3.471	3.670	4.046	3.650	2.929
tot ten transit	13.52	7.524	9.478	6.469	5.509	8.527
mand retire	12	6	8	5	4	7
early retire	2.134	2.130	2.116	2.126	2.138	2.121
deaths	.3879	.3872	.3847	.3866	.3888	.3856
resign	1.552	1.549	1.539	1.546	1.555	1.542
tot fac	465	465	465	465	465	465
ten	323.3	322.7	320.6	322.2	324.0	321.3
unten	141.7	142.3	144.4	142.8	141.0	143.7
TENPCT	.6952	.6940	.6894	.6929	.6967	.6910

	2000
td	16.23
posit dec	10.82
neg dec	5.408
tot ten transit	9.547
mand retire	8
early retire	2.129
deaths	.3871
resign	1.548
tot fac	465
ten	322.6
unten	142.4
TENPCT	.6937

IV. CONCLUSION

As noted earlier, this model was composed and executed using the Interactive Financial Planning System computer planning system. IFPS also provides a number of other highly flexible features which might be employed to manipulate the data. It permits easy modification of any element of the model (e.g., an updated positive tenure probability percentage), and adjusts all projections to whatever element is changed. Thus IFPS provides a basis for periodic updating based on additional information or more informed judgment.

This system also provides a variety of other features which allow the administrator to 'try out' alternative strategies or policies and immediately visualize their impact. For example, any of the proposals for increasing the attrition of tenured faculty or decreasing the probability of positive tenure decisions could be inserted into the model and its implications visualized immediately. Thus the higher education administrator can ask a series of 'what if' questions and receive immediate information critical in evaluating the suitability or efficacity of an alternative.[6]

It was also mentioned earlier that it is possible to separate data, compile information, and calculate ratios for organizational subunits (college, departments). The datafile feature of IFPS allows the creation of a separate datafile for each subunit; the same model can then be used for all of the datafiles which surround it, thus producing projections for combined or separate units.

The tenure model presented above utilizing IFPS is written in English equations; it is simply a nontechnical extension of normal thought processes and a commonsense statement of the variables involved and their relationships. Thus the model provides an adaptable tool which either could be used in its present form in other settings or could be modified in order to fit better the realities of a particular university.

APPENDIX 1: MODEL TRIBB (model for the projection of faculty tenure percentages)

```
MODEL TRIBB  VERSION OF  02/05/82  14:38
1 columns 1982-2000
1.5*UNTENURED FACULTY
2 td = 2,2,2,2,2,2,2,previous 7 dif
3 dif = tot ten transit + neg dec + position change
5       posit dec prob two = .50
6       posit dec = posit dec prob two * td
7       neg dec prob = 1 - posit dec prob two
8       neg dec = td * neg dec prob
9 *TENURED FACULTY
9.5 tot ten transit = adj mand retire + early retire + deaths + resign
10       mand retire = 5
10.5      adj mand retire = mand retire FOR 5, mand retire - previous 5 retiredeath
11       early retire  prob = .005
11.2       early retire = ten * early retire prob
11.4       death prob = .001
11.6       deaths = ten * death prob
12       retiredeath = early retire + deaths
13       resign prob = .002
14       resign = ten * resign prob
15*RESULTS
16 tot fac = ten + unten
16.5 position change = 0
17      ten = DATA, (previous ten + posit dec) - tot ten transit
18      unten = DATA,  (previous unten + tot ten transit + position change) - posit dec
19 TENPCT = ten/(ten + unten)
```

APPENDIX 2: DATAFILE SAMPTEN (a datafile containing the data necessary to solve the tenure projection model for the total university)

```
td = 4,8,9,7,11,6,6,previous 7 dif
mand retire = 2,4,6,6,6,7,7,7,7,5,3,10,12,6,8,5,4,7,8
ten = 355
unten = 110
posit dec prob one = .6087
posit dec prob two = .6667
early retire prob = .0066
death prob = .0012
resign prob = .0048
```

APPENDIX 3: MODEL TENPROB (model used to calculate the probabilities connected with tenure decisions and tenure transitions)

```
MODEL TENPROB  VERSION OF  01/28/82  16:28
1 columns 1977-1981,spec
2 *UNTENURED FACULTY PROBABILTIES
3 resign bef ten = 10
4 neg dec = 8
5 tot non ten = resign bef ten + neg dec
6 posit dec = 12
7 posit dec prob one = posit dec/(posit dec + neg dec + resign bef ten)
7.5 posit dec prob two = posit dec/(posit dec + neg dec)
8*TENURED FACULTY
8.5 COLUMN spec FOR resign bef ten, neg dec,tot non ten, posit dec =sum (C 1977 THRU C 1981)
9 COLUMN spec FOR posit dec prob one = posit dec /(posit dec + neg dec + resign bef ten)
10 COLUMN spec FOR posit dec prob two = posit dec/(posit dec + neg dec)
11 ten resign = 3
12 resign prob = ten resign/tot ten
13 ten death = 1
14 death prob = ten death/tot ten
15 ten retire = 4
16 retire prob = ten retire/tot ten
17 tot retiredeath = ten death+ ten retire
18 retiredeath prob = tot retiredeath/tot ten
19 tot ten transit = ten resign + ten death + ten retire
20 ten transit prob = tot ten transit/tot ten
20.5tot ten = 80
21 COLUMN spec FOR ten resign, ten death, ten retire,tot retiredeath, tot ten transit, tot ten =
22 COLUMN spec FOR ten transit prob = tot ten transit/tot ten                    sum(C 1977 THRU C198
23 COLUMN spec FOR retiredeath prob = tot retiredeath/tot ten
24 COLUMN spec FOR resign prob = ten resign/tot ten
25 COLUMN spec FOR retire prob = ten retire/tot ten
26 COLUMN spec FOR death prob = ten death/tot ten
END OF MODEL
```

APPENDIX 4: DATAFILE SAMPTP (a datafile containing the data necessary to solve the tenure probability model for the total university)

```
1 resiqn bef ten = 1.2.3.3.1
2 neq dec = 7,8,6,7,7
3 posit dec = 12, 15, 15, 13, 15
4 ten resiqn = 2,1,2,1,2
5 ten death = 0,1,0,1,0
6 ten retire = 2.2.3.1.3
7 tot ten = 321,330,334,339,351
```

APPENDIX 5: The Solution of MODEL TENPROB using the DATAFILE $AMPTP (the solution of the tenure probability model using the data from the total university)

	1977	1978	1979	1980	1981	spec
UNTENURED FACULTY PROBABILTIES						
resign bef ten	1	2	3	3	1	10
neg dec	7	8	6	7	7	35
tot non ten	8	10	9	10	8	45
posit dec	12	15	15	13	15	70
posit dec prob one	.6000	.6000	.6250	.5652	.6522	.6087
posit dec prob two	.6316	.6522	.7143	.6500	.6818	.6667
TENURED FACULTY						
ten resign	2	1	2	1	2	8
resign prob	.0062	.0030	.0060	.0029	.0057	.0048
ten death	0	1	0	1	0	2
death prob	0	.0030	0	.0029	0	.0012
ten retire	2	2	3	1	3	11
retire prob	.0062	.0061	.0090	.0029	.0085	.0066
tot retiredeath	2	3	3	2	3	13
retiredeath prob	.0062	.0091	.0090	.0059	.0085	.0078
tot ten transit	4	4	5	3	5	21
ten transit prob	.0125	.0121	.0150	.0088	.0142	.0125
tot ten	321	330	334	339	351	1675

NOTES

1. James W. Vaupel, "Over-Tenured Universities: The Mathematics of Reduction," Management Science 27 (August, 1981), 904-13. See also Harry W. Weart, "Strategies in the Management of Tenure Fraction," ERIC ED 121210.

2. A recent issue of The Chronicle of Higher The Chronicle of Higher Education published a "Point of View" feature entitled "For a University in Financial Trouble, a Faculty 'Buy-Out' Plan Can Save Money and Face." The article describes how in 1981 Michigan State University reduced the size of its faculty by about 100 tenured professors without any dismissals. Mordechai E. Kreinin, Chronicle of Higher Education 22 (20), (January 27, 1982), 56.

3. "The Interactive Financial Planning System (IFPS) developed by EXECUCOM is a computerized simulation system which enables planning as a natural extension of normal management thought processes....

   The simplicity and versatility of IFPS has been repeatedly proven. Over 2,000 managers of all disciplines and levels of mathematical sophistication have used this system in workshops on Computer-Based Planning. These individuals have consistently been able to develop substantial IFPS planning models after one day of introduction to elementary finance, modeling. statistics, simulation, and IFPS.

   IFPS is not a canned program. It is a planning system which permits description of the user's needs in English equations. He does not twist his problem to fit someone else's interpretation of his needs.

   A major contribution made by IFPS is that it provides a workable analytical and decision-oriented environment for open and understandable communication. IFPS provides the means for reducing or eliminating conflicts, intimidation by technical jargon, and personal goal setting when managers and technicians should be working together as a team.

   A major component of IFPS is a truly English-like modeling language. This is supported by a battery of editorial commands which make model building a simple activity at the computer terminal keyboard. IFPS has elaborate report-generating capabilities and a rich variety of options for producing and exploring model outputs."

   IFPS Users Manual, EXECUCOM Systems Corporation (Austin, TX: 1980), p 5.

4. See, for example, A. Walters and others, "A Comprehensive Planning Model for Long-Range Academic Strategies," Management Science 22 (March, 1976), 727-38. The questioning of the effectiveness of these models is not intended to imply that more technical approaches are not useful, but simply to suggest that a system which simultaneously can both solve a large number of typical administrative problems and also allow the administrator direct access has significant advantages. IFPS is built on the premise that the manager should be able to use techniques to pose and solve problems and to test alternatives by using a powerful but simplified planning system which does not require intermediaries with sophisticated technical expertise.

5. Paul Gray, "University Planning Models - A Survey," Center for Futures Research, Graduate School of Business Administration, University of Southern California (March, 1975). Gray elaborates this conflict of cultures: "An important barrier to implementation is that the model builder and the administrator perceive prob lems differently. Decision makers are action-oriented, now-oriented, trying to solve yesterday's problem today. Their perception of planning and decision -making therefore differs from the analyst who has a more systematic, more analytical, and usually more detached view" (p. 19). Bleau, in a more recent survey of planning models in higher education, reaches the same general conclusion concerning the 'fit' between the model and the administrator. The general conclusion of her research on the impact, effectiveness and utilization of planning models is that "the findings have not been all th at encouraging" (p. 162). Barbara Lee Bleau, "Planning Models in Higher Education: Historical Review and Survey of Currently Available Models," Higher Education 10 (1981), 153-68.

6. Gray, p. 17.

7. Gray points out the importance of 'what if' questions but also notes that responses to such questions in the complex models are difficult and expensive (p. 18).