DOCUMENT RESUME

ED 410 894 HE 030 491

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TITLE	Studying Faculty Flows Using an Interactive Spreadsheet Model. AIR 1997 Annual Forum Paper.
PUB DATE	1997-05-19
NOTE	31p.; Paper presented at the Annual Forum of the Association for Institutional Research (37th, Orlando, FL, May 18-21, 1997).
PUB TYPE	Reports - Evaluative (142) -- Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Academic Rank (Professional); *College Faculty; Computer Software; *Decision Making; Early Retirement; Educational Finance; Faculty Mobility; Foreign Countries; Higher Education; Institutional Administration; Institutional Research; Markov Processes; *Mathematical Models; *Personnel Management; Personnel Needs; Predictive Measurement; Predictor Variables; Research Methodology; *Spreadsheets; Strategic Planning; Teacher Salaries; Teacher Supply and Demand
IDENTIFIERS	*AIR Forum; Microsoft Excel; *University of Calgary (Canada)

ABSTRACT

This paper describes a spreadsheet-based faculty flow model developed and implemented at the University of Calgary (Canada) to analyze faculty retirement, turnover, and salary issues. The study examined whether, given expected faculty turnover, the current salary increment system was sustainable in a stable or declining funding environment, and whether further early retirement incentives would be necessary. The model, called the Academic Staff Resource Projection Model, is based on the Markov chain approach to project faculty movement out four years. It was developed using Microsoft's Excel spreadsheet software. Nine alternative policies and assumptions were tested concerning: (1) retirements for ages 55 to 70; (2) resignation rates by years of service; (3) age distribution of newly hired staff; (4) annual attrition of one rank replaced by another rank; (5) overall attrition replacement ratio; (6) adjustments to allow for addition or elimination of academic programs; (7) starting salaries; (8) salary schedule information; and (9) rate of promotion to next rank. Six figures and flow charts illustrate the model and show the spreadsheet file structure and flows. Three appendixes include a policy variables worksheet, a salary schedule, and an age distribution schedule. (Contains 16 references.) (CH)

STUDYING FACULTY FLOWS USING AN INTERACTIVE SPREADSHEET MODEL

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May 19, 1997

Presented at the Association for Institutional Research 37th Annual Forum
(Orlando, Florida, May 18 – 21, 1997)

for Management Research, Policy Analysis, and Planning

This paper was presented at the Thirty-Seventh Annual Forum of the Association for Institutional Research held in Orlando, Florida, May 18-21, 1997. This paper was reviewed by the AIR Forum Publications Committee and was judged to be of high quality and of interest to others concerned with the research of higher education. It has therefore been selected to be included in the ERIC Collection of Forum Papers.

Jean Endo
Editor
AIR Forum Publications

Abstract

Faculty flow modeling, a technique developed in the 1970's, is an important and useful tool for determining how the current faculty demographic characteristics will play themselves out in the future, and for exploring the effects of a large number of faculty policy options. Due to the large numbers of faculty hired during the high growth decades who are reaching retirement age, many universities and colleges will be presented with an unprecedented opportunity for faculty and curriculum renewal. Many of the shortcomings of the original mainframe computer models can be overcome by using newer tools available such as data warehouses, and powerful data base querying, statistical and spreadsheet applications residing on microcomputer workstations. A spreadsheet based faculty flow model, developed at the University of Calgary and used to analyze faculty retirement, turnover and salary issues, is described.

Introduction and Perspectives

Due to the financial constraints faced by universities and colleges for the past decade, openings for new faculty positions have come for the most part from attrition. In the coming years, however, large numbers of faculty hired during the high growth 1960's and 1970's will reach retirement age. This will present many institutions with an opportunity for faculty and curriculum renewal. Institutions need to anticipate the local effects of this phenomenon and, perhaps, consider as well the effects of policies related to both early retirement and mandatory retirement. As institutions strive to achieve program flexibility and faculty vitality and plan for their faculty staffing needs, a dizzying variety of policy options can present themselves to campus decision makers. The use of intuition alone is often insufficient in predicting the future composition of the faculty, rate of faculty turnover and number of faculty positions to be filled.

Modeling of faculty flows can be a useful tool to determine how the current demographic characteristics of the faculty will play themselves out, and to explore the effects of the wide array of policy options. Faculty flow models can help decision makers understand the complex relationships among faculty policy variables, determine those variables having the most influence over faculty composition and rate of turnover, and understand which variables can be controlled and which ones can not. Modeling can sometimes flag unexpected but important differences between short term and long term policy effects. In addition, models that have a salary component are capable of showing the financial effects of policies.

Some of the faculty related questions decision makers must sometimes grapple with are:

- What will the faculty demographics, such as tenure ratio, age and rank mix, look like in ten years?
- What would the demographics look like under conditions of retrenchment? Under conditions of expansion?
- If retrenchment conditions require the elimination of faculty positions, could this be accomplished solely by not replacing normal attrition?

- What will the tenure ratio look like in ten years time if the current tenure policy is maintained? What would it look like if promotion rates to tenure were changed?
- What effect would varying the promotion rates to tenure have on faculty turnover? Or, varying the length of probation for nontenured faculty?
- Would an early retirement program produce significant faculty turnover? What would be the estimated salary budget savings of such a program? How long would any salary savings last?
- How would total faculty salaries vary if the salary structure and/or rank promotion system were varied?
- What effect will a given affirmative action hiring policy have on the male/female ratio? Or, what is a realistic affirmative action goal to achieve within a certain time frame?

Faculty flow modeling can help to answer specific policy questions such as these quickly.

Faculty flow modeling is not a new technique. Its concepts were developed in the 1970's when a number of universities developed models and reported their progress in the literature. Both Bleau (1982) and Hopkins and Massy (1981) provide an excellent review of these various early models, comparing their approaches and features.

Many universities and colleges that developed models at that time concluded that they were difficult, expensive and time consuming to develop. Because of the era, the more ambitious models were necessarily mainframe computer applications, written in high level languages by experienced programmers. In addition, extracting the necessary historical faculty transition data required by the models was, at many institutions, difficult, time consuming and expensive because institutional personnel data file structures did not lend themselves to this type of analysis. The models were often cumbersome to use and difficult to modify. Often, they did not lend themselves to easy interactive scenario testing of alternative staff policies and assumptions, and lacked the dynamic aspects and immediacy that a good simulation tool should possess.

Perhaps the time has come to revisit the concept of faculty flow modeling and consider using newer tools available to institutional researchers. Spreadsheet software has become a familiar tool to institutional researchers. Microcomputer workstations having large working memories and fast processing speeds are available at a reasonable cost. The acquisition and manipulation of raw data from institutional databases has become easier, faster and less mainframe dependent. The tasks of collecting and analyzing academic faculty data have been simplified at many institutions because personnel data are now available on data warehouses, in formats that are more amenable to analysis, using powerful, microcomputer based tools (such as data base management system software having querying capabilities, and statistical software having easy to use interfaces).

In 1996, the University of Calgary developed and tested a spreadsheet based faculty flow model. The necessary historical data concerning faculty flows were acquired by querying personnel data residing on a minicomputer data warehouse, using microcomputer based software. The model has been used to examine certain faculty issues at the University of Calgary. Although the structure and logic of the model borrows heavily from older models described in the literature, it links faculty and salaries in a somewhat novel manner[1]. The model and its applications are described here.

A Brief Review of Faculty Flow Modeling Concepts

Faculty flow models are a mathematical description of faculty demographics, of relationships among faculty variables, and of institutional policies affecting promotion, retirement and staffing goals. Typically, they provide multiyear projections of numbers of academic staff and expected levels of attrition and replacement hiring. Some models are capable of projecting total salary budgets in addition to the future rank, tenure status and age mixes of faculty

Like the majority of models described in the literature, the model developed at the University of Calgary focuses only on the supply side of faculty resources, with attention given to what the faculty will look like in terms of rank and age mix. The literature suggests that faculty flow models can be developed that consider both the demand and supply side of the faculty resource, with demand driven by projections of student enrolments and participation rates. However, this type of model is somewhat rare except at the system level.

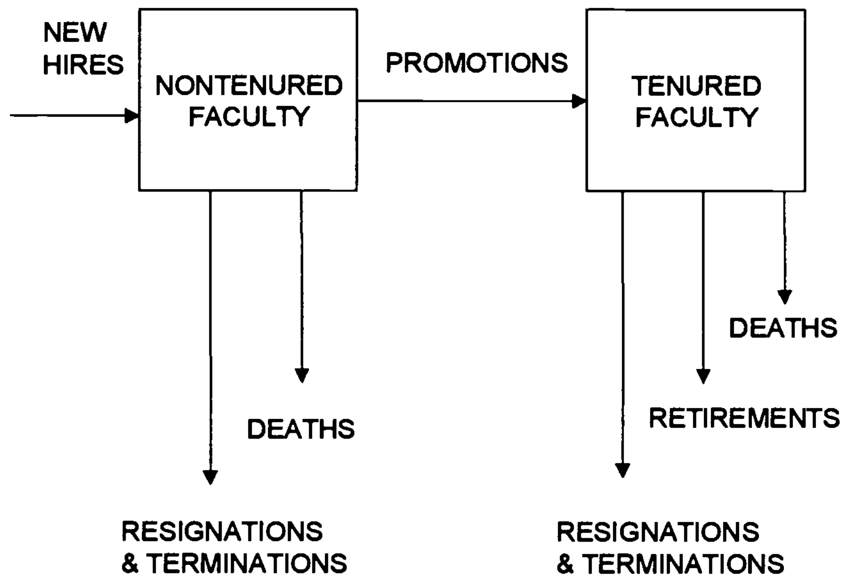
The most common type of approach, and the one chosen for the model described here, is the use of a Markov chain model. This is a model that describes the movement of people through a system of states or categories based on transition probabilities. States may be defined according to a variety of pertinent characteristics such as tenure status, rank, age, and years of service (and, perhaps, gender or minority status if affirmative action is a focus of the analysis). This type of model is time dependent, allowing the projection of faculty movement from year to year.

Such models may be said to be deterministic in that they assume that the proportion of faculty in one state or category who move to another is the same each year, based on institutional policy or past collective behavior. Analysis of historical data on faculty behavior is used to develop the "transition probabilities" that indicate the proportion of faculty who will move from one state (for example, nontenured) to another (tenured) between two successive time periods.

Figure 1 is a schematic representation that depicts the flows of a very simple model having two states: nontenured faculty and tenured faculty (adapted from Mortimer, Bagshaw and Masland (1985), p. 60). The number of nontenured faculty in a given year will equal the number of nontenured faculty in the previous year, plus any new hires, and minus those who were promoted to tenure, resigned or died. Similarly, the number of tenured faculty will equal the number of tenured faculty in the previous year, plus those promoted to tenure, and minus those who retired, resigned or died. This model assumes no one is hired to tenure and no one retires from a nontenured position.

Figure 1

A SIMPLE FACULTY FLOW MODEL



While there is some merit to keeping models simple (see "Caveats and Cautions" below), most models specify several faculty states, in addition to (or instead of) tenure status, for example, age or age range, rank and years of service. Policy variables affecting these states can be manipulated either singly or in groups. The latter approach, of varying more than one variable, can often show unexpected cross effects.

Another general type of faculty flow model, an alternative to the Markov model, is the computer simulator. Simulators model faculty cohorts using data for individual faculty members. They project the flow of individual faculty members through the various stages of their career by using a random number generator to simulate each person's career progress, i.e., a "Monte Carlo" approach. For example, the simulator would grant or deny an individual's promotion based on the random number it generates. Every run of the model will generate a different set of outcomes. Typically, the model is run a certain number of times and the results are averaged, or the results of the iterations are used to display the range of possible outcomes. A great deal more input data is required for simulator models. However, the output data can be much richer in detail. Nevison (1980) describes a case study that used this type of model.

The University of Calgary Academic Staff Resources Projection (ASRP) Model

The University of Calgary is a publicly funded Canadian university. As one of several responses to dramatic cuts in the level of government funding (21% spread over the past three years), an early retirement incentive was offered to faculty, with the result that about 100 individuals are retiring at the end of the current academic year. The impetus for the development of a faculty flow model resulted from a question posed by the Director of Human Resources. Is the current salary increment system sustainable in a stable or declining funding environment, given the expected turnover of faculty resulting from both normal and early retirements, and other factors? Should there be further early retirement incentives or will the normal retirements be sufficient to sustain the system? It was felt that a faculty flow model could answer these questions.

The model needed to have a salary component to allow examination of both the near term salary savings and total salary levels for each of the next few years, given alternative policies and assumptions affecting future retirements, attrition replacement, the salary structure, and possible program expansion or contraction. Within the context of the issues to be explored (retirement attrition and salary costs) a four year projection was felt to be ample. A model capable of a long-term projection, of, say, 15 years, was not necessary because the current environment is too unstable and the future too uncertain. This shorter perspective supported the decision to develop the model using spreadsheet software.

1. Design and Development of the Model

The model, named the Academic Staff Resource Projection (ASRP) Model, was developed using Microsoft Excel 7.0 running on an IBM-compatible 486DX66 workstation with 40 megabytes of RAM memory. A feature of Excel 7.0 crucial to the development of the model is the "workbook" concept that supports the linking of multiple worksheets in one large file.

Certain policy and faculty behavioral assumptions require analyses of a number of faculty data sets for the several years prior to the base year. In addition, the model's base year data must be derived from a current year data set. These data sets were spreadsheet files created from institutional academic personnel data residing on a data warehouse, using the querying capabilities of Microsoft Access database management system software. The empirically based policy and behavioral data as well as the base year data were then derived from the special data sets by means of SPSS statistical software.

The ASRP model allows testing of a number of alternative faculty policies and behavioral assumptions by varying the following parameters:

1. retirement rates for ages 55 through 70
2. resignation/termination rates by years of service
3. age distribution of newly hired staff
4. proportion of annual attrition at a given rank that will be replaced in any other rank
5. overall percent replacement of attrition
6. hiring adjustment (to allow for addition or elimination of academic programs), by rank
7. starting salaries of newly hired staff, by rank
8. salary schedule information such as minimum, maximum, and size of increment, by rank
9. rate of promotion to next rank and the salary at which promotion becomes possible.

It was felt that policy issues surrounding tenure status and promotion to tenure were not of any great interest, thus the model does not use tenure status as a faculty state variable or characteristic.

An output summary is produced showing numbers of faculty attrition, replacement hiring, and total faculty complement for each year of the projection, as well as comparative rank and age distributions for the base year and final projected year. An example is provided in Figure 2, showing a 1996/97 "baseline" or "status quo" run of the model, i.e., a run derived from current institutional policy and empirically derived inputs. Note the "comments" section of the summary, used to document how the model's parameters are altered from those of the baseline for a given run.

The model allows a four year projection of staff numbers and associated salary budgets beyond the base year. A nine year projection can be accomplished by using a companion workbook file (essentially, a file copy of the model) that treats the projected Year 4 output data as its base year input data.

The model's salary cost projections are in constant current dollars because the salary schedule worksheet is held constant for all years of the projection. If one wanted to add inflationary effects to the model, one could expand the salary schedule worksheet to include a unique salary schedule for each projected year (i.e., each having values augmented by estimated cost of living increases). However, doing this might obscure the effects of other policy changes.

2. Accounting Logic of the Model

The model resides on one large Excel workbook file. Figure 3 shows a schematic of the its various interrelated worksheets.

For the base year and each of the projected years, large coupled matrices are used to perform the model's accounting. There are two types of matrices:

- those containing FTE faculty totals and
- those containing mean salary values corresponding to (coupled with) those FTE totals[2].

Figure 2

ACADEMIC STAFF RESOURCES PROJECTION MODEL

PROJECTION SUMMARY

	Attrition from Previous Year					Change	Total Salaries		
	Resigned / Terminated	Retired	Total	Number Hired	Total Staff	from Prev. Year	Total $	% From Base	% From Prior Year
BASE YEAR:									
1996					889.3		63,630,508		
PROJECTED YEARS:									
1997	17.3	103.4	120.7	120.7	889.3	0	61,432,896	-3.5	-3.5
1998	18.8	26.7	45.5	45.5	889.3	0	61,645,556	-3.1	0.3
1999	22	18.1	40.1	40.1	889.3	0	62,191,183	-2.3	0.9

DISTRIBUTION BY AGE RANGE:

	Base Year	Year 1999
AGE <31	1%	4%
31 - 35	7%	8%
36 - 40	11%	14%
41 - 45	17%	16%
46 - 50	17%	18%
51 - 55	22%	19%
56 - 60	17%	15%
61 - 65	6%	7%
AGE > 65	2%	0%
TOTAL	100%	100%

DISTRIBUTION BY RANK:

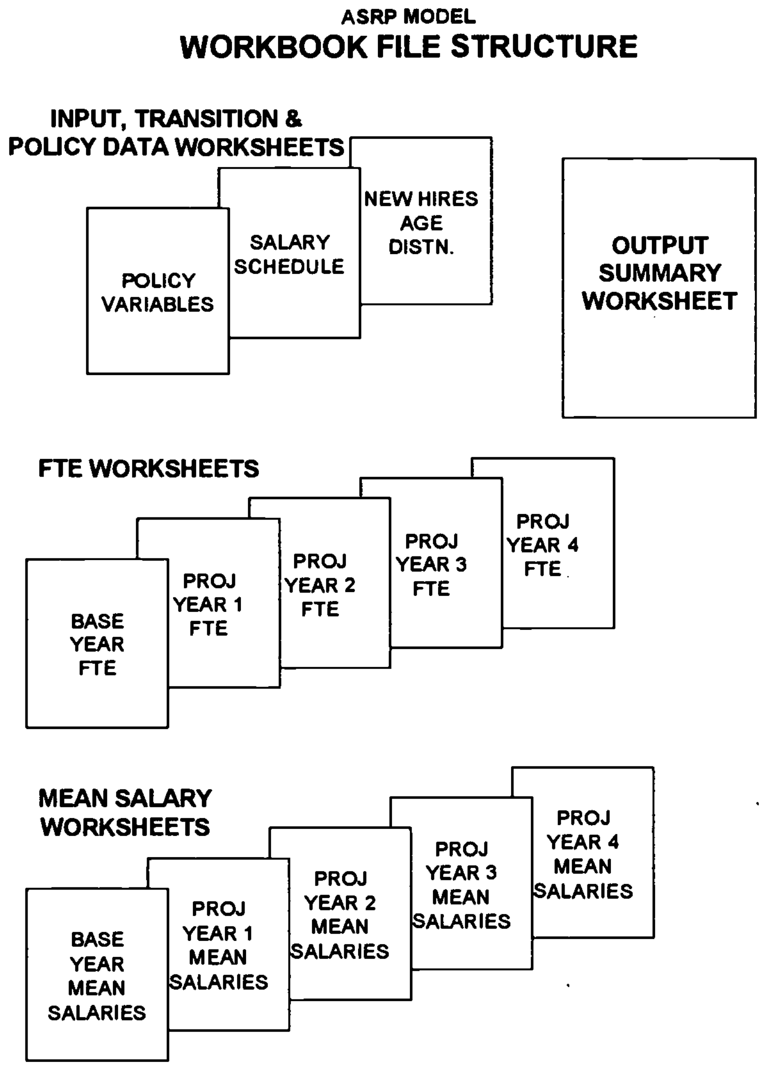
	Base Year	Year 1999
ASSISTANT	12%	20%
ASSOCIATE	42%	39%
FULL	46%	41%
TOTAL	100%	100%

COMMENTS FOR THIS RUN:

BASELINE run derived from current practice and policy:

Salary schedule as per negotiated 1996/97 salary settlement.
100% attrition replacement rate with no hiring adjustment for new or closed positions.
Attrition replacement rates by rank derived from historical data 92/93 through 95/96.
Starting salaries of new appointments by rank are averages for 92/93 through 95/96.
Retirements from 1996 are derived from actual commitments.
Retirements beyond 1996 assume 5% for each of ages 55 through 59,
10% for each of ages 60 through 64, and 100% at age 65.
Promotions assumed to occur at 7th salary step of Asst. and 11th step of Assoc. ranks.
with 57% promoted annually from Assistant and 11% promoted from Associate.

Figure 3



These matrices have an identical structure or organization, depicted in Figure 4, to identify the states of the model. Each matrix has three sub-matrices, one for each rank. And each of these has two dimensions: one dimension for age (e.g. 50 rows for ages 21 through 70) and one for years of service (e.g. 11 columns, with "10 or more years" collapsed as one state). In total, there are 1,650 possible states in the model (i.e., 3 ranks x 50 ages x 11 years of service categories).

An important point to note is that the model does not track the flows of a cohort of individuals. Rather, it uses aggregated numbers of faculty (expressed as FTE counts) in each classification or state.

In any given matrix, some matrix cells are null or zero, and many of the FTE values are relatively small numbers. There are about 900 continuing full-time faculty at the University of Calgary. The current year faculty data set was analyzed by rank, age and years of service, using SPSS, to yield the FTE and mean salary values for the base year matrices. Thus, the 900 individuals are spread quite thinly over the 1,650 states of the model. This accounts for both the small FTE values and numerous null values, in both the FTE matrices and mean salary matrices. As examples, there are currently no full professors under age 34 (most are older than 45), and for certain ages above 50 there are no assistant professors; thus the corresponding cells in the base year matrices are zero).

Conceptually, all accounting for a given year is assumed to occur at the end of the year. Each of the FTE or mean salary worksheets (Figure 3) contains numerous matrices, each designed to compute some aspect of the faculty flows. The series of matrices (all having the identical structure shown in Figure 4) are physically located beside one another[3]. Figure 5 shows a schematic of the model's accounting logic concerning FTE numbers. It depicts, for a single year, how the matrices of one of the FTE worksheets are linked and referenced to one another. Each matrix has the task of calculating some aspect of faculty flow, e.g. resignations, retirements, promoted numbers, unpromoted numbers, new appointments, and year end totals.

Calculations are performed by means of cell references to the policy variables, salary schedule and age distribution of new appointments worksheets (provided in Appendices A, B and C). For example, the value in each cell of the resignations and terminations FTE matrix is the product of the corresponding value in the start of year FTE matrix and the resignation rate for the cell's years of service, referenced by the addressing the appropriate cell of the resignation rates portion of the policy variables worksheet (Appendix A).

In this model, faculty promotions are deemed to occur if a mean salary value is greater than or equal to a rank specific promotion "trigger point" contained in the salary schedule worksheet. When this criterion is satisfied a certain proportion of the corresponding FTE number is moved to the next higher rank.

Figure 4

FORMAT OF ASRP MODEL
FTE AND MEAN SALARY MATRICES

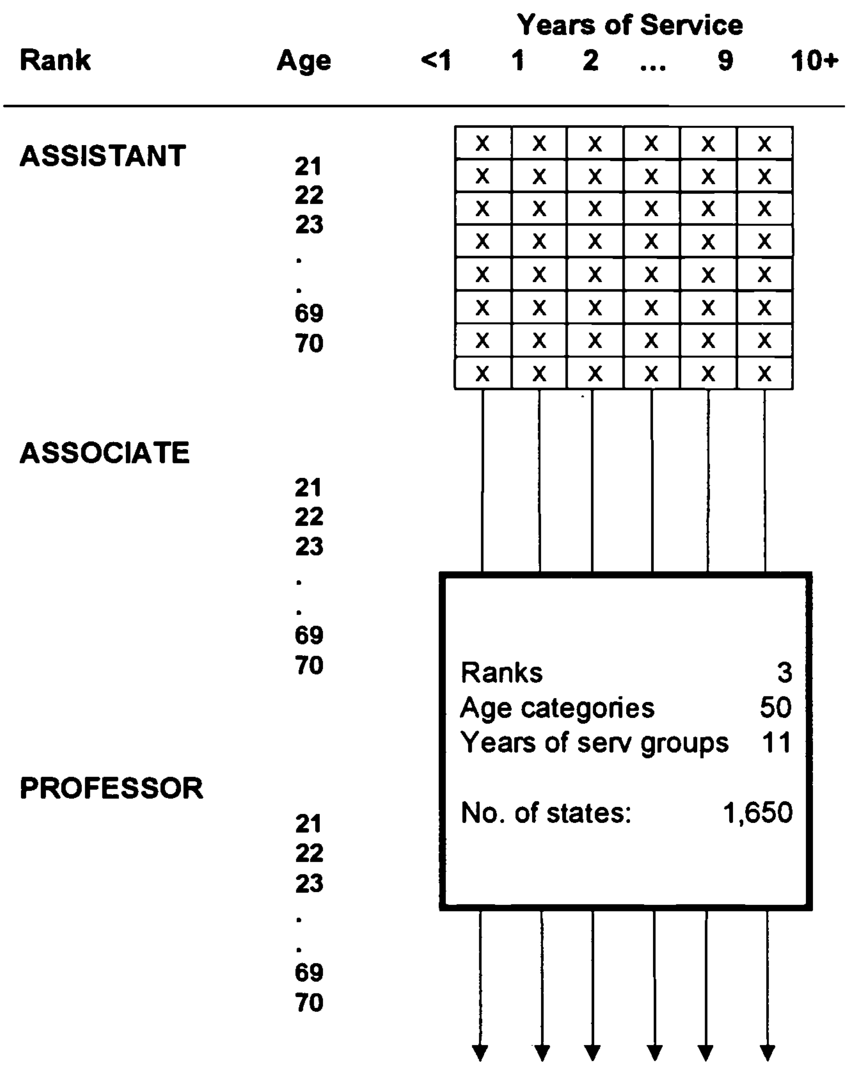
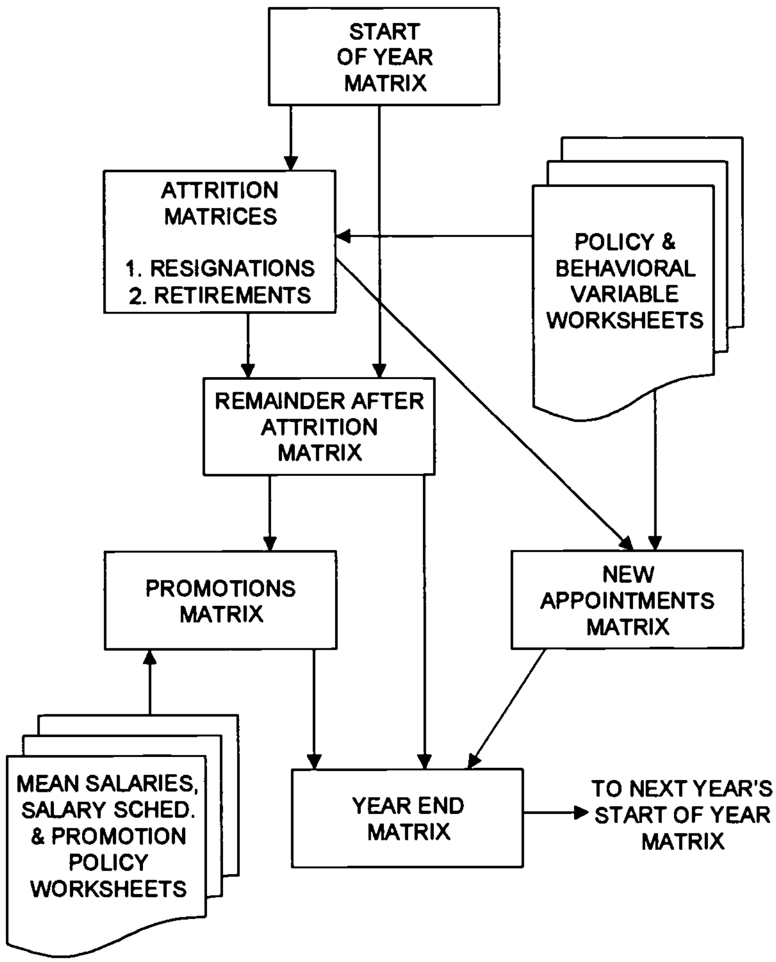


Figure 5

ACADEMIC STAFF RESOURCES PROJECTION MODEL

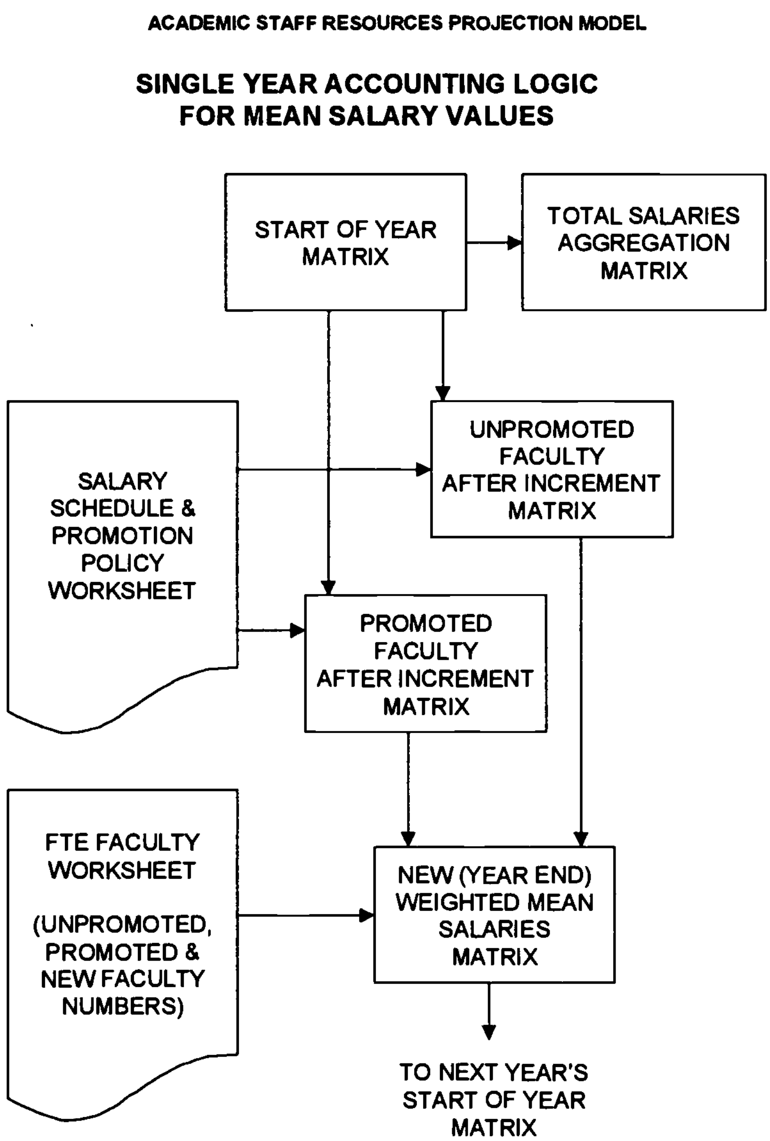
SINGLE YEAR ACCOUNTING LOGIC FOR FTE VALUES



The year end totals are passed to (referenced by) the start of year matrix of the next projected year worksheet. However, note that all faculty have aged by one year and increased their years of service by one year, thus, the cell references must be given a "one cell diagonal shift". For example, the value in the "Assistant / Age 32 / 6 Years of Service" cell must be set equal to the "Assistant / Age 31 / 5 Years of Service" cell of the prior year's worksheet.

Figure 6 shows the accounting logic concerning mean salary and salary aggregations for a single year. The worksheet and its references to the salary schedule worksheet are complex due to the need to determine salary increments for unpromoted FTE as well as promoted FTE, and to make adjustments for salary ceilings (at the University of Calgary) at the lower ranks. The year end matrix values are new weighted mean salary values, computed using the numbers of FTE promoted into the given rank, unpromoted FTE and newly hired FTE. Again, year end values are passed to the start of year matrix of the next projected year worksheet.

Figure 6



3. Applications of the Model

Several scenarios have been explored, or are contemplated, that illustrate the usefulness and applicability of the model:

1. The baseline run of the model indicates that this year's large number of early retirements provides sufficient salary savings to offset or sustain the cost of salary increments for the next few years. The Year 1 "total salaries" figure is 3.5 % lower than the base year. However, the figure will increase in future years.
2. Adjusting the retirement rates for faculty aged 55 – 64 showed the effect of expected "uptakes" of another early retirement incentive program. However, the model indicates relatively few individuals will be in the early retirement age range in the near term. This, in itself, is meaningful information, since there would be little point in offering another program.
3. What are the effects on the rank and age mixes, and on total salaries, if all attrition replacement is at the lower ranks?
4. What is the tradeoff, in terms of total salary cost, of hiring faculty at a salary that is somewhat above, or perhaps significantly above the salary floors, in order to attract higher caliber faculty or to compete with the private sector?
5. Where are the pressure points in the salary system? Are the size of the increments of greater importance than the size of starting salaries?
6. What are the effects of varying the salary schedule (i.e. its rank minima, maxima and increments) in response to collective bargaining negotiations?

Caveats and Cautions

Several caveats and cautions should be mentioned regarding the development of a spreadsheet faculty flow model.

1. Focus a spreadsheet model on one or two faculty characteristics or consider developing more than one model

One should consult with campus decision makers in advance of the model's development and decide on a limited number of issues that need to be explored. A model that contains too many states and too many policy variables may confuse the issues and solutions. More importantly to the construction of a spreadsheet model, when a model allows for too many states and tries to do too much, it can quickly balloon to an unmanageable size and bewildering complexity. It is better to develop a simple model capable of exploring issues related to two or three faculty characteristics, for example, rank and age mix. Whenever an additional characteristic, such as tenure status or gender, is added to the model, the number of states is at least doubled and the size of the workbook file must increase proportionately.

The ASRP model's workbook file is quite large (9 megabytes). Consider building more than one workbook model. For example, perhaps one model might focus on FTE numbers alone, exploring age, attrition, tenure and promotion issues, while a second simplified model, one that ignores age and years of service characteristics, would focus on the salary, increment and promotion structure, and explore salary cost issues. Certain aggregated FTE outputs from the more detailed model could feed in to the simplified salary model.

2. Simplify as much as possible if the issues allow it

Unlike most traditional faculty flow models, the ASRP Model ignores faculty mortality. In part, this was because a sensitivity test showed expected attrition numbers due to death to be small (both the empirical numbers as well as those predicted from provincial mortality rates), and in part because the model construction was much simplified by ignoring mortality.

Hopkins and Massy (1981) suggest that persistence rates tend to be quite stable for faculty with more than ten years of service thus all faculty with ten or more years of service can be lumped together. This simplifies the model by reducing the number of states. There is relatively less faculty mobility today than twenty years ago thus resignations are less common. Also, termination for cause of tenured faculty is rare. Perhaps an argument could be made to ignore resignation and termination attrition. If so, the model does not need the years of service states.

Some models group age into five year groupings and years of service into variable groupings (e.g. 2 to 3 years, 4-6 years, etc.). This serves to reduce the complexity and size of the model by minimizing its number of states. However, a model having greater numbers of states permits a more finely detailed analysis. The particular issues that the model is designed to address may not allow this type of compression. In the case of the ASRP model, it was felt that projecting faculty by discrete ages would more precisely show the turnover effects of the imminent retirements. The tradeoff, of course, is that the workbook file is quite large.

3. Tailor the model to your institution's issues and systems

Each institution has unique systems, policies, and approaches to faculty issues. The structure of an institution's model is dictated by the issues and questions that need to be addressed. The University of Calgary ASRP model is perhaps most appropriate for exploring faculty salary policy in a limited way and in the short term, as well as exploring the very specific issues of retirement attrition and replacement hiring.

The ASRP model can be used for budget planning because it projects salary costs but there are alternative methods of including salary costs in a model. For example, some models described in the literature use a regression equation to compute salaries and total salary costs. In other models, promotion through the ranks is based on years in rank, rather than our approach of triggering promotions based on salary thresholds. A regression approach would seem feasible using spreadsheet software, and perhaps would be simpler.

4. Not all policy variables are policy driven

Not all "policy variables" are, in fact, policy driven. Some are, necessarily, historically or empirically derived inputs, many of them behavioral parameters. For example, it is doubtful that rank promotion rates could be affected by policy change, unless, for example, there was an institutional quota on the numbers or proportion of full professors. One could, of course, vary promotion rates in a "what if" scenario test, but there may be limits on what are realistic questions to pose.

5. Temper empirical data with informed judgement

Empirically derived transition probabilities may need to be modified or tempered by informed judgement if there are artifacts hidden in the historical data, if changes in faculty behavior are anticipated or if trends are observed. As McGuire (1992, p.49) states so succinctly:

> Projections from any faculty flow model are neither fixed nor magical. They simply tell what might happen if recent trends continue with current faculty. Changes in trends and/or in the composition of future faculty can have a tremendous impact on the accuracy of the model's output.

Checking a model's predictions against future trends may serve to validate the model. The causes of discrepancies should be traced in order to correct errors and fine-tune the parameters and probabilities. As the University of Calgary is about to move into the 1997-98 academic year, there are plans to compare actual faculty numbers for the new year with the Year One numbers projected earlier this year that used 1996-97 as the Base Year.

Conclusion

From a number of perspectives, a university's most important resource is the faculty. The faculty perform the core processes of instruction, scholarship and research. At most institutions, faculty salaries are the single biggest operating expenditure item. There is much less faculty mobility between institutions than in the past, and faculty careers tend to be long ones. Thus, institutions must live with expensive mistakes made in faculty hiring for many decades. The efficient and effective use of faculty should be an important part of institutional planning and decision making.

Both the current climate of funding constraints and cutbacks as well as the demographic characteristics of the aging professoriate have created greater incentives for faculty management and planning, and opportunities for faculty and curriculum renewal.

> Anticipated increases in faculty turnover in the years ahead may provide an opportunity for institutions to achieve a higher level of diversity at a faster pace than has been possible for the past 20 years. McGuire (1992, p.50)

Faculty flow modeling, with its ability to track several policy effects at the same time, is an important tool for studying and addressing some of these emerging critical issues. Faculty flow models can aid in understanding the sometimes complicated relationships between personnel policies and faculty demographics.

Using spreadsheet software to construct a simulation model is an important advancement because it overcomes some of the limitations of earlier models. Spreadsheet software is one of several new tools that make institutional researchers less dependent on mainframe programs and processing. Because the model takes less time to develop and refine, it is less expensive than a mainframe application. It is easy to place the model's output information in a format that shows the important variables clearly and concisely. And finally, spreadsheet models are highly interactive, dynamic and immediate, allowing rapid testing of various scenarios involving alternative assumptions about faculty behaviors and policies.

FOOTNOTES

1 Much of the logic of the ASRP model was borrowed from a mainframe model developed in 1980 by Mr. William Caims, Director of Budget and Statistics, the University of Alberta.

2 The base year matrices were initialized with headcount faculty numbers and mean salary values derived from the current year faculty data set. The SPSS Means function was used to calculate salary means broken down by rank, by age and by years of service.

3 For easier visual verification of the correctness of cell formulae, the worksheet matrices should be placed beside one another. In addition, FTE and mean salary matrices should occupy the same rows of their respective worksheets (e.g. FTE values for Assistant rank/Age 21 always occupy row 8 and mean salary values for Assistant rank/Age 21 always occupy row 8). This permits easier verification because, by following this practice, cell formula references to other matrices will, most often, reference cells in the same row, and one can see at a glance whether row references are identical.

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ACADEMIC STAFF RESOURCES PROJECTION MODEL

POLICY VARIABLES WORKSHEET

1. ATTRITION REPLACEMENT RATES

That is replaced in rank:	Proportion of attrition in rank: ASST	ASSOC	FULL
ASST	1.00	0.71	0.76
ASSOC	0.00	0.29	0.05
FULL	0.00	0.00	0.19
TOTAL	1.00	1.00	1.00

(BASELINE values shown here were derived from historical data for four years 1992/93 through 1995/96)

Total attrition is replaced at a percentage rate of: 100.0

2. HIRING ADJUSTMENT

Numbers of additional staff hired after attrition replacement (or, if negative, attrition numbers not replaced) for each year of projection:

ASST	0.0
ASSOC	0.0
FULL	0.0
TOTAL	0.0

(Assume no contraction or expansion)

3. STARTING SALARIES OF NEW APPOINTMENTS

ASST	$46,831
ASSOC	$62,351
FULL	$88,667

(derived from historical data for 1992/93 to 1995/96)

4. ESTIMATED RETIREMENT RATES BY AGE (BEYOND 1996/97) *

Age	Rate	Age	Rate
< 55	0.00	63	0.10
55	0.05	64	0.10
56	0.05	65	1.00
57	0.05	66	1.00
58	0.05	67	1.00
59	0.05	68	1.00
60	0.10	69	1.00
61	0.10	70	1.00
62	0.10		

* Actual committed retirements used for 1996/97

5. RESIGNATION / TERMINATION RATES BY YEARS OF SERVICE

Years of Service	Resignation Rate
< 1 Year	0.035
1 Year	0.074
2 Years	0.065
3 Years	0.054
4 Years	0.079
5 - 9 Years	0.022
10 or More	0.009

Derived from data for four years 1992/93 to 1995/96 for teaching faculties excluding Medicine.

ACADEMIC STAFF RESOURCES PROJECTION MODEL

1996/97 (BASE YEAR) SALARY SCHEDULE

For Non-Medical Teaching Staff

SALARY SCHEDULE						PROMOTION POLICY		
						Promotions begin at:		
Rank	Level	Minimum	Maximum	Step Increment	Number of Steps	Step #	Salary	Proportion Promoted
ASST		0	40,237	0				
	1	40,238	57,266	1,419	12	7	50,171	.57
ASSOC		0	45,085	0				
	1	45,086	66,890	1,817	12	11	65,073	.11
	2	66,890	73,253	909	7			
FULL		0	58,470	0				
	1	58,471	72,737	2,038	7	N/A	N/A	N/A
	2	72,737	84,868	1,733	7			
	3	84,868	999,999	1,529	99			

Currently, there is no ceiling on full professor salaries and increments have no explicit merit component.

ACADEMIC STAFF RESOURCES PROJECTION MODEL

PROPORTIONAL DISTRIBUTION OF NEW APPOINTMENTS BY AGE

Age	N	Proportion	Age	N	Proportion
21	0	0.0015	49	1	0.0148
22	0	0.0015	50	2	0.0148
23	1	0.0015	51	1	0.0044
24	0	0.0015	52	0	0.0044
25	0	0.0015	53	0	0.0044
26	0	0.0415	54	2	0.0044
27	6	0.0415	55	0	0.0044
28	5	0.0415	56	0	0.0028
29	9	0.0415	57	0	0.0028
30	8	0.0415	58	0	0.0028
31	9	0.0607	59	1	0.0028
32	9	0.0607	60	0	0.0028
33	13	0.0608	61	1	0.0028
34	5	0.0607	62	0	0.0028
35	5	0.0607	63	1	0.0028
36	5	0.0430	64	0	0.0000
37	6	0.0430	65	0	0.0000
38	8	0.0430	66	0	0.0000
39	8	0.0430	67	0	0.0000
40	2	0.0430	68	0	0.0000
41	4	0.0296	69	0	0.0000
42	8	0.0296	70	0	0.0000
43	2	0.0296	71	0	0.0000
44	2	0.0296	72	0	0.0000
45	4	0.0296	73	0	0.0000
46	4	0.0148	74	0	0.0000
47	2	0.0148	75	0	0.0000
48	1	0.0148			
			Total	135	1.0000

Derived from analysis of numbers of academic staff (N) hired in teaching faculties (excluding Medicine) over four year period 1992/93 to 1995/96.

For proportions, data smoothing was performed by aggregating and averaging new appointments in five year age intervals.

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