Long-Term and Transient Pay Scale for College Faculty

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Introduction

Our assignment was to design a salary system for the college's faculty without cost of living increases, then incorporate cost-of-living increases, and finally design a transition model to move all current faculty towards our model. We decided that one of the most important issues to consider was the quality of education at the college. Hence, we established a model to push faculty to work toward promotion or else their raise possibilities are minimized. This should raise faculty incentive and increase publications, research, and instruction, which will raise the overall quality of education at Aluacha Balaclava.

The equation for our model without regard to rank is

$$P_x = P_1 + m\left(1 - e^{-k(x-1)}\right).$$

This model satisfies the given criteria and also leaves room for variations.

To incorporate cost-of-living increases into our model, we use the Consumer Price Index, a national measure of inflation.

For the transition, we take a faculty member's current salary and years in current rank and determine a salary curve that starts at that point and follows our model in the best possible way. We tested the transition model as well as possible with insufficient data by modeling salaries for fictional faculty. Results show that the transition model moves all faculty from their current salaries toward our desired system.

Assumptions

- In the data, number of years of service means years of teaching at that institution, not overall career and not teaching at that rank. However,

Table 1.
List of variables.

Variable	Meaning
CPI_{x-1}	cost of living factor from the previous year
F_{required}	funds needed to give all faculty their full raise
F_x	available funds for raises in the xth year
k	decay constant
m	multiplicative factor
P_1	entry-level salary at a given rank
P_x	salary in the xth year
P'	salary the year before the transition plan begins
x	years in rank
x'	years at a given rank when the transition plan begins

many equations throughout our model make use of the variable x', which is the number of years that a faculty member has been at his or her current rank. This information was not given to us, so it will be the responsibility of the Provost to obtain it.

- Each rank should have a minimum base salary and a maximum base salary for newly hired faculty. We also presumed that some faculty with Ph.D.s could be hired above the assistant professor level, based on experience.
- The minimum time for an instructor to complete the Ph.D. degree and be promoted is approximately two years, and there is a four-year minimum of service at the assistant professor level before promotion to associate professor.
- A "normal raise," in reference to our requirement of promotion benefit being equivalent to seven years of raises, could be determined approximately by the average raise for the first twenty years, $(P_{21} - P_1)/20$.
- A decaying exponential curve gives a good basis for the model.

Motivation for the Model

We choose a decaying exponential model for a number of reasons.

- It allows for considerable raises at the beginning of a rank, but as time passes, the raises decrease. We think that this is important because it gives faculty the incentive to work toward promotion by contributing to the college through research, publications, or excellence in teaching. Without being promoted after a certain amount of time, their salary will top out at a value that reflects their rank. Not only would promotion offer a raise, but it would also result in higher future raises.

- By decreasing the multiplicative factor while at the same time increasing the starting salary, we establish a model that causes salaries in the same rank to grow closer over time, as required.

The motivation behind choosing the decay constant is the number of years of experience that we want the faculty to have before the exponential term begins to level off and salary raises decrease dramatically from one year to the next. For each rank, we decide on the the number of years for which a faculty member at that rank would receive 50% of his or her total raises at that rank and solve for the decay constant k:

$$0.5 = 1 - e^{-k(x-1)}.$$

We want an instructor to receive 50% of his or her raises after seven years in an attempt to motivate the instructor to work for promotion. If a promotion does not occur, raises decrease more rapidly.

For assistant and associate professors, we want this time to be longer, because they are less likely to be promoted. It takes a couple of years longer than an instructor to receive about 50% of their raises—by their tenth year of service at that rank.

For a full professor, because there is no possibility for promotion, this amount of time should be even longer. A full professor will receive about 50% of his or her raises by his or her twelfth year in rank.

In choosing the high and low salaries for the first year, we took into consideration a number of things. We averaged the current salaries of faculty, getting $31,919, $35,908, $44,286, and $54,228 for the ranks in ascending order. We set our base salaries taking these averages into consideration so that new faculty would be paid reasonably. We also took into consideration the statistics from the May 1994 *Occupational Outlook Handbook* [U.S. Department of Labor, Bureau of Statistics, 1994], which gives national average salaries as $27,700, $36,800, $44,100, and $59,500.

Another source that we took into account was the the *Statistical Abstract of the United States: 1994* [U.S. Dept. of Labor, Bureau of the Census, 1994], which lists average beginning salaries offered to candidates according to their degree level and their field of concentration. By taking all of these statistics into account, we attempt to establish a fair window for entry-level salaries for all ranks and a top salary at each rank below full professor (see **Table 2**).

The reason that we have a different model for full professors is that we think that there should not be a maximum salary for them because they have no possibility for promotion; if we kept the same type of model, there would be a ceiling. So, although the salaries of full professors at the minimum and the maximum bases for full professors do not tend toward each other together as quickly as with the other ranks, they do get slightly closer over time.

Table 2.
Entry-level base salaries and top salaries.

Rank	Minimum base	Maximum base	Top salary
Instructor	27,000	37,000	42,000
Assistant Professor	32,000	47,000	52,000
Associate Professor	37,000	52,000	62,000
Full Professor	47,000	62,000	—

To determine the raise for promotion from one rank to another, we looked at the time to promotion and the maximum and minimum entry levels at the next rank. If a faculty member is promoted on time, he or she should get a raise equivalent to seven years' worth of normal raises (according to the problem statement). We chose \$3,500 as a raise for a promotion achieved on time. This is a compromise between the calculations we made for normal raises over seven years, which were between \$2,000 and \$5,000, depending on the entry-level salary for the next rank. We chose \$,3500 because that amount keeps faculty receiving promotions within the entry-level salary range of the next rank and is in between the high and low normal raises over seven years.

Another issue is how to allocate available funds. The first thing to consider is how much would be required to give everyone the raise that coincides with his or her salary-scale curve. If the required amount is available, then each faculty member is given his or her expected raise. If the required amount is not available, then each faculty member is given a proportion of his or her raise. If an excess is available, and if all faculty members are where they should be on the curve according to entry salary and the number of years at that level, then the excess is held over until the next year.

The Model

Once the starting salary has been established, our model gives a salary curve for the faculty member to follow, as shown in **Table 3**. See **Figure 1** for maximum and minimum salary curves in each rank and how they converge. We also present a salary schedule for minimum and maximum salary according to year and rank. [EDITOR'S NOTE: We omit the detailed salary schedule.]

What If There Isn't Enough Money?

When determining the amount of the raise, it is necessary to take into consideration the available funds for the year vs. the amount that it would

Table 3.
Salary curves.

Rank	Curve without inflation
Instructor:	$P_1 + (42,000 - P_1)\left(1 - e^{-0.10(x-1)}\right)$
Assistant Professor:	$P_1 + (52,000 - P_1)\left(1 - e^{-0.08(x-1)}\right)$
Associate Professor:	$P_1 + (62,000 - P_1)\left(1 - e^{-0.08(x-1)}\right)$
Full Professor:	$P_1 + \left[10,000 \times \frac{62,000 - P_1}{15,000}\right]\left(1 - e^{-0.07(x-1)}\right)$

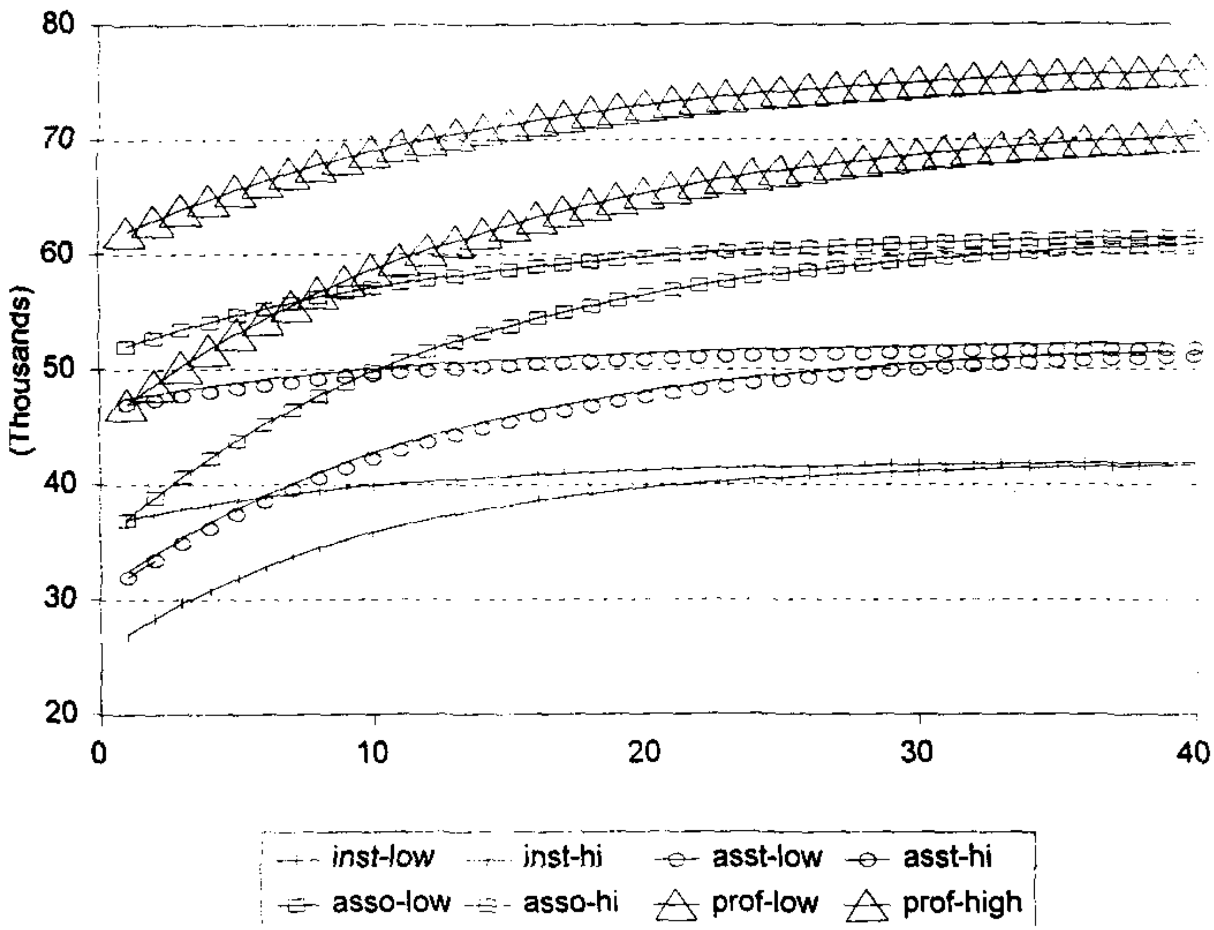

Figure 1. Maximum and minimum salary curves for each rank.

cost to give everyone the raise according to his or her curve. If the amount required exceeds funds available, then the raise for each faculty member will be determined in the following manner.

For each faculty member, divide the expected raise by the total of expected raises and multiply this fraction by the available funds. An exception: If the available amount is less than 10% of the required amount, then no raises are given and the funds are held over until the next year. (This ensures that only substantial raises will be given, i.e., no one will receive a \$0.40 raise.) We multiply each of the formulas in **Table 3** by

$$\frac{(P_x - P_{x-1})F_x}{F_{\text{required}}}.$$

If adequate funds are not available in a certain year, then everyone will be below their salary curve. The following year, the way to determine who gets what percentage of the available funds is again to use the formulas to proportionate.

A faculty member who receives a promotion will jump to the equation for the next rank. The entry-level salary at the new rank will be previous salary plus a raise of:

- \$3,500, if promoted in the least amount of time (i.e., two years for instructor to assistant professor, four years for assistant professor to associate professor, and seven years for associate professor to full professor);
- \$2,500, if promoted within five years of the minimum number of years;
- \$1,000, if promoted any time later.

Cost of Living

The model is the same as the previous model with salaries multiplied by a factor that takes cost of living into consideration. We chose the Consumer Price Index (CPI) because it is gives an all-encompassing measure of the percentage increase of goods and services in the U.S. We use the CPI from the previous year to determine the rise in cost of living for the current year. Many other indices can be inaccurate because they are based on projections of what is expected to happen in the future. We multiply each of the formulas in **Table 3** by $(1 + \text{CPI}_{x-1})$.

Transition

The transition model takes a current faculty member and finds a salary curve that fits our model while considering current salary and years in their rank. For each rank, current salary and years in rank will fall

- above our maximum salary curve for that rank,
- below the minimum curve, or
- between the curves.

We consider each possibility for each rank.

Above the Maximum Salary Curve

We cannot fit faculty who currently are above the maximum salary curve for their rank into our salary range, because we cannot cut their salary. Because we have to allow them to receive raises but do not want them to receive very large ones, we let them increase at only the same rate as the maximum salary curve for their rank. To find their salary curve, we need to project backwards to determine a corresponding P_1. We use the formulas in **Table 3**, substituting P' (salary the year before the transition begins) for P_x and x' (number of years at a given rank when the transition begins) for x.

Below the Minimum Salary Curve

For those who fall below the minimum salary curve for their rank, we increase their salaries so that over a five-year period they move into the salary range for their years at that rank. Our model for this transition calculates what the faculty member's salary should be in five years to fit the minimum salary curve, then divides the difference into five equal increments, for an equal raise each year.

We have

$$P_x = P' + (x - x')\,\frac{P_1 + m\left(1 - e^{-k(x'+4)}\right) - P'}{5}.$$

This equation is used for only five years after the implementation of our model. At the end of this five-year period, all faculty originally falling below the minimum salary curves will be caught up to these minimums, and their salaries will follow the minimum curve from then on.

Between the Two Curves

If a faculty member's current year in rank and salary fall between our maximum and minimum salary curves, we implement our original model. For each rank, we can find the curve that fits our model and passes through the faculty member's current point. To do this, we just project backwards to find the value of P_1 for such a curve, then substitute into the appropriate formula.

Testing the Model

As a preliminary test of our model, we developed tables of salaries for the minimum and maximum entry salaries for each rank based on the number of years at that rank. These tables were the basis for **Figure 1**.

Since we do not know years in rank for actual faculty members in the given data, we could not examine how their salaries would change under the transition model (which would be ideal). Instead, we generated several random contrived faculty members in each rank who are above the maximum salary curve, below the minimum salary curve, or between the two curves. We modeled the curves for these fictitious faculty and observed good transition from current salaries to our model.

For further analysis, we could also test if the model financially coincides with the capabilities of the college. If not, then the model could be scaled down by lowering the entry salaries or by increasing the decay constant.

Strengths and Weaknesses

The most successful way to improve an institution's prestige and quality of their degrees is to improve the quality of the faculty at the institution. This is one of the most important strengths in our model. We have attempted to improve the quality of the faculty at Aluacha Balaclava College by creating a large window for entry salaries, pushing faculty toward promotion, and setting salaries comparable to the national averages.

Our window of entry has established a very wide range of salaries for prospective faculty. This gives Aluacha Balaclava College the opportunity to hire the best available faculty. In turn, these new faculty will boost the quality of teaching and raise the overall rating of the college. At the same time, our minimum entry salary helps keep the faculty salary budget down by not overpaying existing faculty who meet only average criteria.

This window of entry salary may also be a weakness, because it will not allow the college to bring in more-prestigious instructors who expect a higher salary than the scale allows. We compensate with an "extraordinary circumstances" clause. When a faculty member does enter at a salary above what our maximum curve allows for, he or she will follow a salary scale equivalent to that of an existing faculty member who is making more than our curve allows during transition.

The strength of the transition phase is that it brings current faculty up to a fair salary in a relatively short amount of time (five years). The shortness of the transition period should help alleviate any animosity among current faculty that has been caused by their salaries and resulted in the departure of the previous Provost. The shortness, however, may also produce a financial crunch on the college, which is a weakness. A longer transition period would lengthen the transition period and lessen the financial burdens in the first five years.

Our model does not take economic deflation into consideration. Although deflation rarely occurs in the U.S., if it does, we do not want to give the faculty a salary cut. Instead, we use an inflation multiplier of 1 instead of $(1 + \mathrm{CPI}_{x-1})$. The CPI factor also poses another weakness because it is a national and not local average of cost-of-living increase. If there is an index available that estimates the cost-of-living increase in the surrounding area of Aluacha Balaclava College, then perhaps it would be a more accurate estimation of inflation. Another weakness is that by using the previous year for reference, there is a lag in cost-of-living adjustments.

References

U.S. Department of Labor, Bureau of the Census. 1994. *Statistical Abstract of the United States: 1994.* 114th ed. Washington, DC: U.S. Government Printing Office.

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