

A Case Study — An Analysis of University Faculty Salaries

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Abstract

A model study of salary differences between 9-month and 12-month appointments, colleges, ranks and sex. Detail description presented of statistical tools used, and also the results. It indicates certain inequities that administrators and faculty should investigate.

Overall performance of faculty members can be influenced by their attitudes. One factor that can affect attitudes is seeming inequitable treatment with respect to salaries. Faculty members on full year appointments often believe they are underpaid for the required working days relative to those who are on academic year appointments. Female faculty members also are concerned about their salaries with respect to their male counterparts. Equity of salaries for teachers of similar rank, but in different colleges, is another question that is frequently raised.

This report addresses the above salary questions by presenting results of an in-depth study of faculty salaries at the University of Wyoming. The primary objective of the study was to determine if salary disparities existed between faculty members in different colleges, with different types of contractual arrangements and of differing sex.

Even though the data analyzed in this study are unique to the University of Wyoming, the problem of salary disparities is widespread among land grant universities [5 and 6]. One purpose of this research effort, including the techniques, is to encourage similar studies at other universities. Without detailed studies, action taken to correct salary inequities will likely remain passive.

The University of Wyoming, a land-grant university, is the only, 4-year institution of higher education in the state. On-campus teaching is conducted through seven academic colleges, Arts and Sciences (A&S), Agriculture (Agric.), Engineering (Eng.), Education (Educ.), Law, Commerce and Industry (C&I), and Health Sciences (H. Sci.). Off-campus teaching activities are conducted by

Adult Education (Ad. Ed.) and the Agricultural Extension Service (A.E.S.).

Contractual arrangements with the faculty are of two types or terms: (1) 9-month, and (2) 12-month.¹ The characteristics of these terms of appointment are indicated below.

	Contractual Obligation	
	9-Month	12-Month
Months	9	12
Total days excluding weekends	201	261
Administrative holidays	11	11
Academic holidays	19	0
Vacation days	0	20
Actual working days	171	230

Total days, excluding weekends within the appointment terms, were 201 for the 9-month and 261 for the 12-month. People on both types of appointment are entitled to administrative holidays, which are primarily the major national holidays. Faculty on 9-month appointments are also entitled to vacation during academic holidays, which are those days within the term of the school year when school is not in session. Those on 12-month appointments receive 20 days paid vacation per year. Actual working days in 1973 were 171 and 230 for the 9-month and 12-month personnel respectively.

Procedure

Simple comparisons were made among average salaries of individuals categorized by college, rank, sex and 9- or 12-month appointment, and for various combinations of these categories. Nine-month and 12-month salaries were adjusted to put them on an equivalent base for comparison. Some 9-month faculty receive additional pay for teaching summer sessions and/or summer research. The 9-month contractual salary plus the summer pay was compared to the contractual salary for 12-month personnel. Also, 12-month salaries were converted to a 9-month equivalent by using the factor 171/230, which is based on actual work-days.² These adjusted salaries were then compared to the mean contractual salaries of the 9-month faculty members.

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¹ The University of Wyoming administration uses 9- and 11-month terminology to distinguish between contractual arrangements, since 12-month agreements include 1 month vacation.

² The factor 171/230 is approximately equal to 9/12 which is the ratio of months in the two types of contractual agreements.

Analysis of variance (ANOV) was also used to ascertain if variations in salary due to college, rank, degree, sex and term of appointment were statistically significant. If ANOV indicated variation in the above classifications, Duncan's Multiple Range test was performed to discover where the variation in each category occurred.

Data

The analyses in this study were based on contractual salaries for the 1973-74 academic year for 9-month personnel and 1974 fiscal year for 12-month personnel. The 1974 fiscal year is comparable to the 1973-74 academic year which, except for summer session, is contained within the fiscal year. Summer salaries were obtained for the 1973 summer session. Therefore, the total salary for 9-month people is not wholly for the 1974 fiscal year. Years in service and years in rank were calculated from data published in the University of Wyoming General Catalog [4].

Administrators, which includes deans, assistant deans, associate deans, and department heads were excluded from the analyses as were the few lectures. The salaries for specialists in A.E.S. were included in the College of Agriculture, since that is where they hold academic rank. The remaining faculty of A.E.S. were considered to be administrators; consequently, A.E.S. does not appear as a separate college in the analyses.

Comparisons Among Average Salaries

The average 9-month faculty contractual salary at the University of Wyoming for the 1973-74 academic year was \$14,305. Average total contractual plus summer salary for these individuals (including those who received no summer salary) was \$15,665, compared with \$16,938 for the 12-month faculty. These averages are highly aggregated; consequently, they are not particularly revealing. Therefore, the data were disaggregated into the categories specified above.

It is not obvious from the results presented in Table 1 that salary disparities exist between 9-month and 12-month faculty within the same college. Thus, it appears that within a specific college, efforts have been made to keep inequities between 9- and 12-month salaries to a minimum.

Salary disparities among colleges are quite noticeable. The average salary for 9-month full professors in C&I is \$19,482 compared to \$14,654 which is the adjusted average salary for 12-month full professors in Agriculture (Table 1). A comparison of 9-month full professors with summer income with full professors in Agriculture on 12-month contract reveals that full professors in Agriculture earn \$1,900 to \$6,000 less than their 9-month counterparts in other colleges.

Associate professors in Agriculture working on 12-month status receive less on the average than associate professors in C&I and about the same as associates in Engineering who work for 9 months (Table 1). When the

Table 1 The 1973-74 Average Contractual Salary, Total Income and Adjusted Salary by Appointment and College for Full, Associate, Assistant Professors and Instructors

Appointment and College	Full Professors			Associate Professors			Assistant Professors			Instructors		
	9-month basis ¹ No.	Salary	Total Salary ² No. Salary	9-month basis ¹ No.	Salary	Total Salary ² No. Salary	9-Month basis ¹ No.	Salary	Total Salary ² No. Salary	9-month basis ¹ No.	Salary	Total Salary ² No. Salary
9-month appointment												
A & S	57	\$18,877	37 \$21,661	77	\$15,341	49 \$18,011	101	\$12,483	48 \$14,680	20	\$9,645	5 \$11,252
Agric.	-	-	-	-	-	-	5	12,065	2 13,764	3	9,864	-
Eng.	10	19,867	5 24,071	19	16,224	9 18,414	11	13,905	7 17,054	2	7,916	1 D
Educ.	9	17,615	8 21,607	19	15,016	15 17,851	27	12,459	17 14,176	34	10,014	10 11,813
Law	3	21,456	3 25,611	3	15,992	2 17,792	4	13,347	3 15,746	-	-	-
C & I	10	19,482	5 22,972	9	16,776	8 20,505	11	15,118	7 17,529	10	13,786	3 16,822
H. Sei	2	16,068	-	5	14,710	4 16,608	8	12,842	6 14,822	10	10,361	4 12,667
Adult Ed.	-	-	-	-	-	-	3	12,147	1 D	3	10,896	-
12-month appointment												
Agric.	33	14,654	33 19,710	20	12,087	20 16,256	24	11,287	24 15,818	7	8,854	7 11,909
Eng.	-	-	-	3	16,384	3 22,36	2	12,535	2 16,860	-	-	-
Educ.	-	-	-	-	-	-	2	12,268	2 16,500	2	11,376	2 15,300
C & I	-	-	-	3	16,152	3 21,724	2	15,025	2 20,208	-	-	-
H. Sei	-	-	-	3	13,014	3 17,504	-	-	-	3	7,786	3 10,472
Adult Ed.	-	-	-	-	-	-	6	12,186	6 16,390	5	9,918	5 13,339

¹ Regular 9-month contractual salary for people employed on that basis, or adjusted from 12-month to 9-month basis for those on 12-month contracts.

² 9-month contract plus summer teaching and/or research or regular 12-month contractual salary for 12-month employees. Only those 9-month faculty receiving summer income are included and many of these might be employed full-time during the summer months.

D Information withheld due to non-disclosure practice.

table 2 1973-74 Average Contractual Salary Increases for Full, Associate, Assistant Professors and Instructors by Appointment and College.

Appointment and College	Full Professor		Associate Professor		Assistant Professor		Instructors	
	No.	Increase	No.	\$ Increase	No.	1 Increase	No.	\$ Increase
9-month appointment								
A & S	56	771	71	869	74	724	10	469
Agric.	--	--	--	--	5	785	2	216
Eng.	10	506	19	668	10	715	2	2,150
Educ.	9	616	19	676	20	529	22	628
Law	3	680	1	D	3	1,048	--	--
C & I	8	782	9	844	9	880	2	414
H. Sci.	--	--	5	904	7	679	7	504
Adult Ed.	--	--	--	--	1	D	2	570
Weighted Ave. 1	--	722	--	808	--	771	--	611
12-month appointment								
Agric.	33	763	20	764	23	663	5	434
Eng.	1	D	3	1,400	2	750	--	--
Educ.	--	--	--	--	2	1,200	1	D
C & I	1	D	3	820	2	1,008	1	D
Adult Ed.	--	--	3	1,088	4	573	5	794
Weighted Ave. 1	--	763	--	869	--	922	--	614

¹ Based on figures in table only, i.e., does not include those categories where only one individual appears.

^D Information withheld due to non-disclosure practice.

average 12-month salary for associate professors in the College of Agriculture is placed on a 9-month equivalent basis, it is over \$2,500 lower than the lowest 9-month contractual salary in other colleges.

Disparities are also evident for assistant professors. For example, the average 9-month salary for assistant professors in Engineering is \$13,905 as compared to the average salary for the same rank and type of appointment

in C&I of \$15,118 (Table 1). Other salary inequities among colleges are evident in Table 1.

Average contractual salary increases by college, rank and 9- or 12-month status for the 1973-74 academic year are shown in Table 2. There does not appear to be a great difference between average salary increases for 9- or 12-month appointments. If this relationship for salary increases existed in previous years, over time, the percentage difference between 9- and 12-month salaries would tend to decrease. Data presented in Table 2 also indicate that there is a disparity among colleges with respect to salary increases. On the average, assistant professors in Adult Education and Agriculture on a 12-month appointment received lower salary increases than assistant professors on a 9-month appointment in most other colleges.

Average salary, years in service, and years in rank by sex for each rank within the university are shown in Table 3. Males have a higher average salary than females in all ranks. Females have more years in service in all ranks except instructor when compared to males. Also, excluding the instructor level, females tend to spend a longer time in the lower ranks than do males.

It could be argued that salary disparities among colleges and with respect to sex might be attributable to merit, degree held, and other factors. For the most part, it is impossible to separate out the variance in salary due to these "other factors." It is possible, however, to review salaries by degree held. Since most university faculty have obtained the doctorate degree, salaries are broken down by college, 9- or 12-month appointment and rank for individuals with a doctorate degree. The results are presented in Tables 4 and 5. The data in these tables support the results previously presented. There appear to be

Table 3 1973-74 Average Contractual Salary, Average Years in Service and in Rank by Sex for Each Rank.

Sex and Rank	No.	Salary	Years Service	Years Rank
Male				
Professors				
Full	119	\$19,309	17.82	9.55
Associate	148	15,974	7.76	4.96
Assistant	181	13,455	4.21	3.43
Instructor	61	11,488	3.31	3.21
Female				
Professors				
Full	7	\$17,589	23.00	10.43
Associate	15	14,954	11.07	5.67
Assistant	27	12,272	6.48	4.74
Instructor	39	9,792	3.12	2.77

Table 4 Average Contractual Salary for Individuals with a Doctorate by Rank for Each Sex.

Rank	Female		Male	
	No.	Avg. Salary	No.	Avg. Salary
Full Professor	5	\$18,197	107	\$19,431
Associate Professor	7	15,057	133	16,049
Assistant Professor	14	12,333	147	13,373

Table 5 Average Contractual Salary for Individuals with a Doctorate by Appointment, Rank and College.

Term and College	Full Professors		Associate Professors		Assistant Professors	
	No.	Salary	No.	Salary	No.	Salary
9-Month Appointment						
A&S	50	\$19,149	71	\$15,409	83	\$12,487
Agric.	-	-	-	-	2	12,510
Eng.	7	20,203	14	16,911	11	13,904
Educ.	9	17,615	17	15,031	20	12,539
Law	2	21,732	1	D	-	-
C&I	10	19,482	8	16,803	9	15,015
H. Sci.	-	-	1	D	7	12,902
Adult Ed.	-	-	-	-	2	12,190
12-Month Appointment 1						
Agric.	33	14,585	20	12,029	16	11,202
Eng.	-	-	2	16,353	2	12,476
Educ.	-	-	-	-	2	12,210
C&I	1	D	3	16,076	2	14,954
Adult Ed.	-	-	3	12,953	3	11,473

¹ 12-month average salaries are adjusted to a 9-month equivalent.

disparities in salaries among colleges, between individuals on 9- and 12-month appointments and between sexes.

Another issue which is of interest, although not directly related to the question of salary disparities is the time it takes to be promoted in the various colleges. Differences in academic degree held can have a bearing on time required to obtain promotions. An estimate of the average time required to achieve the associate or full professorship for people with Ph.D's is given by the difference between years in service and years in rank (Table 6).

Table 6 Difference in Years in Service and Years in Rank for Full and Associate Professors with Doctorate Degree by Collège. 1

Rank and College	No.	Years Service	Years Rank	Difference
Full Professors				
A&S	50	18.58	10.38	8.20
Agric.	33	18.27	8.24	10.03
Eng.	7	15.43	9.86	6.43
Educ.	9	23.22	12.56	10.66
Law	2	16.00	13.50	2.50
C&E	11	11.63	6.63	5.00
Associate Professors				
A&S	71	7.24	4.53	2.71
Agric.	20	9.20	5.50	3.70
Eng.	16	6.88	4.18	2.70
Educ.	17	7.47	5.47	2.00
C&I	11	7.73	5.36	1.37
Ad. Ed.	3	10.33	6.33	4.00

¹ Information for some colleges withheld due to nondisclosure practice.

In Agriculture, the average full professor required 10.03 years to achieve that rank compared with 8.20 years, 6.43 years, 10.66 years, and 5.00 years for the average full professor in Arts and Sciences, Engineering, Education, and Commerce and Industry, respectively. Differences are also indicated at the associate professor rank. It should be noted that these figures could be biased somewhat by those faculty hired at the full associate professor level. However, the disparities are so great that this factor is unlikely to have been the sole cause.

Results of Variance Analysis

A review of the previous data leads one to hypothesize that factors such as college, rank, and 9- or 12-month status are important contributors to salary variations. Analysis of variance and covariance are tools which can be used to test this hypothesis. The model used for the analysis is of the following form:

$$Y_{ijklmn} = \alpha + C_i + R_j + D_k + M_1 + S_m + C_iM_1 + R_jM_1 + b_1T_{ijklmn} + b_2X_{ijklmn}$$

Where:

Y_{ijklmn} = the n^{th} observation in the m^{th} (sex) class, in the 1^{th} M (month basis) class, in the k^{th} D (degree) class, in the j^{th} R (rank) class and in the i^{th} C (college) class.

α = the population mean when equal frequencies exist in all subclasses and $X_{ijklmn} = T_{ijklmn} = 0$.

C_i = effect of the i^{th} academic college $i = 1, \dots, 8$.

R_j = effect of the j^{th} rank $j = 1, \dots, 4$.

D_k = effect of the k^{th} degree $k = 1, \dots, 4$.

M_1 = effect of the 1^{th} monthly basis, i.e., 9 or 12.

S_m = effect of the m^{th} sex (male or female).

C_iM_1 = effect of interaction between C_i and M_1 .

R_jM_1 = effect of interaction between R_j and M_1 .

b_1 = partial regression for Y_{ijklmn} on T_{ijklmn} .

T_{ijklmn} = an independent continuous variable for years in rank.

b_2 = partial regression for Y_{ijklmn} on X_{ijklmn} .

X_{ijklmn} = an independent continuous variable for years service.

Table 7 Analysis of Covariance for 1973-74 Contractual Salaries.

Factor	Degrees of Freedom	Sum of Squares	Mean Figures	F Ratio
College	7	221,150,000	31,592,000	11.16*
Rank	3	1,097,000,000	365,680,000	129.20*
Degree	3	20,465,000	6,821,500	2.41*
9- or 12-Mo. Appointment	1	134,300,000	134,300,000	47.45*
Sex	1	25,978,000	25,978,000	9.18*
College x 9- or 12-Mo. Appt.	7	77,069,000	11,010,000	3.89*
Rank x 9- or 12-Mo. Appt.	3	21,025,000	7,008,500	2.48*
Regression T 1	1	35,408,000	35,408,000	12.51*
Regression X 1/	1	76,069,000	76,069,000	26.88*
Error	569	1,610,400,000	2,830,300	

¹ T = total years in service and X = years in rank.
 * Significant at the .025 probability level.

The model requires analysis of variance with unequal and disproportionate subclass numbers and continuous variables [1]. The data were analyzed by a computer program designed for this type of problem [2].

The results of the covariance analysis presented in Table 7 indicate which factors help explain variation in the salaries. The college factor has an F ratio of 11.16 which is highly significant ($P < .025$), which means that the evidence is strong that average salaries among colleges are not equal, but does not indicate which college means are different from one another. 3/

All factors analyzed had F ratios that are significant at acceptable probability levels. Some of the results are not surprising. For example, one would expect results that indicate that the average salary is not the same for various ranks, degrees, and 9- or 12-month appointments. The analysis also suggests that female salaries are significantly lower than male salaries.

The interaction term, college x type of appointment, suggests that the differences in salaries, when averaged over all ranks, degrees and sex, between 9- or 12-month appointments are not the same for the eight colleges. Also, the differences among salaries between the eight colleges are not the same for 9 as for 12-month appointments when averaged over the other factors. This result is probably not too important since the great disparity between colleges in numbers of 9 and 12-month appointments may be the main reason the interaction was significant.

Interaction between rank and appointment type was also significant. The interpretation would be the same as above except substitute the words "four ranks" for "eight colleges" and college for ranks. This latter interaction suggests that differences between 9- and 12-month appointments were not uniform over all ranks, a result somewhat more surprising than the previous interaction.

It seemed logical to include other interaction terms such as sex and college in the model. The C&I college, however, had no female faculty members, which left some of the cells empty and did not permit calculation of such an interaction. Other interactions were not included either due to zero observations or due to their illogical nature.

The "error" row in the preceding table shows the amount of variation "left over" of not explained by the factors included in the analysis. The fact that it is large is not unexpected. There should be variations in salaries due to such things as merit that would not be explained by the factors in the model.

Duncan's Multiple Range test [1, 3] was performed to determine which means in each factor were significantly different (Table 8). The least square mean salaries shown in Table 8 are the salaries which would exist in each college if there were equal numbers of observations in all categories and if all salaries were adjusted for the effects of years in service and years in rank. These means are thus distinctly different from the arithmetic means discussed previously.

Table 8 Least Square Mean Contractual Salaries Adjusted for Time in Service and Years in Rank. 1/

Factor	Contractual Salary (\$)
Overall mean	\$15,527
College	
C&I	17,872
Eng.	16,760
Law	15,963
Educ.	15,543
Ad. Ed.	15,085
A&S	14,645
Agric.	14,377
H. Sci.	13,973
Rank	
Full professor	19,606
Associate professor	16,258
Assistant professor	14,185
Instructor	12,060
Degree	
Ph.D.	16,062
M.S.	15,571
Special	15,473
B.S.	15,003
Month Appointment	
12	16,895
9	14,159
Sex	
Male	15,878
Female	15,176

^{1/} Salaries embraced by a common line are not significantly different at the .05 probability level.

It is interesting to note that there are few of the relationships that were not significantly different from one another. For rank, degree and type of appointment.

significant differences are what one would expect. One might question whether significant differences in salaries between most colleges and between sexes should exist.

The fact that 12-month least square mean salaries are significantly higher than 9-month least square mean salaries does **not** mean that all is well in the relationship between appointment types. Dividing these salaries by the appropriate number of months to reflect days worked, nine and 12, shows 9-month appointments earning about \$165 per month more than 12-month type appointments.

Other Results

Total incomes to University of Wyoming faculty (excluding administrators) were ranked in order from highest to lowest salary. Of the top 25 salaries, 21 were received by individuals on 9-month appointments. Nineteen of these 21 individuals received a substantial summer income which pushed their total salaries upward. Eighty percent of the top 50 total salaries were received by 9-month personnel.

When faculty contractual salaries were ranked, 12 of the top 25 salaries were received by 9-month individuals. Fifty percent of the top 50 contractual salaries were received by faculty on 9-month appointments.

Conclusions

Within most colleges noticeable salary differences between 9- and 12-month appointments are not apparent. However, based on number of days worked, evidence indicates salary discrimination against 12-month faculty among colleges. Mean contractual salaries in many instances were lower for 12-month faculty than for comparably ranked and trained faculty on 9-month appointments in other colleges. When salaries for 12-month appointments were adjusted to a 9-month basis, College of Agriculture faculty salaries were lower than 9-month salaries in all other colleges for all ranks except instructor.

Statistically significant salary differences between colleges were found. Salaries in Commerce and Industry, Engineering, Law, and Education were all significantly higher than salaries in the other three colleges and Adult Education.

Female faculty members received significantly lower salaries than their male counterparts. The women faculty members also had more years in service and in rank at all ranks, except instructor, than did male faculty members.

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Does Laboratory Reinforcement Result in Greater Learning?

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Abstract

A one-time study indicates no benefit to learning by a laboratory conducted on a grade contract basis.

As educators at The Ohio State University, we were curious as to whether or not a laboratory supplement to a course resulted in a greater gain in knowledge of the lab participants. The course in question was an introductory lecture course for non-majors in the landscape horticulture curriculum. Being broad in its educational scope, it had wide appeal across the various colleges on the Ohio State campus.

The course had been taught as a lecture only for the past 6 years, with continuous evaluation and feedback from the students resulting in an updating and some minor revision. Lately, students indicated a desire for a practical lab supplement to more clearly objectify some of the principles discussed in the lecture.

Based on this student feedback, a laboratory section was established which gave the students an opportunity to practice some of the concepts discussed in the lecture. The lab was run on a grade contract basis. Students receive a detailed course outline at the start. Based on the depth of their interests and available time, students contract for an A, B or C. Contracts eliminated the usual testing pattern.

The Hypothesis

Van Dalen's (2) believes timely and relevant experiences can lead to educational reinforcement. Therefore, the hypothesis was established that those students who augmented the lecture with a lab section would significantly out-perform other students on a standard post-course test.

Classroom vs Laboratory

Class size has increased. The first class had 32 students, but currently, quarterly enrollments range from 200-300 students. Finding a room large enough to accommodate the students is the main lecture problem. The lectures relied heavily on the use of 35 mm slides to

From the Ohio State University