University of Waterloo boosts female faculty pay after wage gap uncovered

PAOLA LORIGGIO

The Canadian Press

Published Thursday, Aug. 04, 2016 12:35PM EDT

Last updated Thursday, Aug. 04, 2016 5:13PM EDT

http://www.theglobeandmail.com/news/national/university-of-waterloo-boosts-female-faculty-salaries-after-gender-pay-gap-found/article31272503/

An Ontario university is the latest to bump the salaries of its female faculty members after discovering they were being paid thousands of dollars less than their male coworkers, but one professor says steps must be taken to prevent — not just rectify — such biases in academia.

In a memo emailed to faculty Wednesday and obtained by The Canadian Press, the University of Waterloo said a working group tasked with analyzing faculty salaries uncovered a "systemic gender anomaly" that was "consistent across the university."

As a result, it said an adjustment of $2,905 will be made on Sept. 1 to the salaries of all female faculty members who were in the faculty association's bargaining unit as of April 30 of last year.

However, the working group said in its report that the increases will not be applied retroactively.

Aimee Morrison, an associate professor at the university and associate chair of graduate studies, says this type of inequity is a problem across academia "and probably all fields."

While it's great that the university is willing to address the problem, "I don't see a bigger conversation happening in really pointed ways about how does this keep happening," she said.

"It's not an anomaly if it's a pattern."

Several other Canadian universities, including Hamilton's McMaster University and the University of British Columbia, have given raises to female faculty members in recent years so that they earn as much as their male peers.

The University of Waterloo itself has conducted salary reviews in the past, including one in 2008 that made "several recommended salary adjustments for individual women faculty" but did not lead to university-wide increases.

The working group recommends that the university examine salaries every five years on top of conducting annual reviews within each department.

It also stresses that since starting salaries and merit increases are the key factors affecting pay, "care should be taken to ensure that starting salaries are equitable, as inequity at this point can quickly compound."

Morrison, who has sat on faculty evaluation committees, said there could be checklists or other tools to help people take note of their internalized biases when determining salaries.

“The reason that we have to keep doing these reviews is that the underlying inequities in how faculty members are assessed or in how they are supported in their initial salary negotiations is still going to be prey to bias,” she said.

“If we could fix the bias, the anomaly, once fixed, would not reproduce itself, but it keeps reproducing itself.”

Lynne Taylor, co-chair of the working group, said the review’s mandate was simply to identify any discrepancies, not the underlying causes.

“We still don’t have a clear sense of why it happens. I would love that to be fixed and I think there are people in the upper reaches of the administration who would like to see this rectified as well,” she said.

“Until we have a sense of where that’s coming from, though, I think it is smart to have a regular review,” she said. “All of us would just wish it wasn’t necessary but if it is, at least it’s getting fixed.”

Jean Andrey, dean of the faculty of environment, said the anomalous salaries were spread across all faculties and ranks, adding that the university has been “doing a lot of thinking” about how the discrepencies didn’t get noticed before.

Andrey suggested the differences in salaries could be the result of a “legacy effect” due to there not being as much equity in the past, or that starting salaries for some employees could have been lower due to a “different approach in negotiating terms of employment” when they were hired.

“The really good news about the work we’ve done is that by looking at annual performance reviews we’ve been able to conclude that there’s no evidence of a systematic gender bias in the way that we do annual merit evaluations,” she said. “We believe that there is fairness in our assessment processes.”

Waterloo’s latest review was part of a salary settlement between the university and the faculty association that was reached May 1 of last year.

Other faculty members’ salaries were also flagged as “anomalous” and the review recommended that a one-time adjustment be made to make up for the discrepancy.

Salaries were evaluated using a regression model that took several variables into account, including annual performance evaluations and outstanding performance awards.

The report says that 71 of roughly 1,170 faculty members were identified as “potential anomalies,” and of those, 59 were confirmed anomalies, meaning “there was nothing in their career path that could account for the aberration in their actual salaries and the fitted/predicted salary outputted from the regression model.”

The remaining 12 will be investigated further.

Salary Anomaly Working Group
Analysis & Findings
(26 May 2016)

As part of the salary settlement effective 1 May 2015, the Vice President Academic and Provost (VPAP) and the President of the Faculty Association of the University of Waterloo (FAUW) agreed to establish a working group on possible faculty salary inequities that would: investigate all cases where faculty salary inequities, including but not limited to gender-based inequities, may exist and recommend how such cases should be resolved using the Faculties' existing anomaly funds; review the processes by which salary anomalies are currently identified and resolved in each Faculty; establish a standardized university-wide process for the detection and resolution of all faculty salary anomalies that may arise in future, wherever they may occur. The working group was directed to provide a final written report (due 1 February 2016) detailing its methodologies and findings to the VPAP and to the FAUW President.

The Salary Anomaly Working Group's membership consisted of six members in total: Jean Andrey (Dean of Environment and co-chair of the Salary Anomaly Working Group), Lynne Taylor (History, FAUW, and co-chair of the Salary Anomaly Working Group), Benoit Charbonneau (Pure Mathematics), Cecilia Cotton (Statistics and Actuarial Science), Christiane Lemieux (Statistics and Actuarial Science), and Bill Power (Chemistry). The Working Group began meeting in September 2015. Its task was two-fold, to review the current practices used in the Faculties to identify and correct potential anomalies, and to conduct a review of all salaries for potential anomalies. It is important to note that its mandate was not to identify potential causes of anomalies, but to identify anomalies and recommend for adjustment.

It was anticipated that all recommended salary adjustments would be implemented before 30 April 2016 (so that they would be incorporated in the salary increases that take effect 1 May 2016). Largely because of challenges in collecting and verifying the salary and hiring data needed for a robust analysis, the working group was unable to complete its analysis by the 1 February 2016 deadline. With the agreement of both the VPAP and the President of FAUW, the decision was made that it would be better to do a good job of the analysis, than rush to complete the analysis in order to meet the deadline. Accordingly, individual adjustments to faculty members' salaries identified by this review may have been made already in the spring of 2016 as a result of the Deans' normal review processes. Any such adjustments will have to be taken into account when implementing the adjustments recommended by this review. Otherwise, most adjustments are expected to take effect as soon as possible (beginning with the anomaly funds available in the spring of 2017 and as part of the application of annual faculty salary increases). This report summarizes the working group's findings.

Best Practices

The Salary Anomaly Working Group was charged with reviewing the processes by which salary anomalies are currently identified and resolved in each Faculty and establishing a standardized university-wide process for the detection and resolution of faculty salary anomalies within the bargaining unit as defined by the Memorandum of Agreement that may arise in future, wherever they may occur. The Dean of each Faculty (either the current Dean or the former Dean in the case of the Faculties of Science and Mathematics) was interviewed by two members of the Working Group. Not surprisingly, practices regarding the identification of anomalies varied between Faculties. The only shared practice across all six Faculties is consideration of all cases where individual faculty members self-identify as having an anomalously low salary. Beyond this, it is apparent that Faculty practices vary in scope (Faculty-wide vs partial review) and analytical approach (regression plotting versus informal review).

Recommendations.

i. Recommended Best Practices for the Identification and Resolution of Salary Anomalies at the Faculty Level.

a) Deans of all Faculties should be open to self-identification and to identification of potential anomalies by Chairs and Directors of academic units, but should not be reliant upon those means of identifying anomalies.

b) Deans of all Faculties should review all salaries in their Faculty annually for anomalies.

c) Career earnings and annual salaries are a function of two key variables: starting salaries and merit increases. To help prevent future anomalies, care should be taken to ensure that starting salaries are equitable, as an inequity at this point can quickly compound.

ii. Recommended Best Practices for the Identification and Resolution of Salary Anomalies at the University Level.

d) Because annual Faculty-level anomaly reviews may fail to identify inequities that may be developing across the university as a whole, the Working Group recommends that a university-wide anomaly review be done regularly for both men and women faculty, including lecturers, using the regression model developed for the 2015-2016 review. The interval should be long enough to allow the system to detect anomalies as they develop, but short enough to allow corrections to be applied in a timely manner (the Working Group recommends every five years).

e) One subset of those cases identified as potential anomalies are definite-term professorial appointments. The Working Group recommends that the VPAP examine closely the practices around the determination of these salaries, with the purpose of ensuring equity across campus for those hired into this rank.

Salary Anomalies Review

The Working Group was charged with investigating the salaries of all members of the bargaining unit as of 1 May 2015 for the purposes of identifying possible salary inequities, including but not limited to gender-based inequities, and recommending how such cases should be resolved using the Faculties' existing anomaly funds. The method used was a comprehensive regression model, detailed in the appendix to this report.

In the final analysis, 71 individuals were identified as potential anomalies, based on the regression model. Of those 71 individuals, 59 are considered by the Working Group to be certain anomalies, as there was nothing in their career path that could account for the aberration in their actual salaries and the fitted/predicted salary outputted from the regression model. The regression model accounts for the individual's observed employment history including actual average merit ranking from up to the past six years. There are an additional 12 individuals for whom the Working Group felt unable to determine whether they were truly anomalous.

Of the 71 total cases identified, 30 of them are women (of a total population of 344 women in the dataset; so 9% of all women) and 41 are men (of a total population of 827 men in the dataset, so 5% of all men). Eight of the 71 cases are lecturers (continuing or definite-term) and 63 cases are in the professorial ranks (tenure-stream or definite-term).

In addition, after the 71 cases were identified, the regression model was re-run after the individual salaries were adjusted by the recommended amounts. After this adjustment, it was determined that there still existed a systemic gendered anomaly of $2905 in favour of male faculty members.

Recommendations.

a) The Working Group recommends that the 59 anomalies considered to be definitely anomalous be adjusted by the specified amounts. (It may be that some of these recommended corrections have been made, in whole or in part, with the 30 April 2016 annual salary adjustments and the allocation of the 2016 salary anomaly funds made available to the Deans. The Working Group was unable to take any such corrections into account. It is recommended that, in these instances, the amount of an individual's correction as recommended by the Working Group should take into account any anomaly correction applied in 2016.)

b) The Working Group recommends that the remaining 12 cases be investigated further by the VPAP's office, with the objective of determining whether or not they are anomalous.

c) The Working Group recommends that the systemic gender anomaly be adjusted by the amount of $2905, in addition to the individual anomalies identified, for all women in the dataset as soon as possible.

d) The Working Group recognizes that the total dollar value of adjustments exceeds the total annual value of some Faculties' anomaly funds. Accordingly, the Working Group recommends

that the individual anomalies be adjusted as soon as possible and, at a minimum, beginning in the spring of 2017 as part of the application of annual faculty salary increases.

e) The Working Group recommends that those individuals who have been identified as having anomalous salaries be informed of that fact, and the size of their particular anomaly, by 1 September 2016. These communications should be issued jointly by the VPAP and the President of the Faculty Association of the University of Waterloo, as co-sponsors of the anomaly review.

f) In those cases where anomaly adjustments were made and took effect on 1 May 2016, the recommendation is that this amount be deducted from the recommended adjustment amount. If a positive balance remains, this balance should be consistent with the amount of the adjustment effective 1 May 2017. If the balance is zero or negative, then no further action is recommended.

Appendix

Salary Analysis

Objectives

When the Salary Anomaly Working Group was established jointly by the Vice President Academic and Provost (VPAP) and the President of the Faculty Association of the University of Waterloo (FAUW), one of the main tasks that it was asked to perform was the following:

- investigate all cases where faculty salary inequities, including but not limited to gender-based inequities, may exist and recommend how such cases should be resolved using the existing anomaly funds within the Faculty budgets.

This appendix describes the process by which the working group accomplished this task.

Methodology

Regression is an ideal tool to construct a model incorporating several factors to explain a response variable. In the present context, using regression for salary analysis allows us to choose factors (explanatory variables) deemed important to predict faculty salaries, without having to specify which factors are the most important and how they should be weighted in the linear function used for prediction. This approach also comes with diagnostic tools allowing us to determine how good the model is at fitting salaries. Unsurprisingly, other Canadian universities (including UBC, McMaster and Western) have recently used regression to perform salary analysis.

Data requested

The cohort that was used to do the analysis consists of regular full-time and part-time faculty members at UW as of 1 May 2015, included in the Faculty Salary Increase (FSI) process. Note that any individual hired on or after 1 May 2015 is not included in this cohort. The FSI includes individuals defined under Policy 76, 2A; regular faculty with a definite term, probationary, tenured, or continuing appointment, and with a load of full-time, reduced- or fractional-load. The term `part-time' refers to regular faculty with either reduced- or fractional-load intensities.

We requested the following data for each individual in the above cohort. (Note that data was provided in a blinded manner, with each individual being assigned an ID number; also the data was extracted jointly by IAP and HR, e.g., merit scores had to come from IAP.)

Variable	Description	Notes
ID	A unique id number assigned to each individual	
Annual Salary	Annual base salary as of 1 May 2015 excluding stipends	
Starting Salary	Annual base salary at hire excluding stipends	
Rank at Hire	Rank at which person was hired as a faculty member at UW	Assis. Prof., Assoc. Prof, Prof., Lect., Clin. Lect.
Year of Hire	Calendar year when person was hired as a faculty member at UW	
Highest Degree	Highest degree earned by the individual	PhD, Masters, Bachelor, Grad. License, Other
Year of Highest Degree	Calendar year where highest degree was awarded	
Rank	Current rank of the individual	Assis. Pr., Assoc. Pr., Prof., Lect., Clin. Lect.
Faculty	Faculty individual belongs to	AHS, ARTS, ENG., ENV, MATH, SCI
Department	Department or School individual belongs to	
Gender	Male, Female	
FTE	Individual's FTE in their department	
OPA	Number of Outstanding Performance Awards earned over career	
Merit – Overall 09	Overall merit score assigned for year 2009	
Merit – Overall 10	Overall merit score assigned for year 2010	
Merit – Overall 11	Overall merit score assigned for year 2011	
Merit – Overall 12	Overall merit score assigned for year 2012	
Merit – Overall 13	Overall merit score assigned for year 2013	
Merit – Overall 14	Overall merit score assigned for year 2014	
PAC	Past Anomaly Correction: was one received? No=0; Yes=1	

Table 1: Requested Data

After we obtained this data, a few issues had to be addressed before we were able to use it for salary analysis:

- Faculty with joint appointments were placed in the department with the higher percentage of FTE
- Highest degree and year of highest degree had to be manually verified for recent hires as we detected some errors in the original data provided;
- FTE information had to be checked to make sure we had the nominal salary as of 1May 2015, i.e., the salary that would be earned if the FTE was 1.

The tables below provide a summary of the data used for the analysis by rank, gender, and Faculty.

	Female	Male	Total
Applied Health Sciences	31	41	72
Arts	135	165	300
Engineering	53	246	299
Environment	28	53	81
Mathematics	43	183	226
Science	54	139	193
Sum	344	827	1171

Table 2: Summary of Faculty Members by Faculty and Gender

	Female	Male	Total
Assistant Professor	88	134	222
Associate Professor	125	268	393
Clinical Lecturer	4	3	7
Lecturer	51	92	143
Professor	76	330	406
Sum	344	827	1171

Table 3: Summary of Faculty Members by Rank and Gender

Regression Model

The regression model used fits the 1 May 2015 salary as a linear function of the factors below:

- Merit (average merit score out of 2.0 for available years, denoted as R.mean in the table below)
- Lag of years between highest degree and Year of hire
- Years since hire
- Years since hire squared
- Number of previous Outstanding Performance Awards (OPA)
- Highest degree (factor, comparison is Bachelor)
- Current Rank (factor, comparison group is Assistant Professor)
- Academic Group (factor, comparison group is AHS)
- Rank at Hire (factor, comparison is Assistant Professor)
- Interaction between Academic Group and binary variable for Lecturer vs Professorial Rank
- Interaction between Lag and Rank at hire

A total of 14 academic groups were used for the analysis, and are as follows: Applied Health Studies, Economics, Psychology, School of Accounting and Finance, Arts (all other units), Chemical Engineering, Electrical and Computing Engineering, Engineering (all other units), School of Computer Science, Mathematics (all other units), School of Optometry, School of Pharmacy, Science (all other units). This was an attempt to recognize the difference in starting salaries between disciplines or 'knowledge groups' within faculties caused by various factors, including external job market pressures.

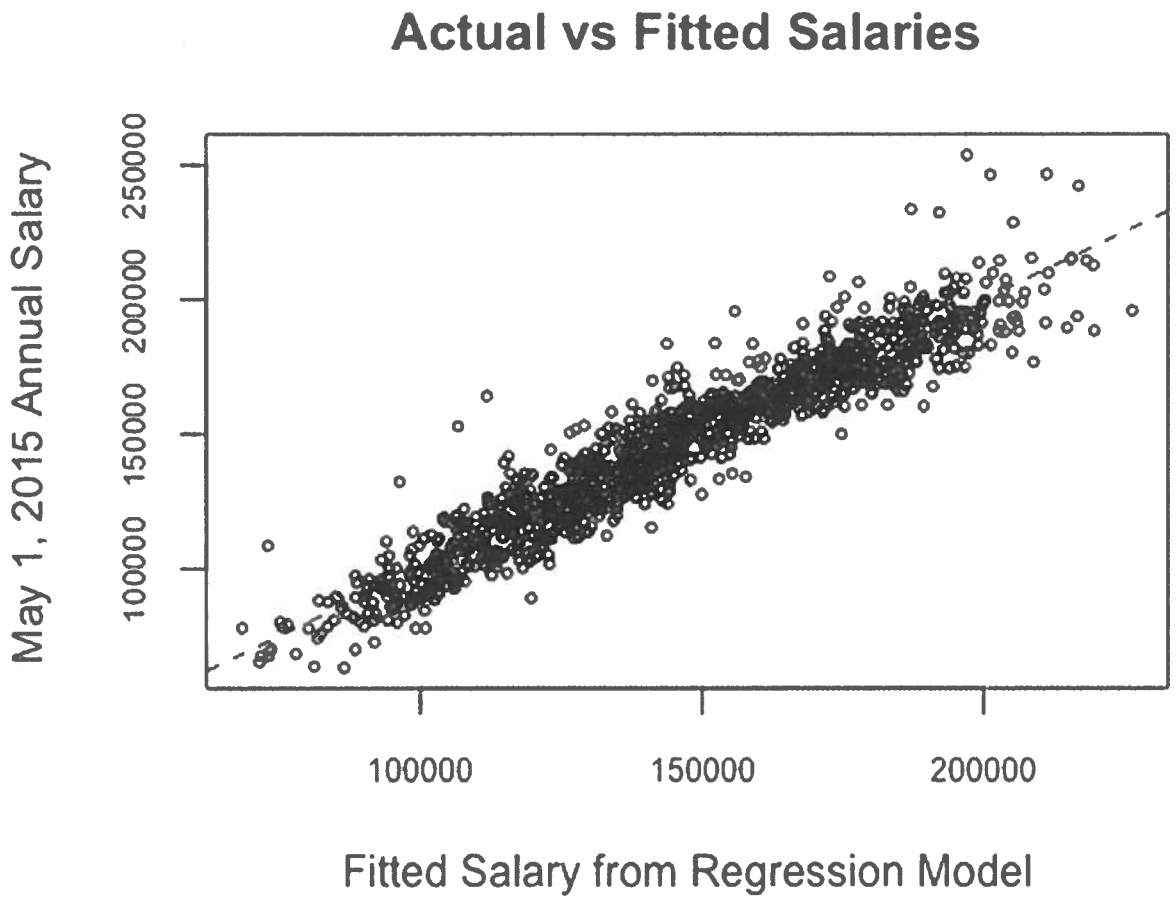
To determine the academic group of faculty members holding a joint appointment between two or more units, the member was assigned to the academic group accounting for the largest portion of the member's total FTE. In cases where the FTE was equally divided between two (or more) units, it was discovered that those units were consistently within the same academic groups.

The resulting model is described below, where for each of the above factors we obtain a coefficient that indicates by how much the corresponding variable must be multiplied to obtain a fitted salary. An example showing how to calculate the fitted salary is given below.

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	46748.06	4592.89	10.18	0.0000
R.mean	26097.98	1791.94	14.56	0.0000
Lag	829.88	147.10	5.64	0.0000
Years.UW	2226.66	140.71	15.82	0.0000
Years.UW.sq	-15.84	3.47	-4.57	0.0000
OPA	3664.14	685.64	5.34	0.0000
factor(Highest.Degree)Doctoral	10084.27	3378.91	2.98	0.0029
factor(Highest.Degree)Graduate License	-7700.33	7201.54	-1.07	0.2852
factor(Highest.Degree)Master's and Equivalent	1616.14	3519.85	0.46	0.6462
factor(Highest.Degree)Professional	7339.61	4825.99	1.52	0.1286
factor(Academic.Rank)Associate Professor	7666.75	1171.28	6.55	0.0000
factor(Academic.Rank)Clinical Lecturer	9038.29	11059.44	0.82	0.4140
factor(Academic.Rank)Lecturer	-7349.55	4462.49	-1.65	0.0998
factor(Academic.Rank)Professor	15811.02	1598.82	9.89	0.0000
factor(Academic.Group)School of Accounting & Finance	15244.60	5091.68	2.99	0.0028
factor(Academic.Group)Economics	5084.50	5922.80	0.86	0.3908
factor(Academic.Group)Psychology	-15413.75	6812.83	-2.26	0.0239
factor(Academic.Group)Chemical Engineering	-7227.35	7405.35	-0.98	0.3293
factor(Academic.Group)Electrical & Computer Eng	13516.82	6268.18	2.16	0.0313
factor(Academic.Group)School of Computer Science	7520.51	5183.75	1.45	0.1471
factor(Academic.Group)School of Optometry	10792.42	12693.56	0.85	0.3954
factor(Academic.Group)School of Pharmacy	21043.85	2811.67	7.48	0.0000
factor(Academic.Group)Faculty of Environment	-12225.70	8596.71	-1.42	0.1553
factor(Academic.Group)Arts - all other units	-10388.70	4735.48	-2.19	0.0285
factor(Academic.Group)Engineering - all other units	14752.95	4697.43	3.14	0.0017
factor(Academic.Group)Mathematics - all other units	6532.34	4439.02	1.47	0.1414
factor(Academic.Group)Science - all other units	-1135.99	5025.57	-0.23	0.8212
factor(Rank.at.Hire)Associate Professor	5319.26	2096.70	2.54	0.0113
factor(Rank.at.Hire)Clinical Lecturer	4242.50	11932.31	0.36	0.7222
factor(Rank.at.Hire)Lecturer	-2210.70	1641.43	-1.35	0.1783
factor(Rank.at.Hire)Professor	10079.46	3681.30	2.74	0.0063
factor(Academic.Group)Arts:factor(Academic.Rank2)Professor	5092.17	4996.96	1.02	0.3084
factor(Academic.Group)Engineering:factor(Academic.Rank2)Professor	779.42	4960.85	0.16	0.8752
factor(Academic.Group)Faculty of Environment:factor(Academic.Rank2)Professor	9908.77	8779.14	1.13	0.2593
factor(Academic.Group)Mathematics:factor(Academic.Rank2)Professor	5397.36	4733.94	1.14	0.2545
factor(Academic.Group)Science:factor(Academic.Rank2)Professor	2055.99	5280.47	0.39	0.6971
factor(Academic.Group)School of Accounting & Finance:factor(Academic.Rank2)Professor	18910.82	5572.08	3.39	0.0007
factor(Academic.Group)Economics:factor(Academic.Rank2)Professor	7780.52	6408.68	1.21	0.2250
factor(Academic.Group)Psychology:factor(Academic.Rank2)Professor	16166.87	7150.68	2.26	0.0240
factor(Academic.Group)Chemical Engineering:factor(Academic.Rank2)Professor	19640.16	7753.66	2.53	0.0114
factor(Academic.Group)Electrical & Computer Eng:factor(Academic.Rank2)Professor	3970.11	6512.00	0.61	0.5422
factor(Academic.Group)School of Computer Science:factor(Academic.Rank2)Professor	16368.08	5508.11	2.97	0.0030
factor(Academic.Group)School of Optometry:factor(Academic.Rank2)Professor	4233.38	12696.43	0.33	0.7389
Lag:factor(Rank.at.Hire)Associate Professor	410.74	237.82	1.73	0.0844
Lag:factor(Rank.at.Hire)Lecturer	-335.24	181.71	-1.84	0.0653
Lag:factor(Rank.at.Hire)Professor	889.20	228.67	3.89	0.0001

Table 4: Summary of Fitted Regression Model

Example: consider a faculty member in Environment hired as Assistant Professor in 2010 with a PhD in 2008 and with an average performance rating of 1.5. Assume the individual is still an Assistant Professor as of 1 May 2015 and did not receive an OPA. Then its fitted salary as determined by the model is:
46748.06 + 26097.98 * 1.5 + 829.88 * (2010-2008) + 2226.66 * (2015-2010) - 15.84 * (2015-2010)^2 + 10084.27 - 12225.70 + 9908.77 = 106059.4
The plot below shows the actual salaries against the fitted salaries.



This plot and the model's R-squared value of about 0.9 provide evidence that the model adequately fits the data and can be used for salary analysis. The R-squared value essentially tells us that 90% of the variability in salaries is explained by the model. The plot confirms this information by showing that most individuals have a salary that is within a reasonable range of the salary predicted by the model (a perfect model would show all points on the x=y diagonal line shown with a dashed line on the plot).
A few alternatives to the chosen model were investigated to see if they provided a better fit:

- we tried to work with a log transform of the outcome variable (1 May 2015 Salary) but it slightly reduces the fit;

- we replaced the Academic Groups with Faculties: the Faculty model was acceptable but the Academic Group model fits the data better than the Faculty one;
- we also considered separate regression for professors and lecturers, but the fit was not very good for lecturers because the sample size is smaller for this group (and we have a lot of parameters to fit).

Key assumptions of the regression model

- The average merit from 2009 to 2014 is representative of the individual's full history of merit ratings over their career.
- The individual has had continuous service with merit ratings given every year.
- For faculty members with a joint appointment, their salary is consistent with the Academic Group for which the corresponding FTE is the largest.
- Because the model makes no distinction between definite term and probationary/tenured appointments in the professorial ranks (we could not distinguish the two because the sample size is too small for the definite term category), these two groups are treated in the same way in the model, which means there is an implicit assumption that salaries are not impacted by this distinction.
- It is assumed that the functional form of the model is correct, including the fact that we assume a linear relationship between the explanatory variables and outcome (actual salary).
- It is assumed that data is accurate, including rank at hire, year of hire, and highest degree.

Criterion used to detect anomalies

Using the fitted salary from the regression model we consider the following two quantities to assess anomalies:

- The **Absolute Difference** between actual salary and the fitted salary = (Actual - Fitted)
- The **Proportional Difference** between actual salary and fitted salary = (Actual - Fitted)/Fitted

The Working Group decided to use the following criterion to identify potential anomalies:

- Actual <90% Fitted AND Actual >$5000 below Fitted

Results

An initial screen to identify potential anomalies resulted in 88 cases, which were all investigated further in consultation with Human Resources. Information that was considered is as follows:

- breaks in service, i.e., non-continuous service history
- incorrect rank and year of hire (e.g., year of hire could have been for a staff position or a sessional appointment, and we need the information about when they entered our cohort)
- employment status (e.g., some individuals have left UW since 1 May 2015)
- joint appointment information.

After this investigation was performed, there were 59 remaining identified anomalies and 12 cases requiring further investigation. A summary of these by gender, Faculty, and rank is provided in the tables below.

	Not Anomalous	Anomalous	Needs further Investigation	Sum
Women	314	27	3	344
Men	786	32	9	827
Sum	1100	59	12	1171

Table 5: Final Anomaly Counts by Gender

	Not Anomalous	Anomalous	Needs further Investigation	Sum
Applied Health Sciences	58	12	2	72
Arts	278	18	4	300
Engineering	290	7	2	299
Environment	77	4	0	81
Mathematics	217	7	2	226
Science	180	11	2	193
Sum	1100	59	12	1171

Table 6: Final Anomaly Counts by Faculty

	Not Anomalous	Anomalous	Needs Further Investigation	Sum
Assistant Professor	196	22	4	222
Associate Professor	371	19	3	393
Clinical Lecturer	7	0	0	7
Lecturer	133	10	10	143
Professor	393	8	5	406
Sum	1100	59	12	1171

Table 7: Final Anomaly Counts by Rank

The amount of the recommended correction in each case is determined as follows: we first compute the dollar amount necessary for the actual salary to no longer be an anomaly. Then we round up this amount to the next $500 amount. The following table contains the sum of the corrections per Faculty.

	Count	Sum Recommended Corrections
Applied Health Sciences	12	$27000
Arts	18	$43000
Engineering	7	$34500
Faculty of Environment	4	$11000
Mathematics	7	$35000
Science	11	$52500
TOTAL	59	$203000

Table 8: Cost of Fixing Identified Definite Anomalies

It may be that some of these recommended corrections have been made, in whole or in part, with the 30 April 2016 annual salary adjustments and the allocation of the 2016 salary anomaly funds made available to the Deans. The Working Group was unable to take any such corrections into account. It is recommended that, in these instances, the amount of an individual's correction as recommended by the Working Group should take into account any anomaly correction applied in 2016.

Gender-Based Analysis

So far, gender has not been included in our analysis. That is, the first step of our analysis was to detect all anomalies regardless of gender, and we did so using a model that did not include gender as a factor to explain salary.

However, as recalled at the beginning of this report, our original mandate included an investigation of gender-based inequities. Therefore we performed the following analysis: we assumed that all 71 identified cases were adjusted and then we re-fitted the regression model, but

included a gender term this time. The value of the regression coefficient for this factor is the expected salary difference between a male and female faculty member with fixed values of all other terms included in the regression model (i.e., all other things being equal, that is, this amounts to comparing individuals with all their factors being the same except for gender, so in the same academic group, with the same performance ratings, the same number of years at UW, the same rank, etc.). The fitted model is given below.

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	47757.05	4401.09	10.85	0.0000
factor(Gender)2	2904.59	700.82	4.14	0.0000
R.mean	25821.67	1699.22	15.20	0.0000
Lag	858.08	138.79	6.18	0.0000
Years.UW	2252.47	133.39	16.89	0.0000
Years.UW.sq	-16.60	3.29	-5.05	0.0000
OPA	3587.37	651.23	5.51	0.0000
factor(Highest.Degree)Doctoral	8564.38	3251.73	2.63	0.0086
factor(Highest.Degree)Graduate License	-10290.55	6873.11	-1.50	0.1346
factor(Highest.Degree)Master's and Equivalent	146.71	3386.44	0.04	0.9655
factor(Highest.Degree)Professional	3533.10	4448.90	0.79	0.4273
factor(Academic.Rank)Associate Professor	7325.93	1118.28	6.55	0.0000
factor(Academic.Rank)Clinical Lecturer	9675.22	10520.73	0.92	0.3580
factor(Academic.Rank)Lecturer	-6553.49	4262.62	-1.54	0.1245
factor(Academic.Rank)Professor	15141.57	1525.42	9.93	0.0000
factor(Academic.Group)School of Accounting & Finance	14049.27	4838.09	2.90	0.0038
factor(Academic.Group)Economics	4167.66	5631.41	0.74	0.4594
factor(Academic.Group)Psychology	-16971.48	6468.86	-2.62	0.0088
factor(Academic.Group)Chemical Engineering	-4803.26	7035.98	-0.68	0.4950
factor(Academic.Group)Electrical & Computer Eng	10629.27	5986.53	1.78	0.0761
factor(Academic.Group)School of Computer Science	5114.92	4948.56	1.03	0.3015
factor(Academic.Group)School of Optometry	11736.54	12002.76	0.98	0.3284
factor(Academic.Group)School of Pharmacy	21177.10	2668.87	7.93	0.0000
factor(Academic.Group)Faculty of Environment	-13716.05	8169.56	-1.68	0.0934
factor(Academic.Group)Arts - all other units	-11526.09	4515.81	-2.55	0.0108
factor(Academic.Group)Engineering - all other units	14007.87	4502.53	3.11	0.0019
factor(Academic.Group)Mathematics - all other units	5383.34	4239.10	1.27	0.2044
factor(Academic.Group)Science - all other units	-1950.10	4779.45	-0.41	0.6833
factor(Rank.at.Hire)Associate Professor	4952.56	1996.99	2.48	0.0133
factor(Rank.at.Hire)Clinical Lecturer	5743.84	11349.63	0.51	0.6129
factor(Rank.at.Hire)Lecturer	-2101.91	1630.66	-1.29	0.1977
factor(Rank.at.Hire)Professor	10097.90	3495.13	2.89	0.0039
factor(Academic.Group)Arts:factor(Academic.Rank2)Professor	5963.93	4769.95	1.25	0.2114
factor(Academic.Group)Engineering:factor(Academic.Rank2)Professor	679.95	4740.64	0.14	0.8860
factor(Academic.Group)Faculty of Environment:factor(Academic.Rank2)Professor	10683.69	8341.98	1.28	0.2006
factor(Academic.Group)Mathematics:factor(Academic.Rank2)Professor	5372.86	4506.28	1.19	0.2334
factor(Academic.Group)Science:factor(Academic.Rank2)Professor	1765.49	5016.45	0.35	0.7249
factor(Academic.Group)School of Accounting & Finance:factor(Academic.Rank2)Professor	19887.39	5284.41	3.76	0.0002
factor(Academic.Group)Economics:factor(Academic.Rank2)Professor	7679.05	6089.70	1.26	0.2076
factor(Academic.Group)Psychology:factor(Academic.Rank2)Professor	17518.53	6793.48	2.58	0.0100
factor(Academic.Group)Chemical Engineering:factor(Academic.Rank2)Professor	15814.88	7365.46	2.15	0.0320

factor(Academic.Group)Electrical & Computer Eng:factor(Academic.Rank2)Professor	5431.13	6200.93	0.88	0.3813
factor(Academic.Group)School of Computer Science:factor(Academic.Rank2)Professor	17615.55	5244.71	3.36	0.0008
factor(Academic.Group)School of Optometry:factor(Academic.Rank2)Professor	4146.50	12024.74	0.34	0.7303
Lag:factor(Rank.at.Hire)Associate Professor	444.89	225.81	1.97	0.0491
Lag:factor(Rank.at.Hire)Lecturer	-383.49	172.40	-2.22	0.0263
Lag:factor(Rank.at.Hire)Professor	889.46	216.39	4.11	0.0000

Table 9: Summary of Fitted Regression Model

The value of the regression coefficient corresponding to gender is $2904.59 and is highly significant (standard error is $701 and p-value is 3.66e-5). This indicates that even after taking account the important work-related factors included in our original regression model, on average and when all other factors are equal, a male faculty member at UW has a salary that is $2905 higher than a female faculty member.

Merit/Gender/Rank Analysis

Separate from the primary task of the Working Group, taking advantage of having access to six years of overall merit ratings (2009 to 2014 inclusive), an additional regression analysis was done to determine whether the overall merit ratings are explained by gender and/or rank. More precisely, four explanatory variables were used to model the 6-year average merit ratings: gender, rank, gender * rank, and gender + rank. The results of the analysis cannot be construed to establish a causal relationship, but are worth noting nonetheless.

First, it was determined that neither gender nor the two-way interaction based on gender and rank were statistically significant. In addition, in the gender + rank term, only the rank term was deemed significant. The only statistically significant difference in merit ratings was that for female and male associate professors, in which female associate professors had an average overall merit rating greater than male associate professors ($p = 0.04$).

	Female	Male
Assistant Professor	1.46	1.43
Associate Professor	1.62	1.58
Clinical Lecturer	1.43	1.46
Lecturer	1.56	1.59
Professor	1.71	1.72
Overall	1.59	1.61

Table 10: Average Overall Merit Ratings - female vs male

Rank, however, was determined to be statistically significant. Assistant professors and clinical lecturers have an average overall merit rating of 1.44; associate professors and lecturers have an overall merit rating of 1.58, professors have an overall merit rating of 1.72.