



# **UNR Equity Analysis for July 1, 2018 Salaries**

Academic Faculty

Serge Herzog, PhD, Director, Institutional Analysis,  
University of Nevada, Reno, PBA, Mailstop 114,  
Reno, NV 89557, [serge@unr.edu](mailto:serge@unr.edu)

**10/23/2018**

## **SUMMARY OF FINDINGS**

- **Testing for possible bias in compensation:**
  - **Based on July 1, 2018 salary data, there are no statistically significant relationships associated with an academic faculty member's age, gender, and ethnicity/race. This suggests there is no systematic bias associated with these personal attributes when evaluating academic faculty salaries.**
  - **Key factors determining level of salary are academic rank, academic discipline, and market level of salary. Notably, the influence of average merit rating on salary has steadily declined since the 2009 recession likely due to the absence of merit pay in some of the ensuing years.**
  
- **Testing for possible bias in tenure decision and academic rank:**
  - **Of the 432 faculty members with tenure or tenure-track status in the submitted HR file, only one case was predicted to be tenured while still on tenure-track.**
  - **There are six faculty members whose predicted academic rank is higher than their current rank. Two are tenured associate professors, the other four are non-tenure track faculty members.**
  
- **Testing for other associations related to faculty personal attributes:**
  - **Faculty of Asian background are more likely to be in engineering fields, while female faculty (and to a lesser extent non-White/non-Asian faculty) are less likely to be in engineering fields.**

## INTRODUCTION

Data for 565 academic faculty members as of AY 2018-19 were analyzed for the possible presence of systematic compensation bias associated with age, gender, ethnicity/race; and equitable rank and tenure promotion.

The analysis controls for the following variables:

| Variable          | Description   |
|-------------------|---|
| Age               | Age as of July 2018   |
| Gender*           | Male or Female  |
| Ethnicity/race*   | White, Asian, Native Am./Pac Is., Black, Hispanic, Multi-Race   |
| Highest Degree*   | Doctorate, Master's, Bachelor's   |
| Terminal Degree*  | yes, no   |
| YrswTermDegr      | Number of years with terminal degree  |
| Appointment type* | Tenured, tenure-track, non-tenure track   |
| Years with tenure | Number of years with tenure   |
| Hired rank*       | Professor, Associate, Assistant, Instructor   |
| Current rank*     | Professor, Associate, Assistant, Instructor   |
| Years in rank^    | Number of years at a rank (Professor, Associate, Assistant, Instructor)   |
| Longevity         | Number of years at UNR  |
| Current salary    | As of July 1, 2018 ('A' adjusts to 'B' contract; NatLog)  |
| Non-OSU*          | Source of market salary Info if not from OSU database   |
| Merit rating      | Average annual merit rating   |
| Market Factor     | Ratio of market salary by field and rank to current salary  |
| Discipline*       | Humanities, Engineering, Math/Science, Business, Natural Sci., Pre-Professional, Fine Arts, Social Sci., Health Sci., Education |

Key: \* Nominal-coded variable, ^ Continuous metric for each rank  
Data source: HR submitted file

The analysis consisted of the following steps:

1. Canonical correlation to identify possible bias associated with age, gender, and ethnicity/race
2. Binary logistic regression to identify possible bias in tenure promotion
3. Multinomial logistic regression to identify possible bias in rank promotion
4. Multiple linear regression to identify possible inequity in compensation

Variable selection and analytical framework are informed by best practices as recommended in higher education compensation research (see CUPA, 2015; Herzog, 2008; Terpstra & Honoree, 2008; Barbezat, 2004; Toutkoushian, 1998; Moore, 1993; Mincer, 1974).

## TESTING FOR POSSIBLE BIAS ASSOCIATED WITH AGE, GENDER, AND ETHNICITY/RACE

There were two noteworthy canonical correlations that explained 74 percent and 27 percent of the variance within their functions, respectively (Table 1). The first positively correlates age with senior rank (full professor), years in rank, years with tenure, tenure status, years of service at UNR, and years with terminal degree (Table 2). These correlations are expected, as they reflect typical time-related progression in professional status. The second and third canonical functions show that affiliation with engineering is correlated with being female and of Asian background. Specifically, faculty of Asian background are more likely to be in engineering fields, while female faculty (and to a lesser extent non-White/non-Asian faculty) are less likely to be in engineering fields (Table 2). The latter result may be expected, as the pool of females entering the physical sciences, though growing, is still small to make up for long-standing male representation. Conversely, people of Asian background are more likely to be hired as engineering faculty than people of other ethnicities. No other significant correlations involving age, gender, or ethnicity/race emerged from the analysis, following the conventional threshold in factor analysis (i.e., structure coefficients above |.45|). **These findings suggest there is no systematic bias associated with age, gender or ethnicity/race other than the correlation between engineering faculty and people of Asian background and female gender.** The analytical model underpinning these results has high explanatory power, with 83 percent of shared variance between the variable sets across all canonical functions (Wilks'  $\lambda = .17$ , Table 3).

## TESTING FOR POSSIBLE BIAS IN TENURE AND RANK PROMOTION

Of the 432 faculty members with tenure or tenure-track status, **only one case was predicted to be tenured while still on tenure-track.** This person was hired in 2009 with a terminal degree (doctorate received in 2009), teaches in the social sciences, and has an average merit rating of 2.66 (vs. 2.69 for the sample). However, the estimated residual suggests that this case is a strong statistical outlier (using Cook's distance and standardized residuals), not fitting the estimation model, and thus should be looked at on an individual basis. Overall model fit is very good, with an accurate classification rate of 98.6 percent and high explained outcome variance (Pseudo-R-square = .95), offering high confidence in the predicted results (Tables 4 and 5).

**There are six faculty members whose predicted rank is higher than their current rank.** Of those, two tenured associate professors are predicted to be at the rank of full professor. Both were hired at the assistant professor level; one receiving tenure in 1998 with an average merit rating of 3.8, the other was tenured in 2011 with an average merit rating of 4.0. The other four cases include one tenure-track assistant professor (hired in 2009 with average merit of 2.66) and three non-tenure track instructors hired between 2010 and 2013 with average merit ranging from 1.33 to 3.66 (detailed data available under separate cover). The rank prediction model yielded an overall correct rank classification rate of 95 percent (Table 6), and the model explained over 96 percent in rank variation (Nagelkerke R-sq). None of the personal attribute factors (age, gender, ethnicity/race) emerged as a significant predictor of faculty rank (i.e.  $\alpha > 0.05$ , Table 7).

## TESTING FOR POSSIBLE INEQUITY IN COMPENSATION

To identify possible salary inequities associated with age, gender, or ethnicity/race, the analysis proceeded with a multiple linear regression model that takes into account factors that typically determine a person's level of compensation. Predictor variable selection is governed by human

capital theory, the cumulative scholarship on faculty compensation modeling, and decisions rendered in US court cases on salary inequity (see reference list). Salary estimation considers faculty rank, time in rank, rank at hire, tenure status, academic degree, years with academic degree, academic discipline, and comparable market salary by discipline and rank in relation to current salary at UNR. The estimation model uses a semi-logarithmic equation to account for curve-linear effects on salary associated with percentage-based promotion and merit pay raises that typically define the academic career path. Medical School faculty are excluded from the analysis due to the distinctly different compensation niveau.

The estimation model examined whether or not the personal attributes of age, gender, and ethnicity/race exert a significant influence on predicted salary, which may suggest systematic bias in compensation. **Table 8 confirms that when controlling for factors that determine compensation along the academic career ladder, personal attributes had no significant bearing on salary estimation (i.e.  $\alpha > 0.05$ ).** The strongest salary predictors are faculty rank, market factor, and academic discipline (based on Beta coefficients in Table 8). Expectedly, these are the same factors as in previous equity studies. Notably, the effect of average merit rating on predicted salary continues to drop due to the absence of merit pay for a number of years since the 2009 recession (i.e. the Beta coefficient declining from .148 to .069 to .044 for the three study years of 2012, 2016 and 2018, respectively). The model explained over 94 percent of the variation in salary (Table 9), just like the 2016 study. The number of outlier cases—poorly predicted salaries for some individuals—is limited, with only about eight cases outside 2.5 standardized residuals (see Graph 1).

#### **Conversion process for A-contract to B-contract base salary: Standard Operating Practice to Convert Faculty Salaries between Fiscal and Academic Year**

Varied circumstances require that a faculty member's salary be adjusted from a fiscal year (12 month) basis to an academic year (9 month) basis and vice versa. The ratio 9:11 is used rather than 9:12 because faculty members on an academic year appointment do not earn vacation or sick leave, but faculty members on a fiscal year appointment do. The latter earn 24 vacation days of leave annually and thus eleven months of work days are used in the comparison.

To convert a fiscal year salary to an academic year salary, divide by 1.22

$$(\text{fiscal year salary}) / 1.22 = \text{academic year salary}$$

## REFERENCED TABLES

**Table 1**  
Eigenvalues and Canonical Correlations (Bolded = sig.)

| Root No. | Eigenvalue | Pct.     | Cum. Pct. | Canon Cor. | Sq. Cor       |
|----------|------------|----------|-----------|------------|---------------|
| 1        | 2.84771    | 85.66268 | 85.66268  | 0.86029    | <b>0.7401</b> |
| 2        | 0.36344    | 10.93266 | 96.59534  | 0.51629    | <b>0.2666</b> |
| 3        | 0.06602    | 1.98583  | 98.58117  | 0.24885    | 0.0619        |
| 4        | 0.04717    | 1.41883  | 100       | 0.21223    | 0.045         |

**Table 2**  
Correlations between COVARIATES and canonical variables (Bolded = sig.)

| Variable | Function No.   |                |                |
|----------|----------------|----------------|----------------|
|          | 1              | 2              | 3              |
| AVEMT    | .07513         | -.07072        | -.08326        |
| YRWTE    | <b>.76294</b>  | .18500         | .07604         |
| TEN      | <b>.47655</b>  | .17695         | -.07687        |
| TT       | <b>-.52487</b> | .14018         | .24716         |
| HINST    | -.12324        | -.21457        | -.06449        |
| HASSOC   | .37032         | -.01723        | -.03922        |
| HPROF    | .26784         | .16573         | .01303         |
| INST     | -.11096        | .02897         | -.10299        |
| ASSOC    | -.00118        | -.05422        | -.15068        |
| PROF     | <b>.58766</b>  | .19568         | .09935         |
| LONG     | <b>.87913</b>  | .04333         | .04297         |
| LONGP    | <b>.81206</b>  | .13529         | .06379         |
| LASST    | -.20587        | -.14393        | .04600         |
| LASSOC   | <b>.48844</b>  | -.06714        | .06078         |
| LPROF    | <b>.66053</b>  | .32210         | .04677         |
| MSCI     | -.00420        | .23131         | .37639         |
| BUS      | -.02031        | .12709         | -.24443        |
| HEALTHPR | -.02396        | -.31572        | -.12819        |
| HUMFA    | -.03521        | -.14998        | .19380         |
| EDU      | .06174         | -.30620        | -.31749        |
| SOC      | .04337         | -.23867        | .01410         |
| ENGIN    | -.08917        | <b>.65918</b>  | <b>-.48458</b> |
| TermDeg  | .05914         | .30416         | .20330         |
| NoDoc    | -.07480        | -.39887        | -.31573        |
| YrsTermD | <b>.81401</b>  | .20577         | .10798         |
| Age      | <b>.99598</b>  | -.04934        | -.00418        |
| Female   | -.17967        | <b>-.85289</b> | <b>-.46591</b> |
| NonWhite | -.13075        | -.09516        | <b>.54037</b>  |
| Asian    | -.17194        | <b>.55074</b>  | <b>-.72410</b> |

**Table 3**  
Multivariate Tests of Significance (S = 4, M = 10, N = 267)

| Test Name    | Value         | Approx. F | Hypoth. DF | Error DF | Sig. of F |
|--------------|---------------|-----------|------------|----------|-----------|
| Pillais      | 1.11363       | 8.31840   | 100.00     | 2156.00  | .000      |
| Hotellings   | 3.32433       | 17.76852  | 100.00     | 2138.00  | .000      |
| <b>Wilks</b> | <b>.17076</b> | 11.95215  | 100.00     | 2127.49  | .000      |
| Roys         | .74010        | -         | -          | -        | -         |

**Table 4**  
Tenure Prediction Classification Table <sup>a</sup>

| Observed           | Predicted No | Predicted Yes | Percentage Correct |
|--------------------|--------------|---------------|--------------------|
| Tenured No         | 90           | 1             | 98.9               |
| Tenured Yes        | 5            | 336           | 98.5               |
| Overall Percentage | -            | -             | 98.6               |

a. The base value is .789

**Table 5**  
Model Summary

| Step | -2 Log likelihood   | Cox & Snell R Square | Nagelkerke R Square |
|------|---------------------|----------------------|---------------------|
| 1    | 35.070 <sup>a</sup> | .613                 | .953                |

a. Estimation terminated at iteration number 20.

**Table 6**  
Rank Prediction Classification Table

| Observed                         | Predicted Assistant Professor | Predicted Associate Professor | Predicted Full Professor | Predicted Percent Correct |
|----------------------------------|-------------------------------|-------------------------------|--------------------------|---------------------------|
| Assistant Professor (Instructor) | 177                           | 4                             | 0                        | 97.80%                    |
| Associate Professor              | 4                             | 197                           | 2                        | 97.00%                    |
| Full Professor                   | 0                             | 19                            | 162                      | 89.50%                    |
| Overall Percentage               | 32.00%                        | 38.90%                        | 29.00%                   | 94.90%                    |

**Table 7**  
Likelihood Ratio Tests

| Effect          | Model Fitting<br>Criteria -2 Log<br>Likelihood of<br>Reduced Model | Likelihood Ratio<br>Tests Chi-Square | Likelihood Ratio<br>Tests df | Likelihood Ratio<br>Tests Sig. |
|-----------------|--|--------------------------------------|------------------------------|--------------------------------|
| Intercept       | 146.550 <sup>a</sup>   | 0.000                                | 0                            | .                              |
| AVEMT           | 191.466 <sup>b</sup>   | 44.916                               | 2                            | 0                              |
| YrsTermDeg      | 149.789 <sup>b</sup>   | 3.239                                | 2                            | 0.198                          |
| LONG            | 164.564 <sup>b</sup>   | 18.015                               | 2                            | 0                              |
| LASST           | 191.457 <sup>b</sup>   | 44.908                               | 2                            | 0                              |
| LASSOC          | 237.198 <sup>b</sup>   | 90.649                               | 2                            | 0                              |
| LPROF           | 303.064 <sup>b</sup>   | 156.515                              | 2                            | 0                              |
| <b>Age</b>      | 148.129 <sup>b</sup>   | 1.579                                | 2                            | <b>0.454</b>                   |
| TermDeg         | 153.587 <sup>b</sup>   | 7.037                                | 2                            | 0.03                           |
| NoDoc           | 166.171 <sup>b</sup>   | 19.621                               | 2                            | 0                              |
| HINST           | 148.634 <sup>b</sup>   | 2.084                                | 2                            | 0.353                          |
| HASSOC          | 146.713 <sup>b</sup>   | 0.164                                | 2                            | 0.921                          |
| <b>Female</b>   | 148.192 <sup>b</sup>   | 1.642                                | 2                            | <b>0.44</b>                    |
| <b>NonWhite</b> | 152.172 <sup>b</sup>   | 5.623                                | 2                            | <b>0.06</b>                    |
| <b>Asian</b>    | 147.196 <sup>b</sup>   | 0.646                                | 2                            | <b>0.724</b>                   |

**Table 8**  
Salary Prediction Model for Academic Faculty (excluding Medical School)

| Model 1         | Coefficients <sup>a</sup>           |  |                                      |         |              |   |                                   |
|-----------------|-------------------------------------|--|--------------------------------------|---------|--------------|---|-----------------------------------|
|                 | Unstandardized<br>Coefficients<br>B | Unstandardized<br>Coefficients<br>Std. Error | Standardized<br>Coefficients<br>Beta | t       | Sig.         | Collinearity<br>Statistics<br>Tolerance | Collinearity<br>Statistics<br>VIF |
| (Constant)      | 11.204                              | 0.030  |                                      | 379.236 | 0.000        | -                                       | -                                 |
| NoDoc           | -0.079                              | 0.012  | -0.097                               | -6.745  | 0.000        | 0.478                                   | 2.093                             |
| YrsTermDeg      | 0.000                               | 0.001  | -0.019                               | -0.854  | 0.393        | 0.206                                   | 4.853                             |
| TEN             | 0.018                               | 0.013  | 0.027                                | 1.373   | 0.170        | 0.256                                   | 3.910                             |
| TT              | -0.029                              | 0.014  | -0.033                               | -1.988  | 0.047        | 0.360                                   | 2.780                             |
| HINST           | -0.007                              | 0.013  | -0.008                               | -0.537  | 0.592        | 0.474                                   | 2.110                             |
| HASSOC          | 0.025                               | 0.013  | 0.023                                | 1.923   | 0.055        | 0.715                                   | 1.399                             |
| HPROF           | 0.056                               | 0.020  | 0.031                                | 2.712   | 0.007        | 0.740                                   | 1.352                             |
| INST            | -0.053                              | 0.021  | -0.039                               | -2.528  | 0.012        | 0.421                                   | 2.374                             |
| ASSOC           | 0.104                               | 0.018  | 0.157                                | 5.886   | 0.000        | 0.139                                   | 7.185                             |
| PROF            | 0.432                               | 0.021  | 0.630                                | 20.696  | 0.000        | 0.107                                   | 9.377                             |
| LASST           | 0.000                               | 0.001  | 0.001                                | 0.087   | 0.931        | 0.471                                   | 2.124                             |
| LASSOC          | 0.002                               | 0.001  | 0.039                                | 2.450   | 0.015        | 0.385                                   | 2.594                             |
| LPROF           | 0.002                               | 0.001  | 0.046                                | 2.329   | 0.020        | 0.250                                   | 3.994                             |
| AVEMT           | 0.016                               | 0.004  | 0.044                                | 3.776   | 0.000        | 0.722                                   | 1.385                             |
| MSCI            | 0.023                               | 0.013  | 0.022                                | 1.765   | 0.078        | 0.627                                   | 1.596                             |
| BUS             | 0.488                               | 0.015  | 0.418                                | 32.329  | 0.000        | 0.591                                   | 1.692                             |
| HEALTHPROF      | -0.007                              | 0.013  | -0.007                               | -0.524  | 0.600        | 0.583                                   | 1.717                             |
| HUMFA           | -0.132                              | 0.011  | -0.161                               | -11.756 | 0.000        | 0.527                                   | 1.899                             |
| EDU             | -0.034                              | 0.015  | -0.026                               | -2.215  | 0.027        | 0.718                                   | 1.394                             |
| SOC             | -0.031                              | 0.012  | -0.034                               | -2.612  | 0.009        | 0.593                                   | 1.687                             |
| ENGIN           | 0.168                               | 0.013  | 0.176                                | 13.248  | 0.000        | 0.559                                   | 1.788                             |
| MarkFacLn       | -0.870                              | 0.025  | -0.502                               | -34.446 | 0.000        | 0.464                                   | 2.153                             |
| <b>Female</b>   | -0.011                              | 0.007  | -0.017                               | -1.522  | <b>0.129</b> | 0.776                                   | 1.289                             |
| <b>NonWhite</b> | 0.003                               | 0.012  | 0.003                                | 0.251   | <b>0.802</b> | 0.921                                   | 1.086                             |
| <b>Asian</b>    | 0.005                               | 0.011  | 0.005                                | 0.482   | <b>0.630</b> | 0.842                                   | 1.188                             |
| <b>Age</b>      | 0.001                               | 0.001  | 0.034                                | 1.882   | <b>0.060</b> | 0.303                                   | 3.304                             |

a. Dependent Variable: SalaryLn



**Table 9**  
Salary Prediction Model: Explained Variance and Estimation Error

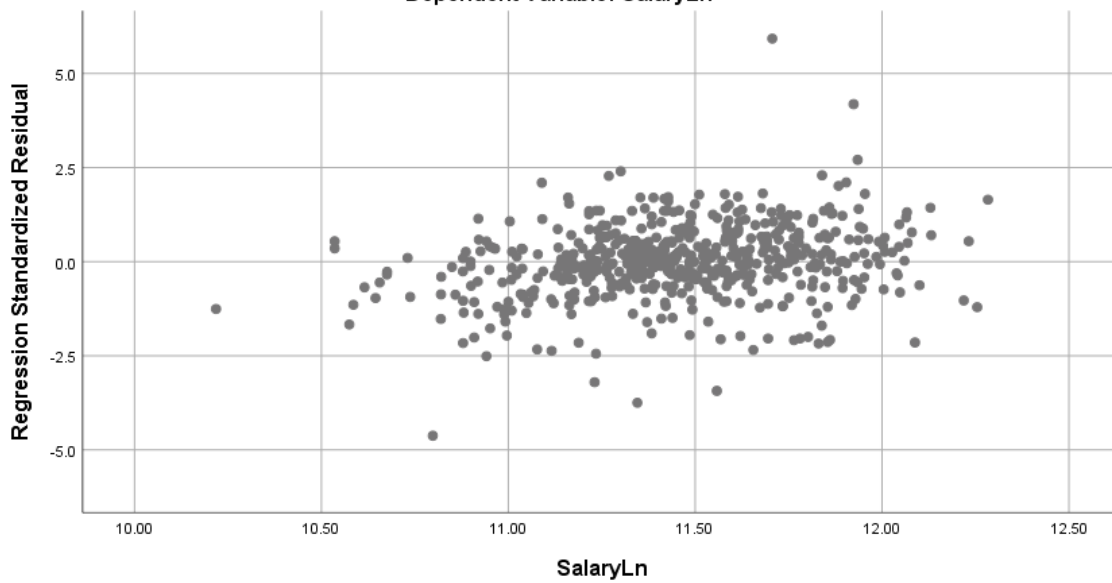
| Model | R                 | Model Summary <sup>b</sup> |                   |                            |
|-------|-------------------|----------------------------|-------------------|----------------------------|
|       |                   | R Square                   | Adjusted R Square | Std. Error of the Estimate |
| 1     | .973 <sup>a</sup> | .947                       | .944              | .07548                     |

a. Predictors: (Constant), Age, ASSOC, BUS, NonWhite, AVEMT, EDU, MSC1, HEALTHPROF, Asian, HINST, HPROF, Female, HASSOC, SOC, LASST, ENGIN, NoDoc, MarkFacLn, HUMFA, LASSOC, INST, TT, TEN, LPROF, YrsTermDeg, PROF  
 b. Dependent Variable: SalaryLn

**Graph 1**

Scatterplot

Dependent Variable: SalaryLn



## References:

- Barbezat, D. A. (2004). A loyalty tax? National measures of academic salary compression. *Research in Higher Education*, 45 (7), 761-776.
- College and University Professional Association for Human Resources [CUPA]. (2015). *Faculty in Higher Education Salary Survey Executive Summary for the 2014-15 Academic Year*. Retrieved on January 25, 2016, at <https://www.cupahr.org/surveys/files/salary2015/FHE4-2015-Executive-Summary.pdf>
- Herzog, S. (2008). A four-step faculty compensation model: From equity analysis to adjustment. *Using Financial and Personnel Data in a Changing World for Institutional Research. New Directions for Institutional Research*, 140. San Francisco: Jossey-Bass.
- Mincer, J. (1974). *Schooling, Experience, and Earnings*. New York and London: Columbia University Press.
- Moore, N. (1993). Faculty salary equity: Issues in regression model selection. *Research in Higher Education*, 34 (1), 107-125.
- Terpstra, D., & Honoree, A. (2008). Faculty perceptions of problems with merit pay plans in institutions of higher education. *Journal of Business and Management*, 14 (1), 43-59.
- Toutkoushian, R. K. (1998). Using regression analysis to determine if faculty salaries are overly compressed. *Research in Higher Education*, 39 (1), 87-100.