Pilot Committee on Working Conditions for Faculty in STEM at Ohio State

October 2011

Summary: A committee of faculty and staff collected and analyzed data on work parameters for faculty in three colleges. Faculty salaries, lab space, startup funds, and teaching assignments were examined as a function of department, rank, and gender. Considerable nuance exists in these data, and the committee took extreme pains to make comparisons that were informative. Overall, we found no evidence of persistent differences between male and female faculty for the variables analyzed, which suggests that deans and chairs do a good job of equalizing these dimensions of the work environment. Even so, some of the data (notably assignments of research space) are highly suspect and point to the need for better institutional monitoring. Furthermore, a key component of workload — service — is not systematically reported for individual faculty.

Background

Comprehensive Equity at Ohio State (CEOS) is a program funded by a five-year $3.6M grant from the National Science Foundation's ADVANCE program. The overall goals of the ADVANCE program are to increase the numbers of women on the faculty in science, technology, engineering, and mathematics disciplines (STEM), and to increase opportunities for academic women to assume leadership roles in their institutions.

At Ohio State, Project CEOS works intensively with three colleges: Veterinary Medicine, Engineering, and the Division of Natural Sciences & Mathematics within the College of Arts & Sciences (NMS). The two principal issues at Ohio State identified by CEOS investigators as different between men and women faculty are retention (especially pre-tenure) and career progression (promotion to Full Professor). Our work on these two core challenges with these colleges is providing insights that will help us to plan for extension of programs to other STEM units on campus.

Several research universities have examined working conditions for faculty in STEM, and some have found persistent differences between men and women in terms of salaries, startup account, lab space, teaching loads, service loads, and other important variables that affect faculty success. A preliminary study of working conditions in the CEOS colleges (2007) had shown no gender disparity in salary. However, the 2008 Culture survey identified other sources of dissatisfaction among our women faculty. Accordingly, it became important to conduct a comprehensive examination of multiple variables that reflect working conditions in the colleges. Our study complements the ongoing culture survey, and has the potential to identify key issues for campus-wide assessment of working conditions. Through our work we also have identified a series of variables that can complicate analysis of data.

PILOT DATA COMMITTEE

In summer 2010, Project CEOS requested that the Office of Academic Affairs commission a study of salaries, lab space assignments, workloads, and other pertinent factors for faculty in the CEOS colleges. Provost Joseph Alutto approved that request. A Pilot Data Committee was appointed to include representatives of the CEOS colleges appointed by the respective deans, the Senate, the Women's Place, and offices that collect and analyze institutional data:

Julie Carpenter-Hubin	Director, Institutional Research and Planning
Laura Gast	Director, Organizational Metrics and Data Analytics
Joan Herbers	PI, Project CEOS and Professor of EEOB
Gene Holland	Chair, Faculty Compensation & Benefits Committee and Professor of Comparative Studies
Jay Johnson	Associate Director, Institutional Research and Planning
Larry Mathes	Professor of Veterinary Biosciences
Hazel Morrow-Jones	Director, The Women's Place
Tom Santner	Professor of Statistics
Yuan Zheng	Professor of Electrical & Computer Engineering

GENERAL METHODOLOGY

The Committee spent several weeks discussing its charge and the kinds of data to be examined. We ultimately settled on four key variables that reflect working conditions: salary; startup accounts; square footage of lab space; and teaching loads. Data on salary are stored in the central Human Resources database. Data on startup accounts offered to incoming faculty were submitted from Dean's offices; area of lab spaces came from the OSURF database as well as college offices; and data on teaching loads came from the Registrar and college offices.

I . Faculty Salaries

Faculty salaries were the trickiest of all metrics to study, because so many factors affect the amount that tenure-track faculty are paid. Rank, market forces, length of service, scholarly record, et al complicate analysis. Assistant professor salaries are the least complicated, because starting salaries are relatively invariant and time in that rank is limited. By contrast, Associate Professor salaries are known to suffer from salary compression (if raise pools do not keep pace with market increases in starting salaries); furthermore, salaries of those who have been in this rank longer than 10 years tend to reflect different forces than those recently promoted from Assistant Professor. Similarly, salaries of Professors are highly variable, reflecting time in rank, market forces (e.g. external offers, hires from other universities) and, sometimes, previous administrative experience. To simplify analysis, we excluded individuals who held administrative appointments, named chairs, or University Professorships.

Methods:
Only tenure-track faculty whose Tenure Initiating Unit (TIU) was in a CEOS college were included in our survey. Thus faculty on research, clinical, and temporary appointments are not included, nor are those with partial and courtesy appointments. We used data on salary from the October 2009 snapshot. All salaries were converted to nine-month equivalents. Individuals with administrative appointments (dean, associate dean, chair, and others) were removed from the data. We also chose to ignore several potential complications (e.g. faculty on sabbatical and thus on partial salary).

Initial data analysis was granular to identify suggestive trends and methods of further analysis. It quickly became apparent that we would have to do some pooling in order to achieve interpretable results. For example, an individual department might have one woman Associate Professor in rank for 3 years and 2 males in rank for 5 years. We chose to aggregate into classes two of our primary variables: time in rank, and department; rank and gender were retained as in the original database. Discussions about how to achieve that aggregation were highly informative about local department culture.

We collapsed time in rank to the following categories:

- Assistant Professors
- Associate Professors in rank 0-5 years
- Associate Professors in rank 6-11 years
- Associate Professors in rank 12+ years
- Professors in rank 0-5 years
- Professors in rank 6-11 years
- Professors in rank 12+ years

We pooled data across departments with similar market conditions and ethos; data were aggregated within, not across, college affiliation:

- Engineering Group 1:
    - Biomedical Engineering
    - Civil & Environmental Engineering and Geodetic Science
- Engineering Group 2
    - Chemical and Biomolecular Engineering
    - Materials Science and Engineering
    - Mechanical Engineering
    - Aviation
    - Aerospace Engineering
- Engineering Group 3
    - Computer Science and Engineering
    - Electrical and Computer Engineering
    - Integrated Systems Engineering
- Knowlton School of Architecture
- NMS Group 1
    - Astronomy
    - Mathematics
    - Physics
    - Statistics
- NMS group 2
    - Biochemistry
    - Chemistry
    - Microbiology
    - Molecular Genetics
    - Plant Cellular & Molecular Biology
- NMS group 3
    - Evolution Ecology & Organismal Biology
    - Earth Sciences
- Veterinary Biosciences
- Veterinary Clinical
    - Veterinary Clinical Sciences
    - Veterinary Preventive Medicine

We then examined salaries as a function of departmental group, rank, time in rank, and gender. A mixed-effects regression model was run first on the entire dataset, and then separately by group.

<u>Findings</u>:

Salary snapshots are given in Figure 1. Visual inspection suggests several patterns, which were born out by statistical analysis:

a) As expected, there are substantial differences among disciplines that reflect market forces.
b) Salary compression among Associate Professors is marked: salaries for individuals with longer tenure at that rank are about the same as those recently promoted
c) Professors earn distinctly more than the other two ranks, as expected. Some department groups show evidence of salary compression at this rank
d) There is no obvious differentiation of salaries by gender in any group of departments or at any rank

Results of a multiple regression of department group, rank, time in rank, and gender on salary explained 56.0% of the variance in the data; the total model was statistically significant (P<0.001), and there was one statistically significant interaction effects among variables we examined. Effects of the independent variables and the one interaction are given in Table 1.

Table 1. Results from a multiple regression of variables on salary.

Source of Variation	**F ratio**	**Probability**
Department Group	25.59	<0.0001
Rank	262.28	<0.0001
Time in Rank	2.32	0.128
Rank * Time in Rank	11.41	<0.0001
Gender	0.08	0.778

Our analysis confirmed that there was no overall disparity of salary between men and women faculty in the colleges we studied. As expected, units varied substantially ("Department Group") and faculty rank was an important source of variation. Overall, time in rank did not affect salary, but it did interact with rank itself. Our interpretation is that Associate Professor salaries remained static despite length of time in tenure whereas, salaries of Professors tended to increase the longer they were in rank. Thus salary compression is most serious among Associate Professors, as expected.

II. Startup Costs

In the STEM disciplines, newly-hired faculty are offered funds to support purchase of equipment, hiring laboratory personnel, and so on. These "startup accounts" are negotiated as part of the original offer, and they can be substantial; for hires at the Professor level, startup accounts exceeding $1M are common in the experimental sciences. There is substantial variation across disciplines with regard to normed startup figures, and even within departments there can be wide variation that depends on the research area of faculty being hired.

Methods:
There are no standard definitions for what is included in startup costs. In addition to the startup funds, commitments are sometimes made to new faculty in the form of laboratory/office renovations, major equipment purchase, summer salary support, graduate assistant support, and time released from teaching. We decided to focus solely on the startup account *sensu stricto* and ignore other forms of faculty support for new hires.

Startup account data were provided by college offices; for NMS we had data for the 2003 -2011 academic years; for Engineering and Veterinary Medicine we had data from 2006-2011 for faculty hired between 2003 and 2010. We examined these data points as a function of department, rank, and gender; an initial analysis showed we had low statistical power, and subsequent analyses combined data from units that *a priori* were judged to have similar markets for startup accounts.

We had data on startup accounts for 110 faculty in NMS, 68 faculty in Engineering, and 49 faculty in Veterinary Medicine (including 9 faculty hired on clinical track who required equipment purchases). There were too few data in any one department to allow for meaningful comparisons between male and female faculty, especially for senior hires; for statistical analysis we combined data from some departments with similar research infrastructure needs. Units in Engineering and Veterinary Medicine were unchanged from the assignments above, and we grouped units in NMR a bit differently to yield the following sets for analysis:

- Engineering Group 1:
    - Biomedical Engineering
    - Civil & Environmental Engineering and Geodetic Science
- Engineering Group 2
    - Chemical and Biomolecular Engineering
    - Materials Science and Engineering
    - Mechanical Engineering
    - Aviation
    - Aerospace Engineering
- Engineering Group 3
    - Computer Science and Engineering
    - Electrical and Computer Engineering
    - Integrated Systems Engineering
- Knowlton School of Architecture
- NMS Group 1
    - Astronomy
    - Chemistry
    - Physics
- NMS group 2

    - Mathematics
    - Statistics
- NMS Group 3
    - Biochemistry
    - Chemistry
    - Microbiology
    - Molecular Genetics
    - Plant Cellular & Molecular Biology
- NMS group 4
    - Evolution Ecology & Organismal Biology
    - Earth Sciences
- Veterinary Biosciences
- Veterinary Clinical
    - Veterinary Clinical Sciences
    - Veterinary Preventive Medicine

Findings
The data are summarized in Figure 2. Hires at Associate and Professor ranks were few in number, rendering statistical analysis inappropriate. Even so, there is no evidence from the data of systemic bias: average startups for all Associate Professors were $303,153 for men and $265,205 for women; and for Professors men had startup accounts averaging $832,186 and women $809,362.

We had sufficient data to analyze startups for men and women junior faculty. A 2-way ANOVA showed that most of the variation was accounted for by disciplinary differences, with no effect of gender on startup account size ($P>0.05$).

III. Lab Space

For many faculty, lab space is the most precious resource the university provides. Space is prized in particular by experimentalists, who must have sufficient square footage to house specialized equipment; bench space for students, postdocs, and technicians; ancillary spaces such as conference rooms, common equipment rooms, and office space contribute to faculty research productivity as well. The quality of the lab space matters as well, and every chair knows that being able to show prospective faculty members clean modern lab space is an important recruitment tool. Assignment of lab space is typically the purview of the unit chair, and often involves negotiations throughout a faculty member's career.

Methods
A global space audit was performed recently by Facilities Operations and Development, but salient data (rank and gender of assignee) were not gathered as part of that exercise.

Data from the Office of Research report square footage assigned to faculty who have external funding; these data are collected in order to negotiate Facilities &Administration rates (also known as overhead or incorrect costs) with the federal government. Faculty without funding (including new hires as well as more senior faculty) are not included in this database. We used the 2007 space census, and ignored shared space, equipment space, and office space, focusing solely on square footage of research laboratory. The Division of Natural and Mathematical Sciences had a comprehensive database they shared with us, but similarly complete data were not available from the other units.

Analysis of space assignments must take into account a variety of factors that are important for faculty research productivity. First, faculty have access to "shared space", which often contains large items of equipment or other facilities used by many investigators. Second, while each faculty member has one office, their personnel also occupy office space; thus depending on how many postdocs, technicians, and graduate students work in a lab group, support space for personnel can vary widely. We chose to examine therefore just the data for experimental lab space used by one faculty members' research group, e.g. main laboratory space.

Space data were analyzed via a regression model with rank, gender, total external funding, and department as independent variables.

Findings

The data are summarized in Figure 3. It is clear from that figure that men and women overall have similar-sized laboratories; indeed, our statistical analysis yielded no significant effect of gender on the average size of lab space assigned to faculty. Yet those averages hide considerable nuance. It would be desirable to analyze laboratory space assignments as a function of academic rank and amount of external funding; it also would be highly desirable to understand how access to shared equipment and office space for lab personnel are assigned within units. Furthermore, there are no metrics for the *quality* of lab space currently available. Experimental faculty in STEM departments value high-quality space (access to shared equipment, reliable power and adequate ventiliation) more than quantity.

We admit to extreme frustration that lab space, which is crucial to faculty success, is so poorly understood by the university. Acquiring useful data has proven extremely difficult, and there is considerable opportunity for Ohio State to improve its internal monitoring and reporting of how it uses space.

IV. Teaching Assignments

Methods

We examined data from the Registrar for teaching assignments in academic years 07 through 09 (three years, before the Student Information System conversion occurred). Those data originate in departments when they report centrally on teaching assignments. We considered numerous complications in the data:

1) units vary substantially in how they report instructors of record for courses taught by more than one faculty member. In some cases a single course is taught by 4-5 faculty, yet only one is recorded in the central database
2) units vary substantially in their protocols for enrolling students in a variety of independent study/research courses. We thus pooled all x93 – x99 courses into the category of individual instruction
3) faculty on sabbatical and those supported during the academic year on external funding by definition have reduced teaching loads
4) faculty with administrative appointments often have reduced teaching loads

We examined four independent variables: N of courses, total N of credits taught, N of contact hours, and total N of students taught. Course numbering conventions vary substantially across units. Even so, we decided to separate courses into lower division undergraduate (100– 299); upper-division undergraduate and beginning graduate (300 – 599) and graduate (600 – 799), fully recognizing that these categories are not mutually exclusive.

It quickly became apparent that the teaching culture varied substantially across the three CEOS colleges. Team-teaching is the norm in Veterinary Medicine but relatively rare in some other units; some units have substantial undergraduate teaching responsibilities whereas others engage primarily in graduate instruction.

Separate regression analyses were conducted on the dependent variables above for 1) all data; and 2) didactic classroom teaching only (e.g. excluding x93 – x99).

Findings

After trying to use the Registrar's data for the College of Veterinary Medicine, we decided instead to use self-reported information. Veterinary Medicine uses team-teaching in virtually all its offerings and only the "team leader" is reported to the Registrar; thus data obtained from the Registrar for Veterinary Medicine fail to capture the intricacies of multiple faculty providing instruction throughout the curriculum. Data were available for 2008-2009 from the College office for the regular course offerings (no independent study/graduate student research credits), and were reported as credit hours of time assigned.

We had data for three academic years for Engineering and NMS (2006-2008). Those data included information on offerings of the various independent study courses (x93 - x99); we ran separate analyses on teaching assignments with and without those independent study offerings, and also ran separate analyses for each of the three academic years. We used several measures of teaching load: 1) Number of courses 2) Number of students taught 3) Student Credit Hours Generated and 4) contact hours. Of those four measures, our committee believes that (1) Number of courses and (3) Student Credit Hours generated are the best metrics for teaching loads within the two colleges.

Summaries of teaching assignments for tenure-track faculty are given in Figure 4. Visual inspection of those charts shows a fundamental complication our committee wrestled with: across the three colleges, the numbers, types and enrollments in courses were fundamentally different. In addition to the different metrics used for Vet Med vrs Eng + NMS, the latter two differed in important ways: Engineering faculty taught predominantly upper-division and graduate courses whereas NMS faculty expended a greater proportion of their effort teaching lower-division courses. Thus we focused on variation within colleges, as a function of faculty rank and gender.

Overall, we found that faculty rank was an important predictor of teaching load in Vet Med and NMS, but not in Eng. In Vet Med and NMS, Associate Professors generated more SCH than the other ranks. The only hint of gender differences in teaching assignments for any year and variable was the increased proportion of laboratory instruction assigned to women Associate Professors in Vet Med. No other measures of teaching load were significantly different between genders in any units.

The greatest variation in teaching load came from enrollments in the independent studies courses (x93 - x99). These data are particularly difficult to interpret. Faculty in STEM tend to have complete discretion accepting undergraduate researchers and graduate students to their groups; it is not unusual for lab size to vary over an order of magnitude among faculty within the same department. Furthermore, many STEM faculty provide oversight to research students who are not enrolled for credits under their direction (e.g. student guests from collaborators' institutions). Thus available data fail to capture all that faculty do to oversee research efforts by students and is open to misinterpretation. We therefore do not report any of those data here.

Summary and directions for future analysis

Overall we found no gender differences in four metrics related to work environments. Our results show that for these units, deans and chairs have done a very good job equilibrating the assignments and reward structures between male and female faculty. This interpretation is further strengthened by results from the OSU culture survey that showed no differences between men and women faculty in their satisfaction with salary, lab space, and teaching assignments.

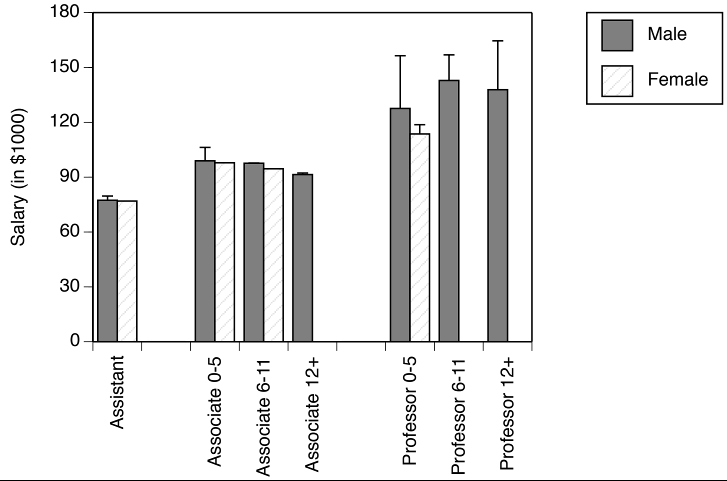
Even so, the culture survey did point out areas of dissatisfaction that are gendered. An important component of our work environment lies in service, particularly advising loads and committee assignments. Service within departments is typically allocated by the chair, whereas other kinds of service (broader university service, service to the profession) are controlled by the individual faculty member. A recent study showed that women faculty perform substantially more service than do their male counterparts, especially within departments (Misra et al. 2011). Here at Ohio State, women faculty likewise report a greater proportion of their time spent in service work; a study of service loads from department data would be highly instructive.

Reference

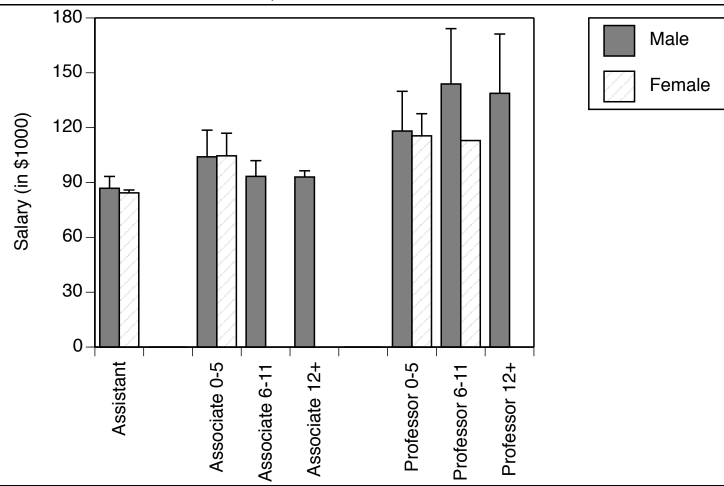
Misra, J, J H Lundquist, E Holmes, and S Agiomavritis. 2011. The ivory ceiling of service work. *Academe* Jan 2011

Figure 1. Salaries (mean + s.d) for faculty by groups define on pages 3-4. Note we used the same scale for all groups.

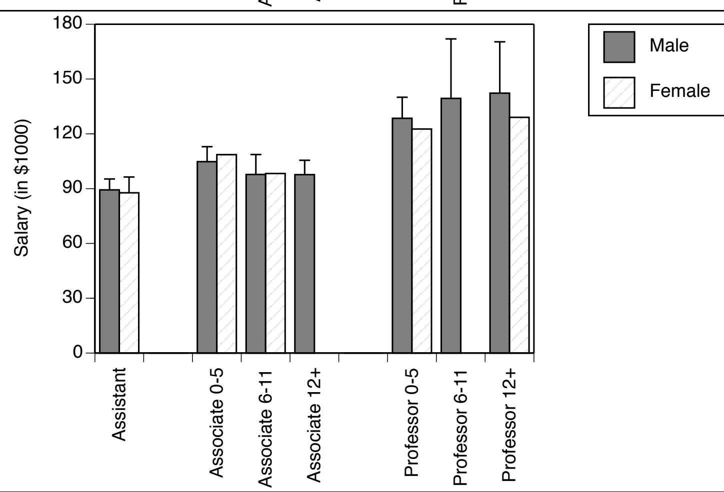
Engineering Group 1

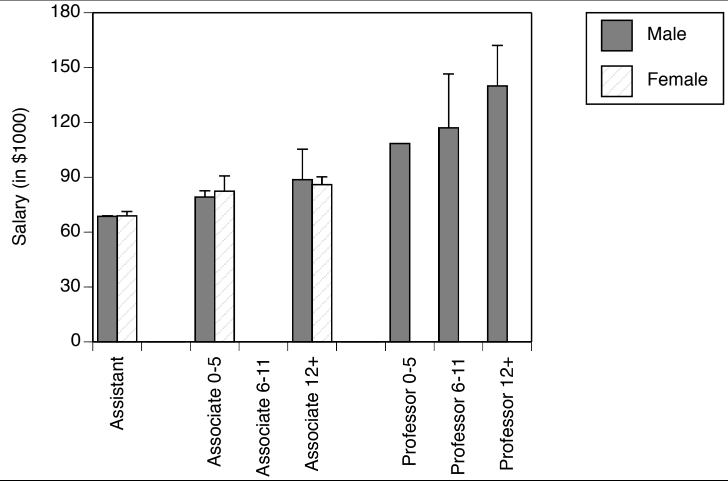
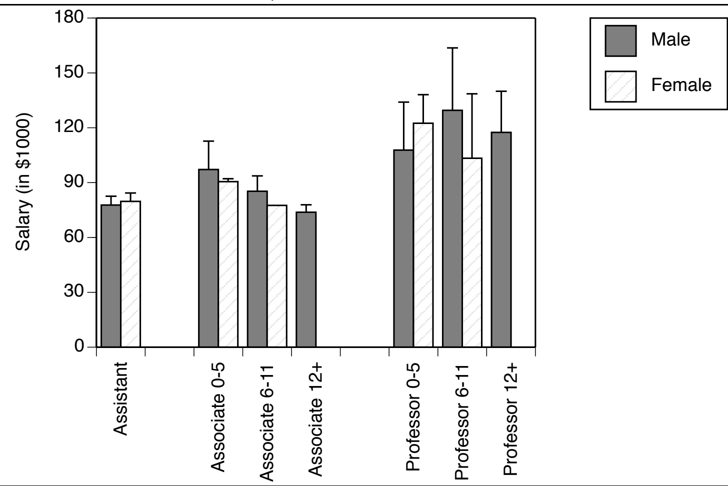
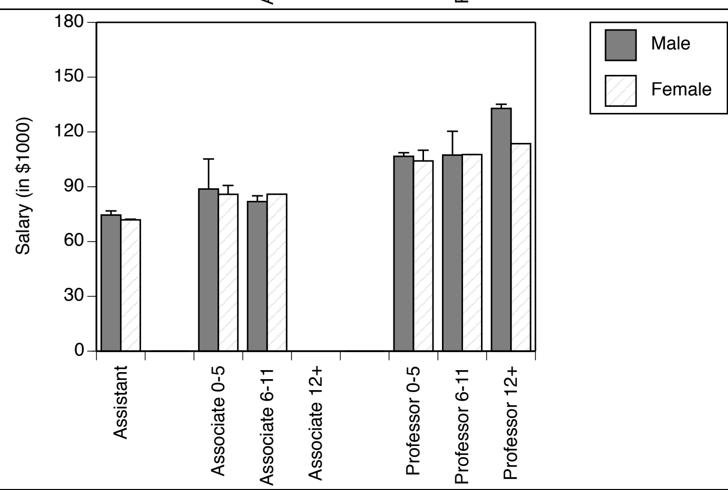


Engineering Group 2



Engineering Group 3



Knowlton School	
NMS Group 1	
NMS Group 2	

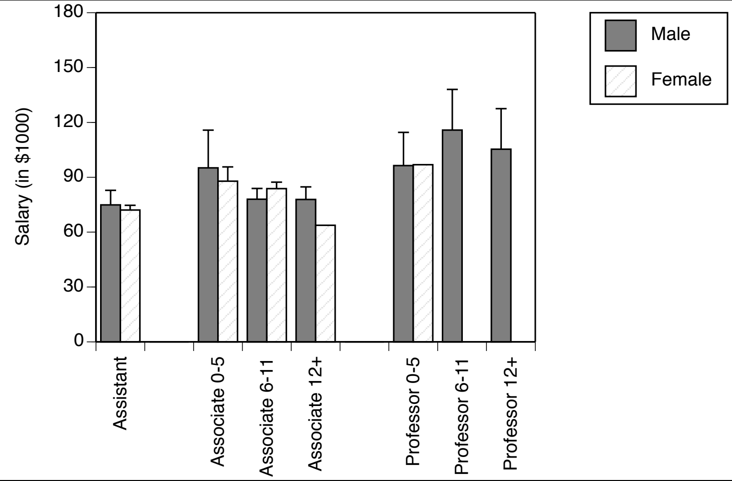
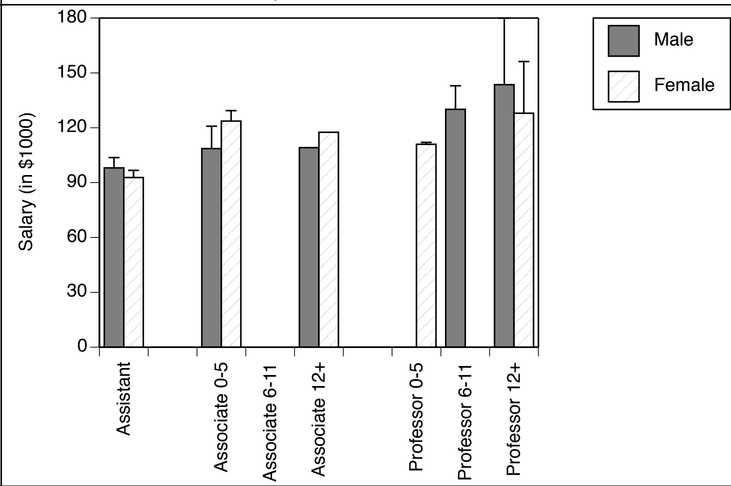
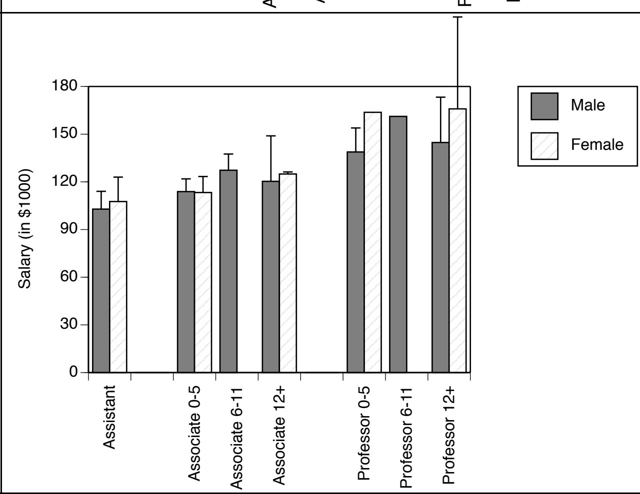
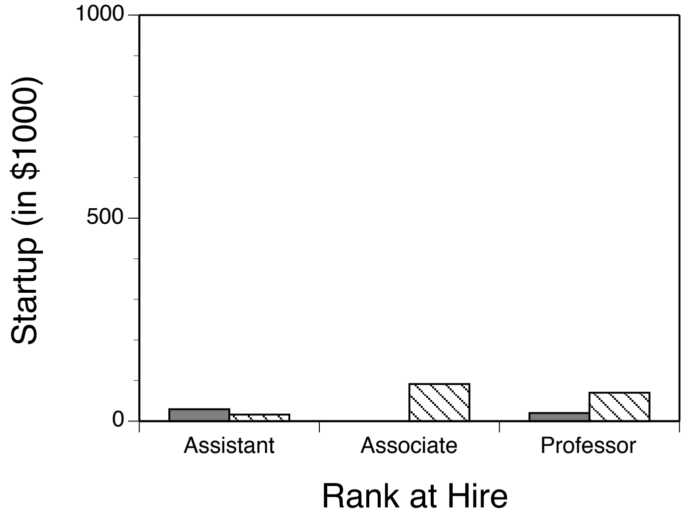
NMS Group 3	
Vet Med Basic	
Vet Med Clinical	

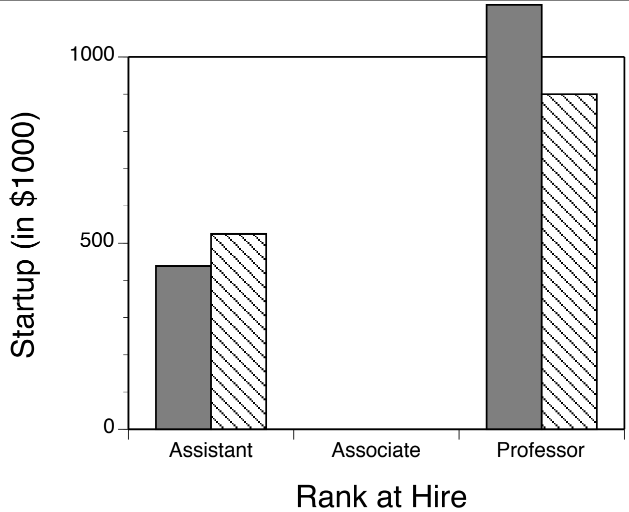
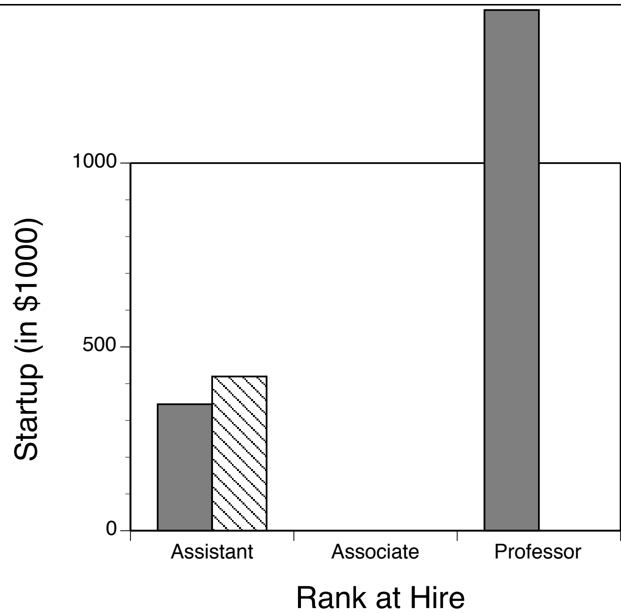
Figure 2. Startup costs. Departments are grouped as described on pages 6-7. With one exception, we used the same scale for all groups.**

Engineering
Group 1

Engineering
Group 2

Engineering
Group 3

Knowlton School	
NMS Group 1**	
NMS Group 2	

NMS Group 3	
NMS Group 4	
Vet Med Basic	

Vet Med Clinical	

Figure 3. Average lab space assignments within each college.

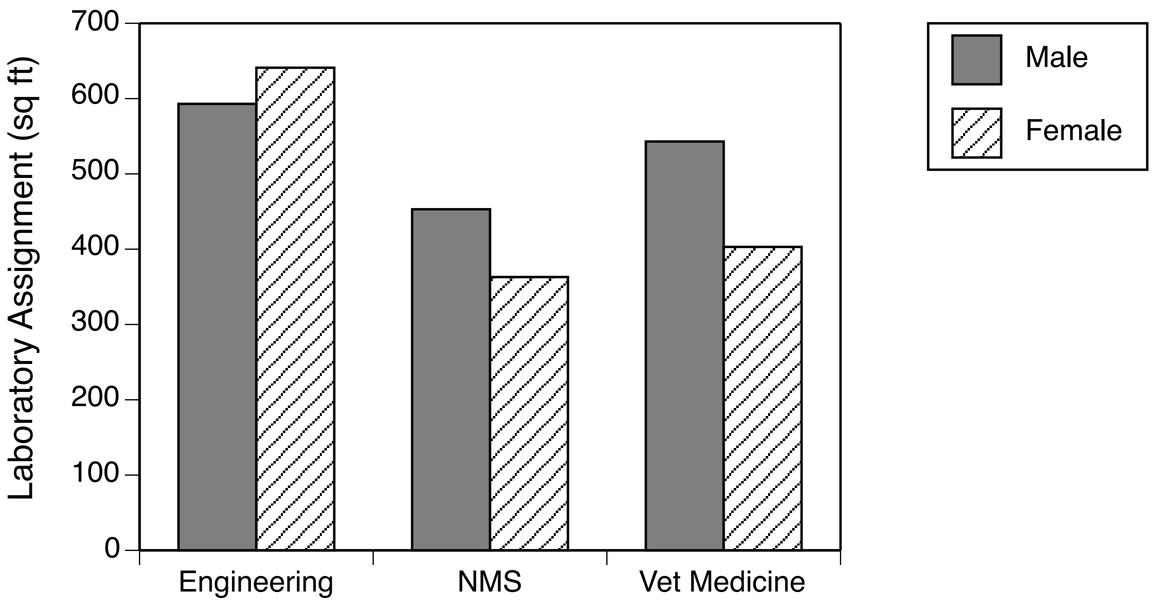
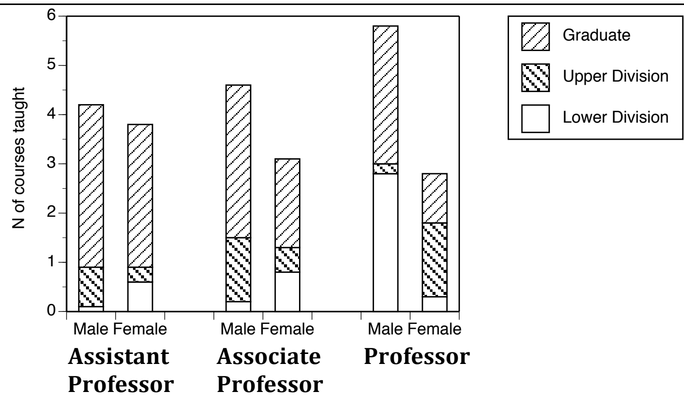
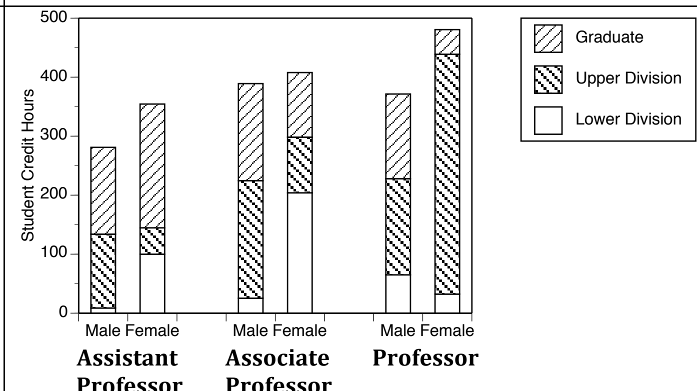


Figure 4. Teaching Assignments (excluding independent study and research credits). For each college, we looked at the number of courses taught, as well as the number of student credit hours generated per faculty member.

<table>
<tr><th>College</th><th>Courses</th><th>Student Credit Hours</th></tr>
<tr><td>Engineering</td><td>
</td><td>
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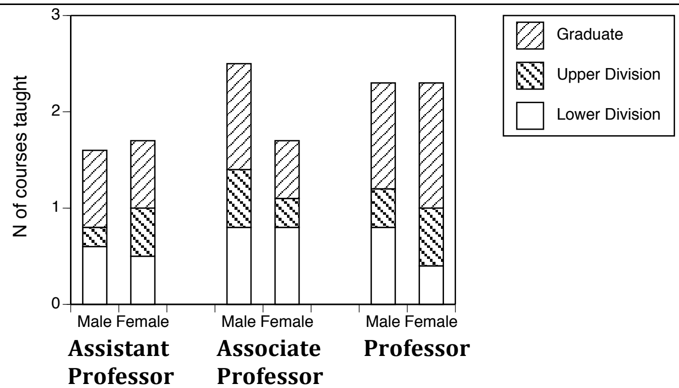
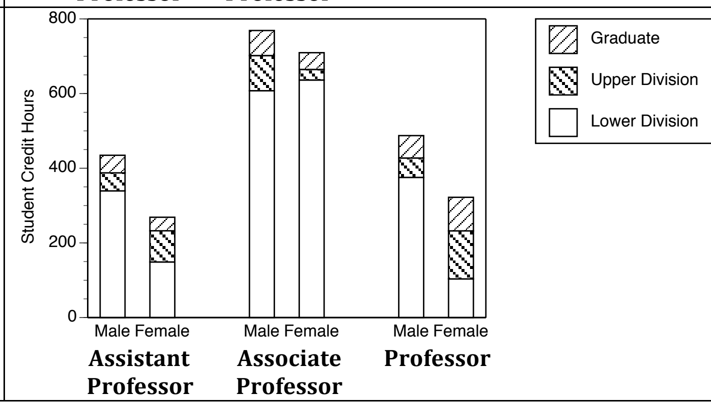
<tr><td>Natural and Mathematical Sciences</td><td>
</td><td>
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Veterinary Medicine