Paper 163-2011

A Detailed Examination of Workload Assigned and Faculty Productivity: Social Networks Using SAS® Enterprise Guide® and SAS Text Miner®

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ABSTRACT

Several motivations drive the need for truthful faculty workload and productivity analysis, including enhancing educational quality and resource reduction under the current economic crisis. The purpose of this study is to examine assigned faculty workloads in Biology and Mathematics Departments and to compare them with faculty productivity as listed in faculty workload assignments. Some departments tend to use minimum administrative positions while others use higher numbers. This study used publicly available records at the University of Louisville to compare and contrast the two departments. Enterprise Guide and SAS Text Miner were employed to investigate the data within the context of social network analysis. It was shown that Biology is more productive compared to Mathematics in terms of research and grants received. Also, it was shown that such global comparisons between departments are useful for faculty outcomes optimization. For instance, Mathematics has increased the number of administrative positions that include course release, with six such positions in spite of having only 25% of the students compared to Biology

INTRODUCTION

For many years faculty workload and productivity has been studied for many reasons such as efficiency, performance or enhancing academic policies; on the other hand, those studies have different approaches. The term “Faculty workload” has been defined with different perspectives and viewpoints; for example, referring to a teaching percentage, research activity or community services in addition to administrative roles to enhance overall department performances. The term “Faculty Productivity” was used to measure what was produced on faculty time; for example, the number of publications, number of instructed classes and external grants.

In this study, we compare the Departments of Mathematics and Biology to see if there are differences in the levels of workloads and productivity between them; that is, to see if there are differences in the social network structure. We investigate both workload plans and curriculum vita. In particular, we show that biology places more emphasis on external grants; the faculty have a much higher level of such grants. We also compare the number of publications as well as the allocation of time for research. There are some troubling aspects in that faculty who have ceased to publish receive up to 25% of their time for research. In addition, many faculty members move on to administration with considerable time allocated to service. It appears that some roles have inflated percentages while others are under-valued in terms of workload.

Teaching and research represent significant portions of faculty time, which highlight the need to examine in detail how faculty utilize their research time. It revealed that there is no uniform approach on how faculty members use their research time; for example, some faculty will use it on internal or non-funded research while others will focus on external grants more.

DATA SUMMARY

Faculty work plans and curriculum vita use two types of variables: interval and nominal. As shown in Table 1, Biology (BIO) and Mathematics (Math) Departments are equally represented in the sample.

Dept				
Dept	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
Bio	52	50.00	52	50.00
Math	52	50.00	104	100.00

Table 1: Department’s Frequency

For data extraction, the most recent curriculum vita has been used, as well work plans (AWP) collected for the years 2004-2009 as shown in Table 2; the most recent years represent the largest portion of the dataset.

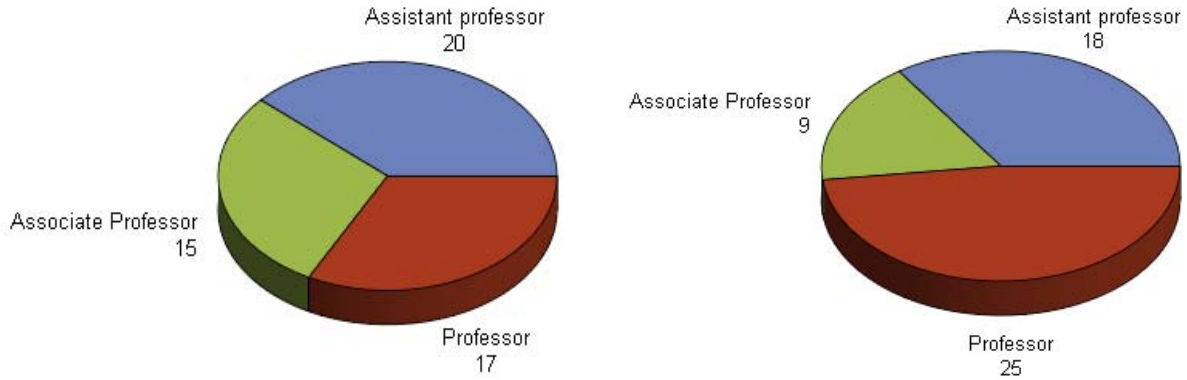
Year				
Year	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
2004-2005	1	0.96	1	0.96
2006-2007	19	18.27	20	19.23
2007-2008	38	36.54	58	55.77
2008-2009	46	44.23	104	100.00

Table 2: AWP Year's Frequency

Since participant's rank is an important factor in faculty workload and productivity analysis, the dataset included the different faculty ranks: Assistant professor, Associate Professor and Professor. As shown on the following table (Table 3), the highest contribution was by Professor Rank followed by Assistant and then Associate Professor. Figure 1 shows the mass distribution of each rank over the departments.

Rank				
Rank	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
Assistant professor	38	36.54	38	36.54
Associate Professor	24	23.08	62	59.62
Professor	42	40.38	104	100.00

Table 3: Rank's Frequency



BIOLOGY Department MATH Department

Figure 1: Faculty's Rank Frequency per Department

Another significant factor for faculty workload analysis is the number of active external grants. Table 4 shows NIH and NSF are the most popular funding organizations where they represent seventy percent of the current active external grants.

External Grants				
Funding Org.	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Bayer Pharma	1	3.45	1	3.45
EPA	1	3.45	2	6.90
NIH	13	44.83	15	51.72
NSF	7	24.14	22	75.86
ORAU	1	3.45	23	79.31
Shulsky	2	6.90	25	86.21
US NPS	1	3.45	26	89.66
USDA	2	6.90	28	96.55
N/A	1	3.45	29	100.00

Table 4: Funding Organization's Frequency

By comparing Mathematics and Biology Departments in terms of active external grants, it was clear that the Biology Department has considerably more variability in funding organizations, which is not valid for the Mathematics Department as Figures 2 and 3 show.

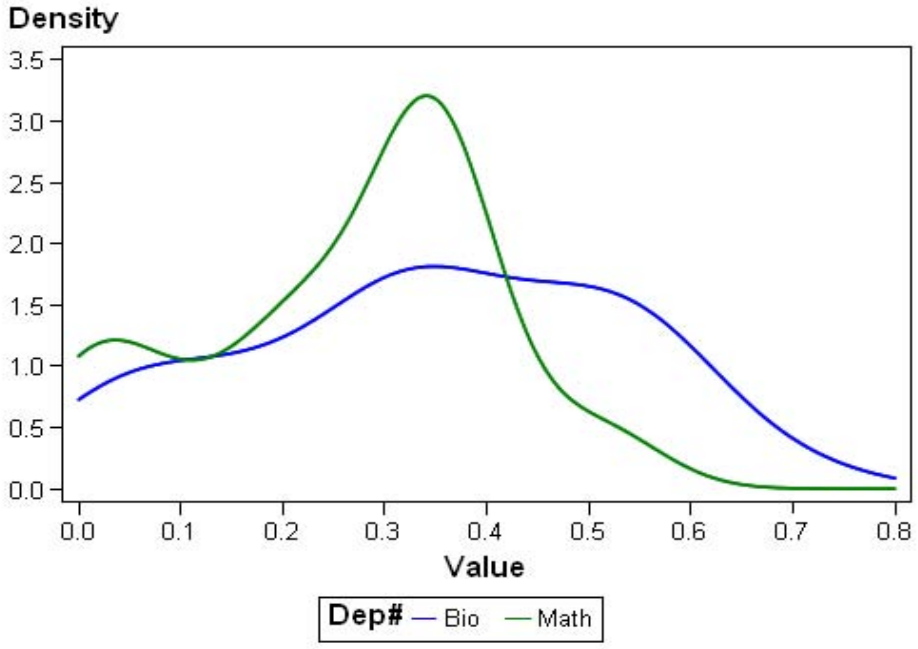


Figure 2: Assignment of Workload to Research Activities

As shown by the above figure, the Mathematics Departments has fewer external fund sources while the Biology Department has larger number of external fund sources. This fact reflects how active the Biology Department members in applying and granting research funds. Also it is clear that the Biology Department get funds from different organizations.

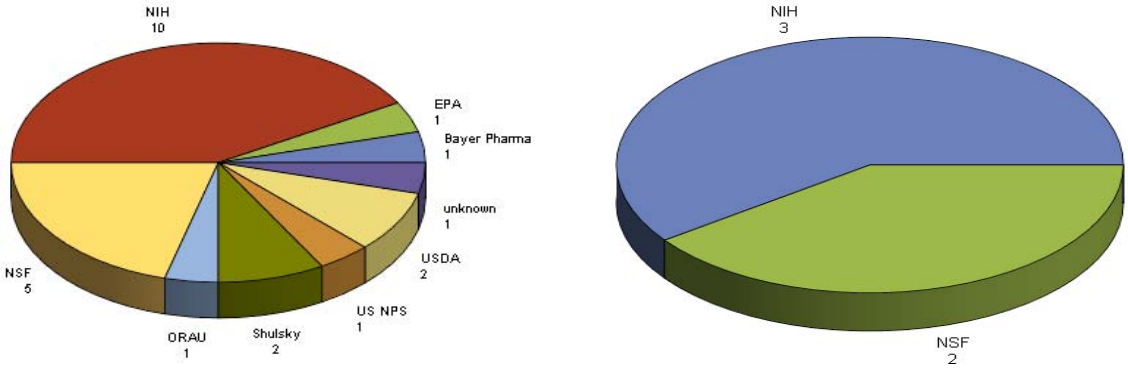


Figure 3: Active External Grants

In contrast, the research for Mathematics peaks sharply around 35%. The teaching assignment is lower for Biology compared to Mathematics (Figure 4).

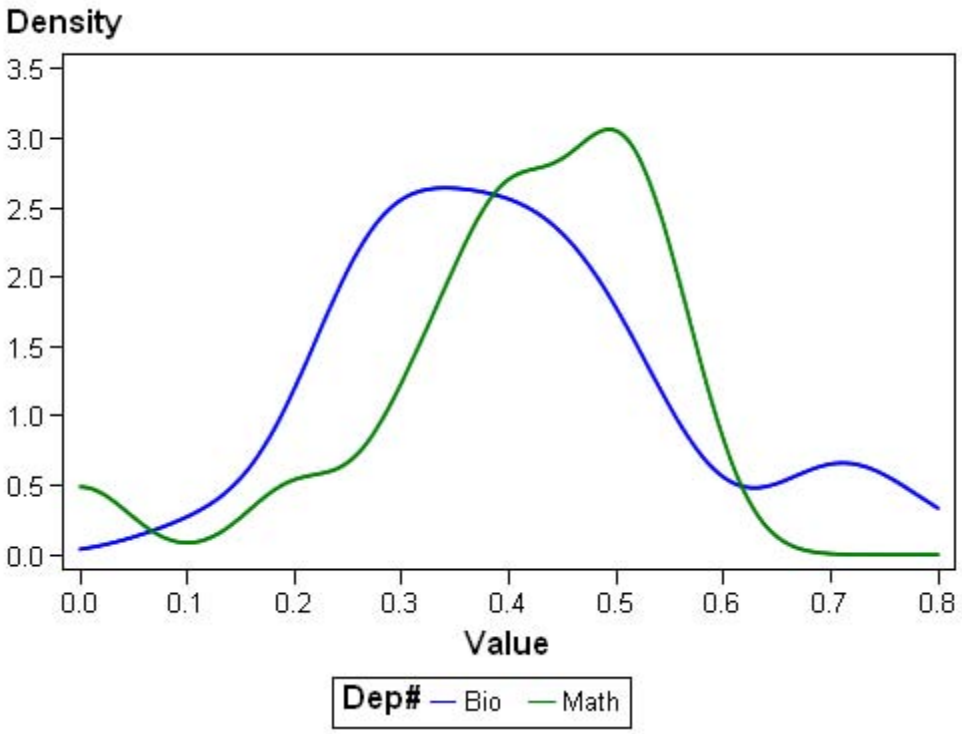


Figure 4: Assignment of Workload to Classroom Teaching Activities

Mathematics peaks at 50% while Biology peaks at 35%. The potential reason that the Biology Department has a lower teaching load and a more varied research load is very likely because of grant activity. Therefore, we want to examine the number of grants by department. We also want to examine teaching activities other than those in the classroom. As it turns out, the Department of Biology has a very high proportion of time for student theses and dissertations; the Department of Mathematics has a negligible allocation for this activity. Figure 5 gives the allocation for the Department of Biology. Note that the peak is 4%, with a high of 14%.

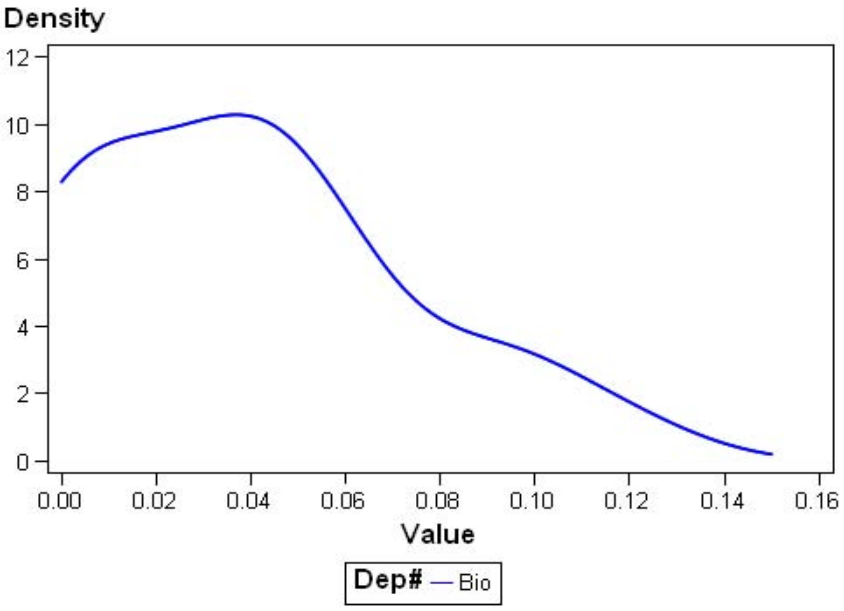


Figure 5: Time Allocated to Supervise Theses and Dissertations

For the three-year period 2006-2007, 2007-2008, 2008-2009, Biology supervised 153 thesis students allocating 82% of an FTE to do so. In the same time period, Mathematics supervised 21 students for 18% of an FTE. There is also a difference in the number of grants by department. Over the three year period, Biology has 27 grants; in the same time period, Mathematics has 7. It suggests that grants are far more highly valued in the Department of Biology compared to the Department of Mathematics. In addition the publication number for the MATH department is much less than the Biology Department as shown by the KDE in the following figure (figure 6). Also, the number of publications reflect that the Biology Department is more productive, which is the typical outcome for a higher number of research grants and a high proportion of time for student theses and dissertations supervision.

Interestingly enough, the Department of Mathematics has 2.70 FTE's allocated for administrative activities while the Department of Biology has only 1.175. It is not clear just why the Department requires more administrative time, so we will investigate the positions in more detail.

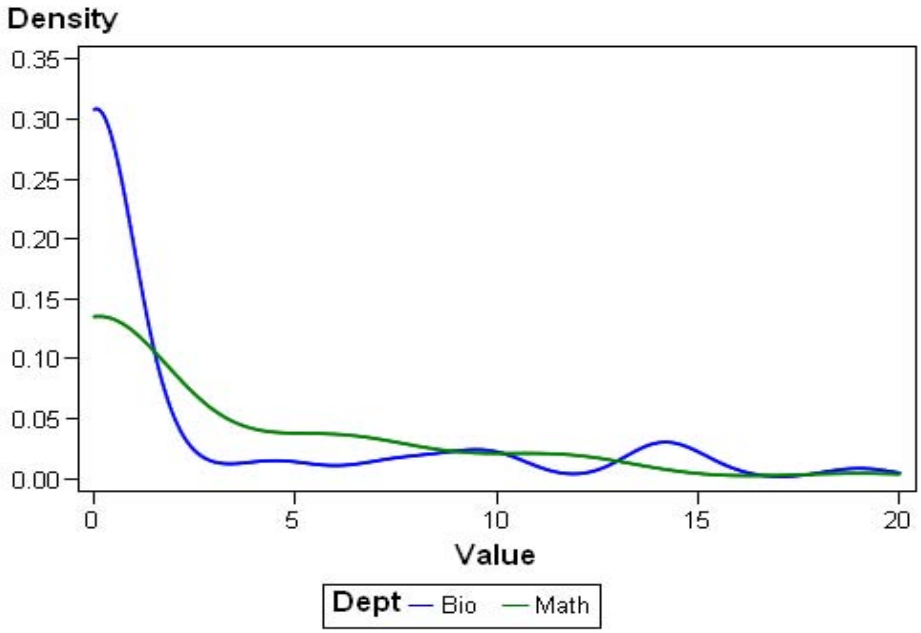


Figure 6: Publication number per department

It is clear the most of the Assistant professor population is contained in a narrow area while the Professor rank shows wider variability as well as the Associate professor as shown on Figure 7.

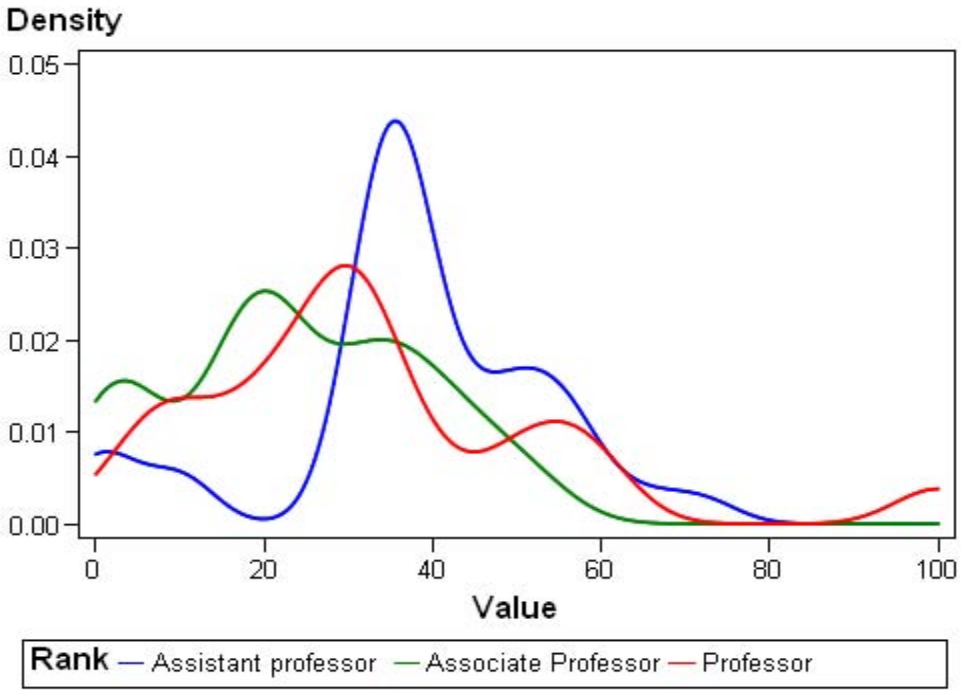


Figure 7: Research by Rank

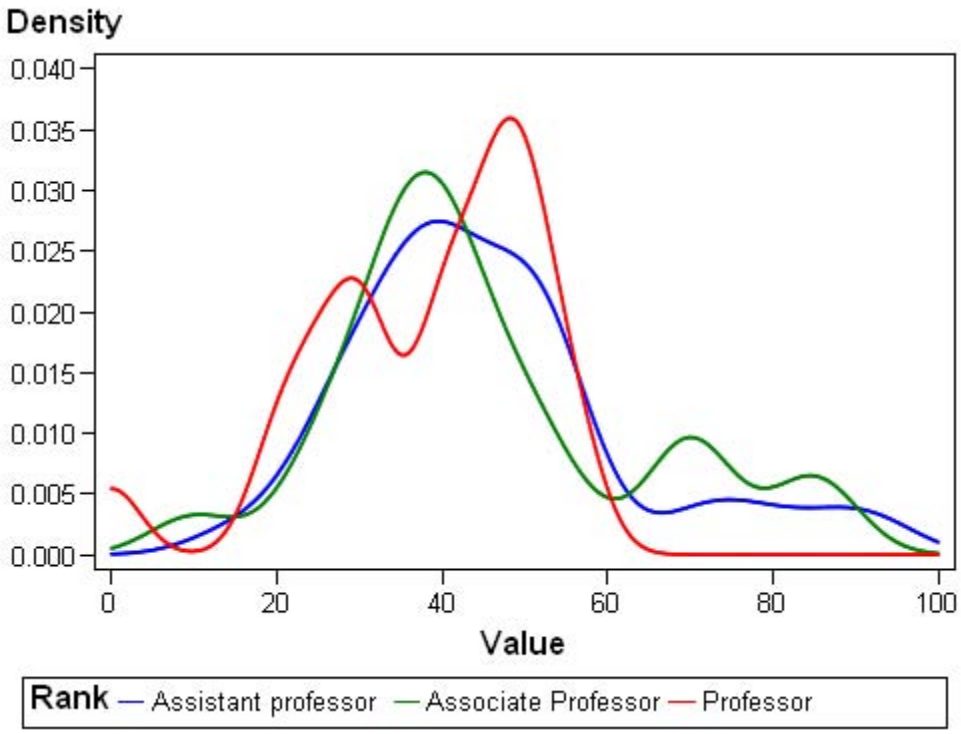


Figure 8: Teaching assignment by Rank

Figure 8 shows professor teaching density is concentrated on two peaks, while the Assistant professor teaching illustrates more variability.

DATA MINING

Time allocation analysis is not informative enough about the nature of the assignments; in this section, we will investigate research, service, and administrative activities by Department. We use text analysis to study the faculty workload by creating a social network define the relation between each task and the correlated tasks or terms.

SERVICE

Table 5 gives a grouping of the service assignments. Most of the service responsibilities (58) cluster focus on coordination and student advising. The next highest number (24) has to do with reviewing proposals and manuscripts. There are some who speak to recruit students (10) and those who sit on boards (13). There remain a few who are listed as giving lectures. These should be combined with those who recruit students in cluster 2. Therefore, we can reduce the six clusters to a total of four. We want to see if there is a difference in cluster membership with relationship to the two Departments. Figure 9 gives the concept links related to administration.

Clusters

#	Descriptive Terms	Freq	Percentage	RMS Std.
1	coordinator, reader, fair reader, co-coordinator, coordination, symposium, webmaster, student advising, student, advising	58	0.517857142...	0.1848407...
2	fair judge, + uofl speaker, + speaker, + presentation, uofl, profession, profession committee, trip, stusent advising, stusent	10	0.089285714...	0.2464886...
3	mcgraw hill, mcgraw, hill, chapter reviewer, chapter, student advising, student, reviewer, advising, committee	3	0.026785714...	4.4554151...
4	board, chair, board member, supervisor, fair board, assistant chair, assistant, director, member, coaching	13	0.116071428...	0.1817813...
5	+ lecture, + community lecture, professional, + medium, + medium relation, + professional lecture, + relation, + seminar, consultant, community	4	0.035714285...	0.0534309...
6	proposal, nsf proposal reviewer, nsf, steering, associate, associate editor, community steering committee, proposal reviewer, + manuscript, + manuscript reviewer	24	0.214285714...	0.1774007...

Table 5: Service Assignments by Group

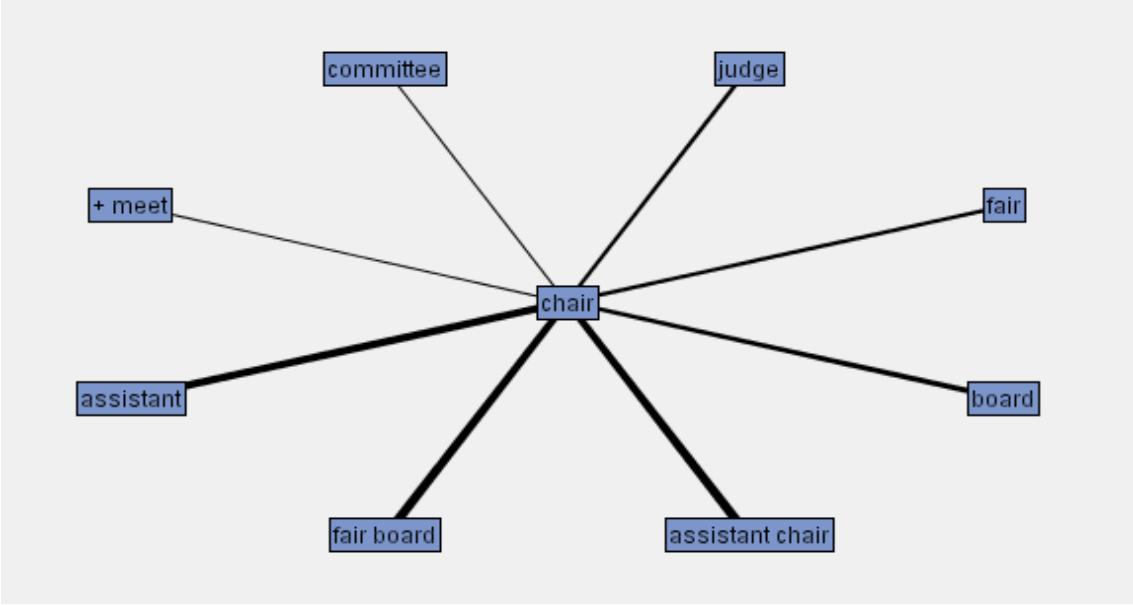


Figure 9: Concept Links for Administration

The position of Chair is related to assistant chair and to meetings. It suggests that the role of Chair is not fully described. To discover the job description, we need to examine the university bylaws and personnel policies. Table 6 gives the different positions in the Department of Mathematics that include administrative time. The Department of Biology only has a position for department chair.

Administration				
Administration	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
Assistant Chair	2	18.18	2	18.18
Chair	2	18.18	4	36.36
Graduate Studies Director	2	18.18	6	54.55
Undergraduate advising coordinator	1	9.09	7	63.64
Undergraduate director	2	18.18	9	81.82
internship director	2	18.18	11	100.00

Table 6: Administrative Positions in the Department of Mathematics

At the same time, the Department of Mathematics has considerably fewer majors compared to Biology, which brings into question just why so many administrative and advising positions are required.

SOCIAL NETWORK ANALYSIS

A successful team management process reduces the stress on team members and increases organization value. It is very important to designate between creating a team work culture and developing an efficient team.

Social network analysis practices a powerful yet simple tool for team building, and management, where the use of social network analysis tool enhances a team member's selection process to achieve the team goals. Any social network consists of two sets: a set of vertices/nodes, and a set of edges/connections.

(1) Node: is the smallest building unit of social network where it can be Individuals, Employees, Teams, Business units or organizations.
(2) Relations: describes how the nodes are connected as they can by one or more of the types of interdependency such as Experience, Knowledge, Friendship, or workloads.

We look at the different aspects of a faculty workload: teaching, research and service. We first look at the research assignments.

One of the important factors in team success is the stress in team member relations. The following formula defines the relations stress level:

$$\frac{\text{(Proximity of the two people) x (importance they succeed together)}}{\text{(Compatibility of their personalities)}}$$

Practically, the only parameter the team leader can adjust is proximity. Preserving the optimal distance between team members (physically, technical skills, workload assigning) will reduce the stress in a relationship. The next sections will investigate the workload assignments.

Research Assignments

Table 7 shows the groups of research assignments. Most (54) are defined by papers either to start, continue, or complete a project. In addition, this group includes the preparation of grant proposals. An additional 23 are directed toward the USDA (United States Department of Agriculture). In addition, we investigate whether there is a difference between departments in the definition of these groups; it is fairly likely that support from the USDA is solicited by members of the Department of Biology. Another 11 concentrate on collaborations and developing a project with a collaborator. Ten focus on a book chapter or on editing a book. There are 7 each for textbook writing and for editing.

Clusters

#	Descriptive Terms	Freq	Percentage	RMS Std.
1	research, + presentation, papaers, completing/continue project, completing/continue, nih/nsf, nih/nsf proposal, preparation, sabbatical, set up	54	0.482142857...	0.2013753...
2	textbook wirting, textbook, nsf project, wirting, continue, nsf, project, research	7	0.0625	0.2116748...
3	lead editor, lead, editor, current, keep up, previous, previous collaboration, with, workshop, + current paper	7	0.0625	0.2537610...
4	project collaboration, collaboration, develop, project, proposal, submi	11	0.098214285...	0.0927131...
5	nsf/usda, fund, internal, international, international meeting, meeting, nsf/usda proposal, nsf/usda propsal , internal fund, + manuscript, continue	23	0.205357142...	0.1832679...
6	book, chapter, + article, book chapter, book revision, prposal, wirte, revision, submit, proposal	10	0.089285714...	0.2211997...

Table 7: Research Assignments

We also look at some concept links related to research. Figure 10 examines the relationship to the term, 'reasearch'. The terms include manuscript, submit, paper, and presentation. Table 8 summrizes research clusters by department, which shows that Mathematics tends to be very concentrated in cluster 1 while Biology has more variability in the accepted research activities.

Table of Research Clusters by Department			
Research Clusters	**Department**		
Frequency **Row Pct** **Col Pct**	**Biology**	**Mathematics**	**Total**
1	12 25.00 23.08	36 75.00 66.67	48
2	3 42.86 5.77	4 57.14 7.41	7
3	4 57.14 7.69	3 42.86 5.56	7
4	9 81.82 17.31	2 18.18 3.70	11
5	20 86.96 38.46	3 13.04 5.56	23
6	4 40.00 7.69	6 60.00 11.11	10
Total	52	54	106

Table 8: Research Clusters by Department

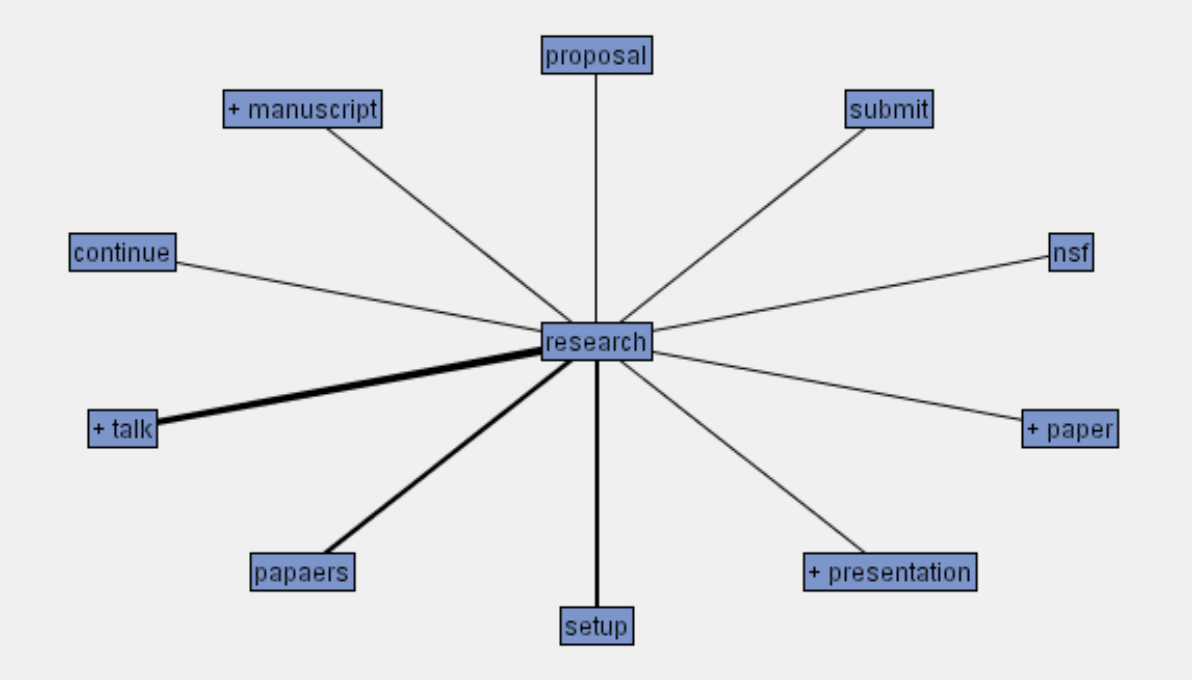


Figure 10: Concept Links to Research

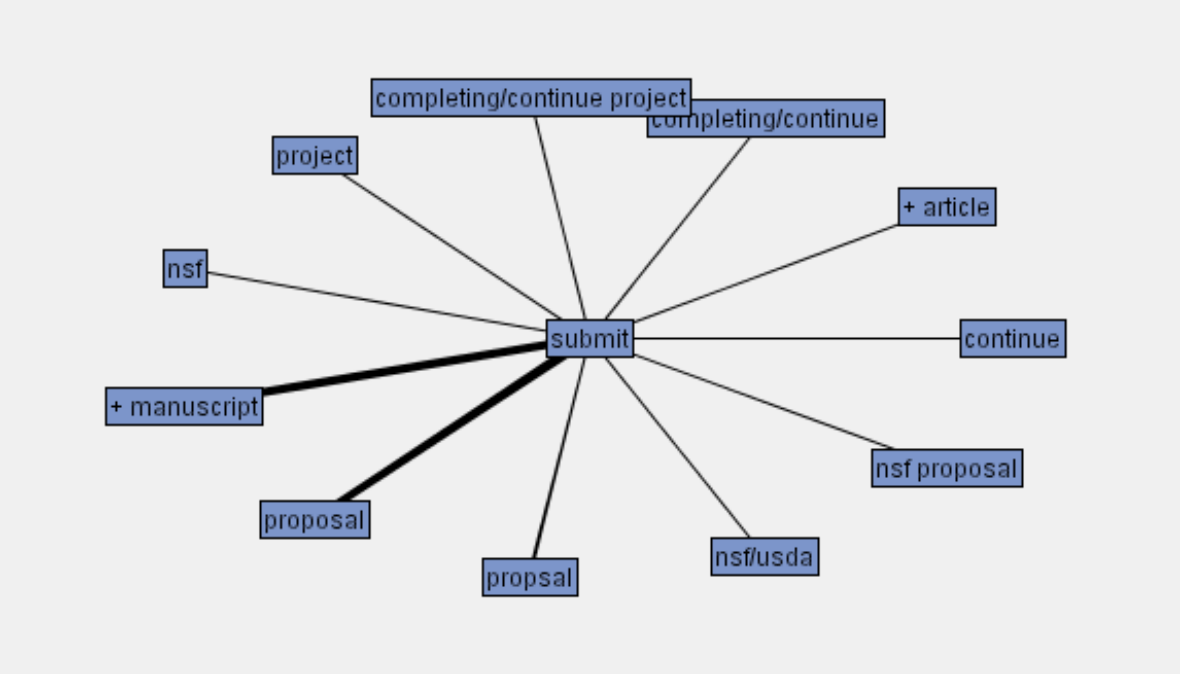


Figure11: Concept Links to Submit

The term 'submit' is linked to proposal, manuscript, and article. These two concept links indicate that that submission is linked to some type of manuscript or proposal. There is an expectation of publication or funding.

Teaching

Table 9 gives a summary of the mentoring of students in the two Departments as well as the total amount of time allocated for instruction, which consists of course preparation, mentoring students, and classroom teaching.

Dep	Rank	N Obs	Variable	Mean	Std Dev	Minimum	Maximum	Sum
Bio	Assistant professor	16	Mentoring time Instruction time	0.1025 0.4425	0.0300 0.0881	0.0500 0.2700	0.1600 0.6100	1.6400 7.0800
	Associate Professor	15	Mentoring time Instruction time	0.0873 0.5486	0.0728 0.1463	0 0.3700	0.2700 0.8000	1.3100 8.2300
	Professor	17	Mentoring time Instruction time	0.0741 0.5000	0.0484 0.1193	0 0.2900	0.1400 0.6800	1.2600 8.5000
Math	Assistant professor	18	Mentoring time Instruction time	0.0405 0.5716	0.0279 0.1418	0 0.3500	0.0800 0.9300	0.7300 10.2900
	Associate Professor	7	Mentoring time Instruction time	0.0271 0.5771	0.0236 0.2146	0 0.4000	0.0600 0.8900	0.1900 4.0400
	Professor	21	Mentoring time Instruction time	0.0314 0.3938	0.0519 0.1604	0 0	0.2000 0.5700	0.6600 8.2700

Table 9: Summary of Teaching

Table 9 shows that Biology spends considerably more time in one-on-one mentoring compared to Mathematics. One of the reasons is that Biology has many more graduate students who need mentoring. Biology gives assistant professors a lighter instructional load; associate professors have a heavier load. In contrast, professors in Mathematics have a considerably lighter instructional load, partially because administrative positions are accompanied by course release, and the course release creates outliers. Figure 12 gives a kernel density estimation of the overall instructional load. It indicates that the distributions of both departments are similar.

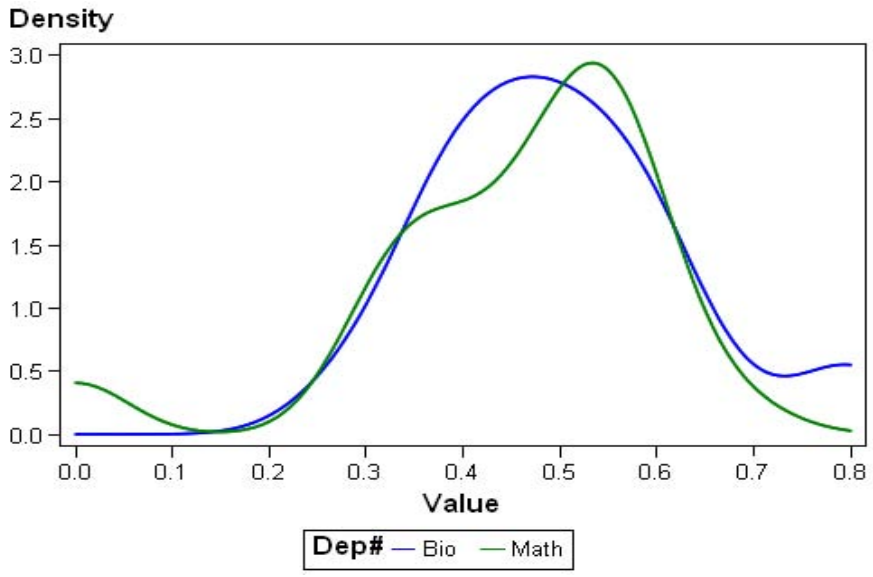


Figure 12: Instructional Time by Department

Figures 13-15 give the distributions of instruction by rank. Mathematics has more variability in the teaching assignments compared to Biology for associate professors. Figure 15 for full professor shows that Mathematics has a definite shift to lower teaching effort; both departments show a bimodal distribution. In Mathematics, the lower instructional load is related to administrative positions; in Biology, it is related to research grants.

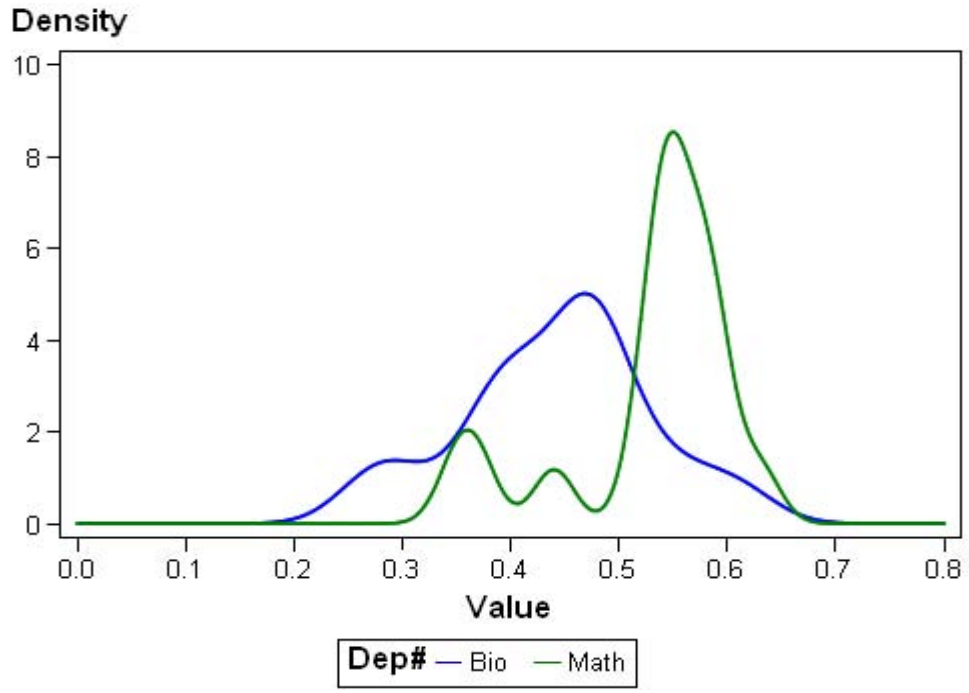


Figure 13: Instructional Time for Assistant Professors

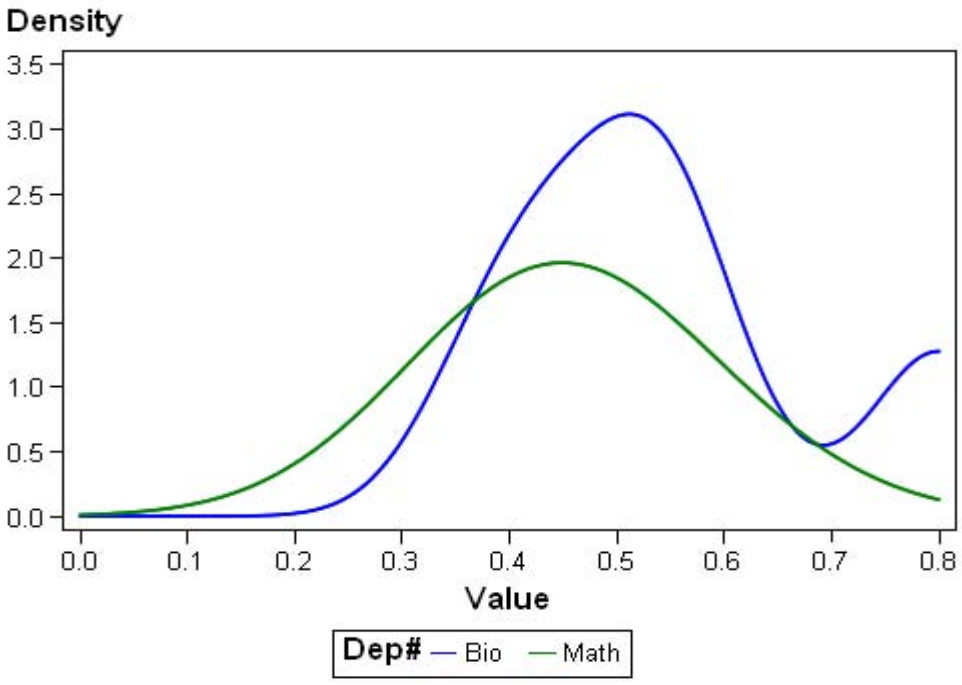


Figure 14: Instructional Time for Associate Professors

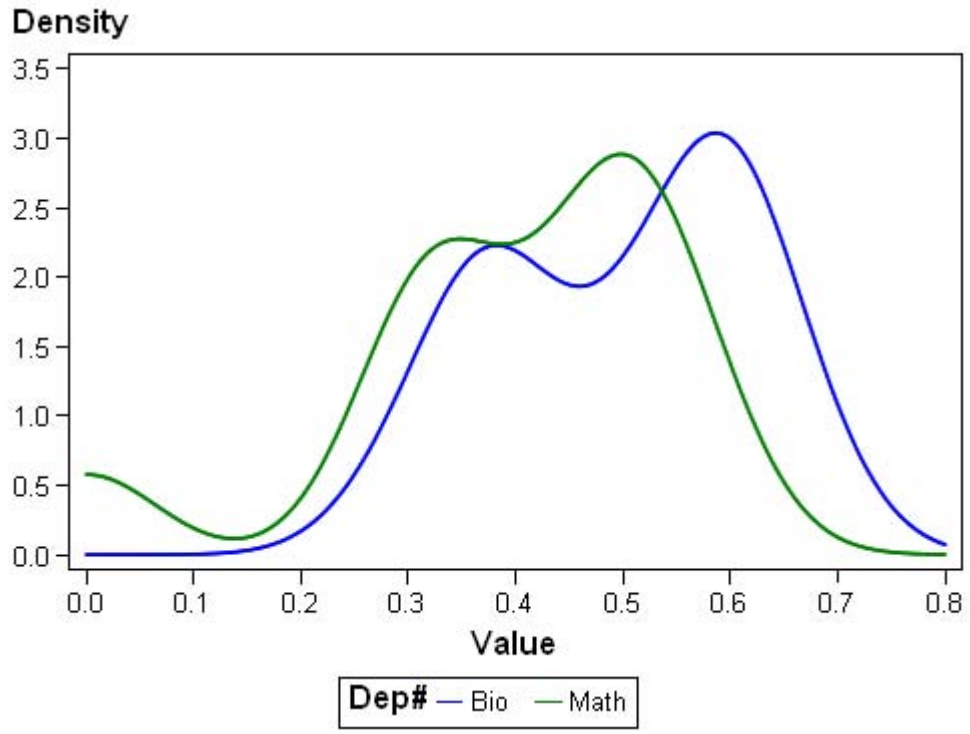


Figure 15: Instructional Time for Full Professors

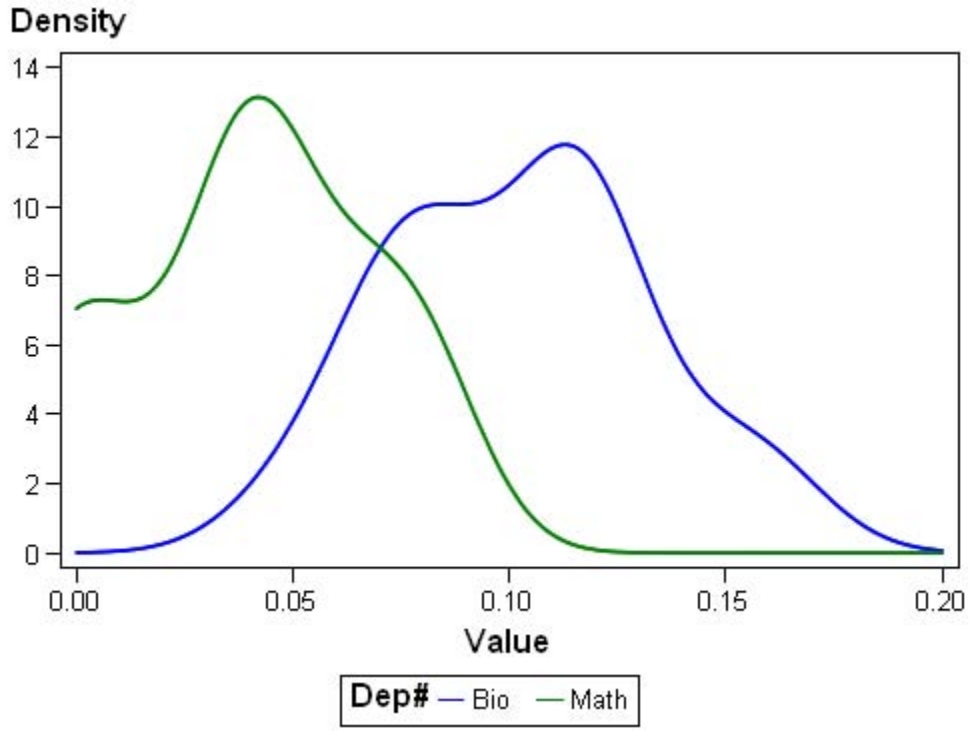


Figure 16: Mentoring Time for Assistant Professors

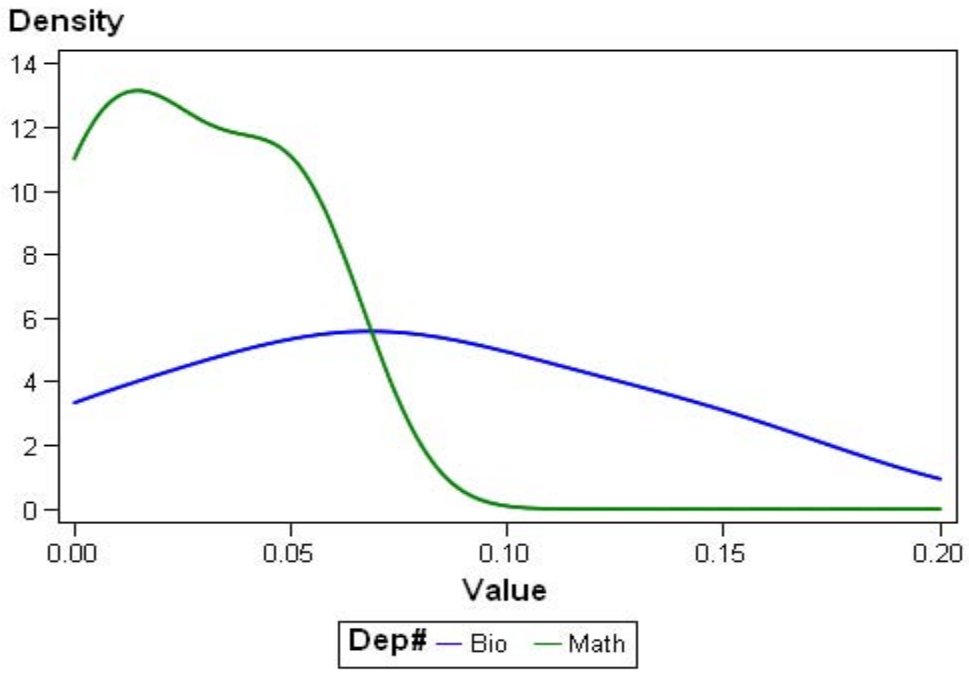


Figure 17: Mentoring Time for Associate Professors

Figures 16-18 show the level of mentoring by rank in the two departments. Assistant professors in Biology spend considerably more time mentoring compared to faculty in Mathematics. Biology clearly has more variability in the level of mentoring, and can have almost 20% time for mentoring. Again, Biology spends considerably more time mentoring students.

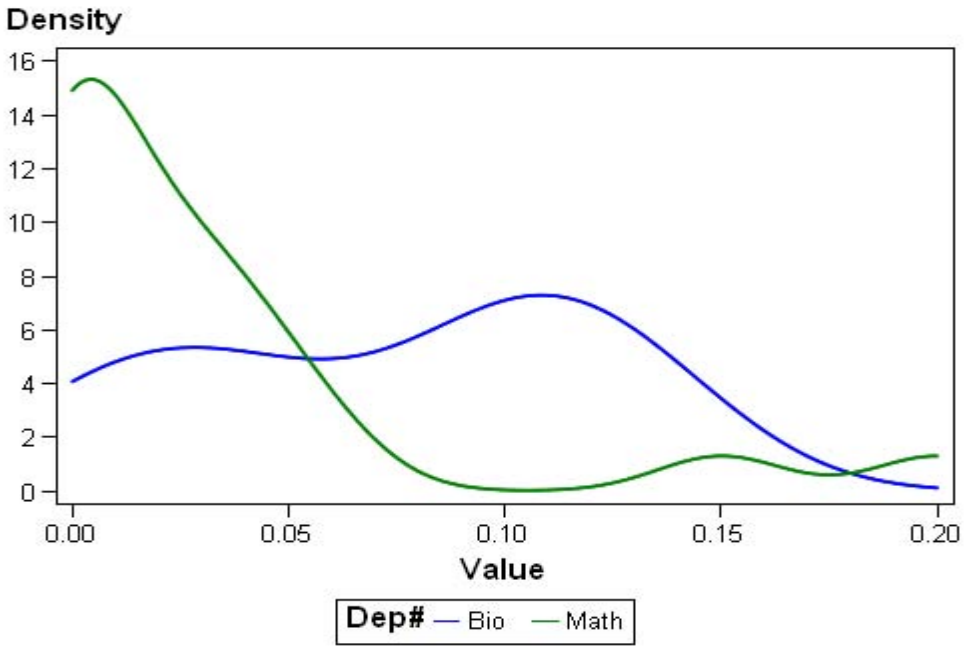


Figure 18: Mentoring Time for Professors

Clusters

#	Descriptive Terms	Freq	Percentage	RMS Std.
1	+ 205, + 640, + 301	13	0.116071428...	0.1195724...
2	+ 102-01, + 501, + 301	20	0.178571428...	0.0844955...
3	+ 301, + 501	15	0.133928571...	0.0680357...
4	+ 640, + 501, + 301	17	0.151785714...	0.0859013...
5	+ 501, + 640	47	0.419642857...	0.0549268...

Table 10: Teaching Clusters by Course Levels

Table 10 gives the teaching clusters defined in terms of course level. It shows that there are three clusters that include graduate courses (600-level) and two clusters that do not. We want to see if there are differences by rank and by Department in the assignment of such courses (Table 7). Graduate courses are considered to be desirable teaching assignments and are sought by most of the faculty.

Table of Teaching Clusters by Department			
Teaching Clusters	**Department**		
Frequency Row Pct Col Pct	**Biology**	**Mathematics**	**Total**
1	9 69.23 17.31	4 30.77 7.41	13
2	3 15.00 5.77	17 85.00 31.48	20
3	12 80.00 23.08	3 20.00 5.56	15
4	17 100.00 32.69	0 0.00 0.00	17
5	11 26.83 21.15	30 73.17 55.56	41
Total	52	54	106

Table 11: Teaching Cluster by Department

Table 11 shows that Mathematics is largely concentrated in two of the 5 clusters; clusters 2 and 5. One contains graduate courses in Mathematics, the other does not. It suggests that there are faculty who are assigned graduate courses regularly while the other faculty are not assigned 600-level courses. We want to examine this in more detail.

Table of Teaching Cluster by Rank				
Teaching Cluster	Rank(Rank)			Total
Frequency Row Pct Col Pct	Assistant professor	Associate Professor	Professor	
1	1 10.00 2.85	8 80.00 36.36	1 10.00 2.63	10
2	8 44.44 22.22	5 27.78 22.73	5 27.78 13.16	18
3	4 26.67 11.11	4 26.67 18.18	7 46.67 18.42	15
4	8 50.00 22.22	2 12.50 9.09	6 37.50 15.79	16
5	15 40.54 41.67	3 8.11 13.64	19 51.35 50.00	37
Total	36	22	38	96

Table 12: Teaching Clusters by Rank

Full professors tend to concentrate in cluster 5 with graduate courses; assistant professors are divided into clusters 2 and 4; one cluster with graduate courses and the other without. We also look at the relationship of teaching cluster to research cluster (Table 13).

Teaching Clusters	Research Clusters						
Frequency Row Pct Col Pct	1	2	3	4	5	6	Total
1	6 46.15 11.11	1 7.69 14.29	1 7.69 14.29	1 7.69 9.09	3 23.08 13.04	1 7.69 10.00	13
2	14 70.00 25.93	1 5.00 14.29	3 15.00 42.86	1 5.00 9.09	1 5.00 4.35	0 0.00 0.00	20
3	2 13.33 3.70	0 0.00 0.00	1 6.67 14.29	3 20.00 27.27	6 40.00 26.09	3 20.00 30.00	15
4	2 11.76 3.70	2 11.76 28.57	2 11.76 28.57	1 5.88 9.09	9 52.94 39.13	1 5.88 10.00	17
5	30 63.83 55.56	3 6.38 42.86	0 0.00 0.00	5 10.64 45.45	4 8.51 17.39	5 10.64 50.00	47
Total	54	7	7	11	23	10	112

Table 13: Teaching Clusters by Research Clusters

Table 13 shows that most of the faculty are in research cluster 1 and most of these faculty are in teaching clusters 1, 2, and 5. However, faculty in research cluster 5 is more likely to be in teaching clusters 3 and 4. These faculty are all in the Department of Biology. These two research clusters are related to collaboration and editing. These same faculty teach advanced, graduate courses.

RESEARCH PRODUCTIVITY

We also want to examine research productivity by examining faculty curriculum vita. Table 14 shows some of these activities.

Rank	Dept	N Obs	Variable	Mean	Std Dev	Minimum	Maximum	N
Assistant professor	Bio	20	IndpSsupervison_pre	2.1000	2.1496	0	6.0000	20
			# students supervised	1.9500	2.2354	0	6.0000	20
			Thesis_S_NO	2.2500	1.6503	0	5.0000	20
			Thesis_pre	3.7500	2.8631	0	9.0000	20
	Math	18	IndpSsupervison_pre	0.6111	1.1447	0	4.0000	18
			# students supervised	0.2941	0.5878	0	2.0000	17
			Thesis_S_NO	0.1111	0.3233	0	1.0000	18
			Thesis_pre	0.2222	0.6467	0	2.0000	18
Associate Professor	Bio	15	IndpSsupervison_pre	0.7333	0.7988	0	2.0000	15
			# students supervised	1.0666	1.1629	0	3.0000	15
			Thesis_S_NO	4.0666	4.2167	0	14.0000	15
			Thesis_pre	5.2000	5.2399	0	20.0000	15
	Math	9	IndpSsupervison_pre	1.3333	4.0000	0	12.0000	9
			# students supervised	0.6666	2.0000	0	6.0000	9
			Thesis_S_NO	0.6666	1.3228	0	3.0000	9
			Thesis_pre	1.2222	2.4381	0	6.0000	9
Professor	Bio	17	IndpSsupervison_pre	1.3529	1.4116	0	4.0000	17
			# students supervised	1.5882	1.6224	0	4.0000	17
			Thesis_S_NO	2.7941	2.6164	0	8.0000	17
			Thesis_pre	3.9411	4.1150	0	12.0000	17
	Math	25	IndpSsupervison_pre	0.5000	2.0641	0	10.0000	24
			# students supervised	0.2916	1.0826	0	5.0000	24
			Thesis_S_NO	0.5416	1.1412	0	5.0000	24
			Thesis_pre	1.2083	2.4491	0	10.0000	24

Table 14: Research activity related summary

As shown in table 14, the research related activities of the Biology Department show higher means across the different faculty ranks.

Dept.: Biology

Variable	Mean	Std Dev	Minimum	Maximum	N
Teaching percentage	40.4423	15.3065	10.0000	80.0000	52
Research percentage	34.4038	18.8744	1.0000	72.0000	52
Services percentage	11.7788	6.5674	1.0000	28.0000	52

Dept.: Mathematics

Variable	Mean	Std Dev	Minimum	Maximum	N
Teaching percentage	44.6274	17.8168	0	93.000	51
Research percentage	30.8627	19.2145	0	100.000	51
Services percentage	13.5400	9.5622	0	50.000	50

Table 15: Teaching, Research, and services activity summary

Table 15 shows the Teaching, Research and Service percentages on the department level; it is clear that for the Biology Department, the teaching percentage on average is less than the teaching percentage in the Mathematics Department, while is the situation is reversed on research. This Table highlights the importance of research in the Biology Department and the availability of funds. It also shows that the service roles on the Biology Department are less than the Mathematics Department.

The dispersion for the Biology Department is less than the dispersion for the Mathematics Department, which reflects the unbalanced faculty work load. As we can see, the service percentage for the Mathematics Department is double the service percentage for the Biology department.

Dept: Biology

Analysis Variable : Publication numbers						
Rank	**N Obs**	**Mean**	**Std Dev**	**Minimum**	**Maximum**	**N**
Assistant Professor	20	2.2000	4.0600	0	14.0000	20
Associate Professor	15	2.7333	5.4177	0	15.0000	15
Professor	17	4.2941	7.6873	0	24.0000	17

Dept: Mathematics

Analysis Variable : Publication numbers						
Rank	**N Obs**	**Mean**	**Std Dev**	**Minimum**	**Maximum**	**N**
Assistant Professor	18	2.8888	3.6118	0	12.0000	18
Associate Professor	9	1.7777	3.6666	0	10.0000	9
Professor	25	7.2400	12.4675	0	46.0000	25

Table 16: Publication number summary

The number of publications is a good representation for research productivity; Table 16 shows interesting results; in the case of Assistant Professors, we can see that although the maximum value for the Biology Department is larger than the corresponding value for the Mathematics Department, the mean value for Assistant Professor in the Mathematics Department is lower than the mean value for Assistant Professor in the Biology Department, which shows less variability. In the case of Associate Professor, the average of Associate Professor in Biology shows more variability, which can be due to the lower number of Associate Professors for the Mathematics Department. The same observation is valid for the Professor rank in the Mathematics Department.

Teaching is the main concern for any educational organization and the number of graduating students is an excellent illustration for department productivity. Table 17 shows the number of students graduating in the different programs. As it demonstrates, the total numbers of students in the Biology Department are more than double the number for the Mathematics Department. Also, it is clear that the BS & BA student, who requires more teaching for the Biology Department, are three times the number for the Mathematics Department (see Figure 18).

	BA	**BS**	**MA**	**MS**	**PhD**	**Total**
BIO	30	30	0	2	1	63
Math	7	15	4	0	1	27

Table 17: Graduating student number summary

In general, the relation between student number and administration positions are escalating, yet the Mathematics Department is not that rule. As shown in Table six, the Biology Department administration positions are much less compared to what the Mathematics Department has.

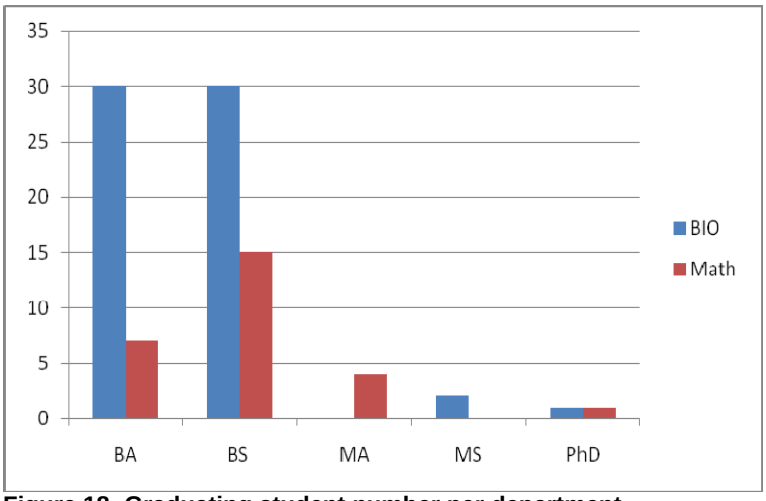


Figure 18: Graduating student number per department

To study the workload balance problem, the faculty members will be clustered based on their workload (teaching, research and services). Multidimensional scaling (MDS) is a class of methods that estimates the coordinates of a set of entities in a space of specified dimensionality that comes from data measuring the distances between pairs of objects. The first step is to use the PROC MDS procedure and to construct the similarity metrics table between objects. Based on the application, appropriate distance metrics should be selected. The following figure demonstrates the PROC MDS procedure output.)

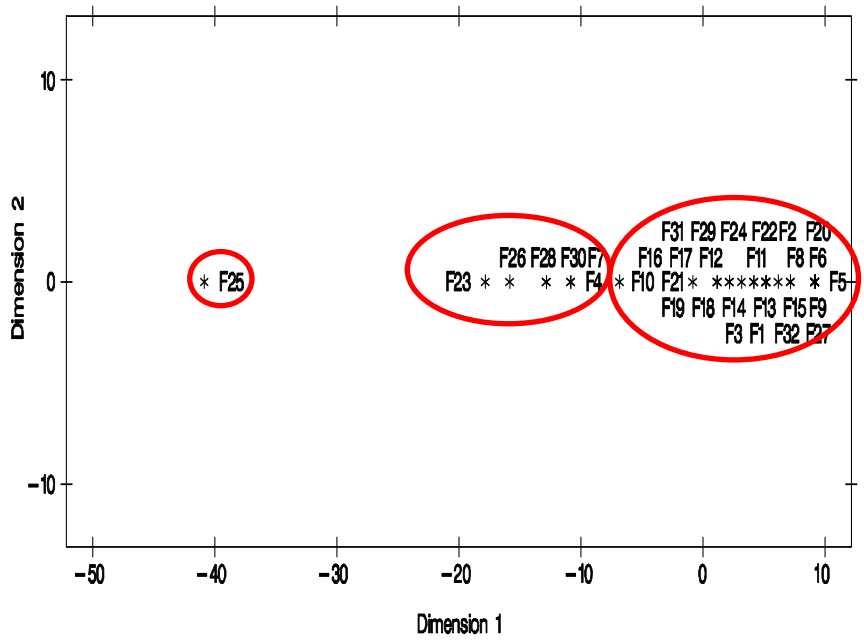


Figure 19: Team members classification based in workload

Figure 19 demonstrates that team member's work load is classified into three clusters. This clustering illustrates unbalanced workload assignments; there is a massive difference between cluster 1 and the others.

Cluster 1:
Teaching ≤ 30%, Research ≤ 6%, Services ≤ 14%, Administration ≤ 50%
Cluster 2:
Teaching ≤ 47%, Research ≤ 20%, Services ≤ 6%, Administration ≤ 25%
OR
Teaching ≤ 20%, Research ≤ 50%, Services ≤ 10%, Administration ≤ 0%
Cluster 3:
Teaching ≤ 88%, Research ≤ 0%, Services ≤ 9%, Administration ≤ 0%
OR
Teaching ≤ 50%, Research ≤ 36%, Services ≤ 9%, Administration ≤ 0%

The basic roles for each team members in this case are:
{Teaching, Research, Administration, Service}. A successful team leader should maintain a balanced workload assignment for each team member, yet this is not valid here. For example in cluster (1), 50% of the team member's time is assigned for administration role while in cluster (3) 0% of the member's time is assigned for administration. In addition, we can find team members with 88% for teaching and others with only 20%. This large variation on workloads will add up to more stress on team member relations, which will cause deterioration in team productivity.
Several reasons can lead to unbalanced workload assignments:

1- Team Leader 's poor knowledge about team members: skills, experience, etc.
2- Dissimilarity of team members' goals.
3- Overrate role requirements.

CONCLUSION

It is clear that there are differences in faculty workload assignments between Biology and Mathematics. While Biology stresses external funding, Mathematics does not. Instead, Mathematics has defined a need to have more administrative positions that serve to reduce the overall teaching workloads for senior faculty members in the Department. These administrative positions bring a reduction in the research productivity as well. Because grants are not stressed in Mathematics in the same way that they are in Biology, Biology has considerably more external funding.

Thorough this study, it was not clear how the faculty members are nominated for administrative roles. In addition, there is no specific set of qualifications required to hold those positions. That creates a lot of concerns about the selection process, which can be influenced by the department chair's personal preference. The number of administrative roles in the Mathematics Department was higher than the number for the Biology Department, which highlight the need to define the optimal number of administrative roles corresponding to the overall department workload.

Annual work plans (AWP) and Curriculum Vitae are the main sources of information for faculty workload study and analysis. It showed that it is very important to design the workload in such away to be more informative and uniform, especially for research sections.

ACKNOWLEDGE

The author would like to thank Prof. Patricia Cerrito of the University of Louisville for her helpful suggestions and advices.

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