

# 1999-2009 TAULBEE DATA: TRENDS AND CHANGES IN COMPUTER SCIENCE DEPARTMENTS

July 2010

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## ABSTRACT

This report summarizes, compares, and contrasts Taulbee survey data collected between 1999 and 2009. It focuses on 163 US CS & CSE departments which this report partitions into eight groups based on the 1995 NRC rankings, private versus public status, and faculty size. These eight groups are different from the groupings used in the annual CRA Taulbee survey which partitions based on NRC rank only. The report focuses on the overall growth and change in number of faculty, Ph.D. generation and B.S. pipeline and production. For all demographics, trends in the representation of women are presented. The data presented shows a number of interesting trends, including:

- The number of female tenure-track and tenured faculty has increased since 1999, both in total number as well as proportion. For all 163 departments, the increase went from 10.6% in 1999 to 14.8% in 2009. Looking at the eight groups, increases are not uniformly distributed.
- The number of females receiving a Ph.D. has increased, both in total number and proportion. For all departments considered, the increase in proportion went from 15% in 1999 to 20% in 2009.
- The number of Ph.D.'s awarded to underrepresented minorities has seen some increase, but numbers remain very small.
- Since 2002, there has been an increase in Ph.D. production, but a decrease in faculty hiring. Ph.D. production peaked in 2007.
- There has been a drop in overall production of Bachelors since 2003 for both male and female. However, there has also been a decline in the proportion of females receiving B.S. degrees (from 18% in 2000 to 10% in 2008). Departments ranked 1-36 in private institutions have seen an increase in the proportion of females since 2006.

## 1. Introduction

The Computing Research Association (CRA) is an association of more than 250 North American academic departments of computer science, computer engineering, information, and related fields engaging in basic computing research. The CRA also includes laboratories and centers in industry, government and affiliated professional societies. CRA's annual Taulbee Survey provides information on the enrollment, production, and employment of Ph.D.s in computer science, computer engineering, and information (CS & CE & I) and it provides salary and demographic data for faculty in CS & CE & I in North America. Results of the annual Taulbee Survey since 1992 are available at <http://www.cra.org/resources/taulbee/>.

This report summarizes, compares, and contrasts selected Taulbee Survey data collected between 1999 and 2009. It focuses on US CS & CSE Ph.D. granting departments and uses data from 163 departments (listed in Appendix 1) focusing on faculty sizes as well as Ph.D. and B.S. enrollment and production. The 163 departments are partitioned into eight groups based on the 1995 NRC rankings, private versus public status, and faculty size. The eight groups are described in Section 2. For information of the 1995 NRC rankings of research and doctoral programs in the United States we refer to <http://archive.cra.org/statistics/nrcstudy2/rankcs.html>. The eight groups used in the report are different from the groups used in the annual Taulbee Survey. The Taulbee survey uses NRC rankings to form three groups containing the 36 top-ranked departments, partitioned by rank into 1-12, 13-24, 25-36. The remaining departments belonging to CRA, some ranked and some unranked by the NRC, are put into one group, referred to as 37+. Reasons for using a different grouping include the ability to compare trends in private and public institutions as well as understanding trends within the 127 institutions of rank 37+ which this report partitions into four groups.

The report focuses primarily on the overall growth and change in number of faculty, Ph.D. generation and B.S. pipeline and production. For all demographics, trends in the representation of women are presented. The data presented shows a number of trends, including:

- The number of female tenure-track and tenured faculty has increased since 1999, both in total number as well as proportion. For all 163 departments, the increase went from 10.6% in 1999 to 14.8% in 2009. Looking at the eight groups, increases are not uniformly distributed as described in Section 3.
- The number of females receiving a Ph.D. has increased, both in total number and proportion. For all departments considered, the increase in proportion went from 15% in 1999 to 20% in 2009. Departments ranked 37 or higher in public institutions and having at least 25 faculty have seen the largest increase. Trends on Ph.D. production are described in Section 4.
- There has been a drop in overall production of Bachelors since 2003 for both male and female. However, there has also been a decline in the proportion of females receiving B.S. degrees (from 18% in 2000 to 10% in 2008). Departments ranked 1-36 in private institutions have seen an increase in the proportion of females since 2006. Trends in undergraduate enrollment and production are described in Section 5.
- Since 2002, there has been an increase in Ph.D. production, but a decrease in faculty hiring. Ph.D. production peaked in 2007. Section 6 provides insight into faculty hiring and Ph.D. production at the 163 departments.

## 2. Materials and Methods

Data for this report were provided by Betsy Bizot from the CRA. CRA releases Taulbee data only in summarized form that protects the responses of individual departments. Our study partitions the 163 departments into eight groups. The institution in Ranks 1-36 and Ranks 37+ are those of the rankings based on information collected in the 1995 assessment of research and doctorate programs in the United States conducted by the National Research Council (NRC). We partition the departments ranked 1-36 into public and private (there are 19 public and 17 private institutions). Within each group, we partition departments into belonging to the top half and bottom half, respectively, based on their 1995 NRC rank. The 127 institutions in the 37+ group are first partitioned into public and private. The public ones are partitioned into three groups using their reported faculty size in 2007: large departments are those having more than 21 tenured and tenure-track faculty, medium department have between 21 and 15 faculty, and small departments have fewer than 15 faculty. The private institutions of rank 37 and higher form their own group.

Table 2.1 shows the description of the eight groups. It also shows average response rates to the Taulbee survey for each of the eight groups. As not all departments complete all sections of the survey, we give response rates for each of the three sections of the Taulbee survey: Faculty, Grad, and Undergrad. We note that the Taulbee survey collects more data than is used in this report. Historically, departments in the Rank 1-36 have a higher response rate than those in the 37+ group. The departments in each of the eight groups are listed, in alphabetical order within each group, in Appendix 1.

Throughout this report we show proportions and counts for the following groupings:

- Eight groups, as described in Table 2.1
- Four groups, partitioning each of rank groups 1-36 and 37+ into Public and Private
- Two groups
  - partitioning all institutions into Public and Private, or
  - partitioning the institutions into ranks 1-36 and 37+

<b>Group Description</b>	<b>Number</b>	<b>RR Faculty</b>	<b>RR Grad</b>	<b>RR Undergrad</b>
Public Ranks 1-36 (1 <sup>st</sup> )	10	100%	100%	100%
Public Ranks 1-36 (2 <sup>nd</sup> )	9	84%	84%	83%
Private Ranks 1-36 (1 <sup>st</sup> )	8	98%	94%	94%
Private Ranks 1-36 (2 <sup>nd</sup> )	9	99%	97%	98%
Public Ranks 37+ (Large)	36	86%	82%	85%
Public Ranks 37+ (Medium)	26	93%	91%	92%
Public Ranks 37+ (Small)	34	77%	70%	75%
Private Ranks 37+	31	75%	71%	74%
	<b>163</b>	<b>89%</b>	<b>86%</b>	<b>88%</b>

**Table 2.1.** Groupings of departments and response rates (RR).

Top ranked departments 1-36 are broken four groups: top-half-public, bottom-half-public, top-half-private, and bottom-half-private. Public Ranks 37+ institutions are broken into four groups: one private and three public groups based on faculty size (Large: #faculty  $\geq 21$ ; Medium:  $21 > \text{\#faculty} > 15$ ; Small: #faculty  $\leq 15$ ).

Table 2.2 lists the variables considered in this report. For all variables we received average and median values and the majority of the plots shown use averages. We note that most plots were also generated for median values, but no significant changes in trends were observed (for comparison, sections 3 and 4 include each contains a median-based plot.)

Tenured and tenure track faculty head count: total, female, URM Full professors: total, female Associate professors: total, female Assistant professors: total, female Faculty positions filled in an academic year
Ph.D. students enrolled: total, female PhDs awarded: total, female, international, URM
Bachelor majors: total, female Bachelor degrees awarded: total, female

**Table 2.2.** Description of variables.

In general, data will be presented in several ways: group averages, group total counts, and group proportions. Group averages represent the departmental average within each group. The formulas used for these calculations are as follows:

$$y_{ij} = \frac{\sum_{k \in j} (x_{ik} * n_{ik})}{\sum_{k \in j} n_{ik}}; \quad z_{ij} = \sum_{k \in j} (x_{ik} * n_{ik}); \quad p_{ij} = \frac{\sum_{k \in j} (f_{ik} * n_{ik})}{\sum_{k \in j} (t_{ik} * n_{ik})}$$

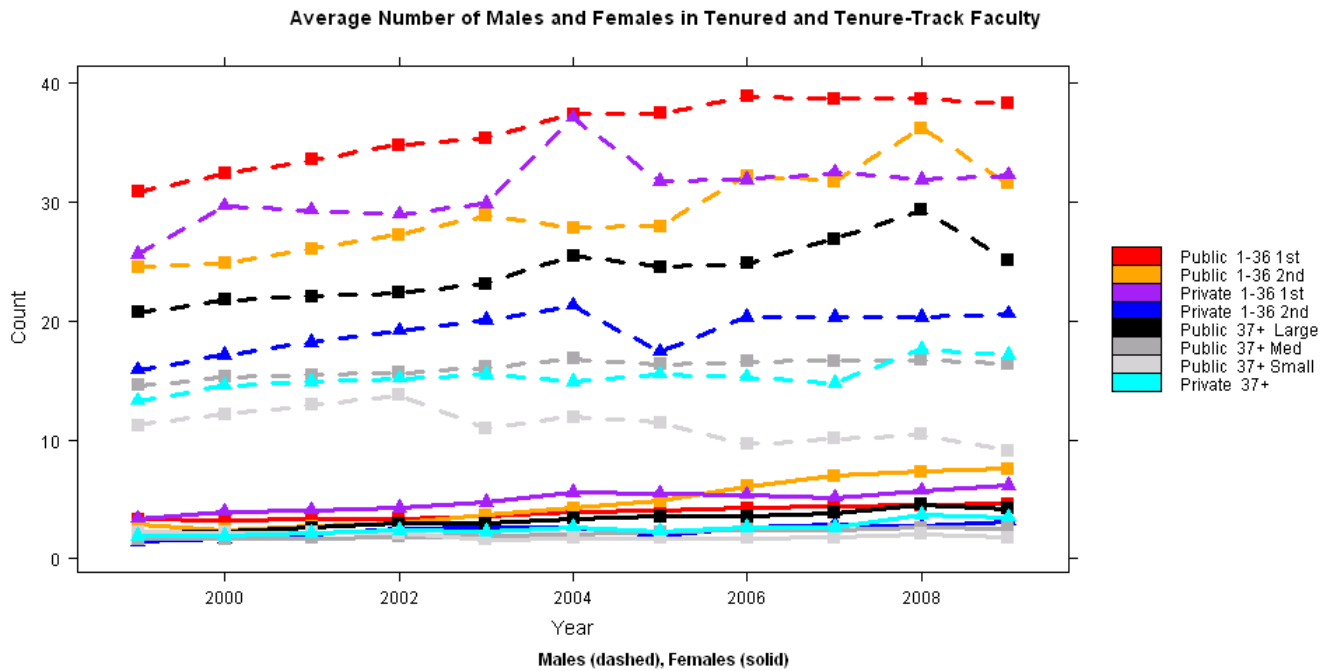
where  $i = 1999, \dots, 2009$  and  $j = 1, 2$  for Public/Private and Ranks 1-36/Ranks 37+, or  $j = 1, \dots, 4$  for Public/Private by Rank, and  $k = 1, \dots, 8$  representing the original groupings as provided by the CRA. Quantity  $y_{ij}$  is the average value for year  $i$  and group  $j$ ;  $z_{ij}$  is the total count for year  $i$  and group  $j$ ;  $x_{ik}$  is the mean value for year  $i$  and CRA ranking  $k$ ;  $n_{ik}$  is the number of reporting institutions in year  $i$  and CRA ranking  $k$ . Similarly,  $p_{ij}$  is the proportion calculation used (e.g., proportion of females for a given category). Generally,  $n_{ik}$  represents the total mean value for year  $i$  and CRA ranking  $k$  for the variable (e.g., faculty count), while  $n_{ik}$  represents the subset mean value for year  $i$  and CRA ranking  $k$  for the variable (e.g., female faculty count), where  $i, j,$  and  $k$  are as described above.

The plots were created in R version 2.7.1 using a package called "Lattice," (the R version of "Trellis" in S-Plus).

### 3. Faculty Demographics

This section examines faculty growth between 1999 and 2009 for various groupings of institutions based on the eight groups listed in Table 2.1. We examined trends using both averages and medians values of the variables given in Table 2.1. Overall, the trends for averages and medians were very similar. We show plots for averages and medians for only a few scenarios and most plots shown are on averages.

The plots in this section explore the representation of female faculty in the various groups as well as their representation within academic ranks. Figure 3.1 shows the number of male and female faculty in the departments in the eight groups from 1999 to 2009. Figure 3.1(a) show this data, in the form of 16 lines, for the averages and Figure 3.1(b) shows the same data for medians.



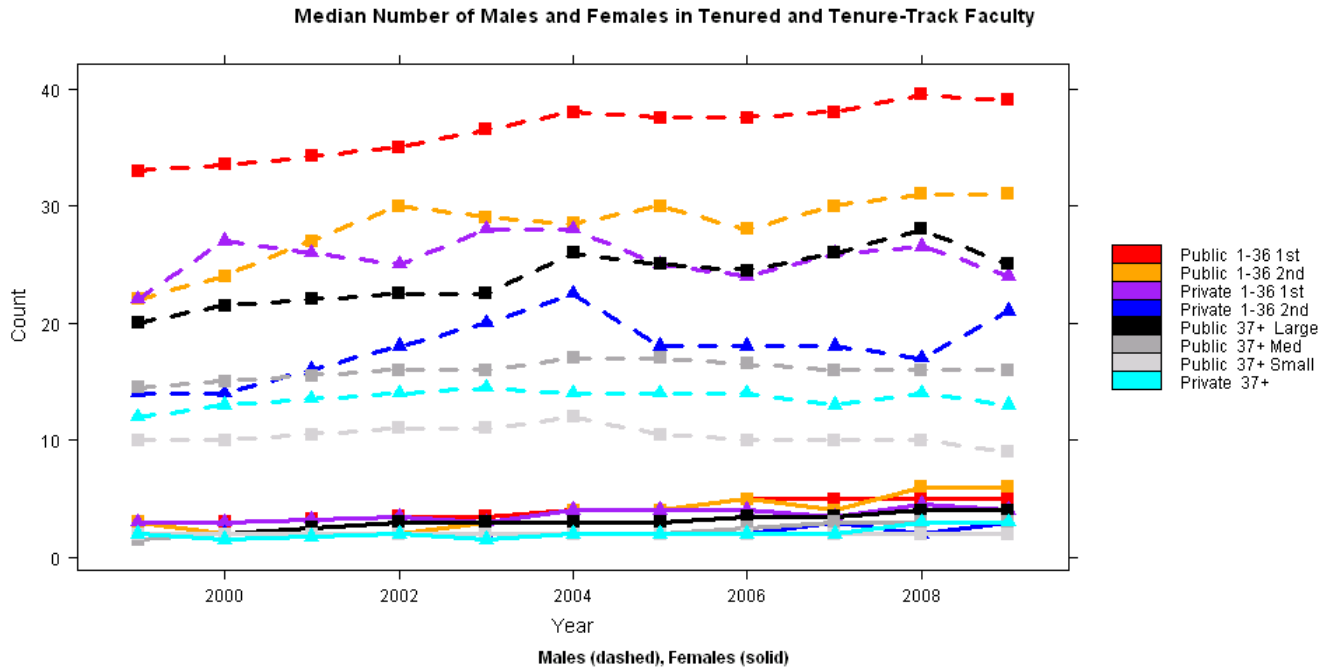
**Figure 3.1(a)** Average number of males (dashed) and females (solid) in tenured and tenure-track faculty.

Looking at Figure 3.1(a) and the eight groups, the average number of female faculty ranges from a minimum of 1.13 (for Public 37+ Med in 2001) to a maximum of 7.57 (for Public 1-36 2<sup>nd</sup> in 2009). The average number of male faculty ranges from 8.76 to 38.9. Group Public Ranks 1-36 2<sup>nd</sup> saw the largest increase in female faculty per department (by 4.71), while Public 37+ Small saw a small decrease in the average number of females faculty per department (by -0.48).

Consider the data of Figure 3.1(a) for two years, 1999 and 2002, and the range of the data points for each the eight groups. For female faculty, the range between the eight groups is 1.94 in 1999 (minimum of 1.44 and maximum of 3.38) while the range is 5.79 in 2009 (minimum of 1.78 and maximum of 7.57). For male faculty, the range is 19.68 in 1999 (minimum of 11.22 and maximum of 30.90) and it is 29.17 in 2009 (minimum of 9.13 and maximum of 38.30).

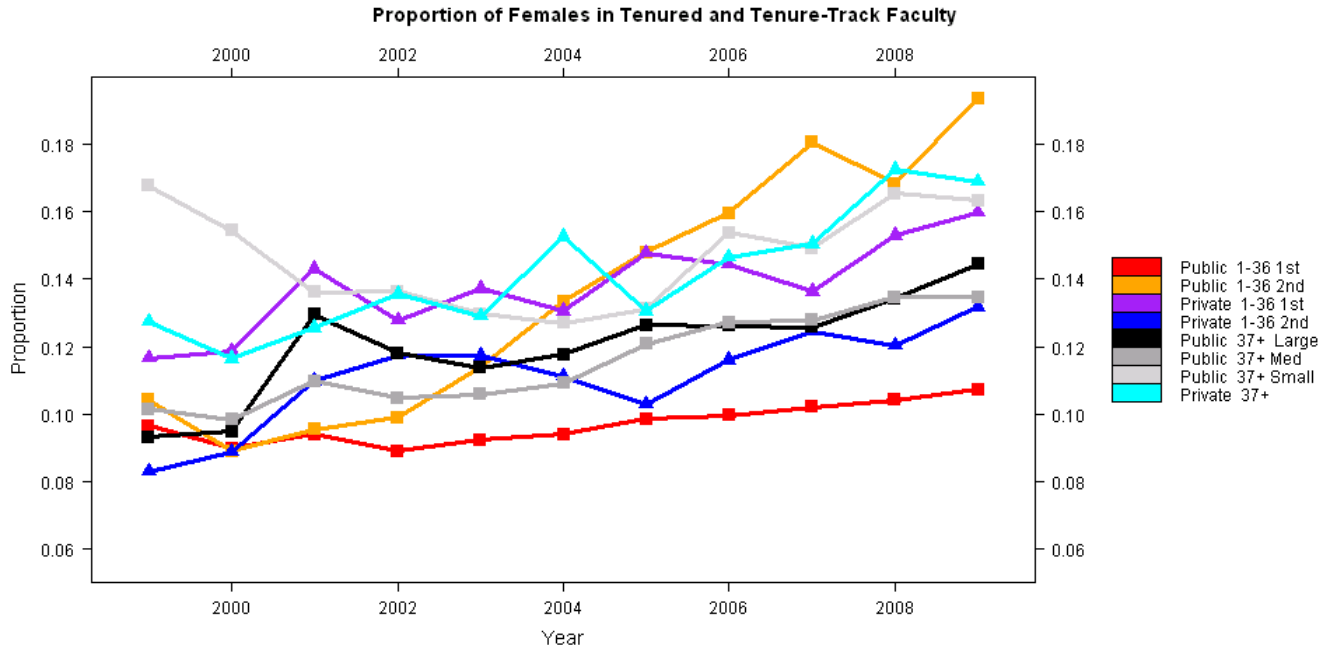
Overall, one can conclude that departments made a significant number of hires since 1999 and that the number of female faculty in departments increased. The later figures in this section show various groupings of institutions

with respect to proportions, average and totals illustrating where the increase in female faculty during the last eleven years occurred.



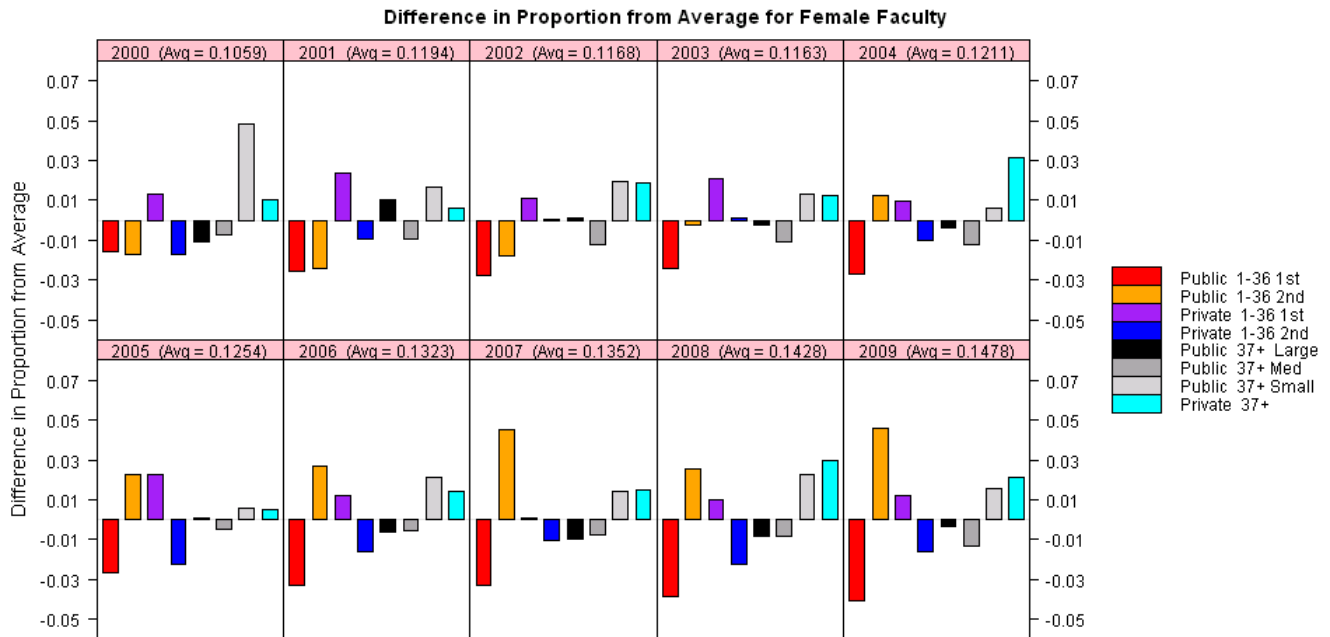
**Figure 3.1(b)** Median number of males (dashed) and females (solid) in tenured and tenure-track faculty.

Figure 3.2 shows that the proportion of women in CS departments across the eight groups. The data suggest that the number of female faculty in departments as well as the proportion has increased. It is unclear whether there is a relation to the size of the faculty. The increase for Public 1-36 2<sup>nd</sup> is noteworthy: from about 10% to 19%.



**Figure 3.2.** Proportion of females in tenured and tenure-track faculty.

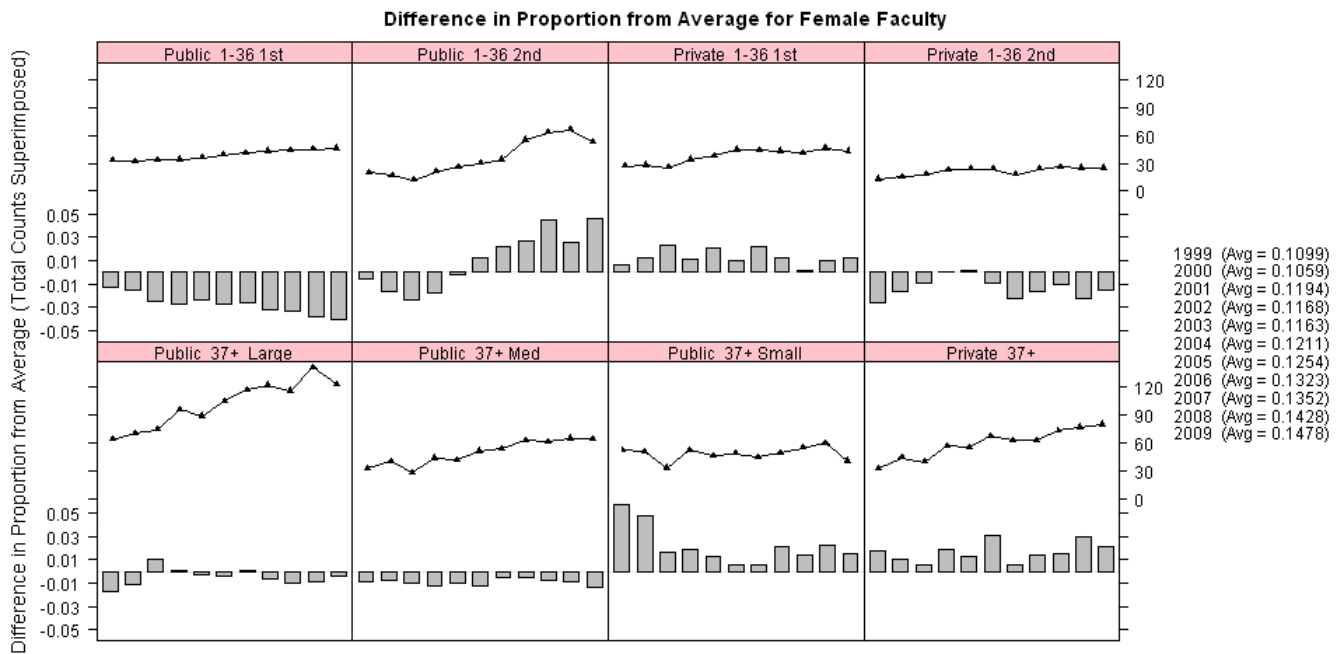
Figure 3.3 uses the average proportion of female faculty for all institutions for each year as a “base line.” This average was just below 11% in 1999 and is almost 15% in 2009, showing a slowly increasing trend. Note that each panel represents a year and the averages are listed on the top of each panel in Figure 3.3. The colored bars show the difference of each group from this average. Figure 3.3 shows some groups consistently below the average and others (e.g., Public, 1-36, 2<sup>nd</sup>) having increased the average proportion of female faculty.



**Figure 3.3.** Difference in proportion of females in tenured and tenure-track faculty from yearly average, with each panel representing the year using the colors representing the eight groups.

Figure 3.4 rearranges the colored bars of Figure 3.3 according to the colors. This shows the differences-in-proportion entries for each group in one panel (years are now the positions on the x-coordinate) and it makes the trend in each group easier to see. Each panel of Figure 3.4 also shows a line representing the total number of female faculty in all the departments of that group. This is done to provide insight into the question “Is the decrease in proportion of female faculty for a group related to departments making overall many hires which increased the number of female faculty, but not their proportion?” We make a number of observations which put Figure 3.4 in better context with the earlier figures:

- The proportion of female faculty in all eight groups increased, as shown in Figure 3.2. Since total faculty numbers went up, one can conclude that staying close to the overall average does translate into having increased the number of female faculty.
- For group Public 1-36 2<sup>nd</sup>, the increase in the total number of female faculty translates to a significant increase in proportions of female faculty after 2004.
- For group Public 1-36 1<sup>st</sup>, the total number of female faculty increased only slightly and it translates into a steady decrease from the average since 1999. The trend is similar for Public 37+, small.
- For group Public 37+, large, the increase in the total number of female faculty does not translate in a significant increase in proportions of female faculty per department (this group contains 36 departments).



**Figure 3.4.** Difference in proportion of female faculty from yearly average (bars), with the total number of female faculty in departments in each group superimposed (lines). Axis labels for the proportions (bars) are on the left, while the labels for the totals (lines) are on the right.

Figure 3.1 shows the average number of male and female faculty for each of the eight groups. The eight lines for female faculty are close together and show a slight upwards trend, but little variation between the eight groups. Figure 3.5 looks at the total number of female faculty by partitioning them into four groups: groups 1-36 and 37+, with each group broken into public and private. The departments in the public institutions ranked 37+ employ significantly more women than any of the other group. However, this is easily attributable to the large number of departments in this group: 96 departments with about 84% reporting data. To give a normalized perspective,



Figure 3.6 shows the proportion of female faculty. The group public 37+ does relatively well when looking at proportions. It is worth to note the increase for private 37+ which consistently has had the largest proportion of female faculty among the four groups.

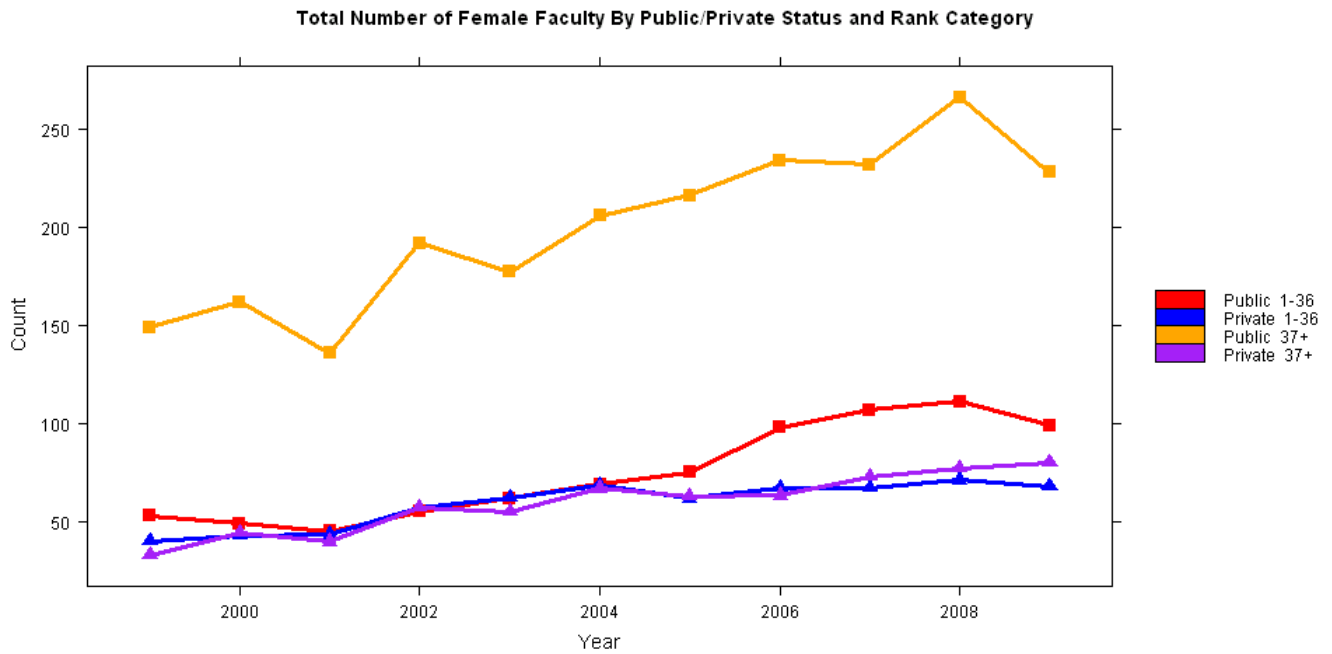


Figure 3.5. Total number of female faculty by Public/Private status and rank category.

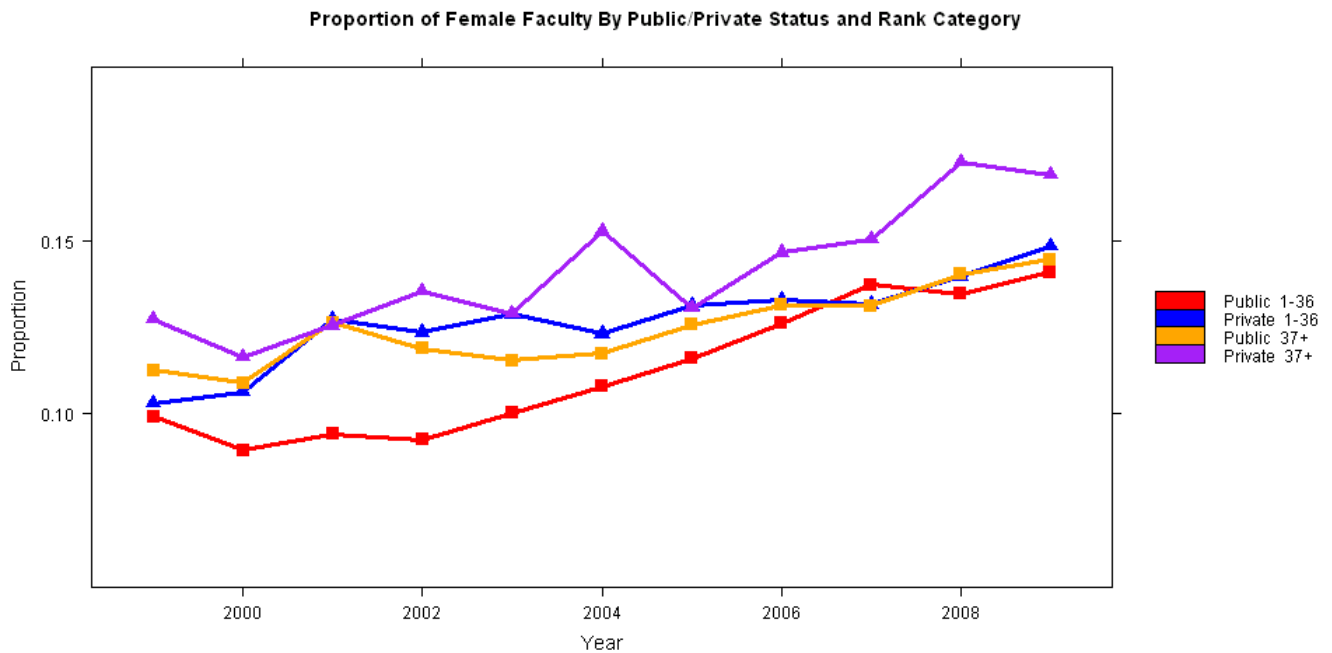
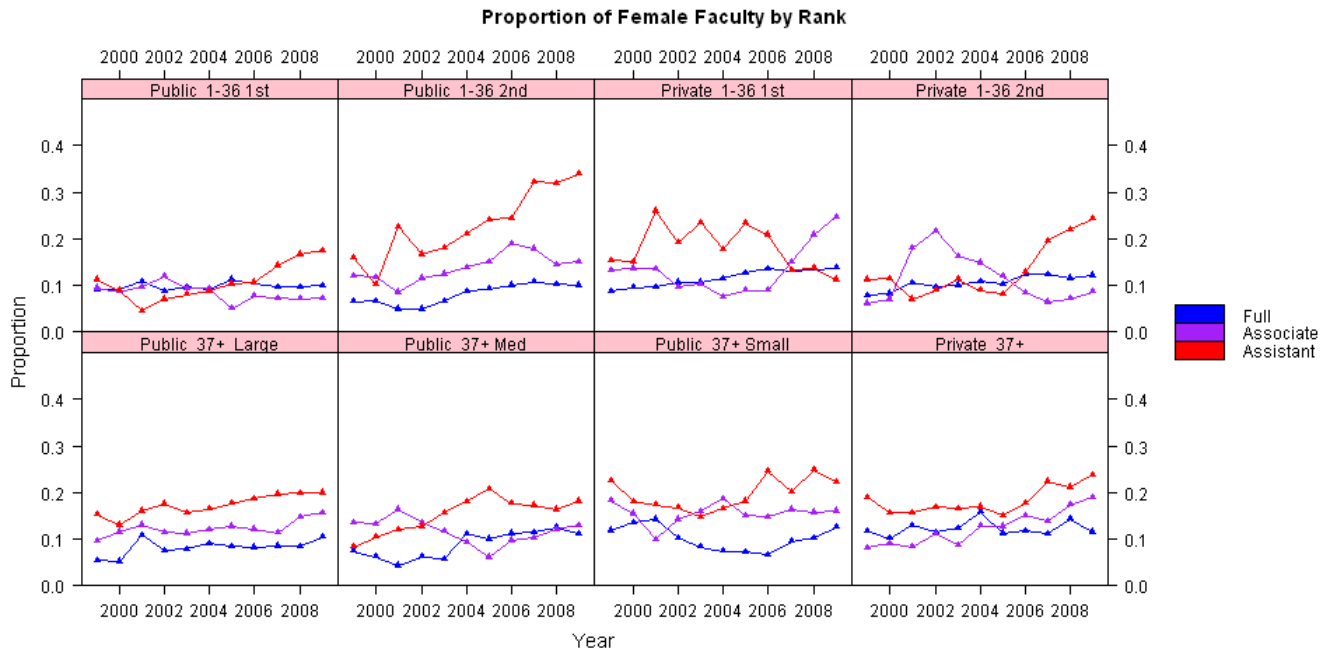


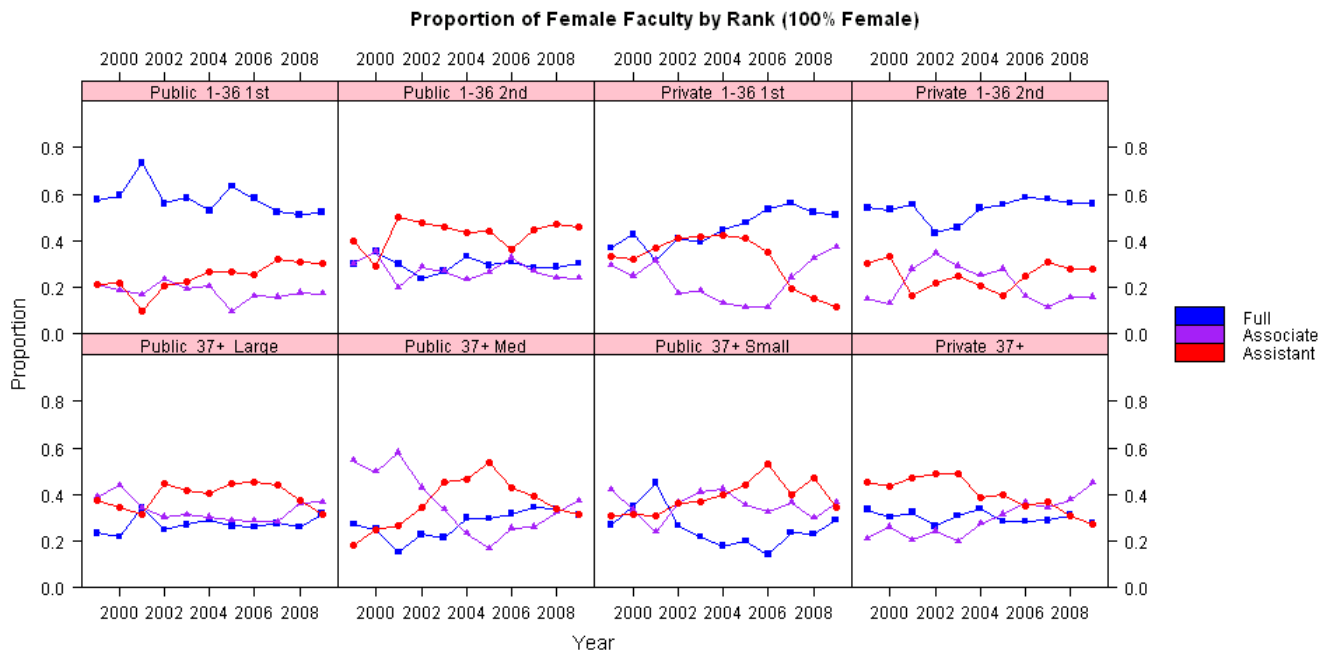
Figure 3.6. Proportion of female faculty by Public/Private status and rank category.

Figures 3.7 to 3.9 examine how female faculty numbers are partitioned across the three academic ranks. The first two figures show the proportion of female assistant, associate, and full professors in each of the eight groups. Figure 3.7 shows the percentage of female faculty in a rank compared to the number of faculty (male and female)

in this rank. It shows what is generally known: that the higher the rank, the smaller the percentage of female faculty in the rank. Figure 3.8 shows the percentage of female faculty in a rank compared to the number of female faculty. While the shapes of the lines is similar in Figures 3.7 and 3.8, their placement along the y-axis and their scaling differs, telling somewhat different stories. Figure 3.8 shows that since 1999, for Public 1-36 1<sup>st</sup> and Private 1-36 2<sup>nd</sup>, over half of the female faculty were full professors, with the percentage seeing little change.

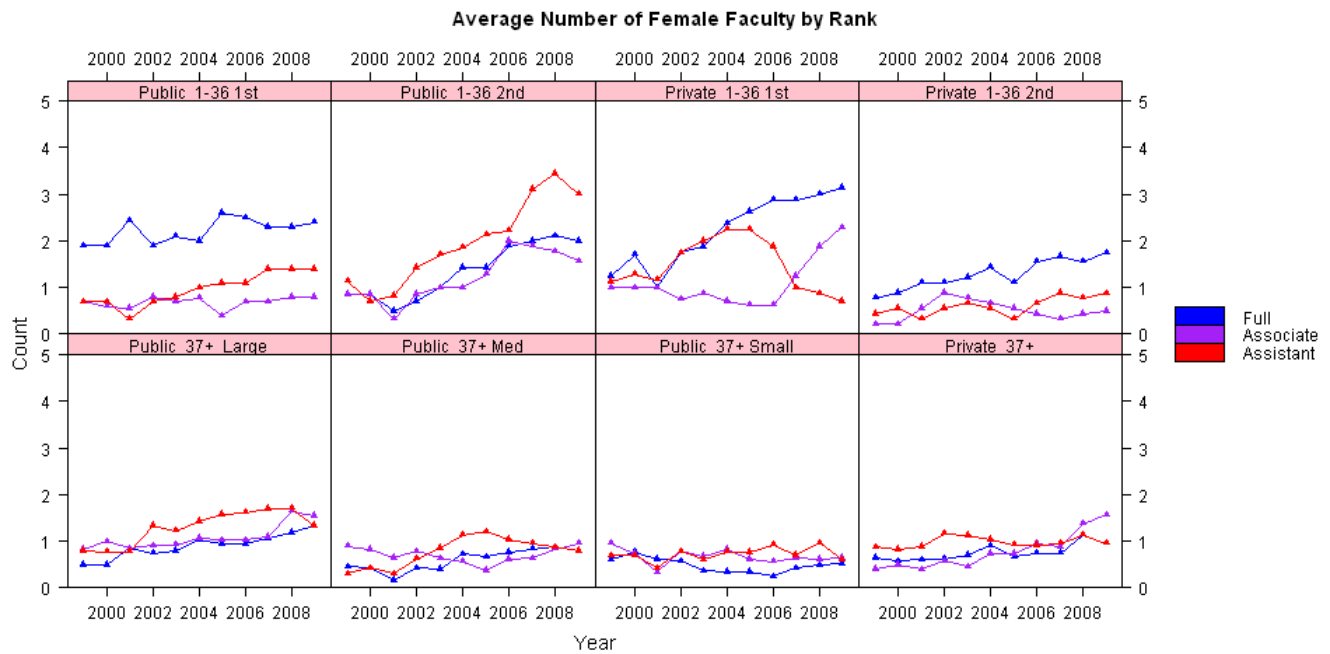


**Figure 3.7.** Proportion of female faculty by academic rank (100% = number of male and female faculty in this rank).



**Figure 3.8.** Proportion of female faculty by academic rank (100% = number of female faculty).

Figure 3.9 shows average number of female faculty in each group, partitioning the total number of female faculty into assistant, associate, and full professors. This view is useful to see trends in the promotion pipeline and the retention of female faculty, even though numbers in the eight groups are very small. It also provides additional insight into Public 1-36 1<sup>st</sup> and Private 1-36 2<sup>nd</sup> having over half of the female faculty being full professors: the number of female full professors is barely above two. It is not clear one can explain general pipeline issues from these plots.



**Figure 3.9.** Average number of female faculty in a department by academic rank.

## 4. PhD Production

This section examines Ph.D. production for various groupings of institutions, as well as total Ph.D. enrollment in the eight groups. Special focus is on the growth and the proportion of females receiving a Ph.D. Additional trends on the total number of Ph.D. degrees awarded are in Section 6, where total Ph.D. production is contrasted with faculty hiring.

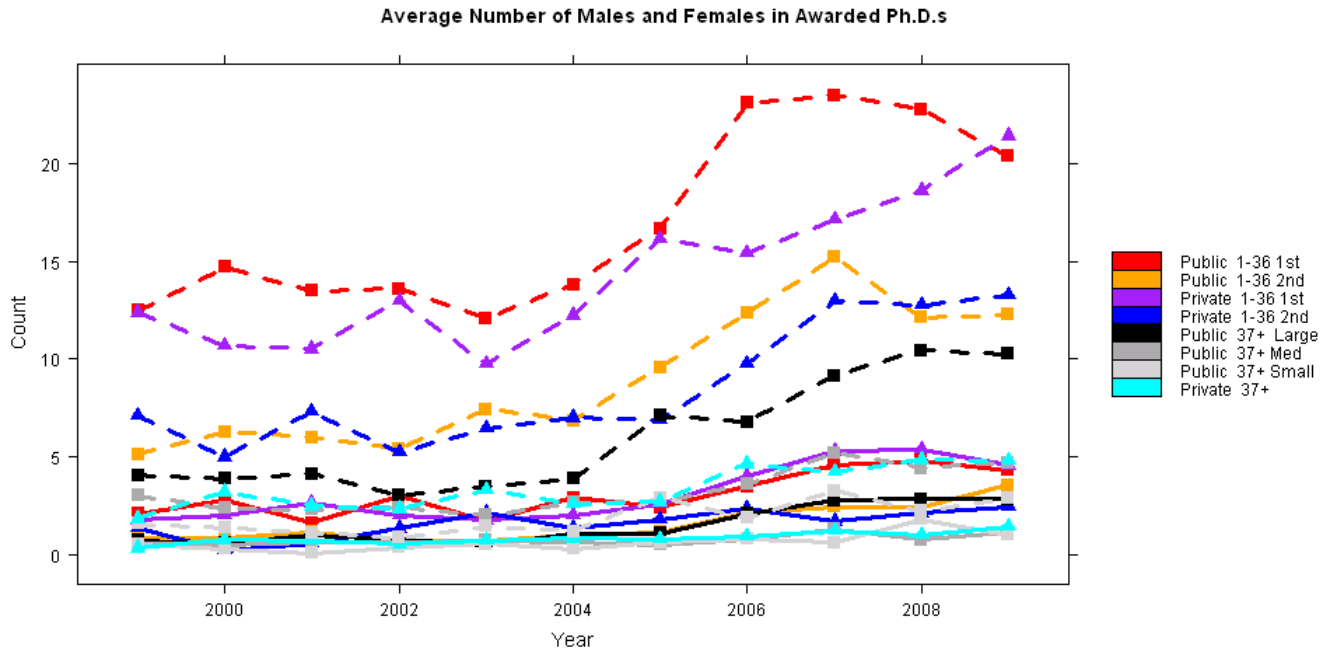


Figure 4.1(a) Average number of males (dashed) and females (solid) in awarded Ph.D.s.

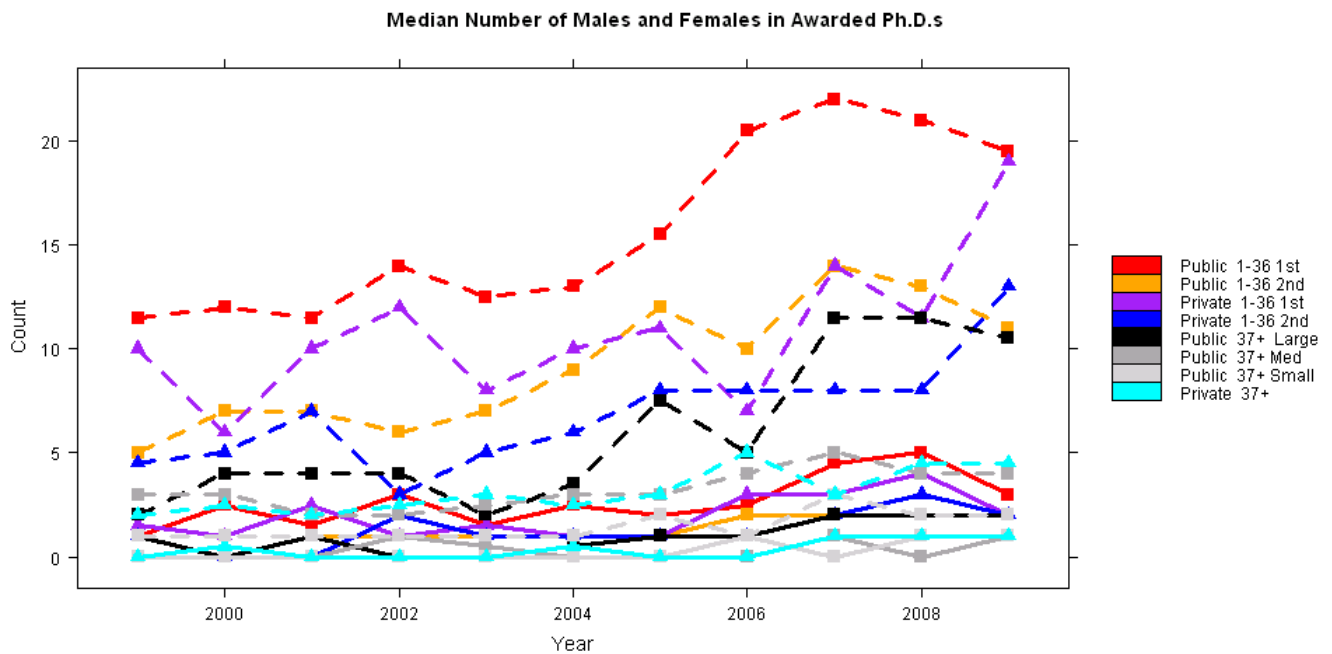
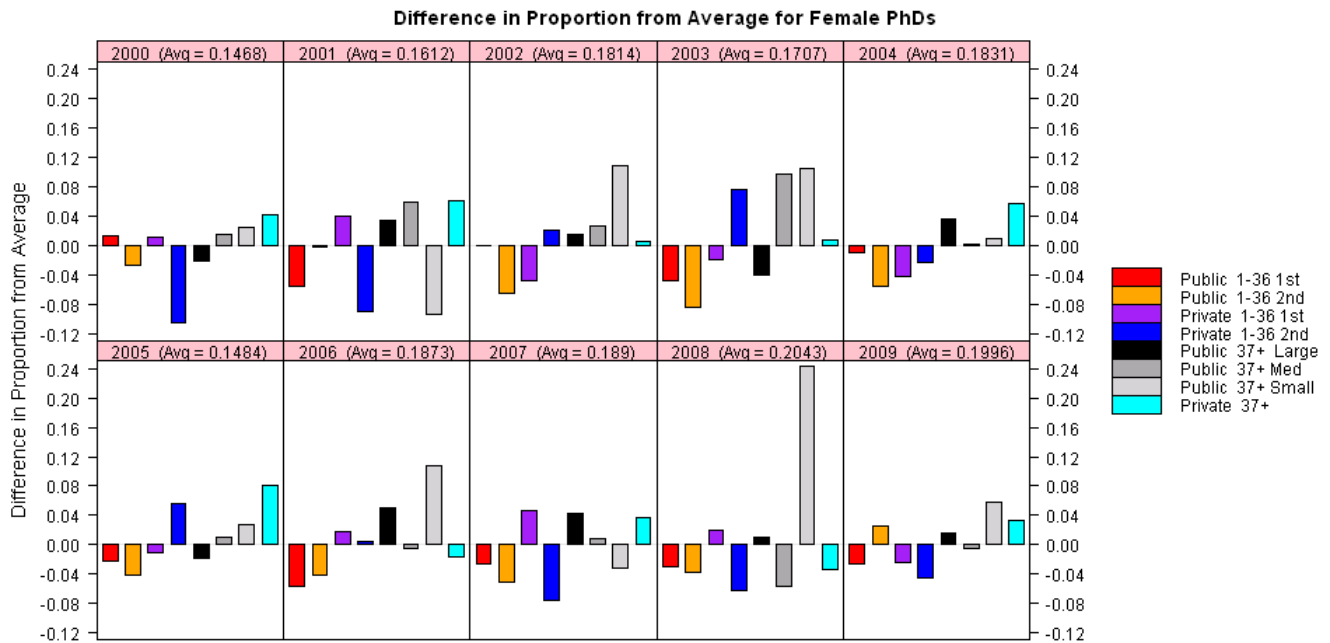


Figure 4.1(b) Median number of males (dashed) and females (solid) in awarded Ph.D.s.

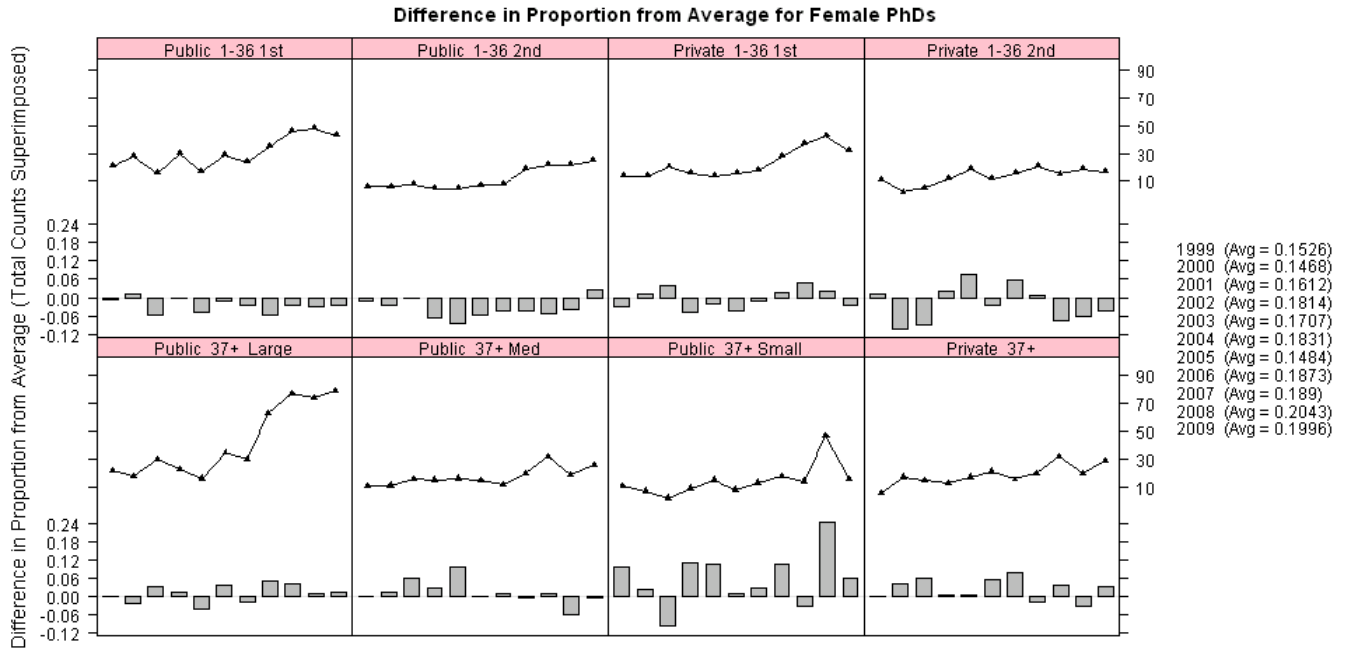
Figure 4.1 shows the number of Ph.D.'s awarded in departments in the eight groups, broken into counts for male and female students. We show averages for departments in Figure 4.1(a) and medians in 4.1(b). Comparing Figures 3.1 and 4.1, one sees that the number of Ph.D.'s awarded to females has some similarities to the trends seen for female faculty: an upward trend for all groups, with the increase for females showing differences between groups. We note that the number of Ph.D.'s awarded can fluctuate for a department from one year to the next, but both the average as well as the median values for each group show rather smooth and quite similar curves.

The total number of Ph.D.'s produced has doubled from 1999 to 2009. See Figure 6.1 for the trend on the total (male and female over all 163 institutions) Ph.D. production and Figure 6.3 for the total for each of the eight groups.

The percentage of females receiving Ph.D.'s has increased from about 15% in 1999 to 20% in 2009. The yearly average forms the "base line" of Figure 4.2 which shows the difference of each group from the yearly average. In Figure 4.2, the averages are given within each panel representing a year. As Ph.D. production in a department varies from one year, it is not surprising that proportions of a group shown in Figure 4.2 oscillate from being above average to being below average. For the four groups of the institutions having rank 1-36, the two private groups (purple and blue) are above average a total of 3, respectively 4, times. IN contrast, the two public groups (red and yellow), are above average in at most two years. Percentages can be misleading without the numbers they are based on. Figure 4.3 arranges the bars of Figure 4.2 associated with one group into one panel (the plot has the same structure as Figure 3.4). In each panel we also show the total number of Ph.D.'s awarded to females. The two groups public 1-36, 1<sup>st</sup>, and private 1-36, 1<sup>st</sup>, have increased the number of females receiving a Ph.D. from 1999 to 2009. In addition, the increase in the number of females receiving a Ph.D. from an institution in Public 37+ large group is clearly noticeable. Overall, the proportion of females receiving a Ph.D. has increased from 15.3% in 1999 to about 20% in 2009.

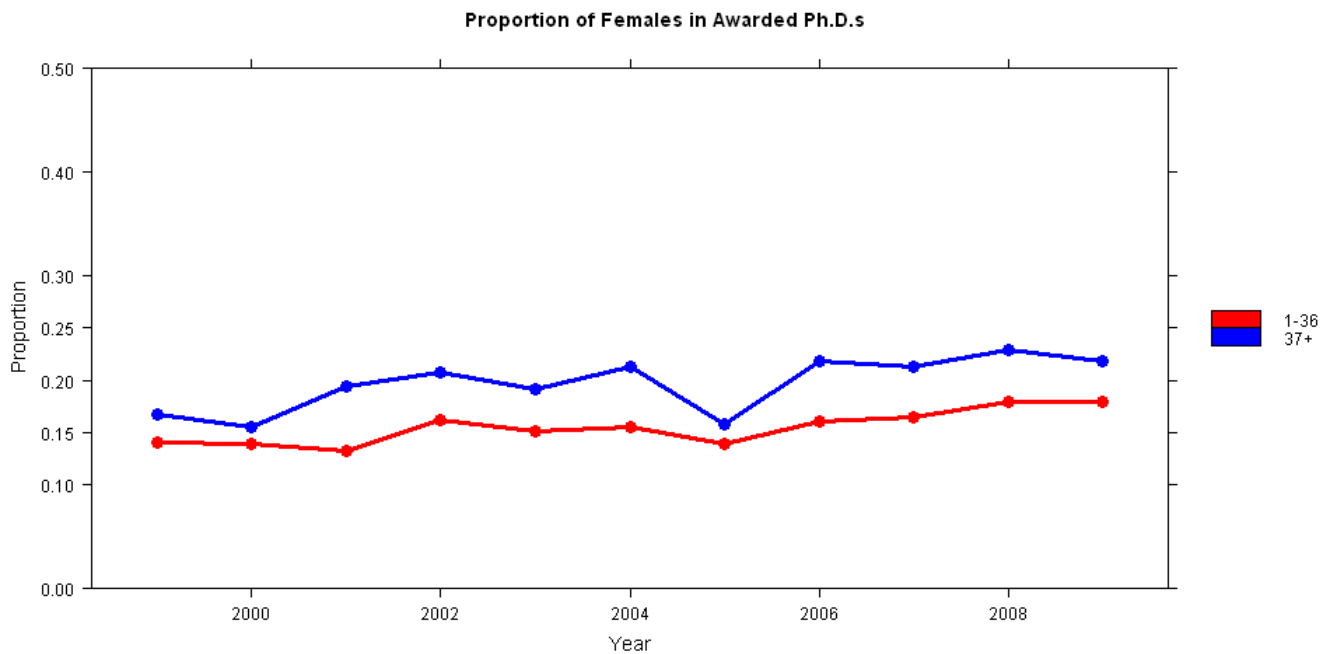


**Figure 4.2.** Difference in proportion of females PhDs from yearly average, with each panel representing a year.

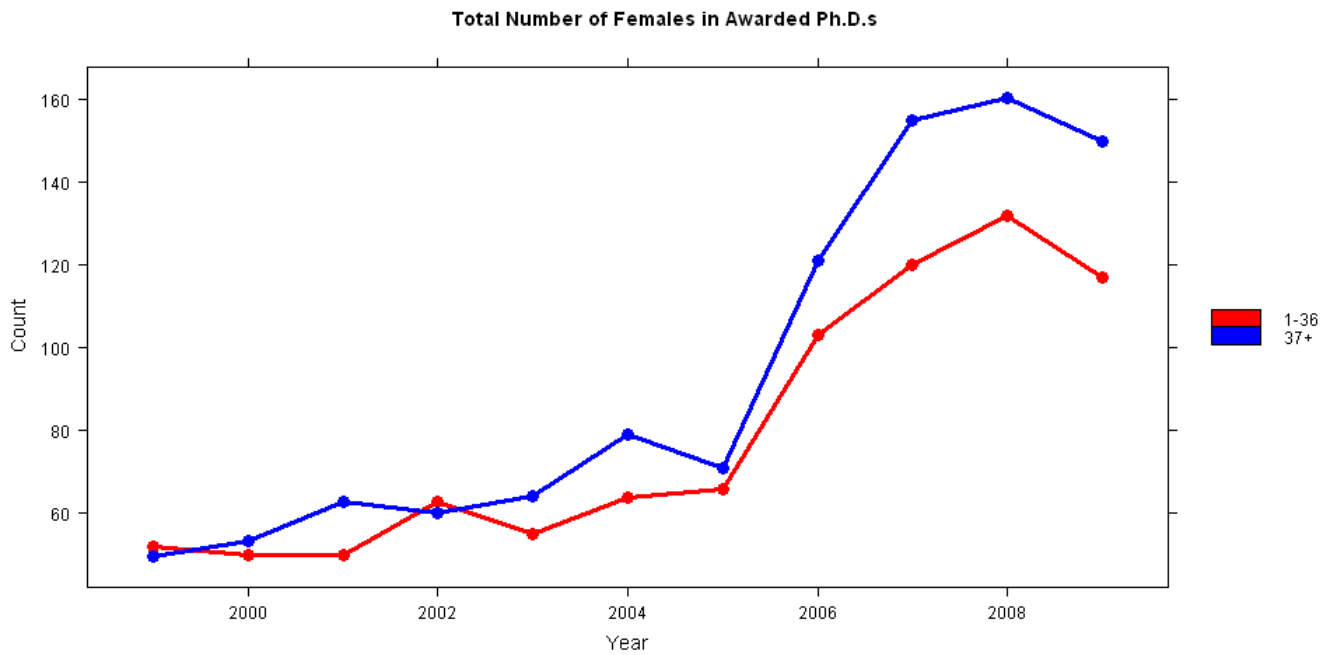


**Figure 4.3.** Difference in proportion of females PhDs from yearly average (bars), with total female PhD production counts per group superimposed (lines). Axis labels for the proportions (bars) are presented on the left, while the labels for the Ph.D. counts are presented on the right.

Figure 4.4 shows Ph.D. production for the two rank groups 1-36 and 37+ both with respect to proportion (4.4(a)) as well as average counts (4.4(b)). For both metrics, the rank group 37+ is above the group 1-36. Figure 4.5 partitions Ph.D. production for females along private versus public. A pattern similar to that of female faculty emerges.

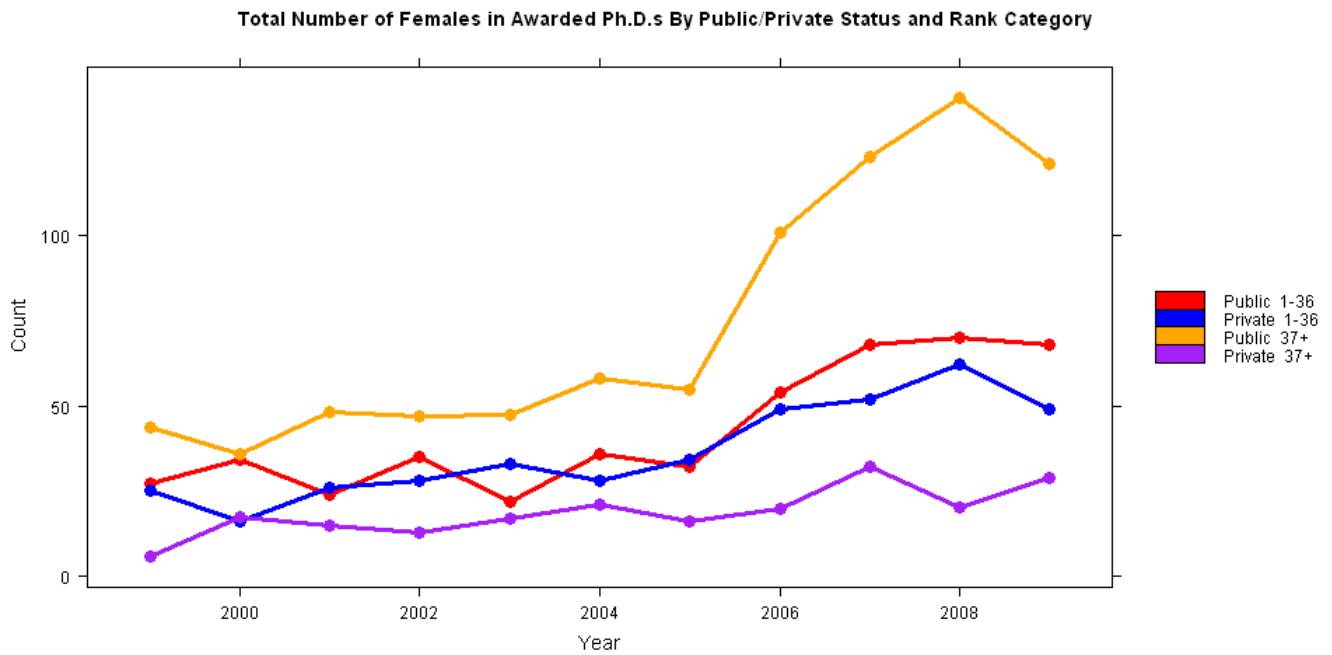


**Figure 4.4(a)** Proportion of females awarded Ph.D.s for the two rank groups 1-36 and 37+.



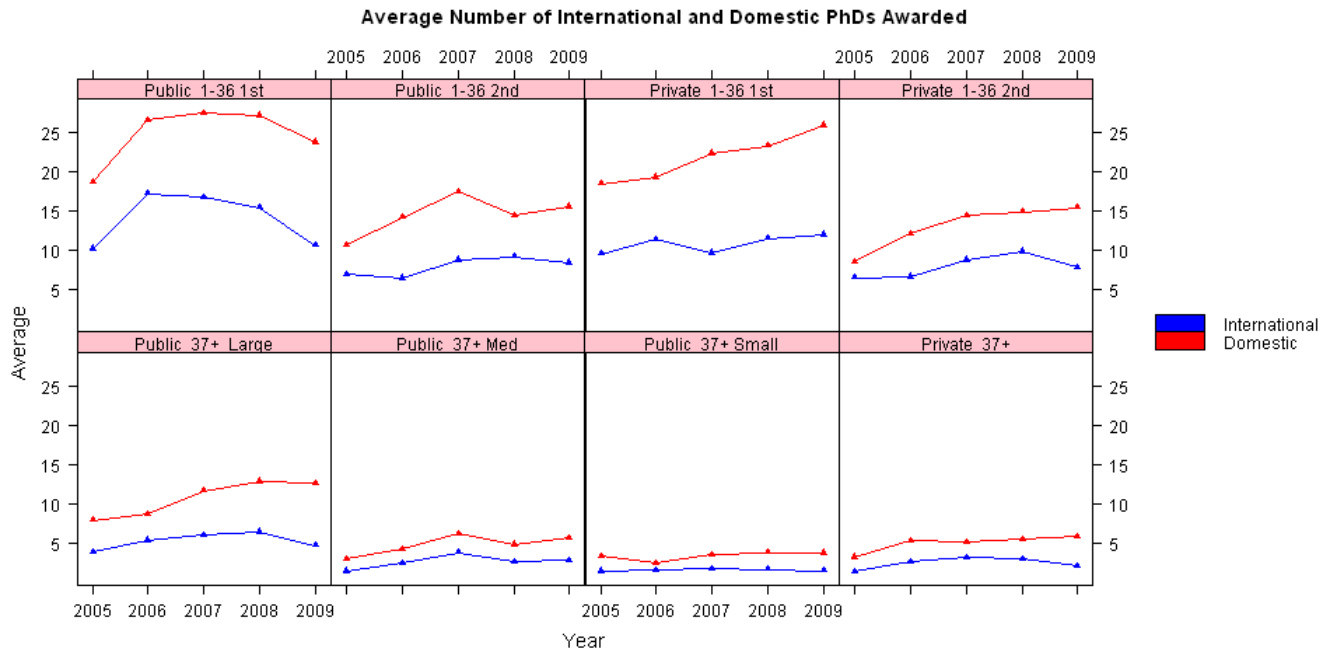
**Figure 4.4(b)** Total number of females in awarded Ph.D.s for the two rank groups 1-36 and 37+.

Figure 4.5 partitions the number of Ph.D.'s awarded to females into public and private for each rank group. This partitioning shows where the increase in the rank group 37+ the number of Ph.D.'s awarded to females occurred: in the public institutions; in the large departments, to be precise, as evident from Figure 4.1.



**Figure 4.5.** Total number of females awarded Ph.D.s split by public/private status and rank.

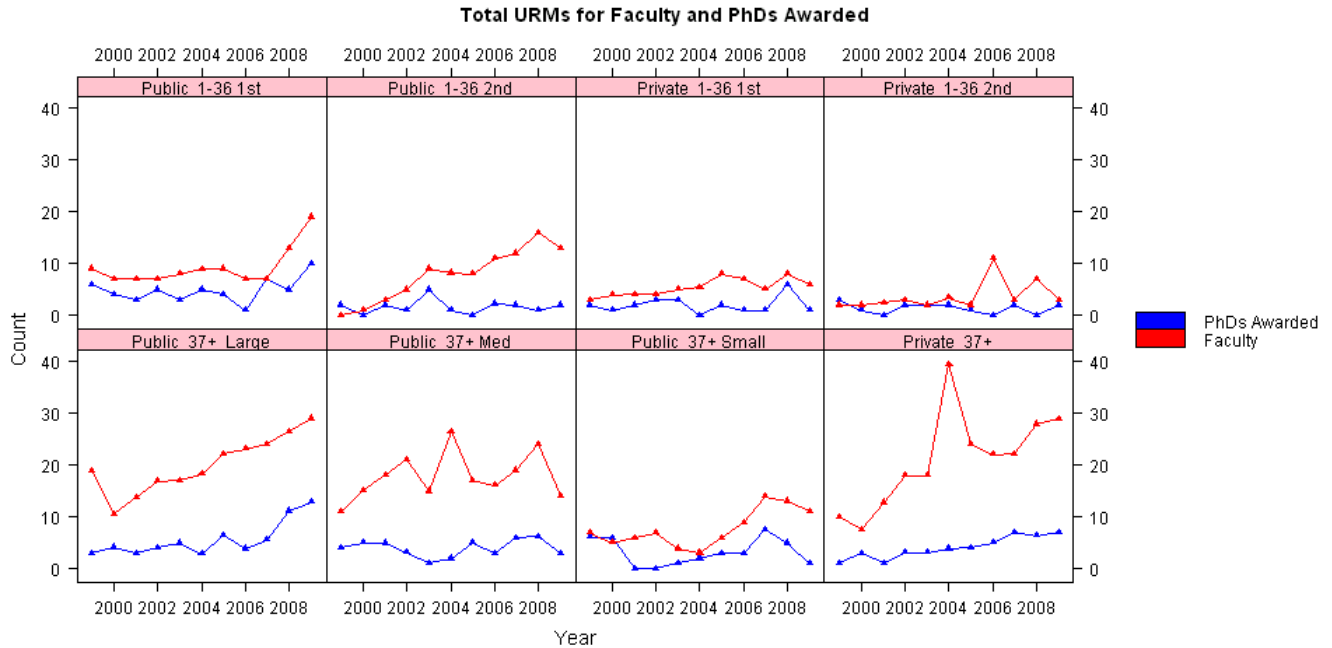
Figure 4.6 shows Ph.D. production for international versus domestic students using the average numbers for each of the eight groups. For all groups, the average number of Ph.D.'s awarded to international students shows a decline or has remained flat. Continuous and noticeable increases in the number of Ph.D.'s awarded to domestic students can be seen for both groups in Private 1-36 as well as Public 37+ large.



**Figure 4.6.** Average number of Ph.D.'s awarded to international and domestic students.

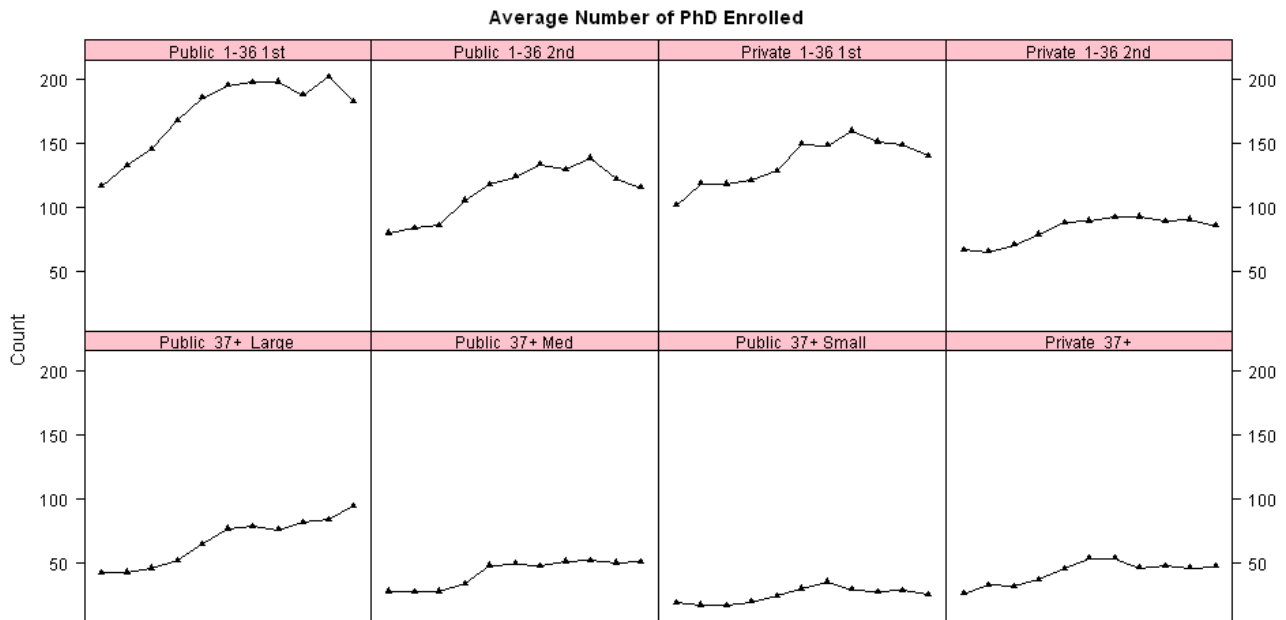
The Taulbee survey collects data on underrepresented minorities (URMs) for faculty and Ph.D.s awarded. Figure 4.7 shows this data in the form of total counts for the eight groups. Average counts or proportions show very small numbers. For example, the average number of URM faculty lies between 0.5 and 1.5, with Public 1-36 2<sup>nd</sup> has the highest counts (rising from 1 to 1.7).





**Figure 4.7.** Total number of underrepresented minorities faculty (red) and the total number of Ph.D.'s awarded to URMs (blue) each of the eight groups.

The final figure of this section shows average Ph.D. enrollment for the eight groups since 1999. A recent decreasing trend in the Ph.D. enrollment is noticeable for two groups, Public 1-36, 2<sup>nd</sup>, and Private 1-36, 1<sup>st</sup>.

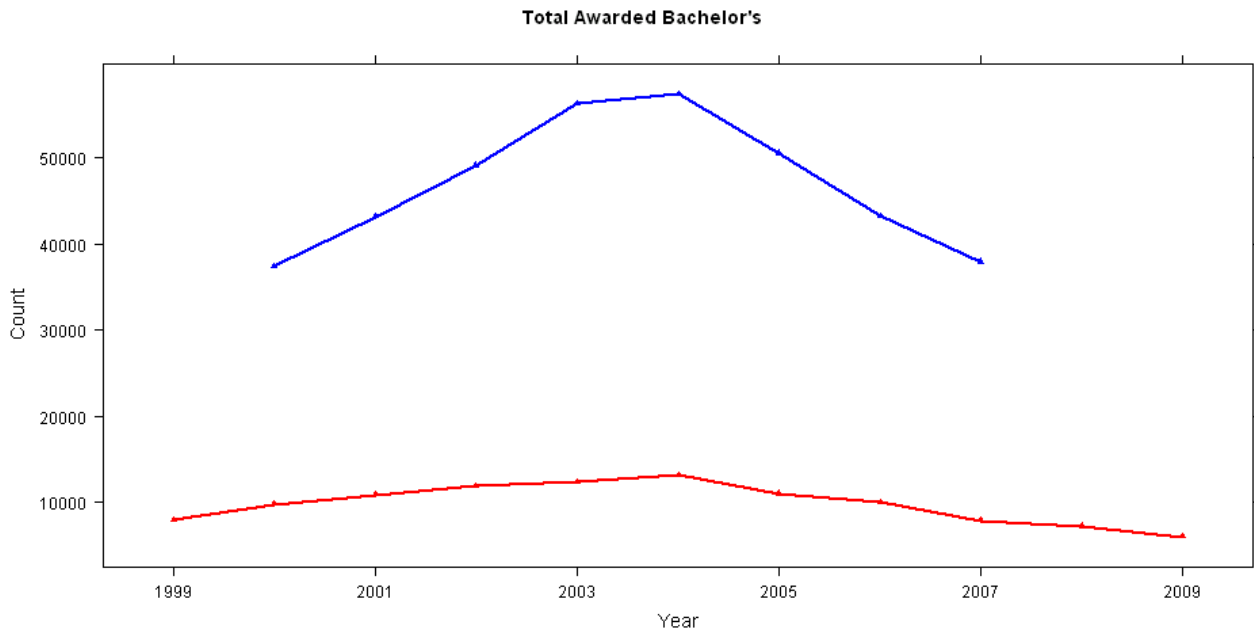


**Figure 4.8.** Average number of Ph.D. students enrolled in each of the right groups

## 5. Bachelor's Production

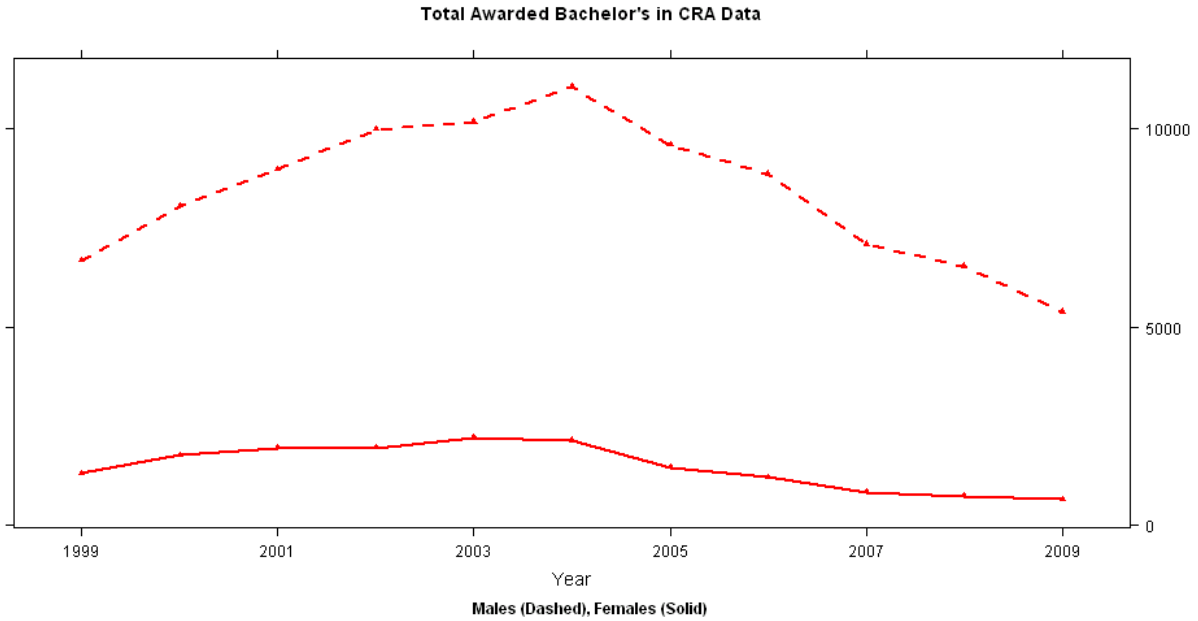
CRA publishes a number of detailed reports on the computer science bachelor's production in the Ph.D. granting institutions. The trends highlighted in this section augment the existing material available at <http://www.cra.org/resources/taulbee/>. The groupings into private and public institutions give additional insight into where changes in Bachelor's production have taken place.

As the number of degrees awarded reported in the Taulbee survey only show numbers from departments offering the doctoral degree, we first show Bachelor degree numbers in computer science for all US institutions. The data was obtained from WebCASPAR (<http://webcaspar.nsf.gov/>) which provides access to statistical data resources for US academic institutions. In particular, IPEDS provides data on degrees awarded from 1966 to 2007 (1999 is not available). Figure 5.1(a) shows the total number of Bachelors awarded in Computer Science for all US academic institutions (blue) and the 163 Taulbee institutions examined in this report (red).



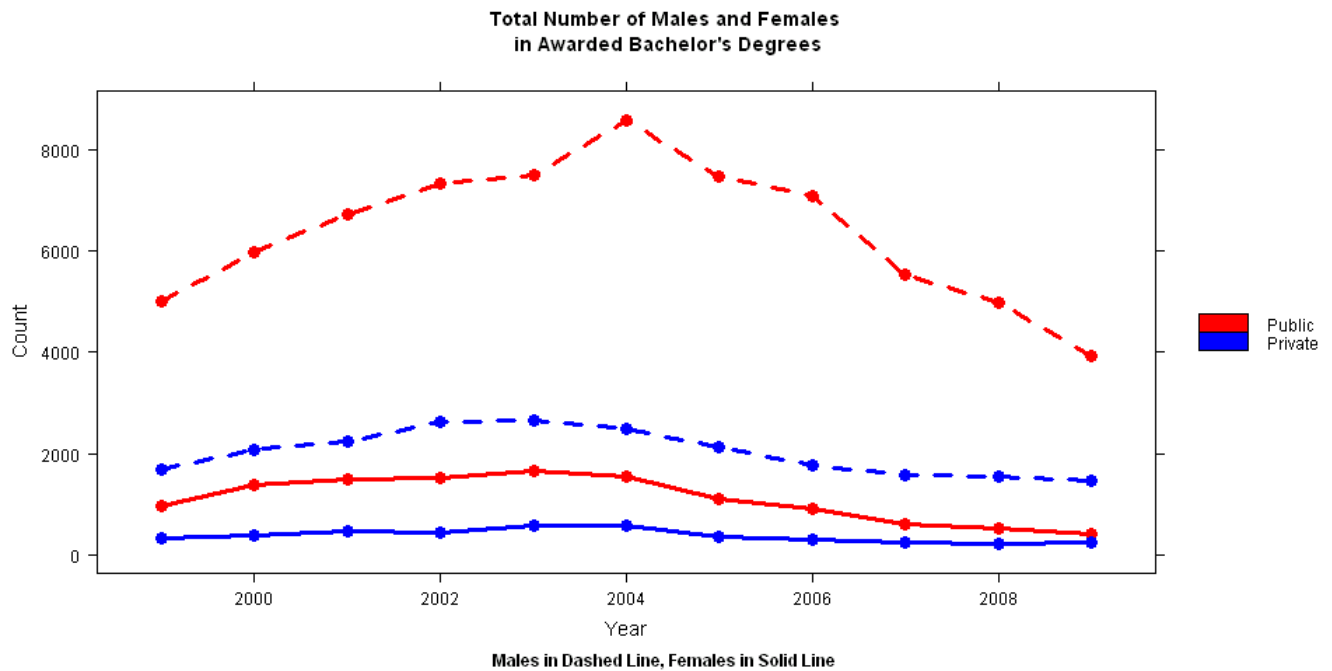
**Figure 5.1(a)** Total number of Bachelor degrees awarded in all 163 Taulbee institutions (red) versus the total number of all US institutions (blue).

Figure 5.1(b) shows the Taulbee curve in a different scale (red, dashed) which now mirrors the trend for all institutions from (a) more closely. The solid line shows the number of Bachelor degrees awarded to females among them. We point out that other comparisons of the total Bachelor production in the US versus Taulbee data have shown that for overall enrollment and production the trends in Taulbee data mirror the overall trend.

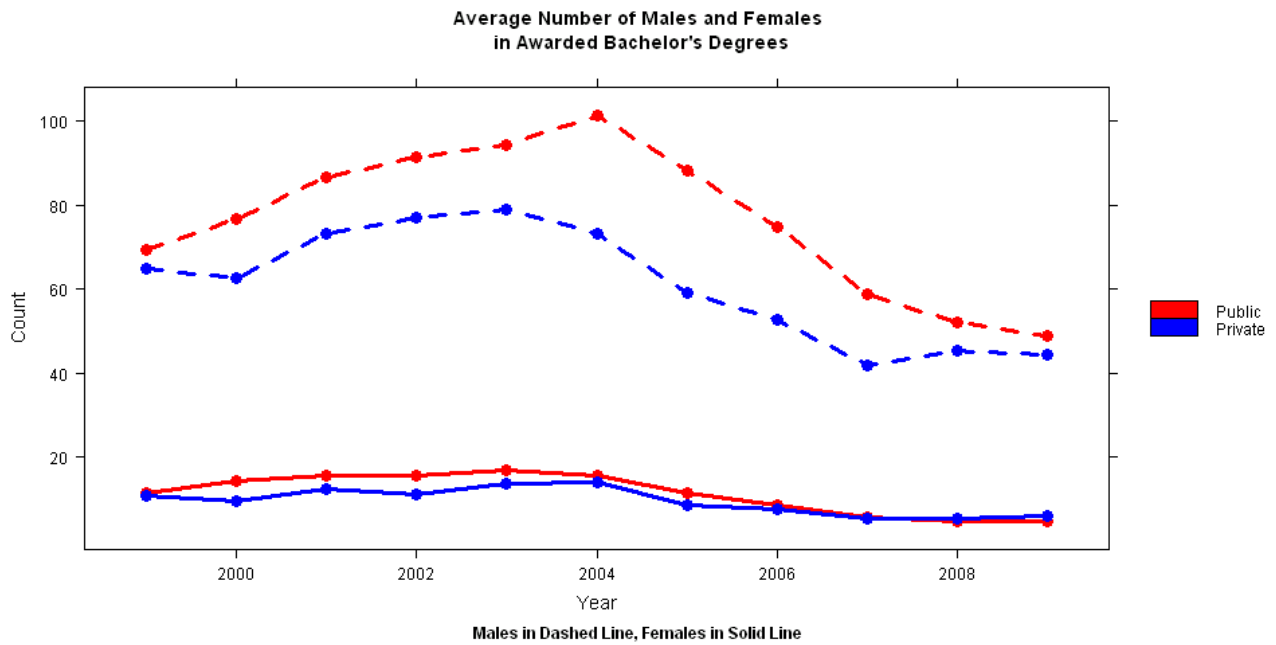


**Figure 5.1(b)** Total number of Bachelor degrees awarded in all 163 CRA institutions (red, dashed) and the total number of bachelor degrees awarded to females (red, solid)

The remaining figures in this section are based on Taulbee data of the 163 departments. Figure 5.2 shows the undergraduate degree production for males and female students for public versus private institutions: 5.2(a) shows total numbers and 5.2(b) shows averages per department. The data suggests a peak in the number of Bachelor's degrees awarded between 2003 (for females) and 2004 (for males). The total number of degrees awarded in the public schools is considerably larger than that in the private schools, but the average counts are not so disparate.

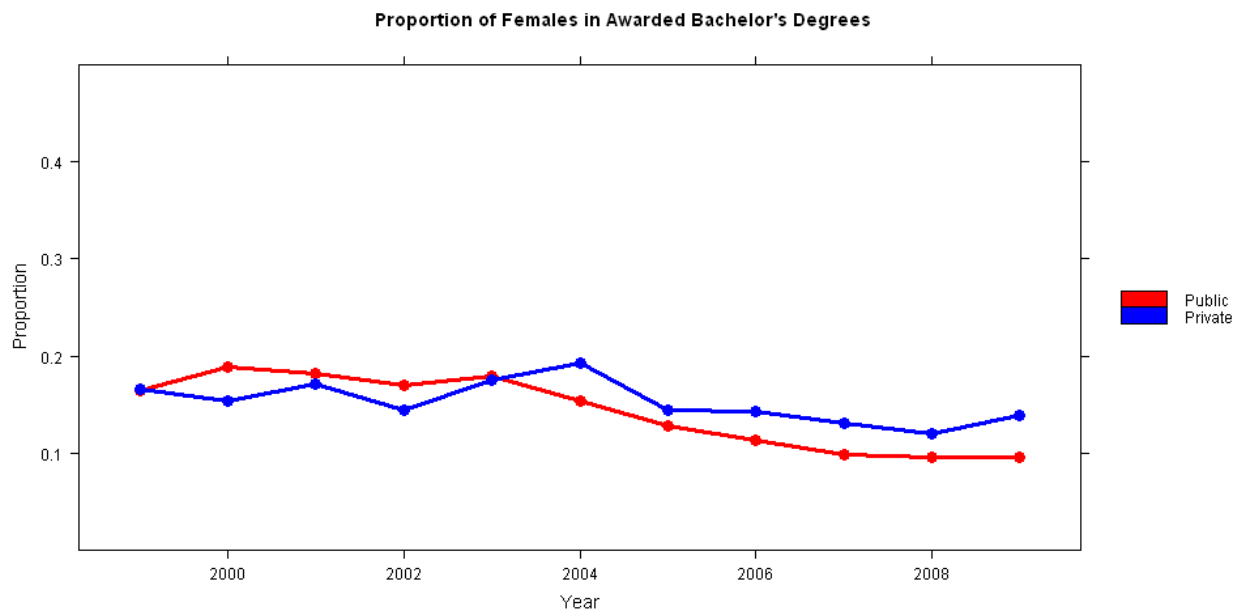


**Figure 5.2(a)** Total number of males (dashed) and females (solid) in awarded Bachelor's degrees for Public and Private schools.

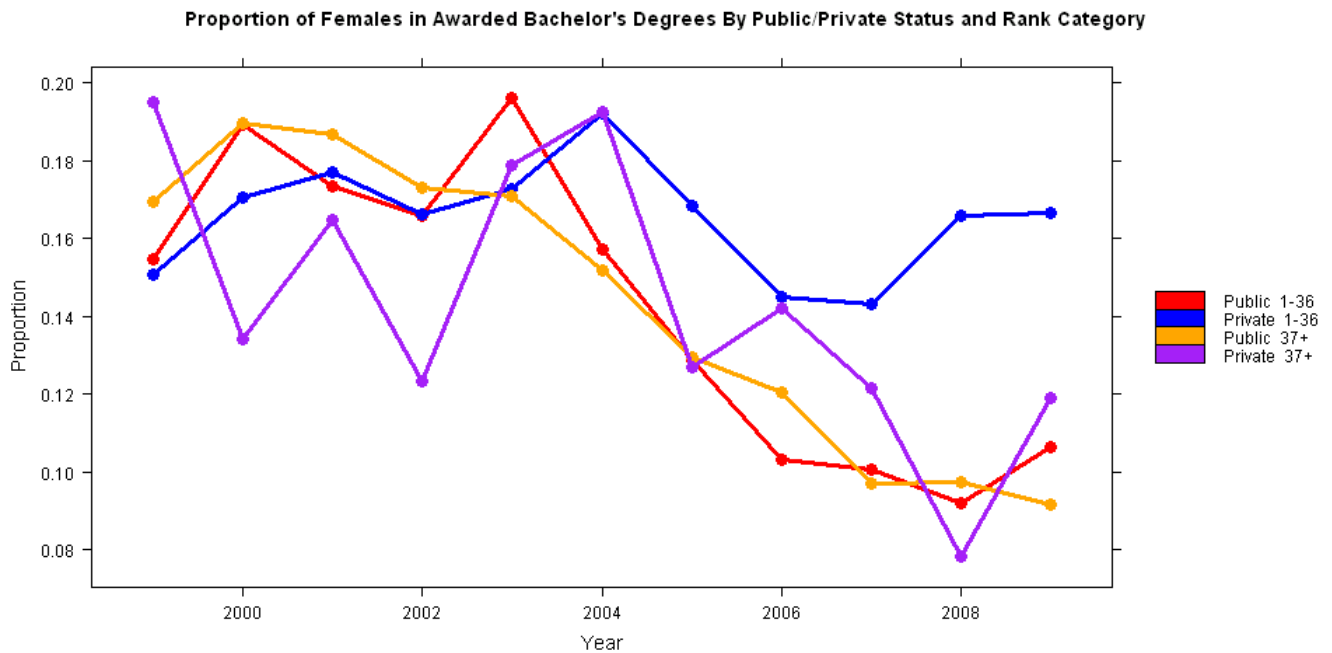


**Figure 5.2(b).** Average number of males (dashed) and females (solid) in awarded Bachelor's degrees for Public and Private schools.

Figures 5.3 and 5.4 show the proportion of degrees awarded to female students for two different groupings. Figure 5.3 shows the proportions of female students receiving a Bachelor degree in all private and all public institutions. Since 2003, the private institutions have had a higher percentage of female students receiving Bachelor degrees. Figure 5.4 shows the same information for four groups by splitting both private and public into two groups based on 1-36 and 37+. The declining trend in the number of Bachelor degrees awarded to females has turned around most visibly for departments in the Private 1-36 group.

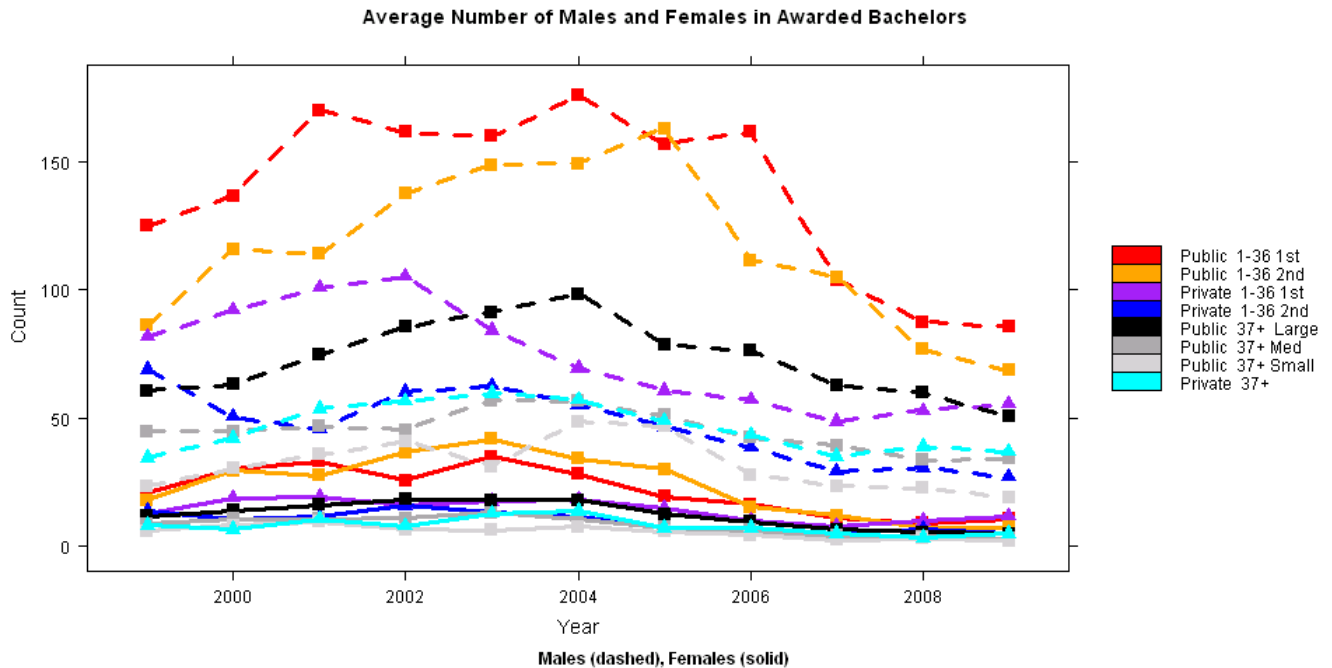


**Figure 5.3.** Proportion of female students awarded bachelor's degrees in private versus public institutions.



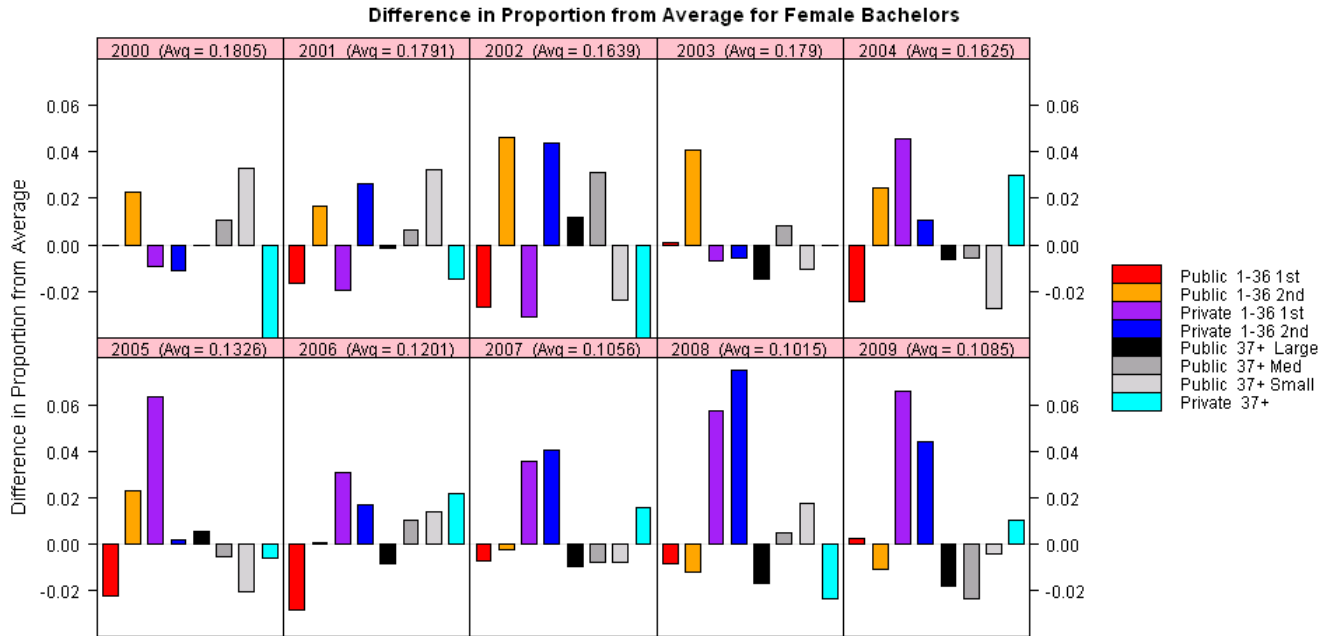
**Figure 5.4.** Proportion of female students awarded bachelor's degrees in private and public institutions broken into the two rank groups.

Figure 5.5 shows the average number of Bachelor degrees awarded in the departments for each of the eight groups, broken into female and male. The sixteen lines make it somewhat difficult to see trends for female students. Figures 5.6 and 5.7 show how far the number of degrees awarded to each of the eight groups is from the overall average.

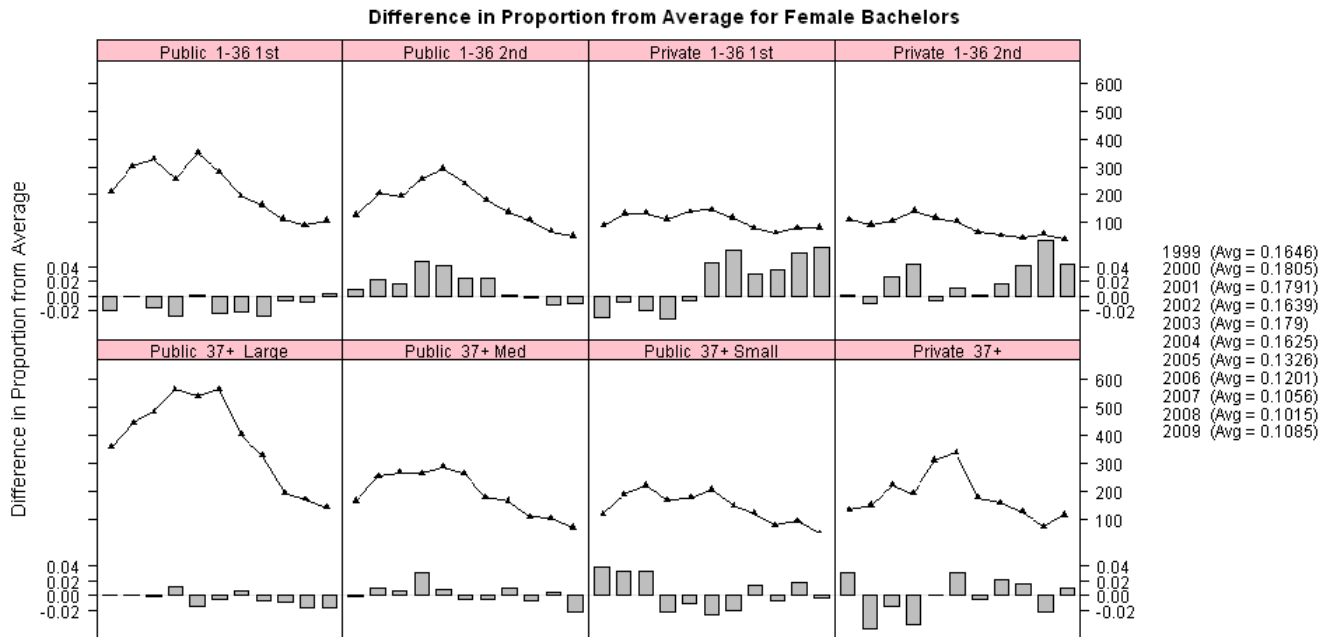


**Figure 5.5.** Average number of males (dashed) and female (solid) students awarded Bachelor's in departments in each of the eight groups.

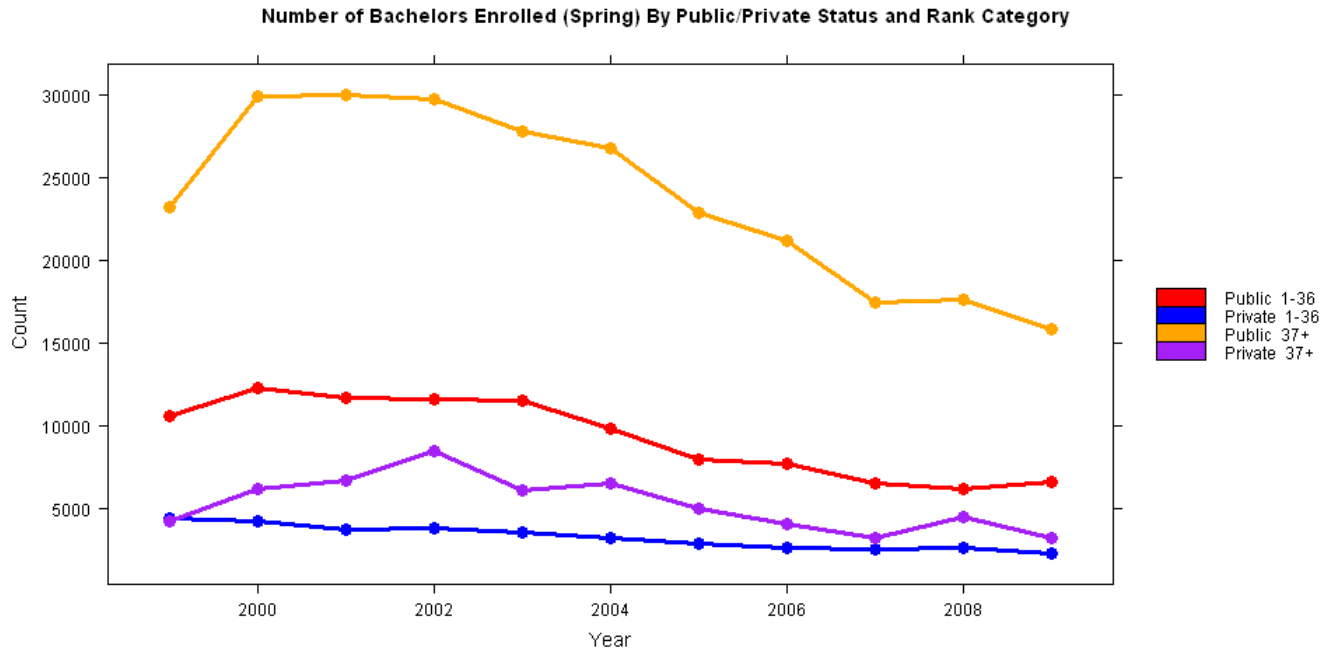
As done in the earlier sections, we generate a panel view showing how far each group is from the average number of production differs in each of the eight groups. Overall averages have decreased: from 18% of the bachelors being awarded to females in 2000 to 10.85% in 2009. The most significant increases since 2004 have been in departments in group Private 1-36, 1<sup>st</sup>.



**Figure 5.6.** Difference in proportion of Bachelor degrees to females from yearly average, with each panel representing the year using the colors representing the eight groups.

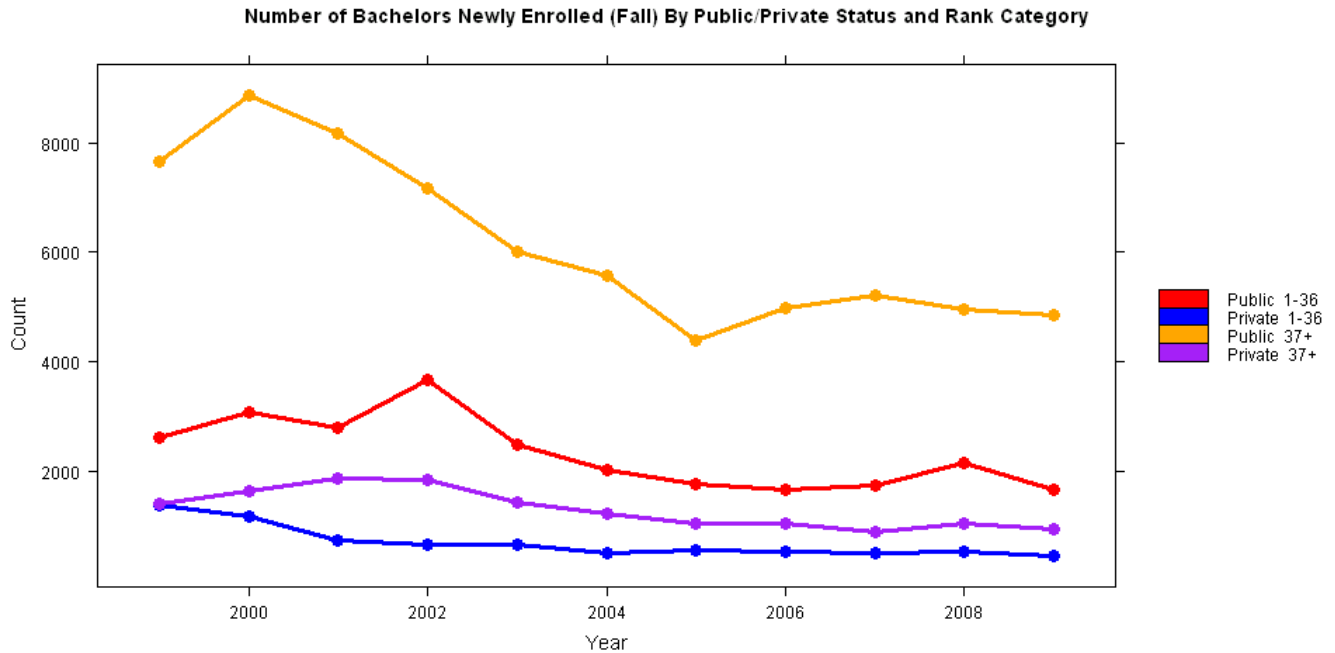


**Figure 5.7.** Difference in proportion of Bachelor degrees to females from yearly average (bars), with the total number of female Bachelor's for each group superimposed (lines). Axis labels for the proportions (bars) are on the left, labels for the counts (lines) are on the right.

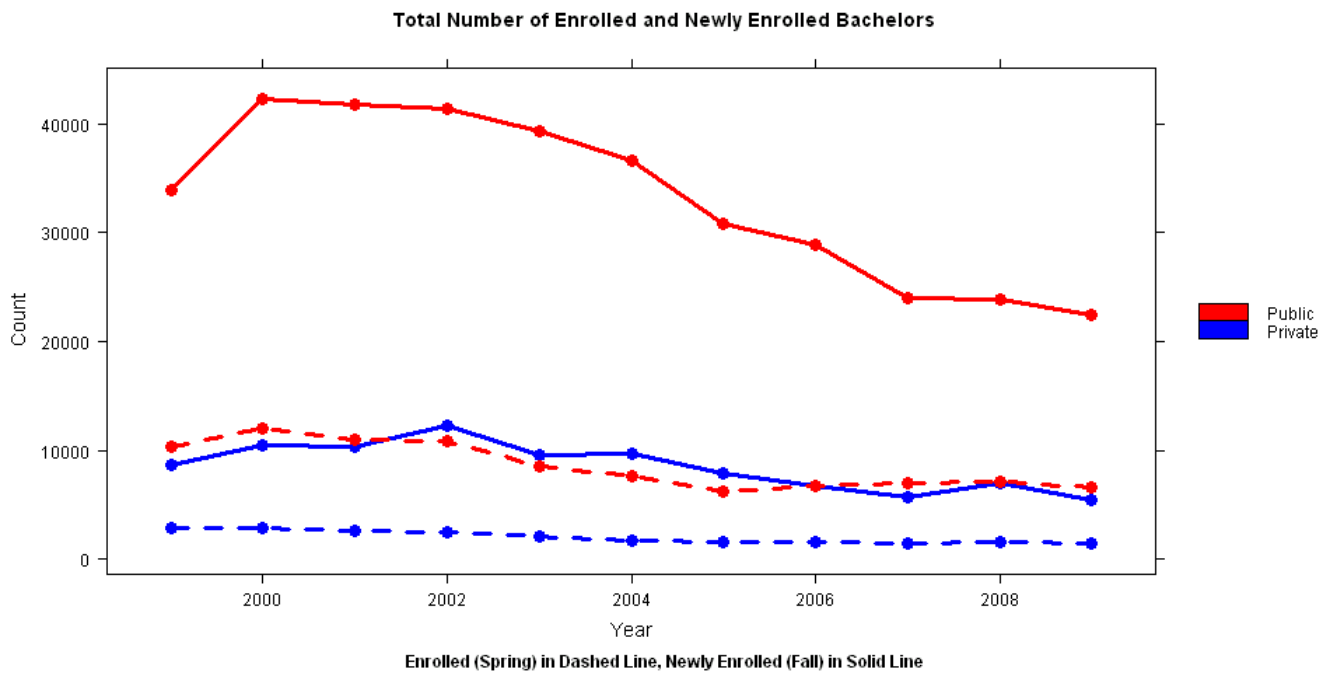


**Figure 5.8.** Total enrollment of Bachelors

The final slides focus on total enrollment and the number of new students (either freshmen or newly declared majors, depending on the institution). Figure 5.8 shows total enrollment trends since 1999 (a year before departments experienced the 2000 enrollment explosion) for 1-36 and 37+ partitioned into public and private. Figure 5.9 shows the same for new students declaring their intention of seeking a Bachelor in CS. Figure 5.10 combines enrolled and newly enrolled students into one figure, partitioned by private and public institutions.



**Figure 5.9.** Total number of new Bachelor seeking students in fall



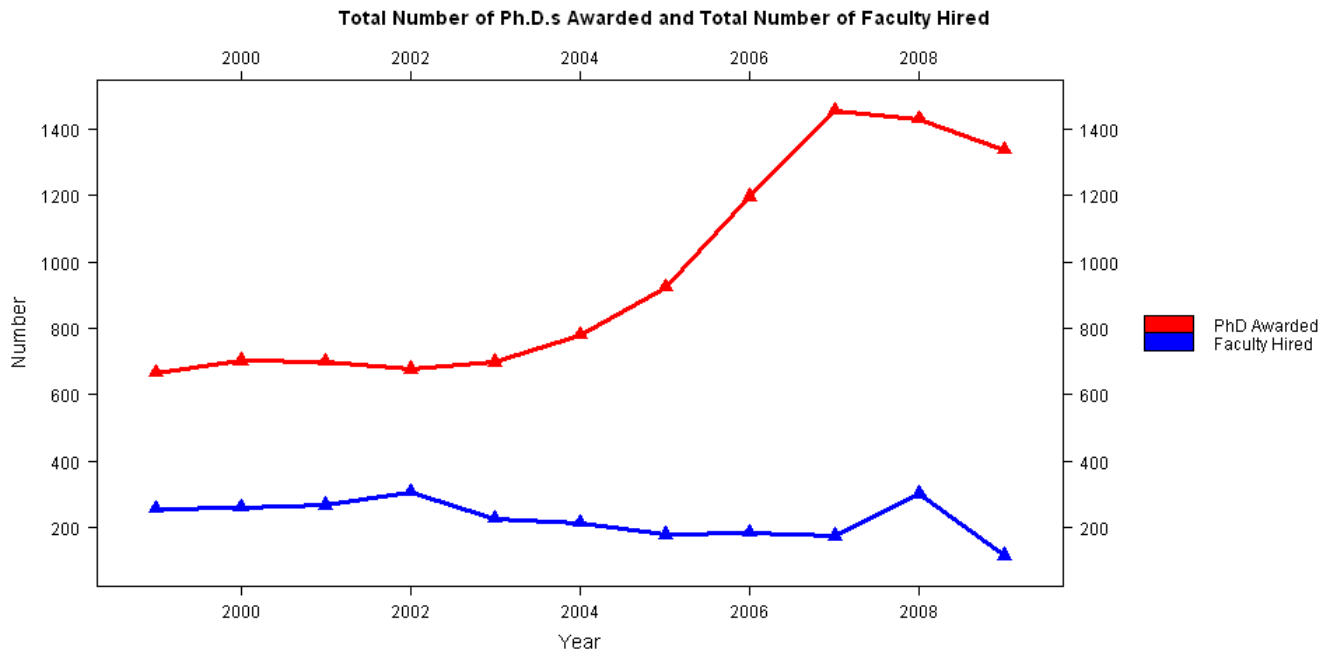
**Figure 5.10.** Enrolled (solid) and newly enrolled students (dashed)

In summary, the plots on B.S. enrollment echo the trends reported in the Taulbee survey reports. For the eight groups studied in this report, it appears that the enrollment and B.S. production have stabilized, but no significant overall increases can be observed. With respect to female students, private institutions have been more successful in increasing their proportions after the overall decrease starting in 2001.



## 6. Faculty Hiring and Total PhD Production

The final section looks at total Ph.D. production versus faculty hiring. The data supports what many departments have experienced since 2006: the number of new Ph.D.'s seeking an academic position has dramatically increased while the number of open tenure-track faculty positions has decreased. Figure 6.1 shows the total number of Ph.D.'s awarded and the total number of faculty hires made. Note that the number of hires includes all faculty hires made by the 163 departments, but the vast majority is at the assistant professor level. The plot shows an increase in the Ph.D. production and a decrease in faculty hiring, both starting in 2002.

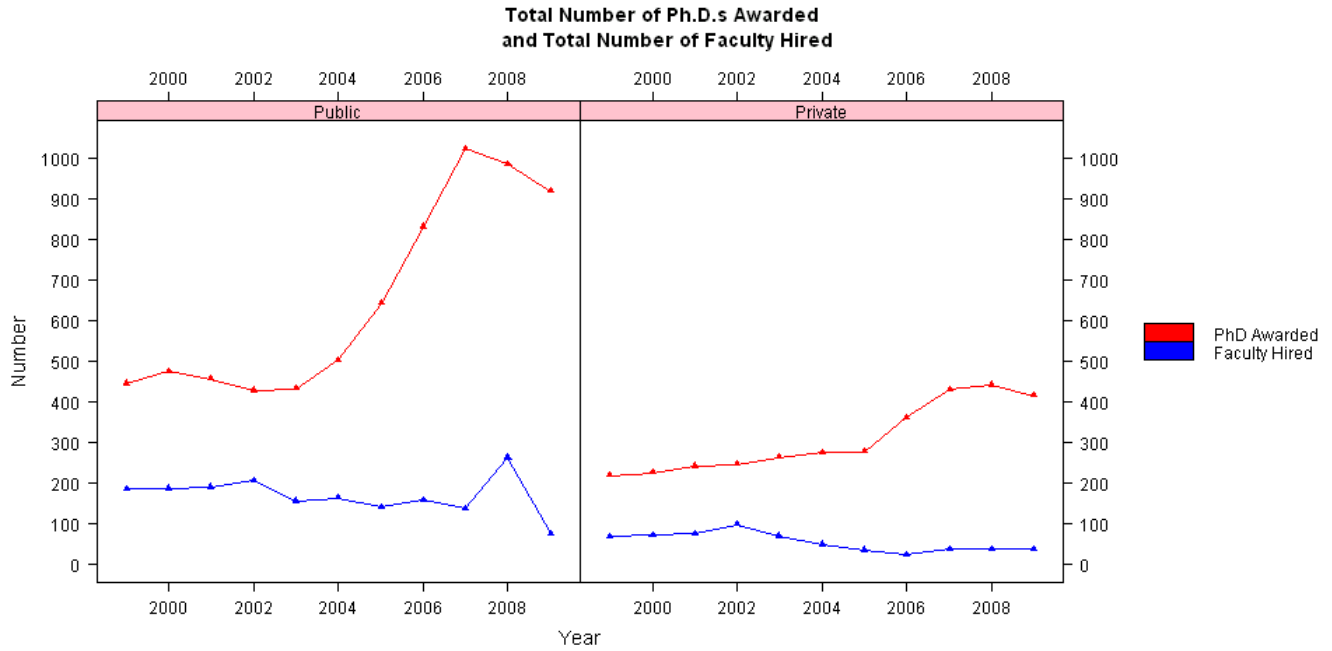


**Figure 6.1.** Total number of Ph.D.s awarded and total number of faculty hired.

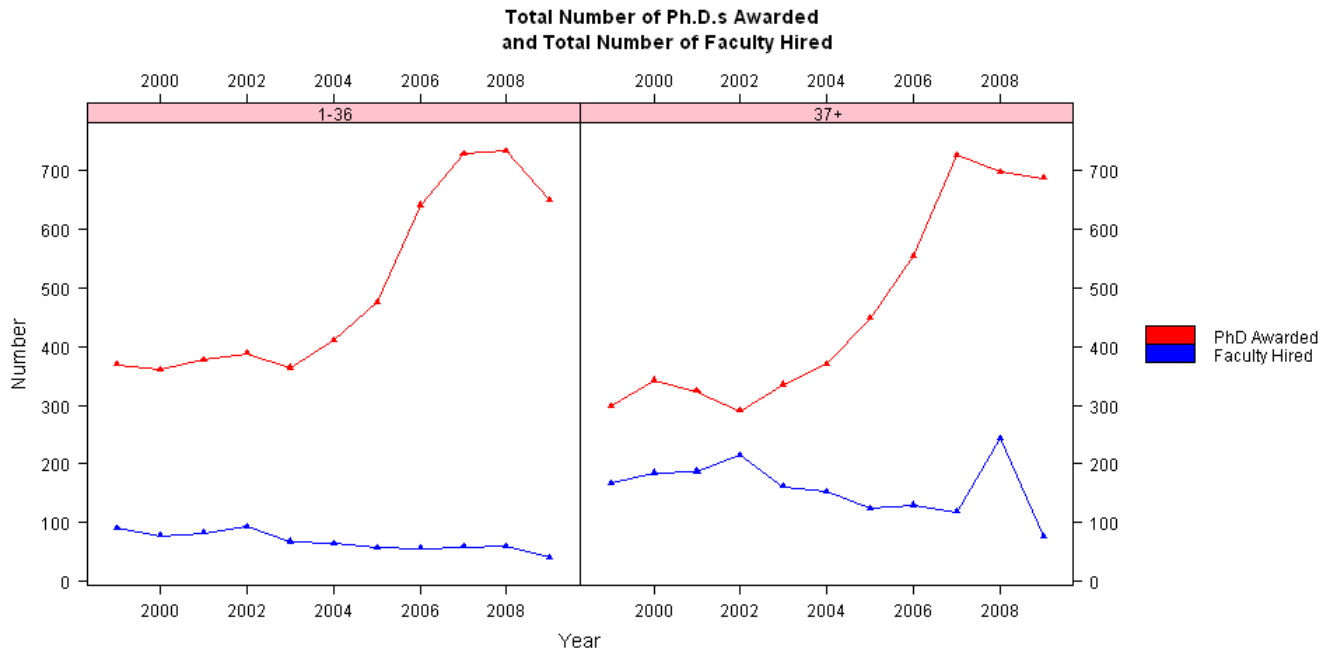
To better understand these trends, we consider the hiring and Ph.D. production data for three different partitions of the institutions:

- total numbers for Public vs. Private (Figure 6.2(a))
- total numbers for Ranks 1-16 vs. Ranks 37+ (Figure 6.2(b))
- average departmental numbers for the eight groups of Table 2.1 (Figure 6.3)

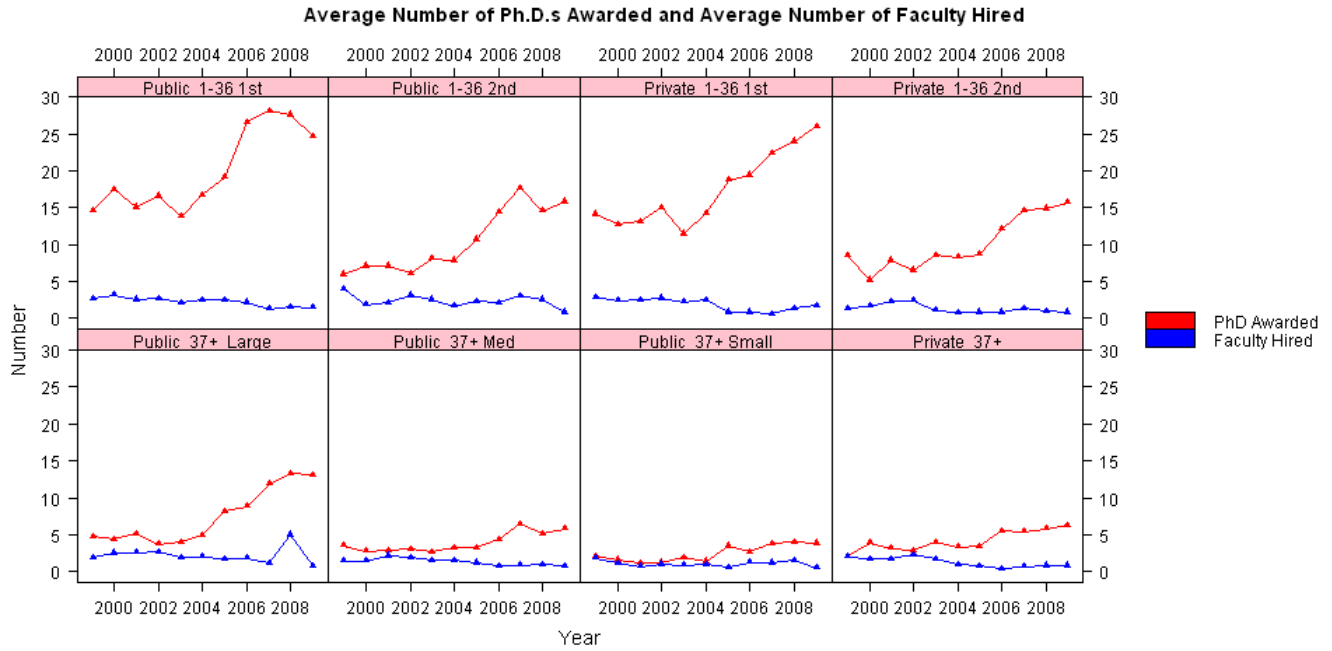
Figures 6.2 and 6.3 provide insight into where more of the faculty hiring took place and where the temporary hiring increase in 2008 took place. Overall, faculty hiring has been flat, with a declining trend, for all groups. The temporary hiring increase in 2008 took place in the large departments in public institutions in the rank group 37+.



**Figure 6.2(a)** Total number of Ph.D.s awarded and total number of faculty hired by public and private.



**Figure 6.2(b)** Total number of Ph.D.s awarded and total number of faculty hired for 1-36 and 37+



**Figure 6.3.** Average number of Ph.D.'s awarded and average number of faculty hired per department for each of the eight groups.

## Acknowledgement

We thank Betsy Bizot from CRA for generating the underlying data sets. Without her support and guidance in understanding data trends and identifying irregularities this report could not have been generated.

## Appendix 1

The following tables list, in alphabetical order, the 163 institutions and academic units in each of the eight groups. The groups are formed using the 1995 NRC rankings of research and doctoral programs in the United States (see <http://archive.cra.org/statistics/nrcstudy2/rankcs.html> for more details).

### **PUBLIC 1-36, 1st (10 institutions)**

University of California, Berkeley	Dept. of EECS
University of California, Los Angeles	Dept. of Computer Science
University of California, San Diego	Dept. of Computer Science & Engineering
University of Illinois, Urbana Champaign	Dept. of Computer Science
University of Maryland	Dept. of Computer Science
University of Massachusetts, Amherst	Dept. of Computer Science
University of Michigan	Computer Science & Engineering
University of Texas, Austin	Dept. of Computer Sciences
University of Washington	Dept. of Computer Science & Eng.
University of Wisconsin, Madison	Computer Sciences Department

### **PUBLIC 1-36, 2nd (9 institutions)**

Georgia Tech	College of Computing
Indiana University	Computer Science
Purdue University	Computer Science
Rutgers University, Busch Campus	Dept. of Computer Science
Stony Brook University, SUNY	Dept. of Computer Science
University of Arizona	Dept. of Computer Science
University of California, Irvine	School of Information & Computer Sciences
University of North Carolina at Chapel Hill	Dept. of Computer Science
University of Virginia	Dept. of Computer Science

### **PRIVATE 1-36, 1st (8 institutions)**

Brown University	Dept. of Computer Science
California Institute of Technology	Computer Science
Carnegie Mellon University	Dept. of Computer Science
Cornell University	Dept. of Computer Science
Harvard University	Division of Engineering & Applied Sciences
Massachusetts Institute of Technology	Dept. of Electrical Eng. & Computer Science
Princeton University	Dept. of Computer Science
Stanford University	Dept. of Computer Science

### **PRIVATE 1-36, 2nd (9 institutions)**

Columbia University	Dept. of Computer Science
Duke University	Dept. of Computer Science
New York University	Dept. of Computer Science
Rice University	Dept. of Computer Science

University of Chicago	Dept. of Computer Science
University of Pennsylvania	Dept. of Computer & Information Science
University of Rochester	Dept. of Computer Science
University of Southern California	Division of Computer Science
Yale University	Dept. of Computer Science

**Public, 37+, large (21 faculty or more in 2007), 36 institutions**

Arizona State University	School of Computing & Informatics
Clemson University	School of Computing
Florida International University	School of Computing & Information Sciences
Iowa State University	Dept. of Computer Science
Michigan State University	Dept. of Computer Science and Engineering
New Jersey Institute of Technology	College of Computing Sciences
North Carolina State University	Dept. of Computer Science
Ohio State University	Dept. of Computer Science & Engineering
Pennsylvania State University	Dept. of Computer Science & Engineering
Portland State University	Computer Science
Temple University	Dept. of Computer & Information Sciences
Texas A&M University	Dept. of Computer Science
University at Buffalo	Dept. of Computer Science & Engineering
University of Arkansas at Little Rock	College of Information Science & Systems Engineering
University of California, Davis	Dept. of Computer Science
University of California, Riverside	Dept. of Computer Science & Engineering
University of California, Santa Barbara	Dept. of Computer Science
University of Central Florida	School of Electrical Engineering & Computer Science
University of Colorado, Boulder	Dept. of Computer Science
University of Florida	Dept. of Computer & Info. Science & Engineering
University of Hawaii	Dept. of Information and Computer Sciences
University of Illinois, Chicago	Dept. of Computer Science
University of Maryland, Baltimore Co	Dept. of Computer Science & Electrical Engineering
University of Minnesota	Dept. of Computer Science & Engineering
University of Nebraska at Omaha	College of Information Science & Technology
University of Nebraska, Lincoln	Dept. of Computer Science & Engineering
University of North Carolina, Charlotte	College of Information Technology
University of Pittsburgh	Dept. of Computer Science
University of Tennessee, Knoxville	Electrical Engineering & Computer Science
University of Texas, Arlington	Dept. of Computer Science & Engineering
University of Texas, Dallas	Dept. of Computer Science
University of Texas, San Antonio	Computer Science
University of Utah	School of Computing
Virginia Tech	Dept. of Computer Science
Washington State University	School of EE & Computer Science
West Virginia University	Lane Dept. of Computer Science and Electrical Eng.

**PUBLIC, 37+, medium (between 15 and 21 faculty in 2007), 26 institutions**

Auburn University	Computer Science & Software Engineering
Colorado State University	Dept. of Computer Science
Florida State University	Dept. of Computer Science

George Mason University	Dept. of Computer Science
Kansas State University	Dept. of Computing & Information Sciences
Kent State University	Dept. of Computer Science
Louisiana State University	Dept. of Computer Science
Mississippi State University	Dept. of Computer Science & Engineering
Oregon State University	School of Electrical Engr & Computer Science
Texas Tech University	Dept. of Computer Science
University of California, Santa Cruz	Computer Science Dept.
University of Connecticut	Dept. of Computer Science & Engineering
University of Delaware	Dept. of Computer & Information Sciences
University of Georgia	Computer Science Department
University of Iowa	Dept. of Computer Science
University of Kansas	Dept. of Electrical Engineering & Computer Science
University of Kentucky	Dept. of Computer Science
University of Louisiana at Lafayette	Center for Advanced Computer Studies
University of Massachusetts, Lowell	Dept. of Computer Science
University of Missouri, Columbia	Dept. of Computer Science
University of North Texas	Dept. of Computer Science & Engineering
University of Oregon	Dept. of Computer & Information Science
University of South Carolina	Computer Science & Engineering
University of South Florida	Dept. of Computer Science & Engineering
Wayne State University	Dept. of Computer Science
Wright State University	Dept. of Computer Science & Engineering

**PUBLIC, 37+, small ( $\leq 15$  faculty in 2007), 34 institutions**

City University of New York, Graduate Center	Dept. of Computer Science
College of William & Mary	Dept. of Computer Science
Colorado School of Mines	Dept. of Mathematical & Computer Sciences
Georgia State University	Dept. of Computer Science
Michigan Technological University	Dept. of Computer Science
Montana State University	Computer Science Department
New Mexico State University	Computer Science
New Mexico Technology	Dept. of Computer Science
North Dakota State University	Dept. of Computer Science & Oprns Research
Oakland University	Dept. of Computer Science & Engineering
Oklahoma State University	Dept. of Computer Science
Old Dominion University	Dept. of Computer Science
University at Albany, SUNY	College of Computing & Information
University of Alabama, Birmingham	Dept. of Computer & Information Sciences
University of Alabama, Huntsville	Dept. of Computer Science
University of Alabama, Tuscaloosa	Dept. of Computer Science
University of Arkansas	Computer Science & Computer Engineering Dept.
University of Cincinnati	Computer Science
University of Idaho	Dept. of Computer Science
University of Louisville	Dept. of Computer Engineering & Computer Science
University of Maine	Dept. of Computer Science
University of Massachusetts, Boston	Dept. of Computer Science
University of Mississippi	Dept. of Computer & Information Science

University of Missouri, Rolla	Dept. of Computer Science
University of Nevada, Las Vegas	School of Computer Science
University of Nevada, Reno	Dept. of Computer Science & Engineering
University of New Hampshire	Computer Science Dept.
University of New Mexico	Computer Science
University of Oklahoma	School of Computer Science
University of Texas, El Paso	Dept. of Computer Science
University of Wisconsin, Milwaukee	Dept. of Electrical Engineering & Computer Science
University of Wyoming	Dept. of Computer Science
Virginia Commonwealth University	Computer Science Dept.
Western Michigan University	Dept. of Computer Science

**PRIVATE, 37+ (31 institutions)**

Boston University	Dept. of Computer Science
Brandeis University	Computer Science
Brigham Young University	Dept. of Computer Science
Case Western Reserve University	Dept. of Electrical Engineering & Computer Science
Catholic University of America	Dept. of EE & CS
Dartmouth College	Dept. of Computer Science
DePaul University	School of CS, Telecommunications & Information Sys
Drexel University	Dept. of Computer Science
Florida Institute of Technology	Dept. of Computer Sciences
George Washington University	Dept. of Computer Science
Illinois Institute of Technology	Computer Science Dept.
Johns Hopkins University	Dept. of Computer Science
Lehigh University	Computer Science & Engineering Dept.
Northeastern University	College of Computer & Information Science
Northwestern University	Dept. of Electrical Engineering & Computer Science
Nova Southeastern University	School of CIS
Pace University	School of Computer Science & Information Systems
Polytechnic University	Dept. of Computer & Information Science
Rensselaer Polytechnic Institute	Dept. of Computer Science
Rochester Institute of Technology	Computer Science
Southern Methodist University	Computer Science & Engineering Dept.
Stevens Institute of Technology	Dept. of Computer Science
Syracuse University	Dept of Electrical Engineering & Computer Science
Toyota Technological Institute at Chicago	
Tufts University	Computer Science
University of Denver	School of Engineering and Computer Science
University of Notre Dame	Dept. of Computer Science & Engineering
University of Tulsa	Dept. of Mathematical & Computer Sciences
Vanderbilt University	Dept. of Electrical Engineering & Computer Science
Washington University in St. Louis	Dept. of Computer Science & Engineering
Worcester Polytechnic Institute	Dept. of Computer Science