Starting Salaries of Chemists and Chemical Engineers 2004

Analysis of the American Chemical Society's Survey of Graduates in Chemistry and Chemical Engineering

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Available from the ACS Office of Society Services

Contents

Acknowledgements

Each year, with oversight of its Council Committee on Economic and Professional Affairs, the American Chemical Society (ACS) surveys recent chemistry and chemical engineering graduates to determine trends in salaries and employment. This report presents detailed results of the 2004 new graduate study. A summary of the survey findings was published in the April 18, 2005 issue of *Chemical & Engineering News*.

Janel Kasper-Wolfe, research associate in the Office of Member Information, conducted this year's survey, provided the tables for this report, and wrote the summary on the following pages. Special thanks go to the 4,213 new graduates who took the time to respond to this year's survey.

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Summary of Findings

The *Starting Salaries of Chemists and Chemical Engineers: 2004* report documents the employment situation for new graduates in these disciplines by looking at a number of factors, including mean and median starting salaries, current employment status, and plans for future education. Overall, the class of 2004 did not report any overly optimistic information. However, there are some signs of a stabilizing employment situation which is significant in itself in a survey that has been reporting some fairly gloomy numbers the past few years.

- Mean and median salaries for new graduates are a mixed picture when viewed by degree and depend largely on the employment sector.
- This year full-time employment increased across degrees, while the unemployment rate held steady for B.A./B.S. and Ph.D. level graduates and decreased at the master's degree level.
- Postdocs continue to be an important employment option for new Ph.D. graduates, although not always voluntarily.
- Median graduate stipends and postdoctoral fellowships continued a multiyear trend and increased at the bachelor's and doctorate levels with stipends for M.S. grads the same as last year.
- Almost a quarter (24%) of all new graduates reported plans to continue their education in chemistry, while 28 percent reported pursuing graduate education in fields other than chemistry.
- About half (49%) of those in chemistry are planning to pursue further studies full-time.

Salaries for the Class of 2004: Means and Median

Mean and median salaries for new graduates in the class of 2004 are a mixed picture when viewed by degree and vary depending on employment sector. Salaries for new graduates over the last few years indicated a softened job market, and nothing occurred in 2004 to contradict that picture. In fact, Michael Heylin points out in *Chemical & Engineering News* that "In constant-dollar terms, however, median salaries for inexperienced new chemistry graduates remained depressed. When adjusted for inflation, the median salaries for 2003-2004 graduates at all three degree levels were about 10% below the salaries received by chemists who had graduated three or four years earlier[1]." Although the overall salary picture is not as optimistic as new graduates might expect, there are glimmers of hope. The fact is that starting salaries are influenced by a range of factors including regional differences in pay structures, individual characteristics of the new graduates, the type of employer, the size of the employer, the work function performed, and the type of industry, to name a few.

TABLE 1. 2004 MEAN SALARIES FOR INEXPERIENCED CHEMISTRY GRADUATES (MEAN SALARY IN CURRENT & CONSTANT DOLLARS)

	Mean Salary 2003	Mean Salary 2004	%Change Current	%Change Constant
Bachelor's	$33,391	$33,981	1.77	-1.43 (3.20%)
Master's	$45,329	$44,796	-1.18	-4.40
Doctorate	$61,627	$63,547	3.12	-0.08

Note: CPI 10/03–10/04 = 3.20%

TABLE 2. 2004 MEAN SALARIES FOR INEXPERIENCED CHEMICAL ENGINEERING GRADUATES (MEAN SALARY IN CURRENT & CONSTANT DOLLARS)

	Mean Salary 2003	Mean Salary 2004	%Change Current	%Change Constant
Bachelor's	$47,842	$48,937	2.29	-0.91
Master's	$56,938	$56,305	-1.11	-4.31
Doctorate	$76,278	$77,418	1.50	-1.70

Mean salaries represent the calculated average starting salary. Because the mean is sensitive to very high or low individual salaries, it is a less descriptive figure than the median for the evaluation of salary data. Means are, however, used in statistical analysis, and when analyzed in consideration with the median, can provide useful information.

Tables 1 and 2 describe the mean salaries for inexperienced chemistry and chemical engineering graduates (those with less than 12 months of experience). The tables also show change between 2003 and 2004 in both current and constant dollars.

In current dollars, mean salaries increased for chemists and chemical engineers at most degree levels[2]. The exception is at the master's degree level. Introducing the consumer price index into the calculation shows that, after controlling for inflation, overall salaries for all degree groups have declined. There are, however, differences in magnitude. For example, the

[1] Heylin, Michael, "Class of 2004 Starting Salaries," *Chemical & Engineering News*, April 18, 2005, 51–55.

[2] The consumer price index (CPI-U) measures the cost of living increase for the U.S and is used as an approximation for inflation. CPI-U for the period of October 2003 – October 2004 was 3.2% (http://www.bls.gov/cpi/home.htm).

largest decrease was at the master's degree level for both chemists and chemical engineers; -4.40 percent and -4.31 percent respectively. At the bachelor's level, average salaries in current dollars increased for chemists and chemical engineers. However, inflation-adjusted figures show an overall decrease of 1.43 percent for chemists and .91 percent for chemical engineers. A similar pattern is evident for Ph.D. chemical engineers, who on average earned 1.5 percent more in 2004 than in 2003, but in constant dollars showed a decrease of 1.70 percent. The .08 percent inflation-adjusted decrease for inexperienced Ph.D. chemistry graduates shows the least change from 2003 to 2004. The low number of responses from chemical M.S. and Ph.D. chemical engineering graduates can lead to volatile means, and conclusions should be drawn with caution.

The median is used as the primary descriptive statistic in the majority of this report to avoid the volatility inherent in the mean statistics described above. The median represents the mid-point of the salary range for new graduates, where half of the salaries are above the midpoint and half are below. The remainder of this section discusses new graduate starting salaries using the median.

Two major factors influencing new graduates' starting salaries are their degree and length of work experience. Table 3 illustrates the relationship between these two variables and salaries. The clearest example of this relationship can be seen in the salary trends for B.A./B.S. chemists. For those with less than 12 months of experience, the median is $32,600, while 12-36 months of experience, brings a median salary of $34,750. With more than 36 months of experience, the median jumps to $40,000 a year—$7,400 more than the median for inexperienced bachelor's chemists.

TABLE 3. 2004 MEDIAN SALARIES FOR ALL NEW GRADUATES EMPLOYED FULL-TIME BY EXPERIENCE (MEDIAN SALARY IN CURRENT DOLLARS)

	Chemistry			Chemical Engineering		
	BA/BS	MS	PhD	BS	MS	PhD
Less than 12 months	$32,600	$43,250	$65,000	$52,000	$59,250	$78,600
12–36 months	$34,750	$43,800	$62,250	$54,000	$63,250	$80,000
More than 36 months	$40,000	$52,000	$70,000	$53,050	$54,000	$74,580

In general, this pattern holds true for new M.S. and Ph.D. chemists, with a couple of caveats. The pattern for new M.S. chemists is similar, although much less variation exists between those who identified themselves as inexperienced and those with 12–36 months of work experience ($550). In a bit of an anomaly, the median salary for inexperienced Ph.D. chemists is greater than the median for those with 12–36 months of experience ($65,000 versus

$62,250 respectively). New Ph.D.s with more than 36 months of experience earned $5,000 more than those with less than 12 months ($70,000).

Table 3 also reports the median salaries for new chemical engineers at all degree and experience levels. However, drawing conclusions based on the small number of chemical engineers that responded is difficult. An examination of Table 3 indicates instability of the means, because breaking them down by the level of experience results in groups of less than 15 for some cells, making the figures highly suspect. Salary comparisons at the general

FIGURE 1. MEDIAN STARTING SALARIES FOR INEXPERIENCED CHEMISTS WORKING FULL-TIME (IN CURRENT DOLLARS 1975-2003)

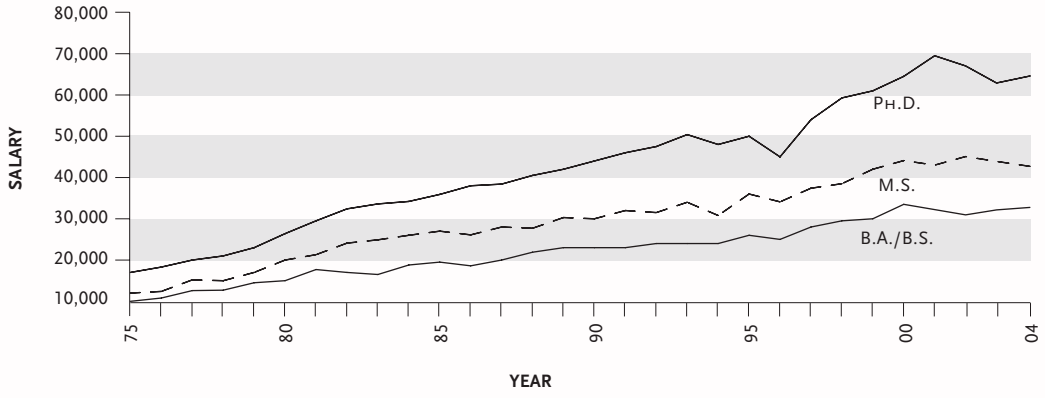
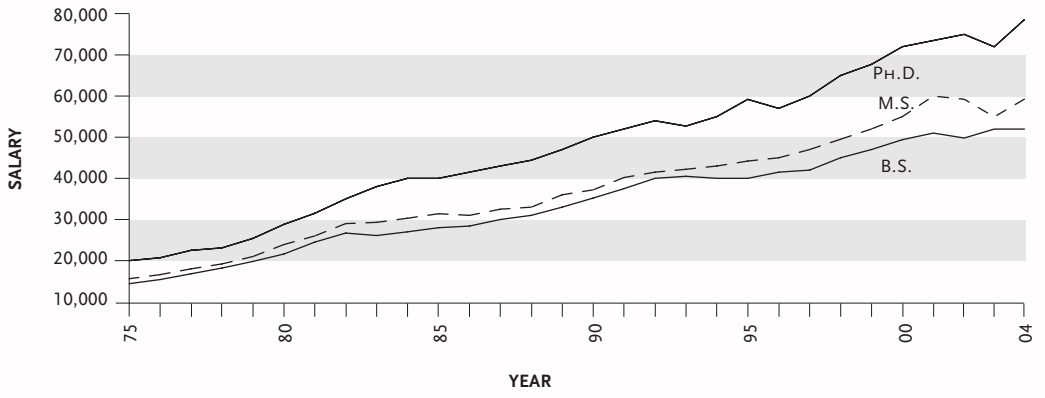


FIGURE 2. MEDIAN STARTING SALARIES FOR INEXPERIENCED CHEMICAL ENGINEERS WORKING FULL-TIME (IN CURRENT DOLLARS 1975-2003)



degree level, rather than by level of experience, provide more stable figures. In general, chemical engineers have higher median starting salaries than chemists, at all three degree levels.

Figures 1 and 2 illustrate changes in median salaries of chemists and chemical engineers over time. Overall, Figure 1 shows a steady pattern of increase for M.S. and Ph.D. chemists until the early 1990s. At this point and until 1996, starting salaries for these two groups began fluctuating almost yearly. Ph.D. starting salaries reached their peak in 2001 and then continued to fall until this year, which witnessed a slight upturn. Median salaries for B.A./B.S. chemists appear relatively stable, although they are still lower than the peak figure of $34,300 in 2000.

Figure 2 reveals that median starting salaries for chemical engineers have very similar patterns (albeit at a higher level because starting salaries for chemical engineers at all degree levels are higher than their comparison group in chemistry). Starting salaries for B.S. chemical engineers have been relatively stable over the last five years after a long period of growth. Those for new M.S. and Ph.D. chemical engineers experienced a slight boost this year after a short period of decline. This year's increase for new M.S. chemical engineers is notable, considering that as recently as two years ago, B.S. and M.S. median salaries appeared to be converging.

Table 4 shows the same information as Figures 1 and 2 in table form. The table, however, allows detailed observations of the median starting salaries by year, while the graphs give an overall picture.

The data in Tables 5 and 6 represent yet another way to examine starting salaries. For comparison purposes, the table includes data for 2003 and 2004. Examining the percentiles for each degree offers a more in-depth and nuanced picture of starting salaries for new graduates.

TABLE 4. MEDIAN STARTING SALARIES FOR INEXPERIENCED GRADUATES 1975-2004 (BY DEGREE AND IN THOUSANDS OF CURRENT DOLLARS)

	Chemistry			Chemical Engineering		
Year	BA/BS	MS	PhD	BS	MS	PhD
1975	10.0	12.0	17.0	14.4	15.6	20.0
76	10.8	12.4	18.3	15.4	16.6	20.7
77	12.6	15.2	20.0	16.8	18.0	22.5
78	12.7	15.0	21.0	18.2	19.2	23.1
79	14.5	17.0	23.0	19.8	21.0	25.4
1980	15.0	20.0	26.4	21.6	23.9	28.8
81	17.7	21.3	29.5	24.5	26.0	31.5
82	17.0	24.1	32.4	26.7	29.0	35.0
83	16.5	24.9	33.6	26.1	29.3	38.0
84	18.8	26.0	34.2	27.0	30.3	40.0
1985	19.5	27.0	35.9	28.0	31.4	40.0
86	18.6	26.1	38.0	28.4	31.0	41.5
87	20.0	28.0	38.4	30.0	32.5	43.0
88	21.9	27.7	40.5	31.0	33.0	44.4
89	23.0	30.3	42.0	33.0	36.0	47.0
1990	23.0	30.0	44.0	35.2	37.2	50.0
91	23.0	32.0	46.0	37.5	40.2	52.0
92	24.0	31.5	47.5	40.0	41.5	54.0
93	24.0	34.0	50.4	40.5	42.2	52.7
94	24.0	30.8	48.0	NA	NA	NA
1995	25.0	36.0	50.0	40.0	44.2	59.2
96	25.0	34.1	45.0	41.5	45.0	57.0
97	28.0	37.5	54.0	42.0	47.0	60.0
98	29.5	38.5	59.3	45.0	49.8	65.0
99	30.0	42.0	61.0	47.0	52.0	67.7
2000	34.3	44.1	64.5	49.4	55.0	72.0
01	32.2	43.0	69.5	51.0	60.0	73.5
02	31.0	45.0	67.0	50.0	59.0	75.0
03	32.0	44.5	63.3	52.0	55.0	72.0
04	32.6	43.3	65.0	52.0	59.3	78.6

TABLE 5. RANGES OF STARTING SALARIES OF INEXPERIENCED FULL-TIME EMPLOYED CHEMISTRY GRADUATES BY DEGREE: 2003 AND 2004 (IN CURRENT DOLLARS)

	DEGREE LEVEL					
	Bachelor's		Master's		Doctorate	
Salaries	2003	2004	2003	2004	2003	2004
90th Percentile	46,060	46,400	60,000	58,600	84,500	85,000
75th Percentile	38,000	40,000	55,000	52,000	76,750	77,000
50th Percentile	32,000	32,600	44,500	43,250	63,250	65,000
25th Percentile	27,000	28,000	37,250	36,600	45,000	46,350
10th Percentile	23,000	24,000	30,000	29,400	35,500	38,680
Mean	33,391	33,981	45,329	44,796	61,627	63,547
Count	363	471	46	63	84	115
Standard Deviation	8,817	8,913	11,796	12,826	18,209	18,499

TABLE 6. RANGES OF STARTING SALARIES OF INEXPERIENCED FULL-TIME EMPLOYED CHEMICAL ENGINEERING GRADUATES BY DEGREE: 2003 AND 2004 (IN CURRENT DOLLARS)

	DEGREE LEVEL					
	Bachelor's		Master's		Doctorate	
Salaries	2003	2004	2003	2004	2003	2004
90th Percentile	58,000	58,750	72,400	73,300	85,400	95,600
75th Percentile	55,500	56,000	60,000	65,250	80,000	84,000
50th Percentile	52,000	52,000	55,000	59,250	72,000	78,600
25th Percentile	45,000	42,125	36,000	47,500	60,750	70,800
10th Percentile	35,000	36,000	31,000	35,700	34,800	61,600
Mean	48,869	48,937	51,909	56,306	69,111	77,419
Count	119	164	11	18	18	27
Standard Deviation	9,754	9,294	14,550	12,748	15,695	12,005

Table 5 compares salary ranges, grouped in percentiles for each type of degree, for 2003 and 2004 chemistry graduates. The difference between the 90th percentile and 10th percentile at the bachelor's level is $22,400; last year the figure was $23,060. For M.S. chemists in 2004, the difference jumps to $29,200. The salary range is highest for Ph.D. chemists, at $46,320. The wide salary range illustrated in Table 5 is related to the different types of employment Ph.D.s seek after graduation. For example, some take positions in industry while others take academic positions at much lower salaries.

Interestingly, Ph.D. starting salaries have a larger range than those for M.S. and B.A./B.S. chemists: the standard deviation for this group is considerably larger ($18,499, $12,826 and $8,913 respectively). The magnitude of the standard deviation indicates how widely the cases range above and below the group's average. In this case, the higher standard deviation for Ph.D.s indicates that the cases are more spread out from the mean than those for B.A./B.S. and M.S. chemists. This affirms the observation made above that there is greater variation in employment sectors for new chemists at the doctoral level.

Table 6 displays the same statistics for chemical engineers. Similar to new chemical professionals in the range of starting salaries, the difference between the 10th percentile and the 90th percentile is larger for Ph.D.s than B.S. degree holders. The highest range is for M.S. chemical engineers; however, with only 18 inexperienced, full-time employed M.S. chemical engineers, the results here are questionable. Unlike chemists, however, the overall range between the high and low percentiles is lower for B.S. and Ph.D.s ($22,750, $37,600 and $34,000 respectively). This difference reflects the fact that there is less variation in the employment sectors in which new chemical engineers find work.

SALARY FACTORS

New graduates' starting salaries vary depending on a number of factors. The previous section outlined how salaries are impacted by the degree level and experience, yet those are not the only major factors. Salaries also vary by the type and nature of the employer, as well as characteristics of the new graduates themselves. For example, the size of the employer, the employer's geographic location and, for bachelor's level chemists, certification from an ACS-approved program all influence a new graduate's starting salary.

For instance, median salaries are typically higher in private industry and lower in academic institutions for graduates at all degree levels. Median starting salaries for new Ph.D. chemists in industry (including manufacturing and non-manufacturing) were $72,500, while those in academia were $43,260. Average starting salaries can also be affected by the industrial sector of the employer. For example, on average B.A./B.S. chemists with full-

time employment in pharmaceutical manufacturing earned $6,000 more than those in chemical manufacturing. At the Ph.D. level, at least for this year's survey, the median salary for chemical and pharmaceutical employment was identical at $75,000.

The difference in median starting salaries impacts more than just the individual graduate's economic situation; it can also influence other statistics discussed in this report. In the class of 2003, the proportion of Ph.D.s going to work in academia versus industry shifted, with more new Ph.D.s taking work in academia, where they earned less. This employment pattern effectively decreased the overall median salary for Ph.D.s. However, when median salaries were broken out for academia and industrial employment, they increased. The class of 2004 witnessed a reversal of this pattern for Ph.D.s, where overall median salaries increased and the proportion working in industry grew from 61 percent in 2003 to 65 percent in 2004. Interestingly, within employment sectors median salaries for new academic Ph.D.s increased from $42,000 to $43,260 while those for new industrial Ph.D. chemists decreased from $74,000 to $72,500.

Although sex can be another factor influencing starting salaries, the challenge in identifying consistent and meaningful differences is challenging. For example, in the 2003 report new male M.S. and Ph.D. graduates earned more on average than did their female counterparts. Yet similar differences did not appear in the results from the class of 2004 survey. In 2004, differences at all three degree levels were no greater than $1,066 (See Tables A-3 and A-4). In another complication, the low number of responses for M.S. and Ph.D. chemical engineers made a comparison of medians by sex for the two groups all but meaningless.

In addition to the inconsistencies discussed above, another reason to be cautious concerns the gender differences related to where new graduates go to work. Employment sectors are often populated with different proportions of men and women finding work in different fields. For example, at the Ph.D. level, 34 percent of women with full-time and permanent employment entered the academic sector compared to 29 percent of men. This figure excludes Ph.D.s taking postdoctoral positions, leading to yet another layer of complexity. Women Ph.D. chemists entering academia are more likely than their male counterparts to do so without first taking a postdoctoral position. Postdoctoral positions are an important part of the professionalization and training process for academic chemists, which can influence their career tracks.

In 2004, the numbers of chemical engineering responding at the M.S. and Ph.D. level were too small to make meaningful comparisons across industrial sectors. In general, chemical engineers are more apt to work in industry than chemists. On average, new graduates with bachelor's degrees

in chemical engineering working in chemical manufacturing earned $55,000 a year. Unlike new B.A./B.S. chemists who earned more working in pharmaceutical manufacturing, their chemical engineering counterparts reported slightly lower median salaries in pharmaceutical manufacturing than in chemical manufacturing, at $54,000.

Company characteristics such as the size of the company can also contribute to a new chemist's or chemical engineer's starting salary (see Table A–9). Consistently, the size of the employer is a strong predictor of starting salaries, with larger companies paying more. For new and inexperienced B.A./B.S. chemists the difference between the smallest employers (less than fifty) and the largest (25,000 or more) is $12,000 ($30,000 versus 42,000, respectively). At the M.S. and Ph.D. level, the lower number of respondents makes it difficult to look at salaries by employer size at this detailed level. However, collapsing categories into companies below 500 (small) and above (large) does indicate a similar pattern for median salaries. New M.S. chemists at small employers earned $40,000, while those at larger companies earned $52,000. The difference for new Ph.D.s was lower in magnitude. Those employed at companies with less than 500 employees reported median starting salaries of $70,000 while their counterparts at large companies reported higher salaries, at $75,000.

Geographic region also impacts the starting salaries of new graduates (see Table A–11). The largest number of new bachelors' chemists went to work in the Mid-Atlantic region, and this group also had the highest median salary at $35,175. New England ($35,000) and East North Central ($34,250) also exhibited strong starting salaries for new B.A./B.S. graduates. M.S. chemists were most likely to go to work in the Mid-Atlantic region or East North Central, but the number of respondents in each region made it impossible to meaningfully compare the median salaries. The Mid-Atlantic also pulled in a large number of new Ph.D. chemists, although those in the Pacific region earned top dollar at $80,000.

Company size and geographic region also affect starting salaries for new chemical engineers, but the only group large enough to compare in this regard is those at the bachelor's degree level. Similar to their peers in chemistry, new B.S. chemical engineers also earn more when they are employed by companies with more than 500 employees: $54,000 compared to $47,250, or a spread of $6,750. West South Central and East North Central regions showed the highest median salaries.

Not surprisingly, median starting salaries for bachelor's graduates tend to be related to the type of job they obtain (see Table A–10). Breaking a multiyear trend in which new grads in development and design reported the highest median salaries, this year's top-paying work function for new B.A./B.S. chemists was teaching, at $35,000. Over eight percent of new bachelor's

graduates reported that their primary work function was teaching. The largest proportion of new B.A./B.S. chemists described their work function as production and quality control (31%), with a median salary of $32,000. About one-quarter (26%) engaged in research as their primary work activity with a median salary of $33,000. The remaining new grads reported professional services (7%), development and design (7%), and management (6%) as their primary work functions.

A final factor frequently contributing to an increase in the median starting salaries of new B.A./B.S. chemistry graduates is ACS certification. Undergraduate students earning a bachelor's degree in chemistry have the option of pursuing an ACS-approved program of study which, upon completion, offers them an ACS-certified degree. On average, students certified by ACS reported an additional $2,000 to their annual salary ($35,000 versus $33,000).

GRADUATE AND POSTDOCTORAL STIPENDS

Median graduate stipends and postdoctoral fellowships continued a multi-year trend and increased at the bachelor's and doctorate levels, with stipends for M.S. grads remaining the same as last year (See Table A–21). This year's increase in graduate stipends for the bachelor's degree group puts them even with those at the masters' degree level, at $20,000. Stipends for postdoctoral fellowships at colleges and universities for Ph.D. chemists increased by $1,500 to a median of $33,500.

It is likely that these increases, which occurred after a decade of stagnant wages, are linked to new and increasing standards set by the National Institutes of Health (NIH)[3]. The NIH stipends are $20,772 for graduate students and $35,568 for postdoctoral fellows with less than one year of experience. The NIH standard sets a higher bar for graduate students and postdocs across disciplines, which could be influencing the salaries of the new graduate respondents in graduate school in this study.

Chemical scientists find postdoctoral positions across employment sectors; compensation levels in academia, industry, and government vary depending on the sector. For example, postdocs at medical schools reported a median salary of $35,000 compared to the $33,500 that postdocs in colleges and universities earned. Those in government averaged $50,000 a year, while non-manufacturing industrial postdocs came in at $37,238. Postdocs in manufacturing earned the highest salaries, with a reported median of $55,000.

[3] Ruth L. Kirschstein National Research Service Award Research Training Grants and Fellowships: http://grants.nih.gov/training/nrsa.htm

POST-GRADUATION PLANS OF BACHELOR'S CHEMISTRY GRADUATES

Starting salaries are not the only measure used to take the pulse of the chemistry enterprise; the post-graduation plans of bachelor's level chemists show trends related to employment and education. New B.A./B.S. chemists have a number of career options upon graduation, ranging from graduate education to employment in manufacturing or an analytical lab.

Figure 3 displays trends in the post-graduation plans of bachelor's chemistry graduates from 1987 to the current year. The data presented compares plans to pursue employment, graduate education in chemistry, or graduate education in another field. In the past, the post-graduation plans for bachelor's chemists involved about one-third entering the workforce immediately, while two-thirds continued their graduate education. This pattern shifted in the mid 1990s with an increasing proportion forgoing further education for employment directly after earning their B.A./B.S. Over time, the proportion of new chemists forgoing graduate education for employment has increased and stabilized at just under half for the last five years.

FIGURE 3. POST-GRADUATION PLANS OF BACHELOR'S CHEMISTRY GRADUATES: 1987–2004

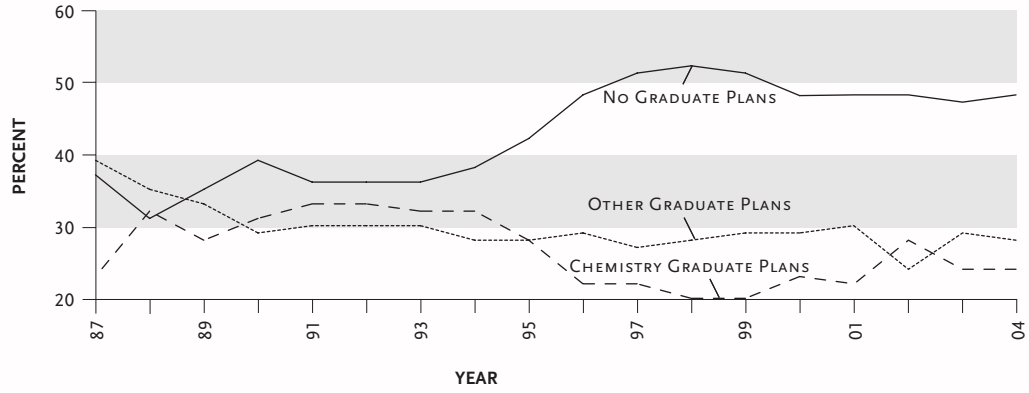
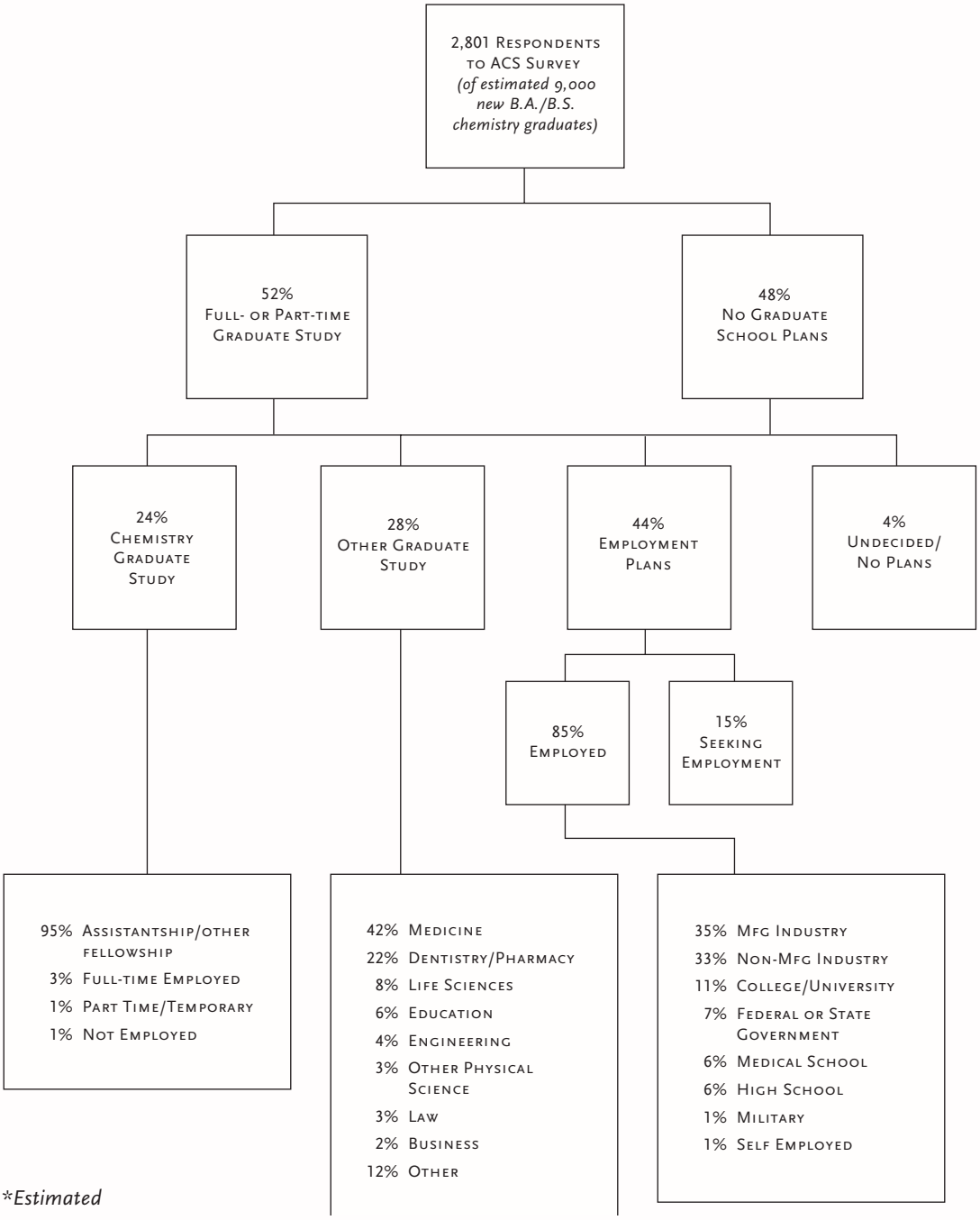


Figure 4 illustrates the detailed post-graduation plans for the class of 2004. Of the 44 percent of new graduates with no education plans (approximately 4% are undecided/no plans), 85 percent reported being employed while 15 percent were continuing to seek employment. Looking in further detail, of the 85 percent with employment, a majority found employment in industry (35% in manufacturing and 33% in non-manufacturing industry). Smaller proportions reported finding employment at a college or university (11%), medical school (6%), high school (6%), the government (7%), military (1%), or self employment (1%).

Almost a quarter (24%) of all new graduates reported plans to continue their education in chemistry, while 28 percent reported pursuing graduate education in fields other than chemistry. The breakdown for the class of

FIGURE 4. POST-GRADUATION PLANS OF 2004 BACHELOR'S CHEMISTRY GRADUATES



**Estimated*

2004's choices of other fields closely mirrors that of the class of 2003. The largest proportion indicated medicine as their field of study (42%). Dentistry/pharmacy appeared as the second largest field of study for this group (22%). Life sciences (8%), education (6%), engineering (4%), other physical sciences (3%), law (3%), and business (2%) represented other fields of study for chemistry graduates. Approximately 12 percent of new B.A./B.S. graduates in chemistry reported continuing graduate studies in fields other than those listed above.

An overwhelming majority of new grads continuing in chemistry reported financial assistance of some kind; 95 percent reported an assistantship or a fellowship. A much smaller proportion reported full-time employment (3%), part-time employment (1%), or no employment (1%).

PLANS FOR ADVANCED STUDY

Tables 7 and 8 display further information about the fall plans of new bachelor's chemistry and chemical engineering graduates. Almost 49 percent of those in chemistry are planning to pursue further studies full-time. Of those, 46 percent plan to study chemistry or biochemistry and 36 percent will pursue education in medicine, dentistry, or pharmacy, continuing patterns observed in the class of 2003. The remainder of the new B.S. grads plan to study life science (4%), education (2%), physical science (2%), law (2%), chemical or biochemical engineering (1%), business or management (1%), and other engineering (1%). About six percent listed a field other than those above.

TABLE 7. PLANS FOR FURTHER STUDY OF BACHELOR'S CHEMISTRY AND CHEMICAL ENGINEERING GRADUATES: FALL 2004 PLANS

Plans	Chemistry	Chemical Engineering
Total further studies		
Full-time	48.7%	23.4%
Part-time	3.4%	3.9%
No plans for further studies	47.9%	72.6%
Total*	100.0%	99.9%
Number of responses	2,794	431

**Note: Any deviation from 100 is due to rounding.*

Only 3 percent of new B.A./B.S. grads in chemistry are pursuing part-time studies, a decrease of 1 percentage point from 2003. Of those, chemistry or biochemistry (31%), education (22%), and medicine, dentistry, or pharmacy (16%) were the top areas of study.

A much smaller proportion of new B.S. chemical engineers plan to pursue graduate education. This reflects a long-standing workforce trend where chemical engineers are more likely to enter directly into the workforce after obtaining a bachelor's degree. This is related to the fact that the professionalization process of these applied scientists is more likely to be complete at the bachelor's level than is the case for chemists. This is not to say that B.S. chemical engineers do not pursue graduate education. In fact, 27 percent of the class of 2004 indicated they have plans for further gradu-

ate studies. Bachelor's level chemical engineers who do pursue graduate education are likely to continue with chemical or biochemical engineering. In particular, 56 percent of this class indicated continuing their full-time education in these fields.

TABLE 8. FIELDS OF STUDY OF CHEMISTRY AND CHEMICAL ENGINEERING BACHELOR'S GRADUATES: FALL 2004

Plans	Chemistry	Chemical Engineering
FULL-TIME STUDY		
Chemistry and biochemistry	46.2%	1.0%
Chemical or biochemical engineering	1.2%	55.6%
Other engineering	0.7%	10.1%
Physical science	1.5%	1.0%
Life science	3.9%	2.0%
Medicine, dentistry, or pharmacy	36.0%	15.2%
Business or management	0.8%	4.0%
Education	2.1%	1.0%
Law	1.5%	3.0%
All others	5.9%	7.1%
Total*	99.8%	100.0%
Number of responses	1,362	99
PART-TIME STUDY		
Chemistry or biochemistry	31.2%	0.0%
Chemical or biochemical engineering	0.0%	31.3%
Other engineering	3.2%	18.8%
Physical science	2.2%	0.0%
Life science	8.6%	0.0%
Medicine, dentistry, or pharmacy	16.1%	6.3%
Business or management	4.3%	25.0%
Education	21.5%	0.0%
Law	1.1%	0.0%
All others	11.8%	18.8%
Total*	100.0%	100.2%
Number of responses	93	16

**Note: Any deviation from 100 is due to rounding.*

POST-GRADUATION EMPLOYMENT STATUS

Table 9 addresses the post-graduation employment status of new chemists and chemical engineers. Employment status figures from the class of 2004 indicate the possibility that the employment situation is stabilizing.

As of the first week in October 2004, 25.4 percent of new B.A./B.S. chemists found full-time and permanent employment, a 1.9 percentage point increase from similar employment figures for 2003. The proportion reporting graduate appointments remained steady at 48.7 percent. The unemployment rate remained largely unchanged at 7.5 percent, compared to 7.7 percent in 2003.

Full-time employment at the M.S. level jumped from 41.1 percent last year to 47.6 percent for the graduating class of 2004. After an increase in 2003, the unemployment rate for this group dropped from 10.0 percent to 7.0 percent.

The proportion of Ph.D.s taking postdoctoral positions increased by a slim margin of 1.2 percentage points and full-time and permanent employment slightly increased by 1.7 percentage points to 38.4 percent from 36.7 percent. Last year a decline in full-time permanent employment occurred concurrently with an increase in new Ph.D.s taking postdoctoral positions. About 43 percent of postdocs reportedly took their position because they could not find full-time and permanent employment.

TABLE 9. POSTGRADUATION STATUS OF CHEMISTRY AND CHEMICAL ENGINEERING GRADUATES: OCTOBER 4, 2004

Major and Employment Status	Bachelor's	Master's	Doctorate
CHEMISTRY			
Full-time employed:			
Permanent	25.4%	47.6%	38.4%
Temporary	9.8%	5.0%	1.5%
Part-time employed:			
Permanent	1.0%	1.7%	0.2%
Temporary	3.8%	3.6%	0.9%
Graduate student, postdoc	48.7%	31.4%	51.8%
Unemployed and seeking employment	7.2%	6.7%	4.6%
Unemployed and not seeking employment	4.0%	3.9%	2.6%
TOTAL*	99.9%	99.9%	100.0%
Number of responses	2,793	357	456
Unemployment as of the week of 10/4/2004	7.5%	7.0%	5.0%
CHEMICAL ENGINEERING			
Full-time employed:			
Permanent	57.2%	50.0%	57.3%
Temporary	3.5%	6.1%	3.7%
Part-time employed:			
Permanent	0.5%	0.0%	1.2%
Temporary	2.6%	6.1%	0.0%
Graduate student, postdoc	23.3%	30.5%	28.0%
Unemployed and seeking employment	12.1%	4.9%	7.3%
Unemployed and not seeking employment	0.9%	2.4%	2.4%
Total*	100.1%	100.0%	99.9%
Number of responses	430	82	82
Unemployment as of the week of 10/4/2004	12.0%	5.0%	8.0%

**Note: Any deviation from 100 is due to rounding.*

The unemployment rate calculation only includes respondents in the workforce, which excludes those unemployed and not seeking employment.

For the class of 2004, 50.2 percent reported accepting postdoctoral appointments because of the lack of full-time permanent positions, casting a shadow on an otherwise cautiously optimistic picture. Similar to the B.A./B.S. new graduates, the unemployment rate for Ph.D.s remained largely unchanged at 5.0%.

While a larger number of new chemical engineering graduates at both levels responded to the survey this year, caution in interpreting the data is still advised. A total of 57.2 percent of B.S., 50 percent of M.S., and 57.3 percent of Ph.D. chemical engineers found full-time permanent employment. Similar to the new chemistry graduates, the unemployment rate changed very little at the B.S. and Ph.D. level while it increased at the M.S. level. A change from 11.4 percent to 12 percent for newly graduated B.S. chemical engineers indicates little change. Ph.D.s witnessed a similar trend, with a shift from 7.4 percent unemployed in 2003 to 8.0% in 2004. Graduates at the M.S. level, however, saw a 2.6 percentage point decrease, to 5.0%. Early sections in this report addressed the volatility in figures for Ph.D. and M.S. graduates in chemical engineering.

BACHELOR'S GRADUATES CERTIFIED TO ACS FROM APPROVED PROGRAMS

Undergraduate students earning a bachelor's degree in chemistry have the option of pursuing an ACS-approved program of study which, upon completion, offers them an ACS-certified degree. New bachelor's level chemists with an ACS-certified degree are more likely to pursue higher education than those without. Almost 58 percent of those with certified degrees reported plans for further studies in fall of 2004. Those with ACS-certified degrees are also more likely to indicate that chemistry is their chosen field of study in graduate school (59 percent compared to 22 percent). Those without ACS-certified degrees are more likely to choose graduate programs in medicine, life sciences, or pharmacy/pharmacology.

Employment status is another area where variation between the two groups exists. B.S. graduates with ACS-certified degrees reported a lower unemployment rate (6.8% compared to 7.7%), a larger proportion in graduate appointments (54.8% compared to 44.9%), and a lower percent with full-time permanent employment (24.0% compared to 26.5%). The higher proportion of ACS-certified graduates in graduate appointments reflects the fact that they are more likely to be planning further studies in the fall.

DEMOGRAPHICS OF NEW GRADUATES

SEX

In general, this survey has charted increases in the participation of women at all degree levels for chemistry graduates (see Table B–1a). However, because women disproportionately responded to this survey, these num-

bers are higher than the real proportion of women and men graduating with chemistry degrees at all three degree levels. For example, as recently as the year 2002[4], the National Center for Education Statistics (NCES) reported that women make up 49 percent of B.S./B.A. degree recipients in chemistry, yet in the 2004 survey, they comprised 58 percent of the B.A./B.S. respondents in chemistry. Men made up 42 percent of the same degree group of respondents, while they received 51 percent of B.S./B.A. degrees nationally. The survey results show that 55 percent of M.S. chemists responding to this survey were women and 45 percent were men. This statistic is the inverse of what would be expected based on the NCES data, which shows that men received 56 percent of M.S. degrees in chemistry and women received 46 percent of them. At the Ph.D. level, 41 percent of respondents were women compared to 60 percent men; yet, according to NCES data, women comprised approximately 34 percent of those earning Ph.D.s in chemistry in 2002[5].

A comparison of the survey data with numbers from NCES on the sex distribution for chemical engineers degrees shows similar trends (See Table B7–a). Over 47 percent of B.S. chemical engineers who responded to the survey were women and 53 percent were men; however, according to NCES only 33 percent of B.S. degrees for chemical engineering were awarded to women. At the M.S. level, women comprised 43 percent of respondents but only 30 percent of actual degree recipients. Finally, for Ph.D.s, women represented 30 percent of respondents compared to 24 percent of degree recipients[6].

CITIZENSHIP

Citizenship for new chemistry and chemical engineering graduates varied by degree with the largest proportion of U.S. citizens found in the categories of B.A./B.S. chemistry and chemical engineering graduates. This reflects general trends in graduate education in science, engineering, and technology fields[7].

In particular, U.S. natives comprised 89 percent of new B.A./B.S. graduates in chemistry (see Table F–1) and 92 percent for chemical engineers (see Table F–4). These proportions reflect very little change from 2003 figures (90% and 92%, respectively). Naturalized citizens (6%), permanent residents (3%), and individuals with temporary visas (2%) made up the remaining categories for B.A./B.S. chemists. For bachelor's chemical engineers, the remaining categories were naturalized citizens (6%), permanent residents (1%), and those with temporary visas (1%).

4 2002 is the most current year of degree data available from NCES.

5 National Center for Educational Statistics, *Digest of Education Statistics 2003*, Table 255, December, 2004, p. 324.

6 National Center for Educational Statistics, *Digest of Education Statistics 2003*, Table 255, December, 2004, p. 322.

7 See the National Center for Educational Statistics *Digest of Education Statistics 2003* for data on the number of degrees granted by citizenship: http://nces.ed.gov/programs/digest/

U.S. citizens comprised smaller proportions of new M.S. and Ph.D. graduates for both chemistry and chemical engineering. At the M.S. level for new chemistry graduates, the breakdown is: U.S. natives (65%), naturalized citizens (6%), permanent residents (7%), and individuals with temporary visas (22%). The Ph.D. level shows similar proportions: U.S. natives (63%), naturalized citizens (5%), permanent residents (4%), and individuals with temporary visas (29%).

New chemical engineering graduates at the M.S. and Ph.D. levels show higher proportions with temporary visas (41% and 30%, respectively) and lower proportions of U.S. natives (41% and 62%). However, as in previous demographic discussions, the low number of respondents from these groups makes it impossible to generalize these findings to the larger group.

RACE AND ETHNICITY

The demographics for the race and ethnicity of the class of 2004 for both chemistry and chemical engineering graduates are very similar to the class of 2003 (see Table F–3 for chemistry and Table F–6 for chemical engineers). Notably, among men at all degree levels (both chemistry and chemical engineering) whites comprise larger proportions than other race/ethnic groups. Conversely, African American and Hispanic women tend to make a larger proportion compared to men in the same race/ethnic groups. Any changes at the M.S. and Ph.D. level for chemical engineers are most likely related to the small numbers when respondents are divided by race and ethnicity, rather than any general patterns among new graduates.

In 2004, Asians represented 10 percent of the bachelor's chemists and 7 percent of bachelor's chemical engineers. The proportion of Asians at the M.S. degree level was 23 percent for chemists and 40 percent for chemical engineers. At the Ph.D. level, Asians comprise 24 percent of new chemistry grads and 30 percent of chemical engineers.

American Indians, Hispanics, and African Americans continued to be under-represented while whites were over-represented. In particular, new African American chemistry grads at the bachelor's level made up 5 percent for chemistry and 6 percent for chemical engineering. The proportion of Hispanics was 4 percent for chemistry and 3 percent for chemical engineering. Whites comprised 78 percent and 83 percent of the groups, respectively. The race and ethnicity breakdown for M.S. chemists is African American (5%), Hispanic (5%), white (65%) and other (1%). The M.S. group for chemical engineering shows slightly different figures: African American (5%), Hispanic (3 %), and white (44%). Finally, at the Ph.D. level for new chemistry graduates, the race and ethnicity breakdown is African American (4%), Hispanic (5%), white (57%), and other (3%). Once again the breakdown for Ph.D.s in chemical engineering looks different than chemistry: African American (4%), Hispanic (5%), white (57%), and other (3%).

Scope and Method

OBJECTIVES

The 2004 New Graduate Study (Starting Salary Survey) is the 54th in the series of annual surveys on the employment and future plans of new graduates in chemistry and chemical engineering conducted by the American Chemical Society. A summary of the results of these surveys appears annually in *Chemical & Engineering News*.

The primary objective of the survey is to gather data on the starting salaries and occupational status of new chemists and chemical engineers who graduated during the 2003–2004 academic year. The survey covers bachelor's, master's, and doctoral degree recipients. In addition, since 1973, the survey provides information on graduates' sex, citizenship, and ethnicity.

METHOD OF COLLECTION AND TIMING OF SURVEY

Chemistry departments approved by ACS and chemical engineering departments approved by the American Institute of Chemical Engineers and the Engineer's Council for Professional Development provided names and addresses of students who graduated between July 2003 and June 2004. The survey was mailed out to two survey groups: Group 1 from October 2004 to January 2005 and Group 2 from January 2005 to March 2005. Questionnaires were mailed to those graduates whose names had been provided and had U.S. addresses.

EXTENT OF COVERAGE

Survey questionnaires to Group 1 were mailed by first class mail on October 22, 2004, to 8,867 graduates. Approximately one week after the initial mailing, a postcard reminder was sent, and then a second questionnaire and cover letter were sent to non-respondents on November 16, 2004. A third full mailing to non-respondents was sent on January 5, 2005. The second Group's questionnaires (2,710) were mailed on January 5, 2005 with the postcard reminder following on January 14. The second mailing for Group 2 happened on February 11, with a final mailing sent on March 11. ACS received 4,213 usable responses. Respondents could complete the survey by mail or on the web at: http://chemistry.org/careers.html.

ACS sent a total of 11,577 surveys to new graduates (8,867 in Group 1 and 2,710 in Group 2). However, 585 bad addresses were removed from the response rate calculation. The final for the 2004 Salary Survey data set contains 4,213 cases. Group 1 comprises 3,318 (79%) of the cases and the remaining 895 (21%) are from Group 2. The overall response rate was 38.3% (39% in Group 1 and 35% in Group 2). Women were more likely than men to respond than men to the survey, potentially leading to sample bias. Fifty-four percent of the respondents were women, yet only 46% of the original list of new graduates were women. Conversely, 54% of the original list were men but they made up only 46% of respondents.

DEFINITIONS

The term "inexperienced" as used in the tables refers to those who have 12 months or less of prior professional work experience. The term "chemist" refers to one who received a degree in chemistry. Salary tables are based on full-time employment. Postdoctoral salaries are analyzed separately. Salaries are reported in U.S. dollars.

"Certified" bachelor's degree-holders are those with bachelor's degrees earned from departments or programs certified by ACS. The certified graduate "has pursued and successfully completed a curriculum as proscribed in the guidelines for ACS-approved programs and that ...has received the bachelor's degree." (ACS Committee on Professional Training, 1998).

For this study, race and ethnicity categories are combined to become mutually exclusive. Hispanics may include all racial categories, but racial categories do not include Hispanics.

The Technical Notes present methods for estimating sampling error and also explain certain discrepancies among some of the tables.

GEOGRAPHIC REGIONS

Pacific
- Alaska
- California
- Hawaii
- Oregon
- Washington

Mountain
- Arizona
- Colorado
- Idaho
- Montana
- Nevada
- New Mexico
- Utah
- Wyoming

West North Central
- Iowa
- Kansas
- Minnesota
- Missouri
- Nebraska
- North Dakota
- South Dakota

West South Central
- Arkansas
- Louisiana
- Oklahoma
- Texas

East North Central
- Illinois
- Indiana
- Michigan
- Ohio
- Wisconsin

East South Central
- Alabama
- Kentucky
- Mississippi
- Tennessee

Middle Atlantic
- New Jersey
- New York
- Pennsylvania

South Atlantic
- Delaware
- District of Columbia
- Florida
- Georgia
- Maryland
- North Carolina
- South Carolina
- Virginia
- West Virginia

New England
- Connecticut
- Maine
- Massachusetts
- New Hampshire
- Rhode Island
- Vermont

Technical Notes

DISCREPANCIES AMONG TABLES

Because not all individuals responded to all of the survey items, some pairs of tables contain totals that should be identical but are not. For example, one table may group Ph.D.s by sex and another by employer. The totals will differ unless the number who did not indicate their sex is the same as the number who did not indicate their employer.

ESTIMATES OF MEDIAN SALARIES

Median salaries displayed within the cells of the salary tables are sample medians and are therefore subject to sampling error. This error could be quite large, especially when the number of respondents in the corresponding cell is small. Therefore, *median salaries in cells with fewer than 15 respondents should not be used to estimate their corresponding population medians.*

COMPARING SALARIES

Often questions arise concerning women's salaries as compared with men's, or salaries of chemists as compared with those of chemical engineers. These and similar comparisons require caution.

Statistical tests should be performed to determine whether observed differences in salaries of various sample groups could be mere chance occurrences resulting from peculiarities of the samples. Whether a difference in salaries is "statistically significant" depends not only on the magnitude of the difference but also on the sample sizes and the magnitudes of the sample standard deviations.

Discussion of statistical tests of significance may be found in *Introductory Statistics for Business and Economics*, by Thomas H. Wonnacott and Ronald J. Wonnacott, NY: Wiley, 1990, and in other similar texts.

ESTIMATING SAMPLING ERROR FOR PERCENTS

Percents in this report are derived from the sample. If the entire population had received and returned questionnaires, most estimates would be somewhat different. How much different? Although this question does not have an exact answer, the table below does provide some guidance. To use the table, find the column headed by the percent (p) derived from the sample, and find the row appropriate for the sample size (n). (Approximations for p and n may be used.) Note the number in that column and that row of the table.

This number from the body of the table measures the precision with which the sample percent estimates the percent of the entire population. Specifically, if this procedure is applied repeatedly, about 95 times out of 100, the population percent will differ from the sample percent by no more than the amount shown in the table.

TABLE B–1. APPROXIMATE SAMPLING ERRORS FOR PERCENTS

n	p=10% or 90%	p=20% or 80%	p=30% or 70%	p=40% or 60%	p=50%
50	8.3%	11.1%	12.7%	13.6%	13.9%
100	5.9	7.8	9.0	9.6	9.8
200	4.2	5.5	6.4	6.8	6.9
500	2.6	3.5	4.0	4.3	4.4
1,000	1.9	2.5	2.8	3.0	3.1
2,000	1.3	1.8	2.0	2.1	2.2
5,000	0.8	1.1	1.3	1.4	1.4
10,000	0.6	0.8	0.9	1.0	1.0

In Table B–1a of the full report for example, 1,619 respondents classified as chemists indicated their highest degree as the bachelor's degree and their gender as female. The percent of this group who are employed full-time and permanent is 26 percent (p=26). A "95 percent confidence interval" for this percent may be approximated by taking n and p to be about 2000 and 30 percent. The above table shows an approximate sampling error of 2.0 percent. Hence, the 95 percent confidence interval is 24 percent to 28 percent. If estimates were made at this "level of confidence" from 100 similar samples, about 95 of the confidence intervals calculated from these samples would contain the true population percent.

List of Tables for Class of 2004

SALARIES OF RESPONDENTS