2005 STARTING SALARIES OF CHEMISTS AND CHEMICAL ENGINEERS

American Chemical Society
Department of Career Services

STARTING SALARIES
of Chemists and Chemical Engineers
2005

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

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Contents

Acknowledgements

Each year, at the direction 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 starting salaries and employment status. This report presents detailed results of the 2005 new graduate study. Summaries of the survey findings were published in the August 7, 2006 issue of *Chemical & Engineering News*.

Janel Kasper-Wolfe, Research Analyst in the Office of Member Information, conducted this year's survey and provided the tables for this report. Megan Henly wrote the summary on the following pages. Special thanks go to the 3,091 new graduates who took the time to respond to this year's survey.

April Orr, *Assistant Director*
ACS Member Research & Technology

Summary of Findings

The *Starting Salaries of Chemists and Chemical Engineers: 2005* report documents employment characteristics 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. The class of 2005 resembles graduates of the past couple of years in many respects, indicating that the workforce has stabilized somewhat. This is good news after a slight downturn in salaries in the early part of the decade.

- Salaries for recent graduates in chemistry and chemical engineering are rising. The mean and median salaries have risen faster than inflation at the bachelor's, master's, and doctorate levels. However, salaries still fall short of those earned by graduates in the year 2000.
- Factors related to salaries include level of degree, amount of work experience, employment sector, region of the country, size of employer, and whether the student completed an ACS-certified program in chemistry.
- Postdoctorates in chemistry and chemical engineering reported annual salaries of approximately $36,000. The primary factor determining the median salary of postdoctorates was the employment sector of the position. Chemistry postdocs reported earning over $49,000, while those in academia earned only about $35,000.
- Half of all chemistry bachelor's graduates were pursuing higher education in the fall of 2005. Of these students, most were enrolled full-time and 21% will remain in the field and study chemistry. About one third of chemical engineering B.S. recipients enrolled in graduate school, while most were working full-time in permanent positions.

Salaries for the Class of 2005: Means and Medians

The class of 2005 in chemistry and chemical engineering reports higher salaries than last year in a variety of employment sectors, indicating a stable job market. Salaries varied only slightly depending on the type of employer, type of work, and employer size.

Starting salaries for recent chemistry graduates with less than a year of work experience were up in 2005. The average salary for inexperienced bachelor's recipients was $35,202, or about 3.6% higher than the average starting salary in 2004. However, after adjusting for inflation, the 2005 average is only marginally higher (0.2%) than the prior year. Master's and Ph.D. recipients in chemistry reported considerably larger salaries in 2005 when compared to the 2004 graduating class. The real increase in salary was 3.8% for chemistry M.S. recipients with little or no work experience and 5.1% for chemistry Ph.D. recipients. The 2005 average starting salary was just over $48,000 at the master's level and just under $69,000 at the doctorate level.

Table 1. 2005 Mean Salaries for Inexperienced Chemistry Graduates (Mean Salary in Current & Constant Dollars)

	Mean Salary 2004	Mean Salary 2005	% Change Current	% Change Constant
Bachelor's	$33,981	$35,202	3.59	0.19
Master's	$44,796	$48,002	7.15	3.75
Doctorate	$63,547	$68,961	8.51	5.11

Table 2. 2005 Mean Salaries for Inexperienced Chemical Engineering Graduates (Mean Salary in Current & Constant Dollars)

	Mean Salary 2004	Mean Salary 2005	% Change Current	% Change Constant
Bachelor's	$48,937	$51,926	6.11	2.71
Master's	$56,305	$59,938	6.45	3.05
Doctorate	$77,418	$81,925	5.82	2.42

Note: CPI 12/04–12/05 = 3.40%

While this increase over last year is promising, Michael Heylin notes in *Chemical & Engineering News* that in terms of constant dollars, "the median starting salaries for 2005 graduates at all degree levels were still below what they had been for 2000 graduates." The job market was strong in the late 1990s to 2000 and salaries for scientists and engineers rose quickly during this period. From 2002 to 2004, salaries in chemistry stagnated, even declining slightly in terms of real dollars. However, data from 2005 indicate that starting salaries for chemists may be back on track.

Chemical engineering graduates also experienced a modest increase in starting salaries in 2005. Inexperienced bachelor's recipients in this field earned an average of $51,926. This was almost $3,000 higher than the average reported in 2004 and represents an increase of 2.7% after accounting for inflation. Graduates with a master's degree in chemical engineering reported a similar increase (3.1%) over last year. The average salary for those with less than a year's work experience was $59,938. Ph.D.s in this field accepted jobs with an average starting salary of $81,925, or 2.4% higher after inflation than 2004 grads.

Note: For the sake of brevity, this report will generally refer to holders of various degrees by the names of their highest degrees only, e.g., "bachelor's chemists," "master's recipients," or "Ph.D. chemical engineers."

Similar to chemistry graduates, chemical engineers had experienced a decline in the real dollar value of their starting salaries for novices from 2000 to 2004. The 2005 increase over last year's reported salaries is encouraging for the chemical engineering job market.

Mean salaries represent the calculated average starting salary. Because the mean can be greatly influenced by a handful of very high or very low values, it is often helpful to also consider the median, or middle value (50th percentile), in concert with the mean when evaluating typical salaries. The median is used as the primary descriptive statistic in the majority of this report to avoid the volatility inherent in the mean statistics.

TABLE 3. 2005 MEDIAN SALARIES FOR ALL NEW GRADUATES EMPLOYED FULL-TIME BY EXPERIENCE (MEDIAN SALARY IN CURRENT DOLLARS)

	Chemistry			Chemical Engineering		
	B.A./B.S.	M.S.	Ph.D.	B.S.	M.S.	Ph.D.
Less than 12 months	$35,000	$45,000	$72,019	$54,000	$62,150	$83,000
12–36 months	$37,390	$45,451	$65,559	$55,381	$60,397	$80,979
More than 36 months	$40,000	$55,827	$65,000	$63,410	$63,736	–

Table 3 displays the median full-time salaries for new graduates by degree field, degree level, and number of months on the job. As one would expect, as degree level and job tenure increases, salary generally increases. The exception to this appears to be the salaries of Ph.D. recipients. Ph.D.s in chemistry and chemical engineering hold about even, perhaps even decreasing as length of time on the job increases. Chemistry Ph.D.s who were at their job for less than a year had a median salary of $72,019, whereas the more experienced Ph.D.s had salaries around $65,000. Similarly, chemical engineering Ph.D.s new to their jobs had a median salary of $83,000, but those with one to three years experience reported salaries just under $81,000.

A similar discrepancy was also found in 2004, so this finding may warrant an explanation. There are likely a variety of unique factors involved in determining salaries for Ph.D.s which may not apply at other levels of education. It may be that those Ph.D.s with more experience are disproportionately employed in an area of the country with a lower cost of living, or in an industry with lower pay. An alternate explanation for this anomaly is that those with work experience are not leaving the jobs they held while finishing their Ph.D.s. Those who were not working while in school may have used their new degree as a bargaining tool during salary negotiation. Those who remained at the same job after completing their doctorates may not be receiving advances or salary increases as a reward for reaching this milestone. This trend should be monitored over the next few years as salaries for the chemistry workforce hopefully continue to stabilize.

Because the ACS starting salary survey focuses mainly on collecting data from chemistry graduates, the chemical engineering statistics are based on fewer responses. As such, they should be interpreted with caution. However, the numbers for chemical engineers show great reliability when compared to data from past years. In general, it is clear that pay for those earning degrees in chemical engineering is higher than that of those who studied chemistry. Recipients of bachelor's degrees in chemistry typically

Figure 1. Median Starting Salaries for Inexperienced Chemists Working Full-Time, 1975–2005 (in current dollars)

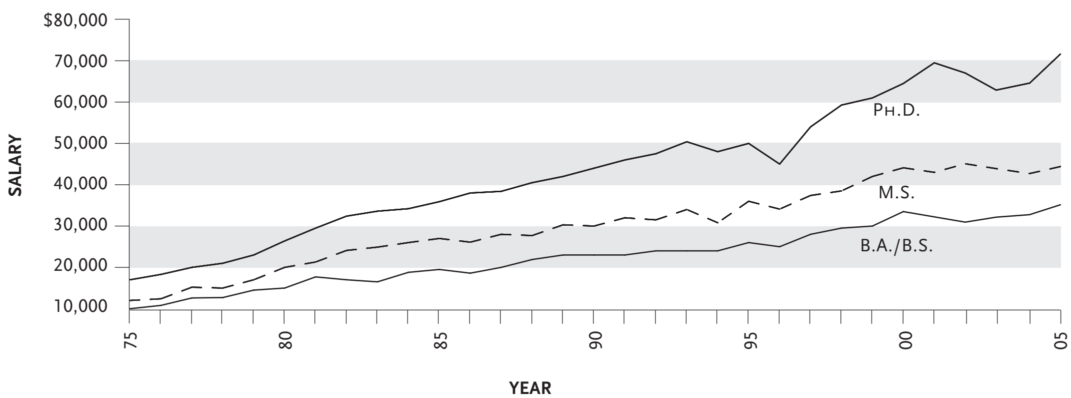


Figure 2. Median Starting Salaries for Inexperienced Chemical Engineers Working Full-Time, 1975–2005 (in current dollars)

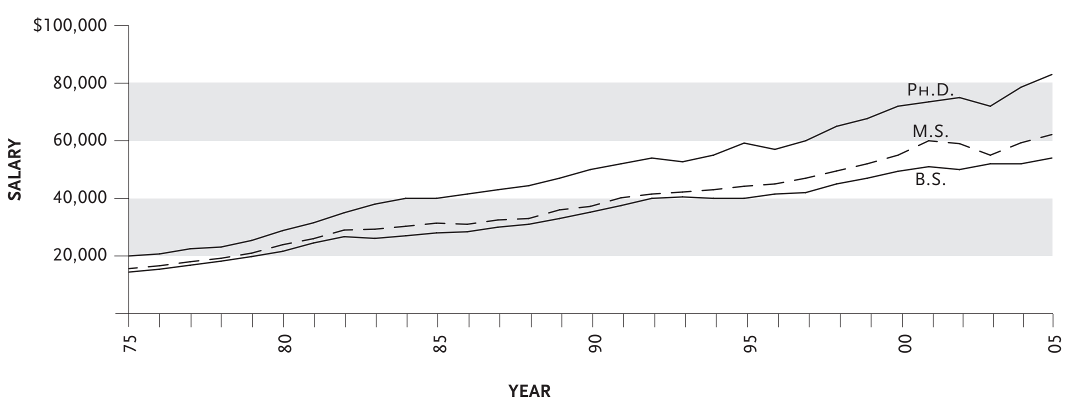


TABLE 4. MEDIAN STARTING SALARIES FOR INEXPERIENCED GRADUATES, 1975–2005 (BY DEGREE AND IN THOUSANDS OF CURRENT DOLLARS)

	Chemistry			Chemical Engineering		
Year	B.A./B.S.	M.S.	Ph.D.	B.S.	M.S.	Ph.D.
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
2005	35.0	45.0	72.0	54.0	62.2	83.0

earned between $35,000 for less than one year experience and $40,000 for more than three years of experience. Chemical engineering bachelor's salaries were more than 50% higher and ranged between $54,000 for beginners up to $63,410 for those with three or more years of experience.

The salaries in these two fields become more similar as education level increases. Typical salaries for chemistry master's were $45,000 for those just out of graduate school and went up to $55,827 for those who have been on the job for a few years. Graduates with an M.S. in chemical engineering reported larger salaries – 38% to 14% higher, respectively – than their M.S. chemist counterparts. Ph.D.s in chemical engineering reported salaries 15% to 24% larger than chemistry Ph.D.s. The typical salaries for doctorates in chemistry were in the upper $60,000's to low $70,000's and were in the low $80,000's for chemical engineers.

The table on this page shows the median starting salaries by level of degree for chemists and chemical engineers over the past 30 years. After essentially leveling off in the earlier part of this decade, starting salaries for chemistry graduates rose slightly again in 2005 for all degree levels. As mentioned above, the 2005 increase exceeded the inflation rate. This continues the larger 30-year trend that indicates a modest rise in salaries over time. The rise has been slightly steeper for master's than for bachelor's recipients and particularly for Ph.D.s compared to others.

Similarly, starting salaries for chemical engineers are up again in 2005. The difference between degree levels is smaller for chemical engineers when compared to chemists. While those with an M.S. earn more than those with a B.S., the difference is small (about 15% in 2005). Ph.D. chemical engineers earn more than those with master's degrees, with a typical starting salary of $83,000 – about a third higher than the master's starting salary of $62,150. In chemistry, master's holders earn $45,000, or almost 30% more than bachelor's ($35,000), and Ph.D.s earn about $72,000 – 60% more than master's.

While Table 4 shows that 2005 salaries for both chemists and chemical engineers are higher than they have ever been, in terms of real dollars these salaries are still not as high as the salaries reported by the class of 2000 (Heylin, 2006). When evaluating these trends, it is important to consider not just the current dollar increase, but whether the increase is greater than the rate of inflation. Increases above the inflation rate are the only ones that indicate real growth.

Tables 5 and 6 summarize statistics for starting salaries of chemistry and chemical engineering graduates in the last two years (2004 and 2005). This display allows for a direct comparison of the distribution of salaries by degree level between the last two years. Note that the mean is very close to the median (50th percentile) for all degree levels. This indicates a normal distribution of salaries with few outliers.

Table 5 compares salary ranges grouped in percentiles for each type of degree for 2004 and 2005 chemistry graduates. By displaying the 10th and 90th percentiles, we get a better idea of the complete range of salary offers accepted. For chemistry bachelor's 80% of full-time starting salaries were between $24,000 and $47,060. Most master's recipient salaries ranged between $33,661 and $62,920, while the corresponding majority of Ph.D.s' salaries ranged from $44,792 to $90,000.

TABLE 5. RANGES OF STARTING SALARIES OF INEXPERIENCED FULL-TIME EMPLOYED CHEMISTRY GRADUATES BY DEGREE: 2004 AND 2005 (IN CURRENT DOLLARS)

	DEGREE LEVEL					
	B.A./B.S.		M.S.		Ph.D.	
Salaries	2004	2005	2004	2005	2004	2005
90th Percentile	46,400	47,060	58,600	62,920	85,000	90,000
75th Percentile	40,000	41,000	52,000	58,306	77,000	81,204
50th Percentile	32,600	35,000	43,250	45,000	65,000	72,019
25th Percentile	28,000	28,855	36,600	38,063	46,350	55,000
10th Percentile	24,000	24,000	29,400	33,661	38,680	44,792
Mean	33,981	35,502	44,796	48,002	63,547	68,961
Count	471	354	63	54	115	65
Standard Deviation	8,913	9,155	12,826	12,624	18,499	16,760

As degree level increases, salary increases. With an increase in average salary comes a larger range in salaries. However, it is important to note that while the salary range between the 90th and 10th percentiles is only $23,060 for bachelor's and is $45,208 for Ph.D.s, these differences are proportionate to the typical salary. That is, this range is within 63 to 66% of the median at all salary levels. Similarly, even though the standard deviation is much larger (in terms of number of dollars) for Ph.D.s than for bachelor's, it is 24 to 26% of the mean salary at all degree levels.

The full range of chemical engineering starting salaries for 2004 and 2005 are shown in Table 6. The mean salary for recent chemical engineering B.S. graduates was $51,926, and 80% of salaries were between $40,000 and $60,565. M.S. recipients averaged just under $60,000, and most salaries were between $46,349 and $71,173. Chemical engineering Ph.D. salaries were generally in the range of $65,622 and $91,955. The mean was $81,925.

Although their salaries are greater, salary ranges for chemical engineers are smaller than those of chemists. Even though these statistics are based on a smaller number of chemical engineers, the standard deviations are smaller than those of chemist salaries (only 14 to 17% of their respective means, compared to 24 to 26% for chemists). This suggests that chemical engineers may be more homogeneous in terms of salary distribution when compared to chemists.

TABLE 6. RANGES OF STARTING SALARIES OF INEXPERIENCED FULL-TIME EMPLOYED CHEMICAL ENGINEERING GRADUATES BY DEGREE: 2004 AND 2005 (IN CURRENT DOLLARS)

	DEGREE LEVEL					
	B.A./B.S.		M.S.		Ph.D.	
Salaries	2004	2005	2004	2005	2004	2005
90th Percentile	58,750	60,565	73,300	71,173	95,600	91,955
75th Percentile	56,000	57,866	65,250	68,370	84,000	86,466
50th Percentile	52,000	54,000	59,250	62,150	78,600	83,000
25th Percentile	42,125	47,500	47,500	54,707	70,800	73,935
10th Percentile	36,000	40,000	35,700	46,349	61,600	65,622
Mean	48,937	51,926	56,306	59,938	77,419	81,925
Count	164	112	18	26	27	26
Standard Deviation	9,294	8,699	12,748	10,079	12,005	11,381

Salary Factors

The data displayed in Tables 5 and 6 show that even if we hold experience and level of degree constant, there is a wide range of salaries reported by recent graduates just beginning their careers. While some ranges are smaller in proportion to others, we must still reconcile salaries differing by $20,000 to $45,000 for graduates within the same field and degree level.

The large range could be attributed to a variety of factors, including region of the country, type of employer, nature of the work, as well as characteristics of the applicant him or herself. The tables in the appendix compare the mean salaries according to some of these factors. For example, those employed in private industries usually earned more than those working in academia (Tables A–5 and A–15). The median salary for Ph.D.s working for private companies in manufacturing was $77,803 and was $74,289 for non-manufacturing private employers. By comparison, the median Ph.D. salary in universities was only $58,563.

The type of work the employer does or product it produces also has a bearing on salary (Tables A–8 and A–17): Those employed in pharmaceuticals or biotechnology had higher average salaries than chemists and chemical engineers working in other areas. The median salary for recent chemistry bachelor's recipients employed in pharmaceuticals was $40,000, compared to the overall median of $35,000. Similarly, master's reported a median salary of $58,000 in this field (versus $50,000 overall), while the median for Ph.D.s was $81,808 compared to $77,000 across all types of employers.

Number of employees (Tables A–9 and A–18) and geographic region (Tables A–11 and A–20) are also relevant to earnings. Small businesses with fewer than 50 employees had lower average salaries than corporations and universities with a larger workforce. The median salary for chemistry bachelor's was $28,718 when there were 50 employees or fewer, whereas for employers with a workforce of 25,000 or more, the median was $42,780. Also, those in the Pacific states and New England typically earn more than those in the central part of the country.

Employee characteristics contributing to starting salary may include primary job duties (Tables A–10 and A–19), degree specialization (Table A–13), and whether or not the individual has received certification (Table A–12). Those teaching typically earn less than those engaged in research, development, and design – at least at the graduate level. Graduates specializing in organic chemistry averaged salaries slightly higher ($57,615 for M.S. holders and $75,000 for Ph.D.s) than those in other fields ($45,000 for M.S. holders and $72,019 for Ph.D.s overall).

The certification process is an option offered to undergraduates pursuing an ACS-approved program of study which, upon completion, offers them an ACS-certified degree. In 2005, students with a bachelor's degree certified by ACS reported average salaries that were about $3,000 higher than non-certified degrees ($37,144 compared to $34,115). While certified employees generally earn more than non-certified, this difference is most apparent with certain types of employers. In manufacturing, for example, bachelor's recipients typically earned $5,000 more when they were certified. However, non-manufacturing employers paid about the same regardless of certification.

Another important comparison in salary differences is between men and women. Because degree level and type of employer are determining factors of starting salary, Tables A–15 and A–16 show the starting salaries of men only and women only within these subcategories. However, by breaking down the salaries to such a specific level of detail, we lose some power in making comparisons as the number of respondents in each category is small. That being said, in some employment sectors and degree levels there are small differences between men and women. This is likely attributable to some other factor such as type of work, number of employees, or geographic area. It remains important to evaluate men's and women's salaries each year and to investigate when differences emerge.

In sum, a variety of factors determine the starting salary of chemistry and chemical engineering graduates. When there is a shift of graduates into a different employment sector, type of employer, or region of the country, this in turn impacts the overall average salary. For example, this year 70% of chemistry Ph.D.s were employed in private industry. That proportion was 65% in 2004 and 61% in 2003. Because the private sector generally pays higher than academic positions, part of the increase in salaries could be related to this shift. These salary factors should be considered for their impact on individual earnings and expectations as well as their effect on the average of all graduates.

GRADUATE AND POSTDOCTORAL STIPENDS

As reported last year, graduate and postdoctoral stipends remain relatively stagnant. Across all degree levels and fields of study, median stipends only increased between $500 and $2,000 over last year's reported stipends (See Table A–21). The medians for bachelor's and master's stipends were about the same ($21,000 for chemistry and $24,000 for chemical engineering), whereas Ph.D.s in both fields reported median postdoctoral fellowships of $35,000 in colleges and universities. This is $1,500 higher than reported by postdoctorates in 2004.

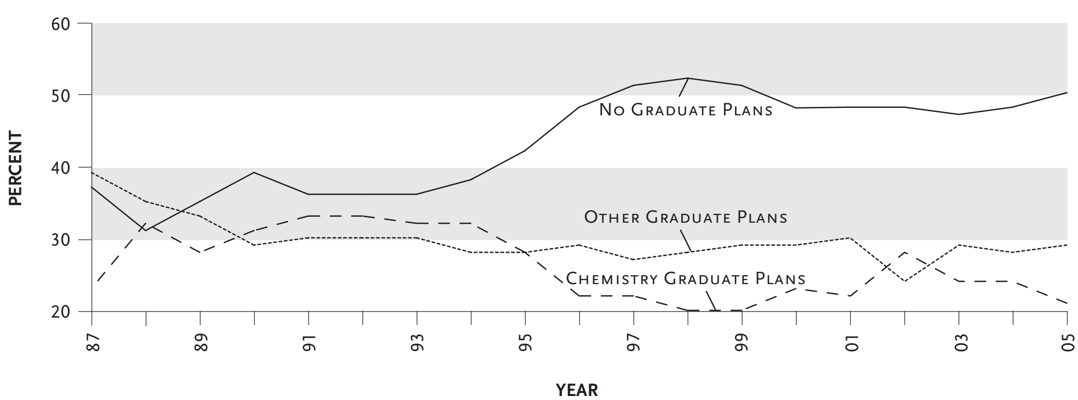
Graduate support was reported most often by those working in academia. However, there are chemists receiving graduate stipends who are employed in private industry, particularly recent bachelor's recipients. These stipends tend to be slightly higher than the average, with a median of $24,857 in non-manufacturing and $26,211 in manufacturing. These private stipends may be associated with a more traditional work arrangement, whereas those employed by universities may be filling teaching and research assistantships.

Post-Graduate Plans of Bachelor's Chemistry Graduates

While starting salaries provide a view of how recent chemistry and chemical engineering graduates are doing in academia, government, and industry, it is important to note that a substantial number of recent college graduates plan to remain out of the workforce to continue their education.

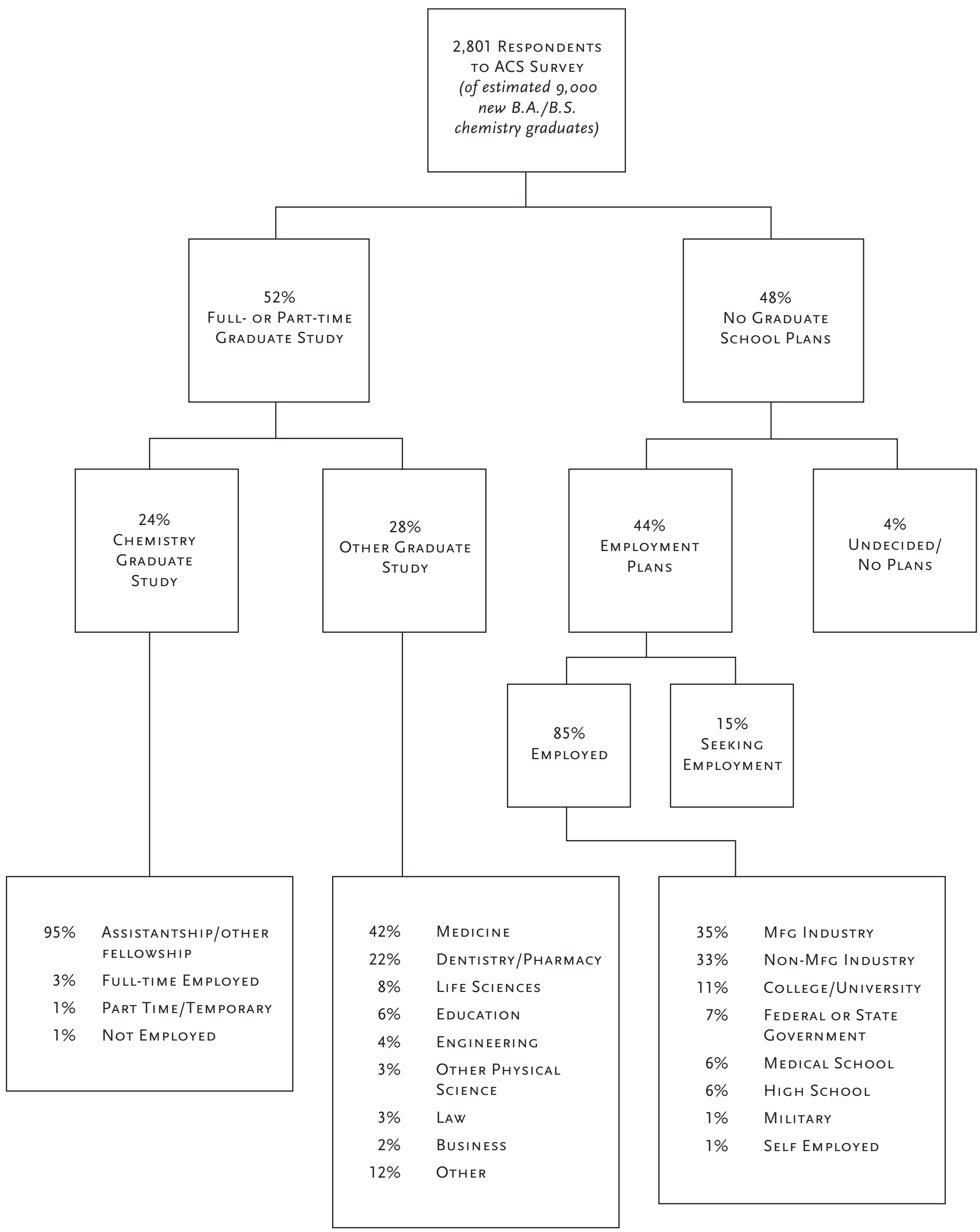
Fully one-half of chemistry bachelor's plan to attend graduate school. As Figure 3 shows, that proportion is down markedly compared to the class of 1987. Eighteen years ago, three-quarters of graduates continued their education immediately following graduation. Most of this drop occurred in the mid- to late-1990s when the proportion pursuing graduate degrees in chemistry dropped significantly. These bachelor's recipients found employment at a time when the job market was strong. Salaries for recent graduates in chemistry peaked in 2000 and then began to fall. During this time period, the proportion of bachelor's working toward chemistry graduate degrees increased (20% in 1999 to 29% in 2002). Over the last several years, the trend to pursue postgraduate education has stabilized.

Figure 3. Post-Graduation Plans of Bachelor's Chemistry Graduates: 1987–2005



A detailed description of the plans of the undergraduate class of 2005 is shown in Figure 4. Half of the graduates have no plans to continue school. Most of these individuals 85% were employed as of October 2005. The most common sectors of employment were in private industry, with 35% in manufacturing and 33% in non-manufacturing; in addition, substantial numbers were working at colleges and universities (11%) and for the government (7%). Eight percent had not yet found employment at the time of this survey and 4% had not yet made post-graduate plans.

FIGURE 4. POST-GRADUATION PLANS OF 2005 BACHELOR'S CHEMISTRY GRADUATES



Of the half of graduates who did intend to continue their education, 24% will do so within the field of chemistry. Most of these students (95%) will receive support through assistantships or other fellowships and a small number will also work to help pay for their education. The remaining 28% of graduates will pursue degrees in a discipline other than chemistry. Medicine (42%), dentistry and pharmacy (22%), and life sciences (8%) were the most common fields of study.

Plans for Advanced Study

A specific breakdown of chemistry and chemical engineering bachelor's graduate school plans is outlined in Table 7. Almost half of all recent chemistry bachelor's recipients were enrolled in graduate school full-time in the fall of 2005. An additional 4.2% participated in a part-time program. These numbers are almost identical to last year's chemistry graduates, indicating a stable trend.

Table 7. Plans for Further Study of Bachelor's Chemistry & Chemical Engineering Graduates: Fall 2005 Plans

Plans	Chemistry	Chemical Engineering
Total further studies		
Full-time	47.0%	29.3%
Part-time	4.2%	3.8%
No plans for further studies	48.8%	67.0%
Total*	100.0%	100.1%
Number of responses	1,987	291

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

Chemical engineering graduates, on the other hand, were less likely to continue their education. Over two-thirds (67%) of B.S. recipients had no plans for further studies. The draw of competitive salaries in chemical engineering may be pulling these graduates into permanent employment. It is interesting to note that the proportion of chemical engineers in graduate school full-time in the fall of 2005 (29%) is slightly higher than the proportion in 2004 (23%). Special attention should be paid to these figures in the future. If the number continues to rise, a temporary deficit of chemical engineers for entry-level positions may result.

Students who decide to continue their education tend to remain within the field of their undergraduate degrees. About half of chemistry graduates continuing full-time graduate programs study chemistry and half of chemical engineers remain in chemical engineering. An undergraduate degree in chemistry also appears to provide an ample background for those who want to enter medical school: one-third of these full-time students studied medicine, dentistry, or pharmaceutical science.

TABLE 8. FIELDS OF STUDY OF CHEMISTRY AND CHEMICAL ENGINEERING BACHELOR'S GRADUATES: FALL 2005

Plans	Chemistry	Chemical Engineering
FULL-TIME STUDY		
Chemistry and biochemistry	49.2%	2.7%
Chemical or biochemical engineering	1.1%	49.5%
Other engineering	0.5%	4.6%
Physical science	1.3%	0.0%
Life science	3.5%	1.3%
Medicine, dentistry, or pharmacy	32.3%	16.8%
Business or management	0.3%	4.6%
Education	1.9%	0.0%
Law	1.4%	7.9%
All others	8.3%	12.5%
Total*	99.8%	99.9%
Number of responses	934	68
PART-TIME STUDY		
Chemistry of biochemistry	30.3%	0.0%
Chemical or biochemical engineering	0.0%	30.6%
Other engineering	3.3%	20.7%
Physical science	2.2%	6.9%
Life science	3.3%	0.0%
Medicine, dentistry, or pharmacy	17.5%	0.0%
Business or management	6.5%	5.6%
Education	15.0%	5.6%
Law	0.0%	5.6%
All others	22.0%	25.0%
Total*	100.1%	100.0%
Number of responses	83	16

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

Chemical engineering undergraduates were a bit more diverse in their choice of full-time graduate programs. Like chemistry grads, the medical fields were the second most popular choice (16.8%) for those pursuing graduate degrees full-time. Interestingly, about 8% entered law school. A fair number studied business (4.6%) and other fields of engineering (4.6%).

Part-time graduate students are distinct from full-time students and warrant a separate analysis. These students are typically employed and their goals may be more career-oriented rather than academic. Thirty percent of chemistry undergraduates who pursue a graduate degree part-time remain in field. A substantial number (17.5%) enter medical school or are studying to become teachers (15.0%). Almost a quarter of chemistry graduates who pursue part-time education are in fields outside of the physical sciences, medicine, business, education, and law.

Chemical engineers resemble chemists in this last respect. Of those who are part-time students, one-quarter are in some other field. Half are studying chemical engineering or some other type of engineering. Smaller numbers study physical science (6.9%), education (5.6%), or law (5.6%).

POST-GRADUATION EMPLOYMENT STATUS

Table 7 illustrated that about half of chemistry bachelor's recipients continued their education while only about a third of college graduates in chemical engineering did so. Table 9 shows whether the remaining graduates were working or seeking work. This table also displays the employment status of those with advanced degrees. Just over one-quarter (26.6%) of recent

TABLE 9. POSTGRADUATION STATUS OF CHEMISTRY AND CHEMICAL ENGINEERING GRADUATES (OCTOBER 2005)

Major and Employment Status	B.A./B.S.	M.S.	Ph.D.
CHEMISTRY			
Full-time employed:			
Permanent	26.6%	44.1%	34.6%
Temporary	9.1%	3.8%	3.7%
Part-time employed:			
Permanent	1.2%	1.4%	0.0%
Temporary	3.7%	8.8%	1.9%
Graduate student, postdoc	47.2%	29.2%	50.6%
Unemployed and seeking employment	8.1%	9.1%	5.5%
Unemployed and not seeking employment	4.1%	3.6%	3.7%
Total*	100.0%	100.0%	100.0%
Number of responses	1,988	292	311
Unemployment as of the week of 10/4/2005	8.4%	9.4%	5.7%
CHEMICAL ENGINEERING			
Full-time employed:			
Permanent	61.4%	50.1%	59.7%
Temporary	4.6%	9.5%	10.3%
Part-time employed:			
Permanent	0.4%	1.1%	0.0%
Temporary	1.3%	2.8%	1.3%
Graduate student, postdoc	21.4%	28.5%	19.7%
Unemployed and seeking employment	8.7%	6.1%	9.1%
Unemployed and not seeking employment	2.2%	1.9%	0.0%
Total*	100.0%	100.0%	100.1%
Number of responses	316	106	71
Unemployment as of the week of 10/4/2005	8.9%	6.2%	9.1%

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

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

bachelor's recipients in chemistry had found permanent full-time employment by October 2004. About nine percent worked temporary full-time jobs and 5% had part-time work. Most of the part-time employed chemists were working part-time at a temporary job.

Many chemistry master's graduates surveyed had no plans to continue their education. Just under half were employed full-time (44.1% permanently and 3.8% in temporary positions), about 10% part-time, and 29.2% remained enrolled in graduate programs. Half of chemistry doctorates found postdoctoral appointments, just over one-third found full-time permanent employment, and 3.7% found temporary full-time employment. Very few worked part-time. These figures follow those of the class of 2004 very closely.

When compared to chemists, chemical engineers were more likely to find full-time permanent employment at all education levels. At all degree levels, between 50% and 62% of graduates found full-time permanent work. Along with the higher salaries, this is another indicator of the strong employment opportunities for chemical engineers.

One weak point for both chemists and chemical engineers is the unemployment rate. The unemployment rate is defined as the proportion of graduates who did not have a job and were seeking work. This rate was between 8% and 10% for chemistry bachelor's and master's recipients and chemical engineering bachelor's and Ph.D.'s. Given that the unemployment rate measured by the Bureau of Labor Statistics was 5.4% of the general population and only 2.3% for all college graduates during this time period (October 2004), this is a cause for concern.

These figures should be interpreted with caution though, as the ACS data are based on a relatively small portion of all graduates. A rate of less than 10% is highly susceptible to fluctuations such as this when the respondent pool is small. It is also possible that unemployed graduates were disproportionately represented among our respondents. Another factor that may impact the unemployment rate measured here is the date of data collection. Graduates were asked to report on their employment status as of the first week of October 2005. Given that this survey is administered several months after graduation, it is possible that many of the unemployed degree recipients eventually found employment. Most of these individuals were not working prior to graduation and it is likely that a number of them will simply need more time to find work.

Bachelor's Graduates Certified in ACS-Approved Programs

ACS has approved over 600 chemistry programs to offer an ACS-certified bachelor's degree. Many undergraduate departments offer several degree tracks, and ACS-certified programs have extra requirements and the most demanding curriculum.

The certification indicates that the student has completed a degree from a nationally recognized department. The extra preparation associated with an ACS-certified degree is valued by employers and graduate admissions committees. In 2005, 42% of all bachelor's recipients surveyed had completed an ACS-certified degree program.

The student who pursues this rigorous specialization is more likely to enter graduate school: 56.6% of certified 2005 graduates were enrolling in graduate programs in the fall of 2005 compared to 47.3% of non-certified graduates (See Appendix Table B–4b). These certified students are also more dedicated to the field of chemistry. Of those bachelor's recipients who pursue full-time graduate studies, 59.9% of certified students choose chemistry programs, compared to just 24.7% of non-certified graduates (See Appendix Table C–5).

Because more certified students than non-certified students enter graduate school, this impacts the representation of certified bachelor's in the workforce. Only 32% of ACS-certified bachelor's were employed full-time, compared to 38.5% of non-certified graduates. Certified students were also less likely to be unemployed (10.6% compared to 14.3% of non-certified graduates).

Demographics of New Graduates

SEX

The tables in the appendix of this report display many survey results separately for men and women. This report series has documented the increase in the proportion of chemistry degrees awarded to women. In 1994, 41% of chemistry bachelor's and master's and 28% of doctorates were female, according to data from the National Center for Education Statistics (NCES). By 2004, the proportion was up to 51% at the undergraduate level, 46% for master's recipients, and 33% of Ph.D.s.

At all levels of education, women represent 47.5% of all degree recipients in the 2005 ACS survey. However, the representation of women in chemistry decreases as degree level increases. This study found that 52% of bachelor's and 51% of master's were female. The real difference occurred at the doctorate level, where only 33% were female.

According to our survey results, the representation of women in higher levels of chemistry will not likely rise quickly. Approximately 49% of female bachelor's recipients in 2005 were enrolled in graduate programs in 2006, compared to 53% of male graduates. Among master's, 35.7% of men were continuing their education and only 30.5% of females were. While these differences are small, they will contribute to the continuing disparity between men and women in chemistry at the highest levels of chemistry, and in turn, among chemistry faculty in the future.

Comparing salaries by sex is important in order to evaluate whether women's salaries compare favorably to men's. As mentioned earlier, tables in Appendix A (Tables A-6 and A–7 for chemistry and Tables A–15 and A–16 for chemical engineering) display these data by employment sector and degree level, which are important determining factors for salary. However, great care should be used in comparing these tables. Ideally, we would also standardize results by other factors shown to have an impact on salary, such as region of the country and area of specialization. As it is, the numbers in each cell are small, so we may not dissect these data further. Even so, it appears as though there is little if any difference between men's and women's salaries. In some employment sectors and degree levels, men earn slightly more than women. But just as often, women earn slightly more than men. Sex does not appear to be a significant determining factor in starting salaries.

CITIZENSHIP

Foreign students comprise a substantial proportion of all science and engineering students in the United States. Graduate programs have come to rely on these students to fill teaching assistantships. Changes in legislation that impact the ability of foreign students to obtain visas can have an effect on chemistry programs. Each year, the ACS reports on the proportion of graduates do not have U.S. citizenship.

Among bachelor's, the proportion of non-U.S. students in chemistry is small. Of all ACS respondents, just 1% of bachelor's in chemistry were foreign citizens in the U.S. on temporary visas. However, 19% of master's and 32% of Ph.D.s in chemistry were in the U.S. on temporary visas (Table F–2). Please note that these numbers may be underestimates; after graduating, many foreign students must return to their native countries as their student visas expire. Therefore, we may be less likely to reach non-U.S. graduates.

The representation of native U.S. citizens, naturalized citizens, and permanent residents among chemistry graduates is similar to recent years and varies widely by degree level. Ninety percent were native citizens, 6% naturalized, and 3% permanent residents at the bachelor's level. For those with an M.S., the proportions were 66% native-born, 9% naturalized, and 6% permanent resident. Among Ph.D. chemists, just 58% were native to the U.S., 4% naturalized, and 6% permanent residents.

Numbers in chemical engineering are quite similar to those of chemists. For chemical engineering bachelor's, 93% were U.S. native, 2% were naturalized, 3% permanent residents, and just 2% were in the U.S. on a temporary visa. Among master's, the representation was 53% U.S. native, 6% naturalized, 4% permanent residents, and 37% temporary visa. At the doctorate level, 64% of recipients were native-born U.S. citizens, 3% were naturalized citizens, 7% were permanent U.S. residents, and 25% had temporary visas.

According to the NCES data, 3.8% of bachelor's, 32.7% of master's, and 37.2% of Ph.D.s in chemistry held temporary visas in 2004. For chemical engineering graduates in 2004, 6.1% of bachelor's, 46.0% of master's, and 49.7% of Ph.D.s held temporary visas. Data for 2005 are not yet available. <http://webcaspar.nsf.gov>

Source: U.S. Census Bureau, 2005 American Community Survey

RACE AND ETHNICITY

The racial composition of the chemistry (Table F–3) and chemical engineering (Table F–6) class of 2005 is similar to recent years. Whites represent the majority of all graduates, with the exception of master's level chemical engineers. Here, the proportion of Asians (40.3%) is close to the proportion of whites (43.0%). Among men, the majority of chemical engineering master's recipients (45.3%) were Asian.

White graduates comprised 76% of chemistry and 80% of chemical engineering bachelor's. Among master's, 63% of chemists and 43% of chemical engineers were white. At the Ph.D. level, 64% of chemists and 62% of chemical engineers were white.

In 2005, Asians represented 9% of bachelor's in both fields, 22% of chemistry, and 40% of chemical engineering master's, and 27% of chemistry and 28% of chemical engineering doctorates. The representation of Asian graduates is greater at higher levels of education. This is consistent with the finding that the representation of non-U.S. born graduates increases at higher levels of education.

Black students are underrepresented in these fields, particularly at the graduate level. In fact, when broken down by sex, the number of black master's and Ph.D. graduates who responded to our survey was in the single digits. They comprised 3% of Ph.D.s, 3% of chemical engineering master's and 5% of chemistry master's. At the undergraduate level, there was a larger proportion of women in this racial category: 8% of female chemists and 11% of female chemical engineers were black.

To put these figures in perspective, in the general population of the United States, whites represented 66.8% of the population in 2005. Approximately 12% were black, 4.3% Asian, and 14.5% Hispanic. Native Americans, other races, and those with more than one race represented the remaining 2.5%.

Scope and Method

OBJECTIVE

The 2005 New Graduate Study (Starting Salary Survey) is the 55th 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 2004–2005 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 Accreditation Board for Engineering and Technology (formally Engineers Council for Professional Development) provided names and addresses of students who graduated between July 2004 and June 2005. Questionnaires were mailed to those graduates whose names had been provided and had U.S. addresses.

EXTENT OF COVERAGE

Survey questionnaires were mailed by first class mail on January 12, 2006, to 10,509 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 February 14, 2006. A third full mailing to non-respondents was sent on March 15, 2006. ACS received 3,091 usable responses, for a 29% response rate. Respondents could complete the survey by mail or on the web at: http://chemistry.org/careers.html.

Forty-seven percent of the new graduates sent surveys were women and 52.7% were men. However, 52.3% of respondents were women and only 47.5% were men. Because of the over-representation of women in the responses, ACS weighted the data by gender to reduce any bias.

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 bachelor's certified by their department or program to ACS. A bachelor's level chemist with a certified degree has completed an ACS approved curriculum.

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 chemists' salaries 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, Table 10 provides 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 10. 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 10 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 2005

Salaries of Respondents

ACS Career Services: Workforce Publications

SALARIES The Society surveys annually the ACS membership, gathering detailed information on member chemists and chemical engineers living in the U.S. The reports based on the survey contain statistical tables describing the respondents' employment status, employer, work function, specialty, salary and demographic characteristics. Reports are available each year from 1973 through the current year.

STARTING SALARIES ACS also surveys new graduates in chemistry and chemical engineering each year and publishes reports detailing the graduates' employment status, post-graduate plans, starting salaries, and other employment and demographic characteristics. Reports are available for each year from 1975.

MILLENNIUM SERIES A series of reports drawn from special studies that detail members' employment characteristics at the turn of the millennium.

Lifetimes in Chemistry 1999–2000—A report drawn from the 1999 study of ACS members, aged 50 through 69.

ChemCensus 2000—A look at the decade of the 1990s through comparing data from the 1990, 1995, and 2000 ACS censuses of working members.

Women Chemists 2000—A look at the decade of the 1990s through comparing data on women chemists from the 1990, 1995, and 2000 ACS censuses of working members.

Industrial Chemists 2000—A look at the decade of the 1990s through comparing data on industrial chemists from the 1990, 1995, and 2000 ACS censuses of working members.

Academic Chemists 2000—A look at the decade of the 1990s through comparing data on academic chemists from the 1990, 1995, and 2000 ACS censuses of working members.

Early Careers of Chemists 2001—A detailed look at the education and early careers of ACS members under age 40 drawn from survey conducted in 2001.

For prices and ordering information, please call or write:

ACS Office of Society Services
1155 16th Street NW
Washington, DC 20036
Phone: 800.227.5558 or 202.872.4600

For all of ACS Career Services: http://chemistry.org/careers

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