SAMPLE DESIGN AND PRECISION IN THE NATIONAL SURVEY OF RECENT COLLEGE GRADUATES: 1993, 1995, AND 1997

Ramal Moonesinghe, Westat

1. Introduction

An important goal of the National Survey of Recent College Graduates (NSRCG) was to improve estimates for minority science and engineering graduates (particularly black and Hispanic graduates) without a substantial loss of precision for all graduates or for nonminority graduates. A redesign of the sampling approach achieved this end. This report provides an overview of the sample design for the NSRCG for the 1993, 1995, and 1997 cycles of the study, highlighting chanages to the design. Within this context, the precision of some selected estimates are compared for NSRCG:93 and NSRCG:95, and the improvement in estimation for minority graduates is demonstrated.

Some general features of the NSRCG design apply to all cycles of the survey. The NSRCG design is based on a two-stage sample. The first stage is a stratified nationally representative sample of colleges and universities offering bachelor's and/or master's degrees in science and engineering. These institutions are selected with probability proportional to size. Stage two involves the selection of graduates from the sampled institutions. Graduates are selected by cohort based on the criteria of degree received (bachelor's or master's), year of degree, and major field of study. While these general features remain unchanged, specifics, such as the sampling rates and the measure of size, change from year to year.

2. Institutional Sampling

In this section, we first address the sample frame for the institutional sample and then discuss specific features of the institutional sample selections in 1993, 1995, and 1997.

2.1 Sampling Frame

The sampling frame for the NSRCG was constructed from the 1990-91 Integrated Postsecondary Education Data System (IPEDS) completions file. Eligible institutions are those that satisfy all of the following criteria:

- The institution must have a FICE code, i.e., it must be a HEGIS institution;
- The institution must offer a bachelor's or master's degree in one of the engineering or science fields, identified by eligible six digit 1990 Classification of Instructional Programs (CIP) code; and
- The school must have a nonzero number of bachelor's or master's degrees awarded in at least one of the eligible fields.

Institutions in the frame were classified by institution control (public or private), Census region, and the percentage of degrees at the institution that were awarded in science or engineering. These characteristics were used in stratifying the institutions for sampling.

Twenty major sampling categories are defined by six-digit CIP codes in the science and engineering fields. Each institution on the frame must have at least one of the eligible major field of study categories.

2.2 1993 Institution Sampling

The institutional sample consisted of 275 institutions**.** Temple University's Institute of Survey Research (ISR) drew the sample of institutions and calculated their probabilities of selection. There were 196 self-representing institutions, but we have not been able to find ISR documentation describing the methods used to identify institutions as self-representing. We do understand that eligible historically black colleges and universities (HBCUs) were selected with certainty. The other 79 were selected with probability proportional to size, where the measures of size were devised to account for the relative rareness of certain specialty and nonspecialty major fields of study. Universities with a high proportion of Hispanic, black, or foreign students were oversampled by doubling their measure of size. The institutions remaining after the selection of certainty institutions were implicitly stratified by sorting the list by ethnic status, region, public/private status, and presence of an agriculture program. The 79 non-SR institutions were then selected by systematic sampling from the ordered list.

2.3 1995 Institution Sampling

In 1995, a new sample of institutions was selected from the same sampling frame used in 1993. For each institution, a composite measure of size[1] was used that was related to both the number of graduates and the proportion of those who were black or Hispanic. This type of composite measure of size procedure was used in conjunction with the oversampling of black and Hispanic graduates within institutions to achieve a larger sample size of minority graduates.

The measure of size for each institution was based on population counts of the number of graduates in the domains, which were sampled at different rates. Three such domains were used within each field of study: minority (black and Hispanic) bachelor's degree graduates, non-minority (non-black and non-Hispanic) bachelor's degree graduates, and master's degree graduates.

The measure of size for institution i, MOS_i , is defined as:

$$MOS_i = \sum_{k=1}^{20} \sum_{j=1}^{3} f_{jk} N_{ijk}$$

where

f_{jk} = sampling rate for major sampling category k, domain j, and
N_{ijk} = total number of graduates in major sampling category k, domain j, and institution i.

As in the 1993 survey, the largest institutions were included in the sample with certainty while the smaller institutions were sampled with probability proportional to MOS. The sampling interval for selecting institutions was initially defined as:

[1] Folsom, R.E., Potter, F.J., Williams, S.R. (1987) "Notes on a Composite Size Measure for Self-Weighting Samples in Multiple Domains", Proceedings of the Survey Research Methods Section of the American Statistical Association.

$$I = \frac{\sum_i MOS_i}{n}$$

Here the summation is over all the institutions in the frame and n is the number of institutions to be sampled (275). Any institution with a measure of size greater than $0.75I$ was designated a self-representing (SR) institution. This step was iterated, revising the sampling interval by excluding all SR institutions from the sum in the numerator and subtracting the number of SR institutions from the total sample size in the denominator. This process was repeated until no new SR institutions were identified. Of the total sample of 275 institutions, 173 were selected with probability proportional to size, and 102 institutions (SR) were selected with certainty or probability equal to unity.

2.4 1997 Institution Sampling

NSRCG:97 used the same institutional sample that was used in the NSRCG:95. Sampled institutions that were identified as ineligible in the NSRCG:95 (i.e., they did not award any eligible degrees in the pertinent time period) were included in the NSRCG:97 list collection process so that their eligibility could be reassessed.

2.5 Effect of Changes in Institutional Sampling

In the 1993 survey, HBCUs and institutions that awarded degrees to relatively large numbers of black and Hispanic graduates were oversampled to improve the precision of the estimates for minorities. Because the majority of black and Hispanic graduates are not concentrated in these institutions, this method was not very effective. It is also likely that the procedures used did not optimally allocate the sample between the SR and non-SR universities, thus increasing the standard error of the estimates. In NSRCG:95 and NSRCG:97, a composite measure of size for each institution that was related to both the number of graduates and the proportion of these who were black and Hispanic was used. Furthermore, the allocation between SR and non-SR universities was approximately optimal, improving the standard errors of the estimates.

3. Graduate Sampling

In each cycle of the NSRCG, recent graduates who had earned bachelor's or master's degrees in the sciences or engineering (S&E) within a specified time frame were sampled from lists provided by the institutions. The following sections discuss the approach used in the NSRCG:93, NSRCG:95, and NSRCG:97.

3.1 1993 Graduate Sampling

Each of the participating sampled institutions sent a list of all their graduates for each cohort to Temple University's ISR. ISR then sampled S&E graduates from these lists. Each eligible graduate was classified into 1 of 42 strata based on the graduate's major field of study and degree status (bachelor's or master's). After the first stage of graduate selection, the sample size of graduates over all three cohorts was about 33,500. Since this was larger than the desired sample size, Westat selected a subsample of the graduates selected by ISR for each of the three cohorts separately. The measure of size used for subsampling was the within-institution sampling rate from the first stage of graduate selection, and a target sample size was specified for each degree and major field of study. This procedure led to a

sample size of 25,785. The NSRCG:93 sample included spring 1990 graduates as well as the 1991 and 1992 cohorts.

3.2 1995 Graduate Sampling

Each of the sampled institutions was asked to provide lists of graduates for sampling. Within each cohort, the graduates were stratified by major field of study and degree. Using these stratification variables, 40 strata for each cohort were created initially. As part of a special study of Native American graduates, all Native Americans who were identified on the graduate lists were assigned to one stratum for each cohort and included in the sample. Thus, there were 41 strata for each cohort, one of which consisted of all the Native American graduates. Rather than explicitly stratifying by race, black and Hispanic graduates were assigned a measure of size equal to three, while non-black/non-Hispanic/non-Native American graduates were assigned a measure of size equal to one. This method had the same effect as oversampling black and Hispanic graduates by a factor of three. The sampling rates by stratum were applied within each eligible, responding institution, and resulted in a sample of 23,771 graduates.

A subsample was selected to reduce the sample to the target of 21,000. Since at the time of subsampling most of the sampled graduates had been processed to some extent and many had completed interviews, the subsample was selected from the cases that were currently nonrespondents and in tracing to find a telephone number or address. There were 7,971 cases eligible for subsampling and the target sample size was 5,200. The cases eligible for subsampling were sorted by cohort, degree, major sampling category, and school, the same sorting procedure used in the full sample. An equal probability sample was selected. This procedure led to a minimal increase in the variance to obtain the desired sample size.

3.3 1997 Graduate Sampling

Within-institution sampling of graduates for the NSRCG:97 was similar to that of NSRCG:95, but with three main differences. First, the overall sample size was reduced by one-third, to approximately 14,000 graduates. Second, the special study of Native Americans was not done; instead, those identified by the institutions as Native American were assigned a measure of size of three. This revision allowed for more equal allocation of the sample (the weights are not as variable) across major fields of study, thereby improving the precision of the estimates. This was particularly important because the sample size was reduced significantly. Third, eliminating the selection of a larger sample of graduates at the initial stage and then subsampling to achieve the required sample size improves the efficiency of the sample. The elimination of this step somewhat reduces the variability of the weights and improves the precision of the estimates. In order to accomplish this goal, the sample size for the NSRCG:97 was allowed to vary slightly around an expected sample size. A sample of 14,057 graduates for the two cohorts combined was selected from the lists of graduates provided by the selected institutions.

Despite the similarities in the sampling plans and the addition of small improvements in the sample design, the estimates from the 1997 cycle will still be less precise than those from the 1995 cycle because the overall sample size for the 1997 cycle is about two-thirds the size of the 1995 sample.

3.4 Effect of Changes in Within Institution Sampling

Tables 1-1 and 1-2 show the sampling rates applied to each stratum by cohort for the 1991 through 1996 cohorts of bachelor's and master's degree recipients, respectively. The sampling rates for

most of the strata in the 1993 survey are less than those of the 1991 survey. At the bachelor's degree level, sampling rates were reduced by at least 32% for Chemistry, Physics/Astronomy, Other Physical sciences, Industrial Engineering, Other Engineering, and Other Social Sciences. At the master's degree level, sampling rates were reduced by at least 40% for Chemistry, Physics/Astronomy, Other Physical Sciences, Chemical Engineering, and Psychology. Sampling rates were further reduced in all the strata in the 1997 survey compared to the rates in the 1993 survey. The sampling rates were reduced by at least 41% in Chemistry, Environmental Sciences, and Sociology/Anthropology for bachelor's degree recipients, and sampling rates were reduced by at least 49% in all the strata except for Computer Sciences, Electrical Engineering, and Other Engineering at the master's degree level. This change in rates affects the precision of the estimates by field.

Another major difference in within-institution sampling procedures is associated with the oversampling of minorities. The procedures used in 1995 and 1997 were much more effective at increasing the sample sizes for blacks and Hispanics, thus improving the precision of the estimates. This is discussed in more detail in the next section.

4. Precision of Selected Estimates from the NSRCG:93 and NSRCG:95

In this section we examine the impact of changes in the NSRCG sample design on the precision of estimates produced from the NSRCG:93 and NSRCG:95.

4.1 Estimates of Graduates by Race

One of the important goals of the NSRCG is to provide reliable estimates of characteristics of minority scientists and engineers. In order to increase the precision of these estimates, black, Hispanic, and Native American graduates were sampled at higher rates than other graduates, although the approach to doing so varied. Table 2-1 and Table 2-2 give the estimates, number of respondents, and coefficient of variation (CV) by race for each cohort and degree.

While the goal in both the 1993 and 1995 surveys was to increase the precision for black and Hispanic graduates, it is clear from Table 2-1 that the procedure used in the 1995 survey was much more effective than the 1993 procedure. Not only were the sample sizes for blacks and Hispanics greater (as a percent of the total sample size) but the CVs of the estimates for these graduates were also much lower. In addition, the sample size and precision of the estimates for Native Americans were much better for 1995, due to the special study described above. It is also important to note that while the sample of white graduates declined from 1993 to 1995, the CV for the estimate of white graduates remained nearly constant, and the CV for the estimate of Asian graduates generally declined.

A similar increase from the NSRCG:93 to the NSRCG:95 in the sample sizes for black and Hispanic graduates with master's degrees is evident in Table 2-2. The sample sizes for minority graduates in the 1995 survey are about twice those for the 1993 survey. The CVs of estimates of totals for black, Hispanic, and American Indian/Alaska Native master's degree graduates did not decline as significantly as they did for bachelor's degree graduates. This might be due to greater clustering of these graduates within the institution.

Next we examine changes in the precision of estimates of characteristics of minority graduates from the 1993 survey to the 1995 survey using estimates from each cohort and degree level of graduates. Tables 3-1 and 3-2 give the estimated percent of graduates who worked for pay or profit during the reference week by race for each cohort. Estimates for bachelor's degree recipients are presented in table 3-1 and those for master's degree recipients are presented in table 3-2. The estimated

percentage of black graduates with bachelor's degrees who worked for pay or profit is 82.1% in the 1993 cohort and 81.9% in the 1991 cohort. Because the number of black respondents in the 1995 survey doubled over the number in the 1993 survey, there was a nearly 50 percent reduction in the CV of the estimate, from 4.9 to 2.6. The CVs for estimates of Hispanic and Native American graduates who worked for pay or profit also declined significantly, while CVs of estimates related to white and Asian graduates showed only a slight or negligible change. An analysis of similar estimates by whether graduates took courses during the reference week, were employed full time, and by major field of study produced very similar results.

Overall, it can be concluded that the sampling procedures used in the NSRCG:95 led to substantially more reliable estimates of the total number and the characteristics of black, Hispanic, and Native American graduates as compared to the NSRCG:93. At the same time, these sampling procedures had little or no effect on the reliability of the numbers and characteristics of white and Asian graduates. This result is very important because the NSRCG has the goal of providing reliable estimates for all graduates as well as for minority graduates.

4.2 Estimates of Graduates by Major Field

Another analytical goal of the NSRCG is to produce estimates for detailed major fields of study within S&E. We examine the consequences of the sample design for this domain by focusing on engineering graduate estimates for the NSRCG:93 and the NSRCG:95 by cohort and degree. Tables 4-1 and 4-2 present the estimates of the number of engineering graduates by their sampling categories for each cohort and degree.

The sampling rates for these sampling categories are given in Tables 1-1 and 1-2. The sampling rates have important implications for analysis purposes because oversampling a major field within engineering increases the variability of the weights for estimates of all engineers (and consequently decreases the precision for estimates of all engineers). This is the "cost" of increasing the sampling rate for a specific major field category. Within the seven sampling categories for engineering bachelor's degree recipients, sampling rates varied considerably. For example, the rates ranged from 0.0169 to 0.0906 for the 1993 cohort. The sampling rates for engineering master's degree recipients also varied considerably.

The ranges in sampling rates are roughly the same for the 1993 and the 1995 surveys, so no major changes took place in the design between the years. Thus the CVs for the estimates of aggregates of all engineers for each cohort (at both the bachelor's and master's degree levels) did not change much across the surveys due to this factor. (Some differences in CVs are observed as a result of changes in sample sizes.) While the sampling rate did not change in the two surveys, there was a significant effect on the reliability of aggregate estimates for all engineers due to the requirement to produce reliable estimates at the detailed major field of study. Because the disproportionate sampling rates were consistent over the cohorts, none of the tabulated NSRCG estimates show how this effect compares to a proportionate sampling approach.

5. Summary

In general, the changes to the NSRCG sample design resulted in improvements in the precision of estimates for black and Hispanic graduates without significantly affecting the precision of estimates for white graduates and for all graduates. The implications of these analyses for the NSRCG:97 estimates are clear because the sample design for the NSRCG:97 is very similar to that of the NSRCG:95. However, a very important change that occurred between 1995 and 1997 is that the sample size for the

NSRCG:97 was reduced by about one-third. As a result, the estimates obtained from the NSRCG:97 will be less precise than those from the NSRCG:95. We expect the CVs of the estimates will be approximately 20% greater for the NSRCG:97 than for the NSRCG:95, due to the reduction in the sample size.

Table 1-1. Sampling rates for major field by cohort for bachelor's degree graduates

Major field	1991	1992	1993	1994	1995	1996
Chemistry	0.0417	0.0417	0.0278	0.0284	0.0163	0.0150
Physics/Astronomy	0.1666	0.1666	0.0572	0.0598	0.0442	0.0413
Other Physical Sciences	0.1666	0.1666	0.0460	0.0425	0.0360	0.0364
Mathematics/Statistics	0.0208	0.0208	0.0185	0.0194	0.0123	0.0126
Computer Sciences	0.0139	0.0139	0.0163	0.0159	0.0093	0.0092
Environmental Sciences	0.0417	0.0417	0.0315	0.0305	0.0146	0.0129
Aero/Astronautical Engineering	0.0833	0.0833	0.0906	0.0910	0.1064	0.1133
Chemical Engineering	0.0833	0.0833	0.0522	0.0467	0.0270	0.0250
Civil Engineering	0.0417	0.0417	0.0298	0.0276	0.0162	0.0152
Electrical Engineering	0.0139	0.0139	0.0169	0.0176	0.0121	0.0125
Industrial Engineering	0.1667	0.0833	0.0643	0.0662	0.0429	0.0432
Materials Engineering	0.5	0.5	-	-	-	-
Mechanical Engineering	0.0208	0.0208	0.0212	0.0205	0.0118	0.0125
Other Engineering	0.0139	0.0139	0.0385	0.0386	0.0236	0.0226
Biological Sciences	0.0069	0.0069	0.0098	0.0092	0.0082	0.0075
Psychology	0.0069	0.0069	0.0101	0.0098	0.0061	0.0060
Economics	0.0139	0.0139	0.0169	0.0180	0.0092	0.0102
Sociology/Anthropology	0.0139	0.0139	0.0129	0.0118	0.0063	0.0056
Other Social Sciences	0.0069	0.0069	0.0164	0.0168	0.0092	0.0090
Political Science	-	-	0.0103	0.0105	0.0093	0.0097
Agricultural Sciences	0.0833	0.0069	-	-	-	-
Unknown Major	0.0833	0.0417	0.0098	0.0092	0.0061	0.0056

Source: National Science Foundation/SRS. National Survey of Recent College Graduates.

Table 1-2. Sampling rates for major field by cohort for master's degree graduates

Major field	1991	1992	1993	1994	1995	1996
Chemistry	0.1667	0.1667	0.0902	0.0876	0.0271	0.0269
Physics/Astronomy	0.1667	0.1667	0.0859	0.0816	0.0273	0.0280
Other Physical Sciences	0.1667	0.25	0.0938	0.0969	0.0345	0.0349
Mathematics/Statistics	0.0416	0.0417	0.0492	0.0505	0.0219	0.0234
Computer Sciences	0.0208	0.0208	0.0262	0.0255	0.0201	0.0209
Environmental Sciences	0.0833	0.0833	0.0754	0.0648	0.0201	0.0188
Aero/Astronautical Engineering	0.1667	0.1667	0.1265	0.1200	0.0635	0.0683
Chemical Engineering	0.3333	0.3333	0.1144	0.1138	0.0509	0.0481
Civil Engineering	0.0417	0.0417	0.0506	0.0485	0.0228	0.0232
Electrical Engineering	0.0417	0.0417	0.0273	0.0272	0.0244	0.0260
Industrial Engineering	0.3333	0.25	0.0845	0.0802	0.0301	0.0277
Materials Engineering	0.25	0.25	-	-	-	-
Mechanical Engineering	0.0417	0.0417	0.0516	0.0509	0.0236	0.0252
Other Engineering	0.0417	0.0417	0.0375	0.0356	0.0205	0.0212
Biological Sciences	0.0417	0.0417	0.0383	0.0371	0.0168	0.0153
Psychology	0.0417	0.0417	0.0247	0.0236	0.0108	0.0109
Economics	0.0417	0.0417	0.0596	0.0544	0.0191	0.0184
Sociology/Anthropology	0.0833	0.0833	0.0693	0.0654	0.0180	0.0181
Other Social Sciences	0.0417	0.0417	0.0444	0.0404	0.0138	0.0144
Political Science	-	-	0.0419	0.0382	0.0177	0.0173
Agricultural Sciences	0.0167	0.0167	-	-	-	-
Unknown Major	0.0417	0.0417	0.0247	0.0236	0.0108	0.0109

Source: National Science Foundation/SRS. National Survey of Recent College Graduates.

Table 2-1. Estimate, coefficient of variation (CV), and sample size for 1991, 1992, 1993, and 1994 science and engineering bachelor's degree recipients by race

Race	1991	1992	1993	1994
White				
Estimate	247,835	266,868	282,588	274,897
CV	3.1	2.8	3.4	3.4
Sample size	3,920	3,680	3,803	3,704
Black				
Estimate	20,173	23,871	19,487	21,680
CV	18.1	17.2	10.0	8.8
Sample size	284	277	550	577
Hispanic				
Estimate	16,391	13,780	18,225	21,392
CV	13.4	11.2	7.6	7.3
Sample size	258	208	511	579
Asian/Pacific Islander				
Estimate	23,129	25,446	26,470	30,111
CV	8.6	8.8	6.7	5.2
Sample size	384	371	356	405
American Indian/ Alaska Native				
Estimate	1,034	938	1,820	1,627
CV	40.9	28.3	13.0	19.0
Sample size	11	14	329	313

Source: National Science Foundation/SRS. National Survey of Recent College Graduates.

Table 2-2. Estimate, coefficient of variation (CV), and sample size for 1991, 1992, 1993, and 1994 science and engineering master's degree recipients by race

Race	1991	1992	1993	1994
White				
Estimate	41,238	41,485	51,790	51,473
CV	4.5	3.3	3.7	3.5
Sample size	1,789	1,783	1,793	1,750
Black				
Estimate	2,476	2,157	3,194	3,127
CV	19.7	16.5	16.1	11.4
Sample size	84	91	204	212
Hispanic				
Estimate	2,002	1,758	3,335	2,802
CV	10.3	10.5	9.8	8.9
Sample size	94	86	199	204
Asian/Pacific Islander				
Estimate	11,112	13,071	14,469	15,699
CV	6.1	5.5	6.1	5.9
Sample size	483	542	460	505
American Indian/ Alaska Native				
Estimate	193	167	370	317
CV	36.1	42.8	26.8	32.2
Sample size	8	7	55	50

Source: National Science Foundation/SRS. National Survey of Recent College Graduates.

Table 3-1. Estimated percent of science and engineering bachelor's degree recipients who worked for pay or profit, by race, for 1991, 1992, 1993, and 1994

Race	1991	1992	1993	1994
White				
Estimate	85.6	85.4	85.0	84.7
CV	0.8	0.8	0.9	0.8
Sample Size	3,437	3,206	3,355	3,212
Black				
Estimate	81.9	87.6	82.1	82.3
CV	4.9	2.7	2.6	2.5
Sample Size	231	245	458	482
Hispanic				
Estimate	85.2	77.2	79.3	79.8
CV	3.6	5.3	3.2	2.8
Sample Size	222	163	415	466
Asian/Pacific Islander				
Estimate	74.6	76.0	77.8	74.2
CV	3.7	4.0	3.8	3.2
Sample Size	292	286	279	310
American Indian/Alaska Native				
Estimate	88.9	96.5	82.9	77.9
CV	13.0	3.1	14.2	9.9
Sample Size	10	12	271	243

Source: National Science Foundation/SRS. National Survey of Recent College Graduates.

Table 3-2. Estimated percent of science and engineering master's degree recipients who worked for pay or profit, by race, for 1991, 1992, 1993, and 1994

Race	1991	1992	1993	1994
White				
Estimate	92.5	89.1	88.9	90.1
CV	0.8	1.1	1.6	1.2
Sample Size	1,645	1,598	1,600	1,579
Black				
Estimate	87.6	81.3	88.4	87.0
CV	4.2	6.8	3.7	3.5
Sample Size	73	72	183	181
Hispanic				
Estimate	85.7	81.8	83.9	88.4
CV	5.3	5.3	4.4	2.9
Sample Size	83	72	171	171
Asian/Pacific Islander				
Estimate	84.9	85.1	87.8	77.2
CV	2.1	2.4	2.5	3.8
Sample Size	394	446	391	387
American Indian/Alaska Native				
Estimate	93.1	100.0	96.1	78.9
CV	8.0	0.0	2.2	15.1
Sample Size	7	7	48	44

Source: National Science Foundation/SRS. National Survey of Recent College Graduates.

Table 4-1. Estimate, coefficient of variation (CV), and sample size for 1991, 1992, 1993, and 1994 science and engineering bachelor's degree recipients in engineering

Engineering Field	1991	1992	1993	1994
Aero/Astro				
Estimate	3,508	3,822	2,341	2,092
CV	14.1	5.8	7.9	9.6
Sample size	235	255	202	175
Chemical				
Estimate	3,325	3,409	4,318	5,293
CV	6.1	6.9	7.0	8.0
Sample size	256	195	208	228
Civil				
Estimate	7,171	8,395	8,555	9,493
CV	5.7	5.6	6.2	6.6
Sample size	267	229	245	255
Electrical				
Estimate	22,117	19,692	20,005	18,624
CV	11.0	5.4	6.3	7.0
Sample size	269	227	318	322
Industrial				
Estimate	3,726	3,968	3,283	3,073
CV	8.3	8.7	7.6	8.2
Sample size	270	232	200	191
Mechanical				
Estimate	12,914	12,211	13,854	15,023
CV	3.8	4.6	7.9	7.1
Sample size	251	232	288	299
Other Engineering				
Estimate	7,882	6,248	6,088	6,449
CV	2.7	12.0	2.3	10.8
Sample size	359	298	192	189
All Engineering				
Estimate	60,643	57,745	58,444	60,027
CV	4.8	2.1	4.6	4.8
Sample size	1,907	1,661	1,653	1,659

Source: National Science Foundation/SRS. National Survey of Recent College Graduates.

Table 4-2. Estimate, coefficient of variation (CV), and sample size for 1991, 1992, 1993, and 1994 science and engineering master's degree recipients in engineering

Engineering	1991	1992	1993	1994
Aero./Astro.				
Estimate	964	955	810	920
CV	4.7	6.5	14.4	17.2
Sample size	125	158	84	81
Chemical				
Estimate	729	938	941	828
CV	7.5	11.0	17.3	12.7
Sample size	141	144	76	70
Civil				
Estimate	2,570	2,380	2,934	3,179
CV	7.0	8.0	8.6	8.9
Sample size	107	113	127	132
Electrical				
Estimate	8,080	7,582	8,274	8,181
CV	4.9	6.0	9.2	8.2
Sample size	136	155	194	180
Industrial				
Estimate	1,236	1,353	1,461	1,550
CV	7.6	10.4	10.7	12.3
Sample size	160	143	101	93
Mechanical				
Estimate	3,084	3,303	3,870	3,569
CV	6.4	8.2	8.5	7.2
Sample size	129	135	156	157
Other Engineering				
Estimate	3,477	4,396	4,690	5,406
CV	6.8	6.1	8.9	9.8
Sample size	222	284	151	166
All Engineering				
Estimate	20,140	20,907	22,980	23,633
CV	2.0	2.9	4.8	4.2
Sample size	1,020	1,132	889	879

Source: National Science Foundation/SRS. National Survey of Recent College Graduates.