ACT Research Report Series 2004-4

High School Grade Inflation from 1991 to 2003

David J. Woodruff

Robert L. Ziomek

ACT

March 2004

For additional copies write:
ACT Research Report Series
P.O. Box 168
Iowa City, Iowa 52243-0168

High School Grade Inflation from 1991 to 2003

David J. Woodruff
Robert L. Ziomek

Abstract

This report presents the results of a study investigating inflation in high school grade point average (HSGPA). Inflation was measured by comparing HSGPA to ACT Assessment (ACT) scores over the years 1991 to 2003. The results indicate the presence of grade inflation over the 13 years. That is, HSGPAs increased without a concomitant increase in achievement, as measured by the ACT. Both the marginal analyses and the conditional analyses reveal the presence of grade inflation. Depending on the subject area, the average amount of grade inflation over the 13 years varied between 0.20 and 0.26 on a HSGPA scale of 0 (F) to 4 (A).

Acknowledgement

The authors thank Jim Sconing for suggesting the analysis.

High School Grade Inflation from 1991 to 2003

This report presents the results of a study that compared mean high school grade point averages (HSGPA) and ACT Assessment (ACT) scores from 1991 to 2003 for the purpose of assessing grade inflation. The HSGPAs were derived from grades in 23 courses tracked over the 13 years. Increases over time in the means of three different HSGPAs were compared to increases over time in the means of three corresponding ACT scores. HSGPA means conditional on specific ACT scores also were tracked over the 13 years. The results indicated the presence grade inflation.

The ACT is an achievement test battery used by colleges for admission and course placement, and is usually taken in the eleventh or twelfth grade of high school. It is composed of four tests: English, Mathematics, Reading, and Science. A fifth score, the Composite score, is the average of the four test scores. This study used the ACT Composite score, the ACT English score, and the ACT Mathematics score. HS Overall GPA, HS English GPA, and HS mathematics GPA were computed for all students. These HSGPAs were derived from grades in 23 courses that were tracked over the 13 years. All grades were self-reported by the students.

This study distinguishes between grade inflation and differential grading standards. Grade inflation is an increase in grades over time for the same level of student achievement. Differential grading standards result from different schools assigning different grades in the same time period for the same level of student achievement. This study focuses on grade inflation. Grade inflation is present when grades increase over time without a concomitant increase in achievement. The term "grade increase" is used when an increase in grades over time is observed but the status of achievement over time has not been determined.

The ACT tests were used as objective measures of student achievement across schools and over time. The ACT is an achievement test designed to measure skills taught in typical college-preparatory high school curricula. ACT regularly conducts national curriculum studies to ensure that the content of the ACT is consistent with the high school curriculum. Different forms of the ACT tests are used at the same time and over time. However, the test development process incorporates procedures to ensure that all forms measure the same content and have the same difficulty and variability. Statistical adjustments also are employed to ensure that scores on all forms are comparable.

The hypothesis under investigation in this study was that, unlike ACT scores, high school grades have been subject to inflation. The present study was a follow-up to a previous study by Ziomek and Svec (1995). They studied ACT Composite scores and HS overall GPA from 1990 to 1994. They used data similar to the data used in this study, but they divided schools into deciles based on their average ACT Composite scores. They then computed HS overall GPA and ACT Composite score statistics for the students attending the schools in each decile for the five years. They found evidence for modest grade inflation in all deciles.

Koretz and Berends (2001) also investigated high school grade inflation with an emphasis on grades in mathematics. They collected test and HSGPA data for 1982 high school seniors from the High School and Beyond study and similar data for 1992 high school seniors from the National Education Longitudinal Study of 1988. They did not find evidence for widespread high school grade inflation during the ten years from 1982 to 1992, but they did find some evidence for a modest amount of grade inflation for high-income high school students.

Attention also has been focused on college grade inflation. Stuart Rojstaczer, a professor of environmental science at Duke University, wrote a newspaper article about no longer giving C's

in his courses (Rojstaczer, 2003). This led him to compile a database of college GPA data from a variety of four year colleges and universities and publish it on his Web site, http://gradeinflation.com. His analysis, which extends back to the late sixties, suggests grade inflation has occurred in college grading.

Johnson (2003) has written a book describing an extensive study of college grade inflation at Duke University. He found that student evaluations of instructors are affected by the instructors' grading practices, that course grading affects course enrollment, and that grading practices differ in different departments. He concludes that grade inflation is a serious problem, and he offers a number of suggestions for dealing with it.

Collins (2002) attributes high school and college grade inflation to credential inflation. First, he notes that in 1900 only 10% of the U.S. population had high school diplomas, while now more than 25% of the U.S. population have college degrees. This increase in the education level of the population has led to an increase in the requirements necessary for a wide variety of jobs. Increasingly higher levels of education have become necessities for employment. This has led to high school grade inflation to enable entry into college and college grade inflation to enhance competitiveness in the job market or enable entry into graduate school.

Data

The data used for the analysis was drawn from students who graduated from public high schools between 1991 and 2003, and who took the ACT in the eleventh or twelfth grade of high school. If a student took the ACT more than once then only the student's scores from the most recent testing were included in the analysis. ACT collects course information on 30 different courses when students register to take the ACT. Because some students do not report their grades, there is a modest amount of nonrandom missing data. HS Overall GPA is based on the

students' self-reported grades in 23 of these 30 courses. Four foreign language and three art courses are excluded. HS English GPA is based on self-reported grades in five courses, and HS mathematics GPA is based on self-reported grades in seven courses. The 23 courses are listed in Table 2 and Table 3. Sawyer, Laing, & Houston (1988) studied the accuracy of these self-reported grades and found them sufficiently accurate for research purposes.

Method

First, demographics for all 13 years of data are presented. Next, proportions of students completing each of the 23 courses at the time of ACT testing are presented for each year. This is followed by average grades for the 23 courses over the 13 years. Then, three different areas are analyzed. One area is the ACT Composite score and HS overall GPA derived from students' grades in the 23 courses. Another area involves the ACT English score and HS English GPA derived from students' grades in 7 English courses. The last area uses the ACT Mathematics score and HS mathematics GPA derived from students' grades in 5 mathematics courses.

Two sets of analyses were done. First, a marginal analysis was done for each area. The variation in HSGPA means and ACT means over the 13 years were compared. Then conditional analyses were undertaken. For each conditional analysis, the mean HSGPA for students with the same specific value of an ACT score was computed; this was done for all ACT score values from 13 to 32. (Though the ACT score range is from 1 to 36, stable results could only be obtained for values from 13 to 32.) These conditional HSGPA means (conditional on specific values of ACT scores) were computed for all 13 years from 1991 to 2003. The students taking the ACT differed from year to year. It was assumed that students with the same ACT score had the same average level of achievement across all 13 years. An increase in these conditional HSGPAs over time would indicate grade inflation. The student samples were so large as to make formal statistical

hypothesis testing unnecessary, because even the smallest difference would result in statistical significance. Instead, descriptive results are presented in several tables and graphs, and effect sizes are used to judge the practical significance of the results.

Results

Demographics

Table 1 contains gender, ethnicity, and grade at time of ACT testing proportions for the 13 years. Over the time period studied, there was a small decrease in the proportion of white students and a small increase in the proportion of African-American and Hispanic students. The proportion of males also decreased. The results in Table 1 are based only on students with ACT Composite scores between 13 and 32. This was done to keep the analysis consistent with later analyses that condition on specific values of ACT Composite scores.

TABLE 1

Gender, Grade at Time of ACT Testing, and Ethnicity
Sample Proportions for all 13 Years

	Gender		Grade at ACT Testing		Ethnicity			
Year	Female	Male	Eleventh	Twelfth	White	Black	Hispanic	Other
1991	0.57	0.43	0.35	0.65	0.77	0.10	0.04	0.09
1992	0.56	0.44	0.33	0.67	0.74	0.09	0.05	0.12
1993	0.56	0.44	0.34	0.66	0.73	0.09	0.05	0.13
1994	0.56	0.44	0.34	0.66	0.71	0.10	0.05	0.14
1995	0.57	0.43	0.34	0.66	0.70	0.10	0.05	0.15
1996	0.57	0.43	0.36	0.64	0.72	0.10	0.05	0.13
1997	0.57	0.43	0.34	0.66	0.70	0.10	0.05	0.15
1998	0.58	0.42	0.36	0.64	0.73	0.10	0.05	0.12
1999	0.58	0.42	0.31	0.69	0.73	0.10	0.05	0.12
2000	0.58	0.42	0.33	0.67	0.72	0.11	0.05	0.12
2001	0.58	0.42	0.34	0.66	0.72	0.11	0.06	0.11
2002	0.58	0.42	0.32	0.68	0.72	0.12	0.05	0.11
2003	0.59	0.41	0.32	0.68	0.71	0.12	0.06	0.11

Course Statistics

Table 2 contains the proportions of students who had completed various courses at the time of ACT testing for each of the 13 years. Proportions are given for each of the 23 courses used to compute HS overall GPA. The first five courses are used in computing HS English GPA, and the next seven courses are used in computing HS mathematics GPA. The difference between the proportion of students completing particular courses in 1991 and 2003 is given in the second column of Table 2. There are several differences worth noting. The first is twelfth-grade English. The proportion of students who completed twelfth-grade English steadily declined from 0.62 in 1991 to 0.52 in 2003. The group of three mathematics courses, algebra 2, geometry, and advanced mathematics, shows substantial increases over the 13 years. Computer science shows a 0.10 decline over the 13 years. Finally, the proportions of students having completed chemistry, world history, and geography increased from 0.06 to 0.10 over the 13 years. Changes in completion proportions for other courses are smaller and less significant.

The changes over time in the proportion of students completing certain courses at the time of ACT testing could have affected ACT test scores over time. The ACT is an achievement test designed to measure the content of many of these 23 courses. From the proportion changes noted, one might have expected over time a very slight decrease in ACT English scores, an increase in ACT Mathematics scores, and a small increase in ACT Composite scores. As shortly will be seen all of the ACT scores increased over time, though not in a steady manner, and the increases were small relative to the increase in HSGPA. However, the ACT Mathematics score shows the greatest increase, while the ACT English score shows the smallest increase.

TABLE 2

Proportions of Students Having Completed Courses at Time of ACT Testing for all 23 Courses Used in Computing HS Overall GPA for all 13 Years

Year	2003-1991	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Course														
English 9	0.00	1.00	0.96	0.96	0.95	0.95	0.98	0.97	1.00	1.00	1.00	1.00	1.00	1.00
English 10	-0.01	1.00	0.96	0.95	0.95	0.95	0.98	0.97	1.00	1.00	1.00	1.00	0.99	0.99
English 11	-0.01	0.99	0.95	0.95	0.95	0.95	0.97	0.97	0.99	0.98	0.98	0.98	0.98	0.98
English 12	-0.10	0.62	0.61	0.60	0.60	0.60	0.57	0.59	0.53	0.55	0.53	0.51	0.53	0.52
Speech	0.00	0.30	0.29	0.28	0.28	0.27	0.27	0.28	0.28	0.28	0.29	0.31	0.31	0.30
Algebra 1	0.01	0.96	0.93	0.92	0.92	0.93	0.95	0.95	0.97	0.97	0.97	0.97	0.97	0.97
Algebra 2	0.10	0.78	0.76	0.77	0.78	0.79	0.82	0.83	0.86	0.86	0.87	0.87	0.88	0.88
Geometry	0.07	0.87	0.84	0.85	0.85	0.86	0.89	0.89	0.92	0.92	0.93	0.93	0.93	0.94
Trigonometry	-0.01	0.35	0.34	0.35	0.36	0.36	0.37	0.37	0.38	0.37	0.36	0.35	0.35	0.34
Calculus	0.03	0.07	0.07	0.08	0.09	0.09	0.09	0.09	0.09	0.10	0.10	0.09	0.10	0.10
Advanced Math	0.11	0.21	0.21	0.22	0.23	0.25	0.25	0.27	0.28	0.29	0.29	0.30	0.31	0.32
Computer Sci.	-0.10	0.21	0.19	0.17	0.15	0.14	0.14	0.13	0.13	0.12	0.12	0.11	0.11	0.11
General Sci.	-0.01	0.81	0.79	0.78	0.78	0.78	0.80	0.80	0.80	0.80	0.80	0.80	0.81	0.80
Biology	0.00	0.96	0.93	0.93	0.93	0.93	0.95	0.95	0.97	0.97	0.97	0.97	0.97	0.96
Chemistry	0.08	0.68	0.67	0.68	0.70	0.71	0.73	0.74	0.76	0.76	0.76	0.76	0.76	0.76
Physics	0.04	0.25	0.25	0.25	0.26	0.27	0.27	0.28	0.28	0.28	0.28	0.28	0.28	0.29
US History	-0.01	0.99	0.95	0.95	0.94	0.94	0.96	0.96	0.98	0.98	0.98	0.98	0.98	0.98
World History	0.06	0.76	0.74	0.75	0.75	0.76	0.78	0.78	0.80	0.80	0.80	0.81	0.81	0.82
Other History	-0.04	0.26	0.25	0.24	0.24	0.25	0.25	0.25	0.25	0.24	0.24	0.24	0.23	0.22
US Government	0.00	0.60	0.58	0.58	0.58	0.60	0.59	0.60	0.57	0.59	0.59	0.58	0.59	0.60
Economics	-0.02	0.38	0.36	0.35	0.35	0.35	0.35	0.35	0.33	0.35	0.35	0.35	0.36	0.36
Geography	0.10	0.36	0.36	0.37	0.39	0.39	0.41	0.42	0.45	0.46	0.47	0.47	0.48	0.46
Psychology	0.01	0.22	0.21	0.21	0.21	0.21	0.21	0.22	0.21	0.22	0.22	0.22	0.23	0.23

It also is of interest to examine average grades in the 23 courses over the 13 years. Table 3 contains average grades on a scale of 0 to 4 for the years 1991 to 2003 for each of the 23 courses used in computing HS overall GPA. In the second column of Table 3 is the 2003 average grade minus the 1991 average grade for each course. These average grade differences do not appear to be particularly unusual for the courses that had substantial changes in the proportion of students completing them. Twelfth grade English has the largest grade increase of all courses, but its grade increase is not that much greater than that observed in other courses. Advanced mathematics has the second lowest grade increase after calculus, but it is a specialized course

taken by only a moderate proportion of students. Though significant changes in the proportion of students completing 8 of the 23 courses did occur over the 13 years, those 8 courses did not display unusual grade increase. All 23 of the courses in Table 3 show positive grade increases, and all but 3 show grade increases greater than 0.20 over the 13 years.

TABLE 3

Average Grades for all 23 Courses Used in Computing HS Overall GPA for all 13 Years

Year	2003-1991	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Course														
English 9	0.23	3.05	3.06	3.09	3.12	3.16	3.19	3.21	3.24	3.25	3.26	3.27	3.27	3.28
English 10	0.23	3.02	3.05	3.07	3.10	3.14	3.17	3.19	3.22	3.22	3.23	3.24	3.25	3.25
English 11	0.26	2.98	3.01	3.04	3.08	3.11	3.13	3.14	3.18	3.18	3.20	3.21	3.22	3.24
English 12	0.30	3.02	3.05	3.08	3.13	3.15	3.17	3.19	3.24	3.25	3.27	3.29	3.31	3.32
Speech	0.25	3.32	3.35	3.36	3.39	3.42	3.44	3.45	3.48	3.50	3.53	3.55	3.56	3.57
Algebra 1	0.26	2.91	2.93	2.96	2.99	3.02	3.05	3.08	3.13	3.13	3.15	3.16	3.16	3.17
Algebra 2	0.22	2.88	2.90	2.93	2.96	2.98	3.01	3.02	3.06	3.07	3.07	3.08	3.09	3.10
Geometry	0.26	2.82	2.84	2.86	2.89	2.93	2.96	2.98	3.03	3.04	3.05	3.06	3.07	3.08
Trigonometry	0.21	3.10	3.12	3.15	3.17	3.20	3.22	3.23	3.26	3.27	3.27	3.28	3.30	3.31
Calculus	0.09	3.39	3.39	3.41	3.44	3.44	3.44	3.45	3.45	3.45	3.45	3.46	3.46	3.48
Advanced Math	0.15	3.18	3.19	3.22	3.24	3.25	3.26	3.27	3.31	3.30	3.31	3.32	3.32	3.33
Computer Sci.	0.23	3.36	3.39	3.42	3.45	3.49	3.51	3.52	3.55	3.56	3.57	3.58	3.59	3.59
General Sci.	0.25	3.10	3.12	3.14	3.18	3.21	3.24	3.27	3.31	3.32	3.34	3.34	3.35	3.35
Biology	0.24	2.98	3.00	3.03	3.06	3.10	3.12	3.14	3.18	3.20	3.20	3.21	3.22	3.22
Chemistry	0.25	2.87	2.90	2.92	2.95	2.97	3.00	3.02	3.06	3.06	3.07	3.09	3.10	3.12
Physics	0.19	3.11	3.13	3.16	3.19	3.20	3.23	3.23	3.26	3.26	3.26	3.27	3.29	3.30
US History	0.27	3.09	3.12	3.15	3.19	3.22	3.25	3.27	3.31	3.31	3.33	3.34	3.35	3.36
World History	0.26	3.10	3.12	3.15	3.18	3.22	3.24	3.27	3.31	3.32	3.33	3.34	3.35	3.36
Other History	0.26	3.21	3.23	3.25	3.29	3.32	3.36	3.38	3.42	3.44	3.45	3.46	3.47	3.47
US Government	0.24	3.12	3.14	3.17	3.20	3.23	3.25	3.28	3.32	3.32	3.34	3.35	3.36	3.36
Economics	0.24	3.12	3.14	3.16	3.19	3.22	3.23	3.26	3.31	3.32	3.33	3.35	3.36	3.36
Geography	0.25	3.23	3.25	3.28	3.31	3.34	3.37	3.39	3.44	3.44	3.46	3.47	3.47	3.48
Psychology	0.29	3.17	3.20	3.22	3.26	3.29	3.31	3.34	3.38	3.40	3.41	3.43	3.45	3.46

Marginal Analyses

Table 4 contains sample sizes, means, standard deviations, and correlations for HS overall GPA and ACT Composite score for all students and all 13 years. Only students with ACT Composite scores between 13 and 32 are included in the analysis. This is done to keep the

marginal and conditional analyses consistent with one another. This range of ACT scores includes most of the tested students; as can be seen, the sample sizes for all years are large.

While the HS overall GPA means increased steadily from year to year, the ACT Composite means increased from 1991 to 1998, except in 1992, and then started to decrease. Yearly HS overall GPA means increased 0.26 from 1991 to 2003. Considering the overall increase for the entire 13 year period, yearly ACT Composite means increased about the same amount, 0.28. The two variables are on very different scales, however, and the relative increase in the HSGPAs is much larger than the increase in ACT means. The two increases can be made comparable by dividing each by the average of its 13 yearly standard deviations. This converts the increases into effect sizes (Cohen, 1988). The average of the 13 yearly HS overall GPA standard deviations is 0.60, and the average of the 13 yearly ACT Composite standard deviations is 4.5. If each increase is divided by the appropriate average standard deviation, one obtains an effect size for the HSGPA increase of 0.43, and one obtains for the ACT Composite increase an effect size of 0.062. As an effect size, the ACT Composite increase is only about 14% of the HS overall GPA increase. This analysis attributes nearly all of the increase in HS overall GPA to grade inflation because the HSGPA increase is not accompanied by a correspondingly large increase in mean ACT scores. An effect size of 0.43 for HS overall GPA grade inflation is considered a moderate effect size (Cohen, 1988). Another way to consider the practical effect of this amount of grade inflation is its size in proportion to the range of grades. For grades on a scale of 0 to 4, 0.26 represents 6.5% of that range, so in that sense high school grades have inflated by 6.5% over the 13 year period 1991 to 2003.

The last column in Table 4 contains the correlations between HS overall GPA and ACT Composite score for the 13 years. The correlations are very stable from year to year; they are

essentially equal for all years. The values of the correlations are fairly typical for HS overall GPA and ACT Composite score (Woodruff, 2003a). The values of the correlation are high when one considers the wide variability in grading standards from high school to high school (Woodruff, 2003b). It appears that the grade inflation that is occurring is not decreasing the correlation between HS overall GPA and ACT Composite score.

TABLE 4

Sample Sizes, Means, Standard Deviations, and Correlations Between HS Overall GPA and ACT Composite Score for 1991 to 2003

Year	N	HSGPA Mean	ACT Mean	HSGPA SD	ACT SD	Correlation
1991	637,261	2.94	20.62	0.63	4.40	0.58
1992	700,869	3.00	20.56	0.61	4.42	0.57
1993	721,963	3.02	20.67	0.61	4.44	0.57
1994	733,320	3.05	20.72	0.60	4.51	0.57
1995	778,594	3.09	20.72	0.60	4.51	0.57
1996	756,678	3.11	20.78	0.60	4.54	0.57
1997	781,080	3.13	20.88	0.60	4.59	0.57
1998	725,375	3.14	21.12	0.60	4.58	0.57
1999	725,724	3.16	21.03	0.60	4.56	0.57
2000	781,460	3.17	21.02	0.59	4.56	0.57
2001	762,793	3.18	20.97	0.59	4.58	0.56
2002	702,397	3.19	20.89	0.59	4.58	0.57
2003	706,978	3.20	20.90	0.59	4.58	0.57

Table 5 contains similar statistics for HS English GPA and ACT English score. While HS English GPA means increased steadily from year to year, ACT English score means go up and down, but finish the 13 year period with a gain. From 1991 to 2003 yearly HS English GPA means increased 0.25, and yearly ACT English means increased 0.22. The average of the 13 yearly HS English GPA standard deviations is 0.67, and the average of the yearly ACT English standard deviations is 5.0. Dividing the increases by the standard deviations give effect sizes of

0.37 for HS English GPA and 0.044 for ACT English score. The ACT English effect size is only about 12% of the HS English GPA effect size. Nearly all of the increase in HS English GPA can be attributed to grade inflation because it is not accompanied by a corresponding increase in achievement as measured by the ACT English test. An effect size of 0.37 is considered a small to moderate effect size (Cohen, 1988), and 0.25 is 6.25% of the 0 to 4 HSGPA range.

The correlations between HS English GPA and English ACT score are smaller than their overall and Composite counterparts, and they do slightly decrease over the 13 years. Their smaller size is likely due to the shorter length of their components.

TABLE 5

Sample Sizes, Means, Standard Deviations, and Correlations Between HS English GPA and ACT English Score for 1991 to 2003

Year	N	HSGPA Mean	ACT Mean	HSGPA SD	ACT SD	Correlation
1991	633,935	3.04	20.22	0.69	4.95	0.50
1992	697,345	3.06	20.19	0.70	4.99	0.49
1993	718,524	3.09	20.27	0.70	4.96	0.49
1994	728,576	3.12	20.27	0.70	5.09	0.48
1995	773,942	3.16	20.20	0.69	5.13	0.47
1996	748,850	3.17	20.23	0.69	5.10	0.47
1997	772,473	3.19	20.26	0.69	5.13	0.46
1998	715,526	3.23	20.49	0.67	5.04	0.47
1999	708,704	3.25	20.58	0.66	5.04	0.47
2000	766,817	3.26	20.53	0.66	5.08	0.46
2001	744,977	3.27	20.48	0.65	5.09	0.45
2002	681,826	3.28	20.38	0.65	5.09	0.45
2003	687,281	3.29	20.44	0.65	5.12	0.45

Table 6 contains similar statistics as Table 4 and Table 5 but for HS mathematics GPA and ACT Mathematics score. Again, while the HS mathematics GPA means increased steadily from year to year, the ACT Mathematics means vary up and down, but end the 13 years with a gain.

From 1991 to 2003, yearly HS mathematics GPA means increased 0.27 and yearly ACT Mathematics means increased 0.41. The average of the 13 yearly HS mathematics GPA standard deviations is 0.82, and the average of the 13 yearly ACT Mathematics standard deviations is 4.7. Dividing the mean increases by the average standard deviations give effect sizes of 0.33 for HS mathematics GPA and 0.087 for ACT Mathematics. Because 0.087 is about 26% of 0.33 it appears appropriate in this case to consider adjusting the increase in HS mathematics GPA by the increase in ACT Mathematics means. The overall increase in ACT Mathematics means combined with the increases in the proportions of students completing three of the mathematics courses supports the conclusion that there was an increase in average mathematics achievement over the 13 years.

In terms of effect sizes, one could attribute about 26% of the increase in HS mathematics GPA to an increase in mathematics achievement as measured by the ACT Mathematics test. If only 74% of the increase in HS mathematics GPA is considered grade inflation, an effect size of 0.24 is considered a small effect size (Cohen, 1988). On the HS mathematics GPA scale 74% of 0.27 is 0.20 and 0.20 represents 5% of the 0 to 4 HSGPA range.

The correlations between HS mathematics GPA and ACT Mathematics score are similar to the HS overall GPA and ACT Composite correlation. Though they decrease very slightly over the 13 years, they are essentially equal for all years. The mathematics correlations are larger than the English correlations even though HS mathematics GPA and ACT Mathematics test also are shorter measures than HS overall GPA and ACT Composite score. Their larger correlations are perhaps due to the hierarchical nature of mathematics.

TABLE 6

Sample Sizes, Means, Standard Deviations, and Correlations Between HS Mathematics GPA and ACT Mathematics Score for 1991 to 2003

Year	N	HSGPA Mean	ACT Mean	HSGPA SD	ACT SD	Correlation
1991	619,672	2.80	20.04	0.85	4.54	0.57
1992	695,969	2.80	19.95	0.85	4.57	0.56
1993	717,783	2.82	20.06	0.85	4.61	0.56
1994	730,120	2.86	20.10	0.85	4.66	0.56
1995	776,293	2.90	20.14	0.84	4.71	0.56
1996	754,119	2.92	20.17	0.84	4.64	0.56
1997	777,064	2.94	20.48	0.83	4.79	0.56
1998	714,205	3.01	20.91	0.80	4.88	0.56
1999	715,115	3.02	20.72	0.79	4.74	0.56
2000	771,059	3.04	20.72	0.78	4.78	0.55
2001	753,103	3.05	20.65	0.78	4.73	0.55
2002	691,344	3.06	20.59	0.78	4.72	0.55
2003	696,939	3.07	20.55	0.77	4.77	0.54

The sample sizes for the various years differ slightly in Table 4, Table 5, and Table 6. In selecting the students for the three analyses the condition that the ACT score be between 13 and 32 was applied to the specific ACT score for each analysis. This resulted in small differences in the sample sizes for the three different analyses.

Conditional Analyses

The conditional analyses track over time the HSGPA of students with specific ACT score values. It is assumed that students with the same ACT score have, on average, the same level of achievement in different years. Therefore, any increase in their HSGPA over time is evidence of grade inflation, and no adjustments for changes over time in achievement have to be made. Such an approach yields a simpler analysis of grade inflation. It does have a limitation. Students with high ACT scores tend to have high HSGPA's, and this produces a ceiling effect on grade

inflation. As will be seen, because grades cannot exceed 4.0, grade inflation for students with high ACT scores is less than that for students with low ACT scores.

Figure 1 and Figure 2 present the results of the analysis involving the ACT Composite score and HS overall GPA. Figure 1 contains 13 curves, one for each of the 13 years, one stacked above the next with the bottom curve being for 1991 and the top curve being for 2003. This stacking of the curves indicates grade inflation. If all of the curves lay on top of each other, there would be no grade inflation. Each curve is created by connecting adjacent dots with a straight line; no smoothing is used. Each dot represents the HS overall GPA for all students with a specific ACT Composite score value. ACT Composite score values are indicated on the bottom axis of the graph, which is labeled ACT Composite Score. HSGPA values are indicated on the two vertical axes. The number of students contributing to each conditional HSGPA varies from year to year and more dramatically across ACT Composite score values. The middle ACT Composite score values have sample sizes in the tens of thousands, but the ACT Composite score values very near the upper end, and to a lesser degree, the lower end of the scale, may have sample sizes only in the thousands. Score values outside the range 13 to 32 did not have sufficient sample sizes for stable year to year results.

The curves in Figure 1 are all slightly S-shaped. Each curve represents the regression of HS overall GPA on ACT Composite score for a specific year. Grade inflation from year to year is represented as the distance between two adjacent curves, and grade inflation from 1991 to 2003 is represented by the distance from the lowest curve, labeled 1991, to the highest curve, labeled 2003. The amount of grade inflation varies for different values of the ACT Composite score. The grade inflation at any specific ACT Composite score value is represented by the vertical array of dots above that score. Grade inflation is highest for low and middle values of the ACT

Composite score, and grade inflation slowly decreases as the ACT Composite score increases. Though grade inflation is present at the very highest ACT Composite scores, it is lowest there, and this is due to a ceiling effect. Students with high ACT Composite scores tend to have high HSGPAs and there is less room for these high HSGPAs to increase because HSPGA cannot exceed 4.0.

Composite grade inflation from 1991 to 2003 varies between 0.21 and 0.29 for ACT Composite scores between 13 and 27. Beginning at ACT Composite score 28, composite grade inflation from 1991 to 2003 starts slowly decreasing to 0.07 at ACT Composite score 32. In Figure 1, one can see from the spacing between the curves that a substantial proportion of the grade inflation that occurred during the 13 years occurred between 1991 and 1995. After 1995, the amount of grade inflation that occurs in each year decreases and remains stable from year to year. Whether this 8 year trend will continue is unknown.

Figure 2 is an alternative presentation of the data used in Figure 1. HS Overall GPA is still represented on the vertical axis, but now year is represented on the horizontal axis. The various tilted horizontal lines represent specific ACT Composite scores. Several of them are labeled: 13, 17, 21, 25, 29, and 32. Each dot on a line represents the overall HSPGA at that ACT Composite score for the year that the dot is above. The vertical array of dots above each ACT Composite score in Figure 1 is, in Figure 2, spread out as a horizontal line with a slope that represents the rate of grade inflation for that ACT composite score. The amount of grade inflation at any specific ACT Composite score over the 13 year period equals the difference between where that score's line ends on the right axis and where that score's line begins on the left axis. Similarly, grade inflation from one year to another year for a specific ACT Composite score equals the increase between the two dots representing those years.

In Figure 2 one can recognize that HS overall GPA grade inflation is highest for the low and middle ACT Composite scores, and that it decreases as the ACT Composite score increases. The lines in the low and middle parts of Figure 2 are steeper than the lines near the top of Figure 2. This is a result of the ceiling effect of HSGPA. The lines also tend to be steeper between 1991 and 1995 indicating that this was a period of greater grade inflation as compared to the latter years.

Figure 3 and Figure 4 present the results of the analysis involving the ACT English score and HS English GPA. Figure 3 is similar to Figure 1 but is for English. The vertical axis in Figure 3 goes from 2.55 to 3.85, whereas the vertical axis in Figure 1 goes from 2.30 to 3.85. The curves in Figure 3 are not as smooth as the curves in Figure 1. HS English GPA is based on only 5 courses whereas HS overall GPA is based on 23 courses, and the ACT Composite score is the average of 4 tests whereas English is just one test. HS English GPA and ACT English are shorter measures than their composite counterparts, and so are somewhat less stable; hence their curves are not as smooth as the curves in Figure 1, even though the sample sizes are as large as in Figure 1. However, the results presented in the two Figures are similar. Grade inflation is highest for low and middle values of the ACT English score, and grade inflation slowly decreases as the ACT English score increases. Though grade inflation is present at the very highest ACT English scores, it is lowest there, and this is again due to a ceiling effect. English HSPGA cannot exceed 4.0. English grade inflation from 1991 to 2003 varies between 0.21 and 0.29 for ACT English scores between 13 and 23. Beginning at ACT English score 24, English grade inflation from 1991 to 2003 starts slowly decreasing to 0.07 at ACT English score 32.

FIGURE 1. Plot of HS Overall GPA by ACT Composite Score, 1991 to 2003

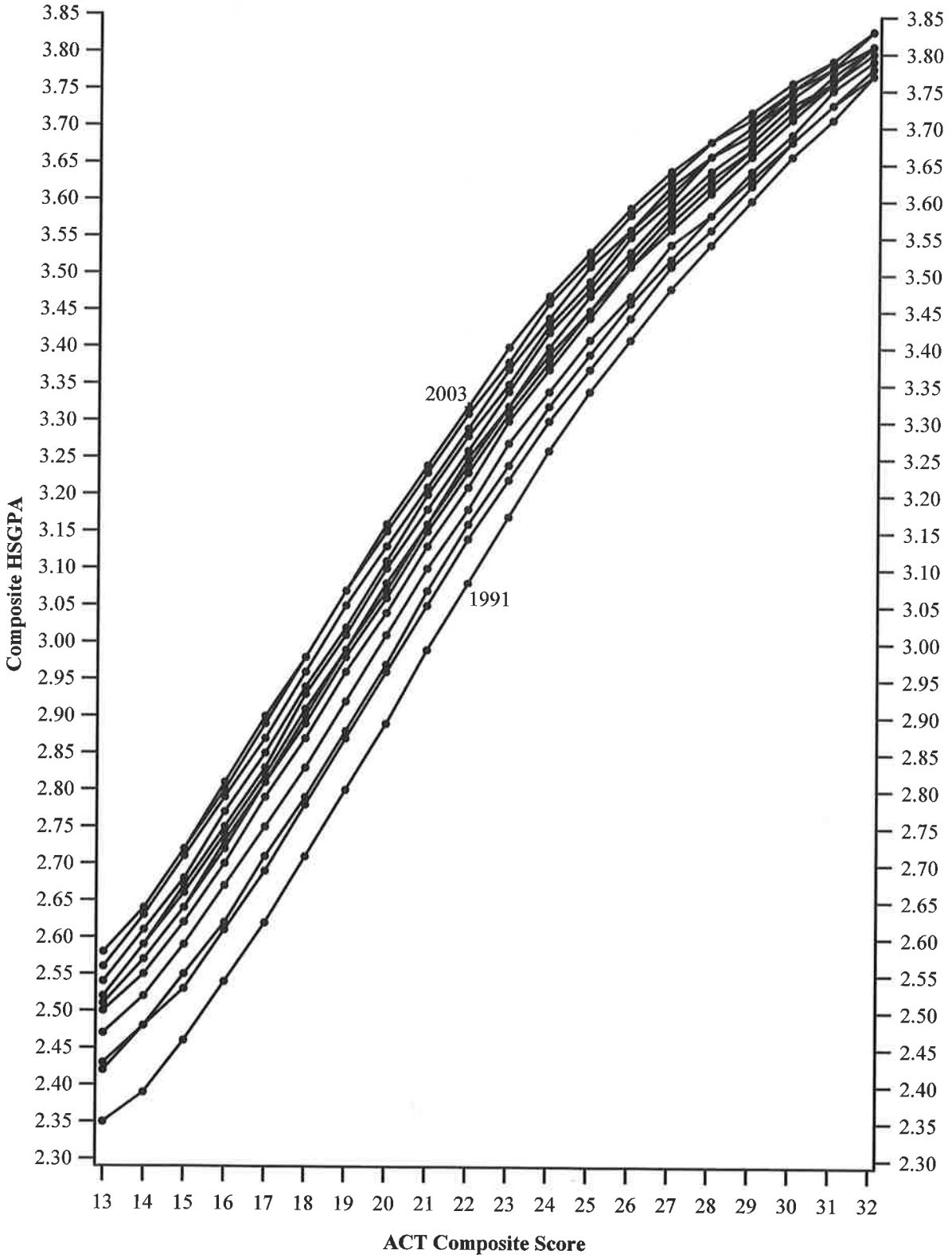


FIGURE 2. Plot of HS Overall GPA for Specific ACT Composite Scores Across the 13 Years

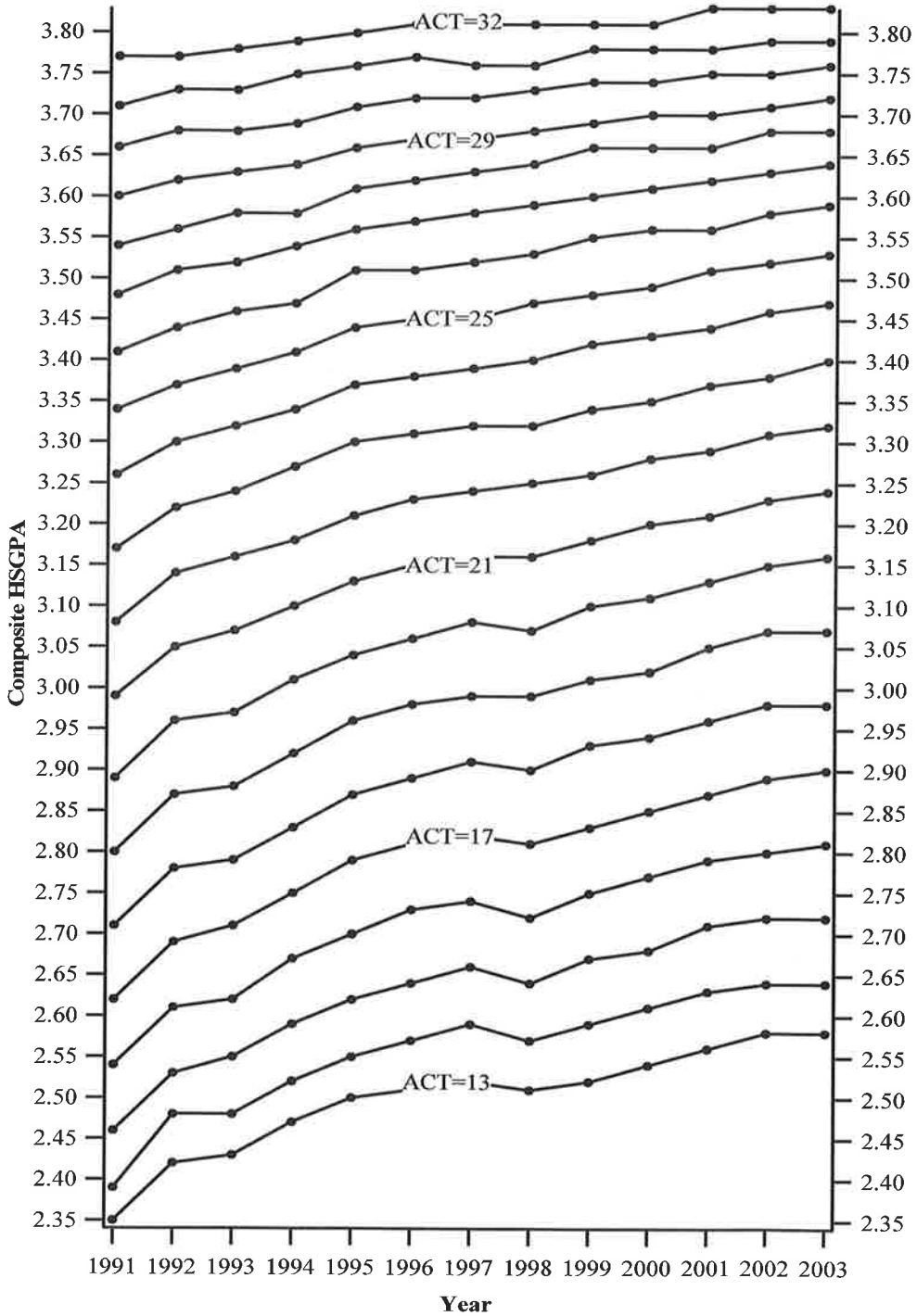


FIGURE 3. Plot of HS English GPA by English ACT Score, 1991 to 2003

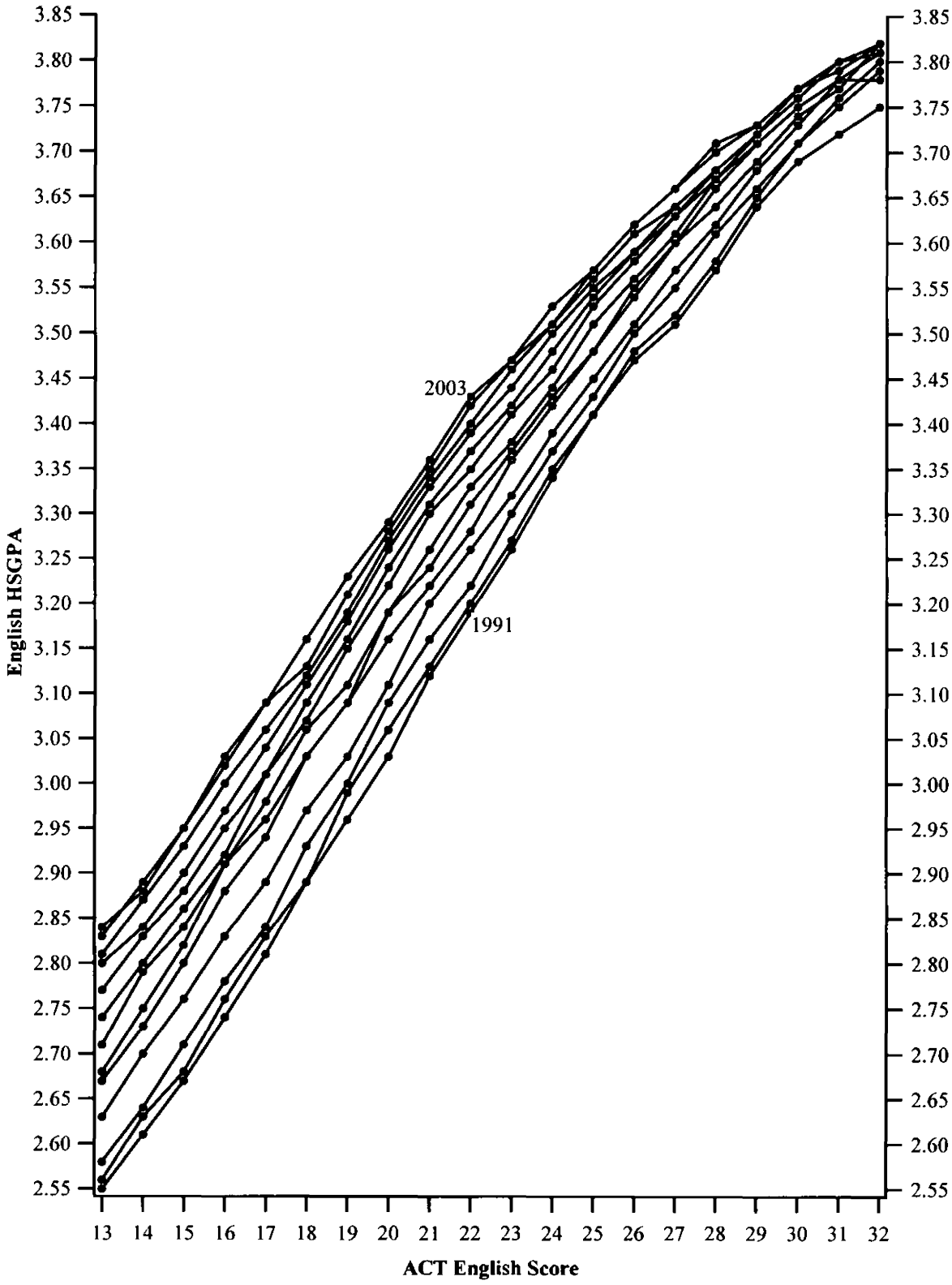


FIGURE 4. Plot of HS English GPA for Specific ACT English Scores Across the 13 Years

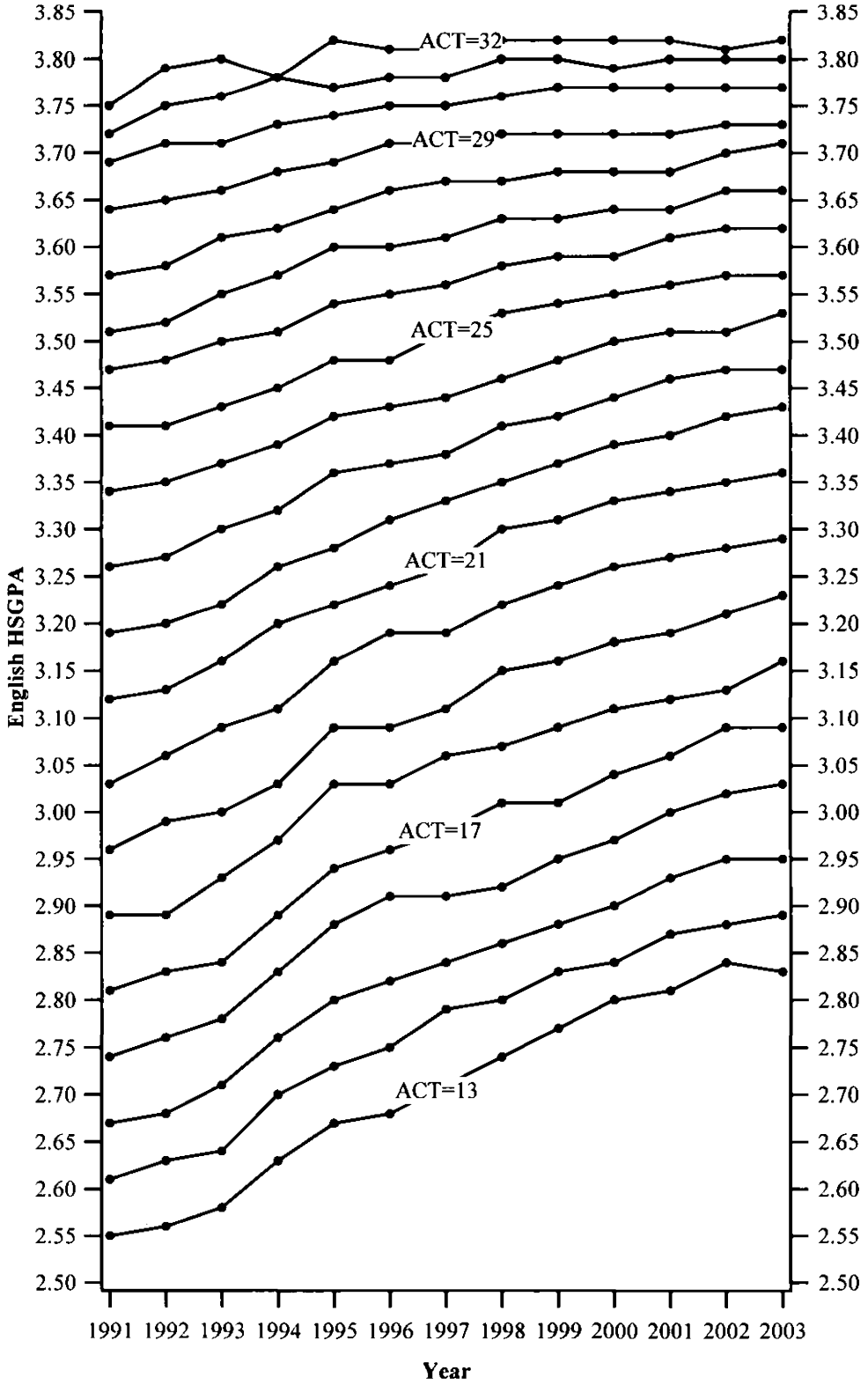


FIGURE 5. Plot of HS Mathematics GPA by ACT Mathematics Score, 1991 to 2003

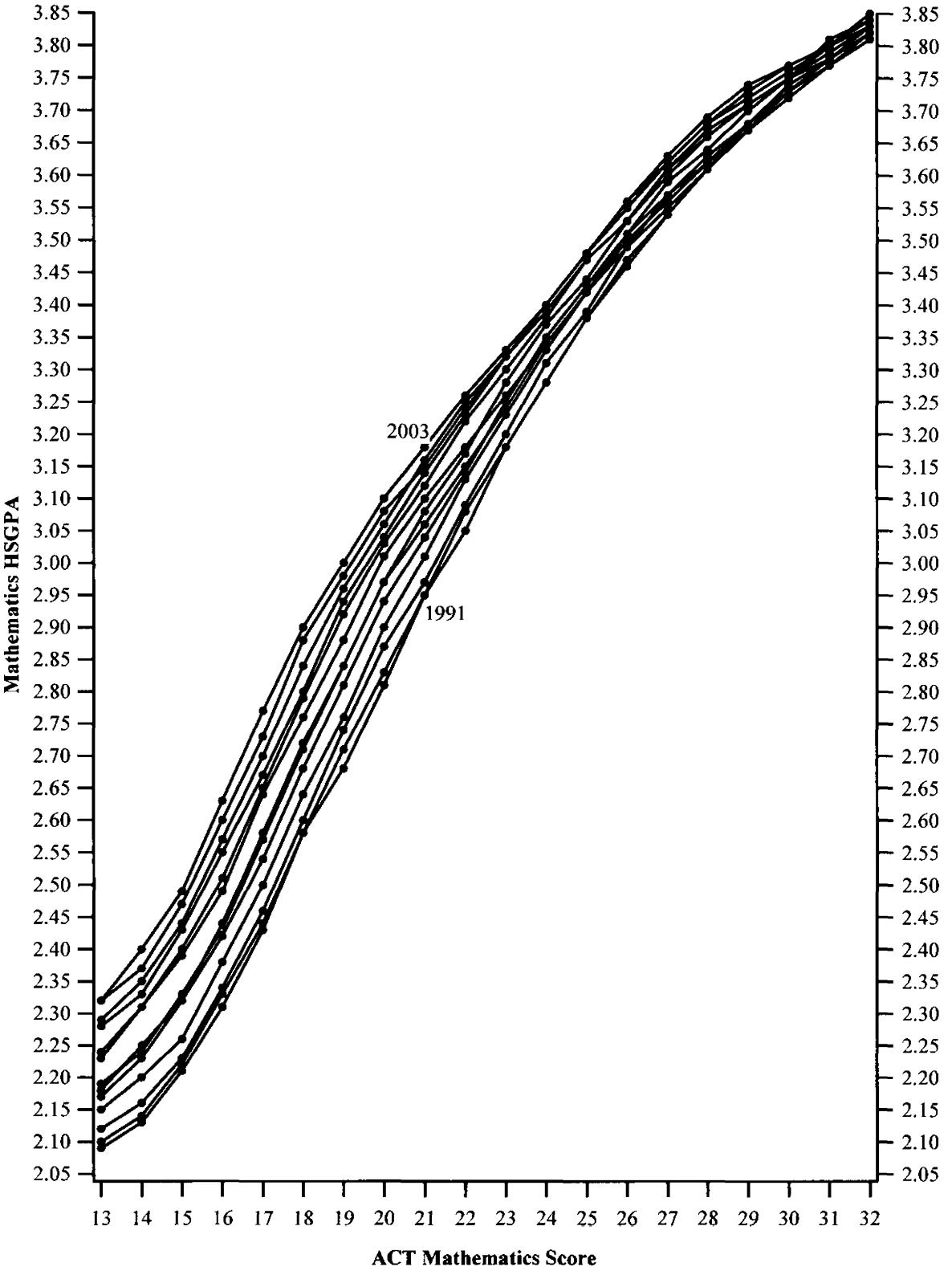
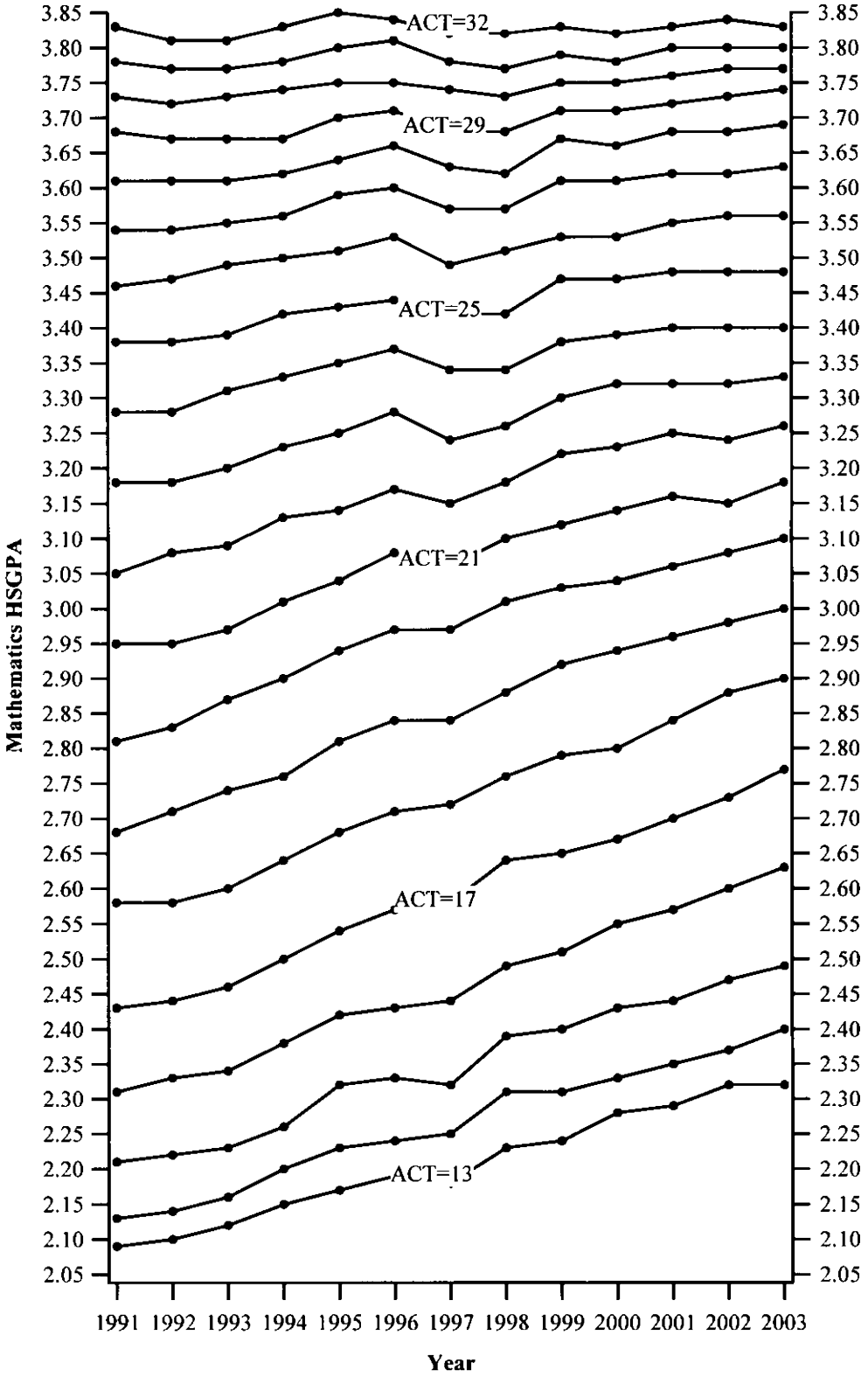


FIGURE 6. Plot of HS Mathematics GPA for Specific ACT Mathematics Scores Across the 13 Years



English grade inflation appears more concentrated between 1991 and 1998 though not as concentrated as HS overall GPA was between 1991 and 1995. Starting in 1999 the yearly increase becomes smaller and more stable.

Figure 4 is similar to Figure 2 but is for HS English GPA. In Figure 4 one can recognize that HS English GPA grade inflation is highest for the low and middle ACT English scores and that it decreases as the ACT English score increases. The lines in the low and middle parts of Figure 4 are steeper than the lines near the top of Figure 4. This is a result of the ceiling effect of HSGPA. The lines also tend to be steeper between 1991 and 1998, though this trend is not as pronounced as it is with HS overall GPA, indicating that this was a period of greater grade inflation as compared to latter years.

Figure 5 and Figure 6 present the results of the analysis involving the ACT Mathematics score and HS mathematics GPA. Figure 5 is similar to Figure 1 and Figure 3, except that Figure 5 is for Mathematics. The vertical axis in Figure 5 goes from 2.05 to 3.85, which differs from Figure 1 and Figure 3. Again, the curves in Figure 5 are not as smooth as the curves in Figure 1. The reason is the same as for English. The results for mathematics are similar to the composite and English results except at the top of the ACT Mathematics scale. Grade inflation is highest for low and middle values of the ACT Mathematics score. Mathematics grade inflation from 1991 to 2003 varies between 0.21 and 0.34 for ACT Mathematics scores between 13 and 22. Starting at ACT Mathematics score 23, grade inflation starts decreasing with a dip to 0.01 at ACT Mathematics scores 25 and 26 and then an increase back up to 0.09 at score 27 before starting a decrease to 0 at score 32. This can be observed by the narrowing together of the curves for the different years at the upper end of the ACT Mathematics scale. Another difference between HS

mathematics GPA and composite and HS English GPA is that the grade inflation is not as concentrated in the early years but is more spread out over all 13 years.

Figure 6 is like Figure 2 and Figure 4, except that Figure 6 is for HS mathematics GPA. Figure 6 confirms the findings illustrated by Figure 5. Figure 6 emphasizes how HS mathematics GPA grade inflation flattens out as the ACT Mathematics score increases. It also shows that mathematics grade inflation is more evenly spread out across the 13 years.

Summary and Discussion

Because the ACT is an objective measure of high school academic achievement, unvarying over time, and equally applicable to all students, one can conclude from this study that a moderate amount of high school grade inflation occurred between 1991 and 2003. The marginal analyses indicated the average amount of grade inflation for this 13 year period to be about 0.25 on the 0-to-4 HSGPA scale. The effect sizes for this average amount of grade inflation varied for the three areas due to differences in their standard deviations: HS overall GPA 0.43, HS English GPA 0.37, and HS mathematics GPA 0.33. These effect size are in the moderate-to-small range (Cohen, 1988). For grades on a scale with a range from 0 to 4, 0.25 represents 6.25% of that range, so in that sense high school grades have inflated by 6.25% between 1991 and 2003. This inflation in HSGPA is over and above any concomitant increase in average high school achievement as measured by the ACT, except, perhaps, for mathematics. ACT Mathematics had an effect size increase of 0.087 between 1991 and 2003. In terms of effect sizes, the ACT Mathematics effect size increase is about 26% of the HS mathematics GPA effect size increase. In these terms, one could attribute 26% of the HS mathematics GPA increase to an increase in mathematics achievement as measured by the ACT Mathematics test. This small increase over time in mathematics achievement would agree with the increase over time in the proportions of

students completing courses in algebra 2, geometry, and advanced mathematics at the time of ACT testing. If one only attributes 74% of the increase in HS mathematics GPA to grade inflation, then its effect size is reduced to 0.24, and its increase on the grade scale of 0 to 4 is reduced to only 5%.

The conditional analyses presented in Figure 1 through Figure 6 confirm the results of the marginal analyses. The magnitude of grade inflation is in the 0.20 to 0.34 range for ACT scores in the low to middle region of the ACT score range. In the upper region of the ACT score range, grade inflation decreases, but this is due to a ceiling effect. Students with high ACT scores tend to have high HSGPAs, and because HSGPA cannot exceed 4.0, this limits the amount of grade inflation that can occur for students with high ACT scores. The score range where grade inflation was highest also was the score range with the largest number of examinees. The number of examinees with high ACT scores was much less than the number of examinees with low and moderate ACT scores.

Various procedures are included in the development of the different forms of the ACT to ensure that it is measuring the same content from year to year, and that it has the same statistical properties from year to year. The ACT scores tended to vary up and down over the 13 years, though with an overall gain, but the HSGPAs tended to steadily increase from one year to the next. These characteristics support the conclusion that the increase in HSGPA between 1991 and 2003 is due to grade inflation, rather than to an increase in the average level of achievement. Further, the conditional analyses completely controlled for any gain in achievement as measured by the ACT.

References

Cohen, J. (1988). Statistical power analysis for the behavioral sciences. 2nd ed. Hillsdale, NJ: Erlbaum.

Collins, R. (2002). The dirty little secret of credential inflation. *Chronicle of Higher Education, 49, 5*, B20.

Johnson, V. E. (2003). Grade inflation: a crisis in college education. New York, NY: Springer.

Koretz, D. & Berends, M. (2001). *Changes in high school grading standards in mathematics, 1982-1992.* (MR-1445-CB). Washington, DC: RAND.

Rojstaczer, S. (2003). Where all grades are above average. *Washington Post*, January 28, 2003; A21.

Sawyer, R., Laing, J. & Houston, W. M. (1988). *Accuracy of self-reported high school courses and grades of college-bound students.* (ACT Research Report Series 88-1). Iowa City, IA: ACT.

Woodruff, D. J. (2003a). *Relationships between EPAS scores and college preparatory course work in high school.* (ACT Research Report Series 2003-5). Iowa City, IA: ACT.

Woodruff, D. J. (2003b). *Differential grading standards among high schools.* (ACT Research Report Series 200X-X). Iowa City, IA: ACT.

Ziomek, R. L. & Svec, J. C. (1995). *High school grades and achievement: Evidence of grade inflation.* (ACT Research Report Series 95-3). Iowa City, IA: ACT.