AC 2011-2511: PROPOSED RENORMALIZED GRADE POINT AVERAGE ACCOUNTING FOR CLASS GPA

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Abstract

An adjusted grade-point-average (GPA) is proposed based on both the grade earned in a class, as well as the grade distribution for the class. The purpose of the adjusted GPA is to more accurately assess performance among students. An "A" earned in a class with a low class GPA is a stronger measure of academic excellence than an "A" earned in a class with a high class GPA. The study looks at classes relevant to the mechanical engineering program over a three year period. Grade distributions in each class are compared, showing that class grade distributions can be highly variable and linked to the instructor. One adjustment scheme is proposed where grades earned in classes with a high class GPA are adjusted downward from the standard 4.0 scale and likewise grades earned in classes with low class GPA are adjusted upward. If an institution adopts an adjusted GPA calculation, instructors will probably revisit their individual grading philosophies and adjust class grade distributions to be more consistent with other distributions.

Introduction

It is understood that grade distributions can depend on the faculty who teach the class. Grades in rigorous mathematical classes, such as Calculus, often vary significantly from class to class, depending on the instructor. There can be significant grade distributions for the same course description, educational objectives, and textbook. Instructors often have different standards and grading philosophies. What is required to earn an "A" in one instructors class is different from what is required by another. It appears there is little consensus regarding the value of grades and some tend to discount the importance of grades because significant difference exist. There has been a trend to issue a greater number of higher grades and this has led to discussions about grade inflation and the inherent meaning of grades.[1-4] Given the importance of grades and the student's Grade Point Average (GPA), some have proposed that institutions report both the grades issued by the faculty as well as supplementary information to provide more context to those reviewing grades and GPA, as well as attempting to counteract the effects of grade inflation.[4-6] By shedding more light on both the student's grade earned in a class as well as some indication of all other grades issued in the class, some believe this will pressure lenient faculty into issuing fewer "A" grades, hence reduce grade inflation.

Grades are an important measure of student success at the university and are used in many ways, such as: honor roll recognition, graduation with honors distinction, admission to honors classes, competitive scholarships, and admission to graduate programs. In many cases, potential employers have minimum GPA requirements before an application will be considered. As enrollment in engineering programs has increased, some institutions believe they need to limit enrollment so that the existing infrastructure, especially laboratory classes, are not overwhelmed. Many programs have a minimal GPA requirement in key foundational courses to limit continuation into a major program of study. If students fail to achieve a sufficient GPA, although they have passed all of the prerequisite classes, they can't continue in the engineering program. Overall, GPA is a very important measure of a student's academic progress and more attention should be given to ensure that it is a robust metric with which to compare students, especially if GPA is used to recognize academic excellence or deny progression in the program. It appears possible that some GPA can be significantly changed, by up to half a point, by having students aggressively seek lenient and avoid harsh instructors.

A new GPA computation is proposed in this paper that accounts for the grade earned in each class, as well as the distribution of grades in each class. The key idea is that an "A" earned in a class relatively few high grades, is more significant measure of academic excellence than an "A" earned in a class where most are high grades. It is not uncommon to see classes taught by certain instructors with over 70% "A" grades issues, and this not only happens in core foundational mathematics, physics and engineering classes.

Grade Information

With the internet, it is relatively easy for students to learn about instructors, and especially learn which instructor are easy graders and which are harsh. Students visit sites like www.ratemyprofessor.com, www.pick-a-prof.com, and www.myedu.com before enrolling in classes. Students look at how others evaluate instructors before enrolling. In addition to comments, students now have detailed historical grade distributions available to them in order to pick instructors. Because this information is becoming more readily available to students via the internet, this "shopping" for instructors appears to be intensifying. The internet has become a repository and primary source for this information.

Figure 1 provides an example of the type of information available for MAT 1214: Calculus I class taught at the University of Texas at San Antonio. Detailed grade distributions are available from www.myedu.com for the different instructors who teach the class. The class size is often limited to 40 students, and over 20 different faculty have taught the course in the past three years. Because of the limited class size, there are numerous sections offered each semester, and students spread themselves among the sections taught by different faculty. The Grade Point Average (GPA) for the class varies widely depending on the instructor. When one looks at other possible factors (such as time offered and format of the class), these don't affect the grades. The grade distributions in Figure 1 are for the average of the instructor, averaged over all sections of the class, in the most recent semester.

Figure 1 highlights four instructors where two are viewed as being lenient because of the high class GPA and two are harsh. It can be argued that the first two instructors may simply be better instructors and are able to help students in their class master the material, while the other two are relatively poor instructors. Although plausible, this is highly doubtful. This is discussed later in the paper, but student comments often reveal why it is "easy" to earn an "A" from one instructor while "impossible" from another instructor. The grading and testing strategies used by different instructors are highly variable. It isn't argues that some instructors are better teachers. The best strategy is to separate instruction from assessment. Then the instructor who is responsible for teaching isn't the judge who is responsible for grading.

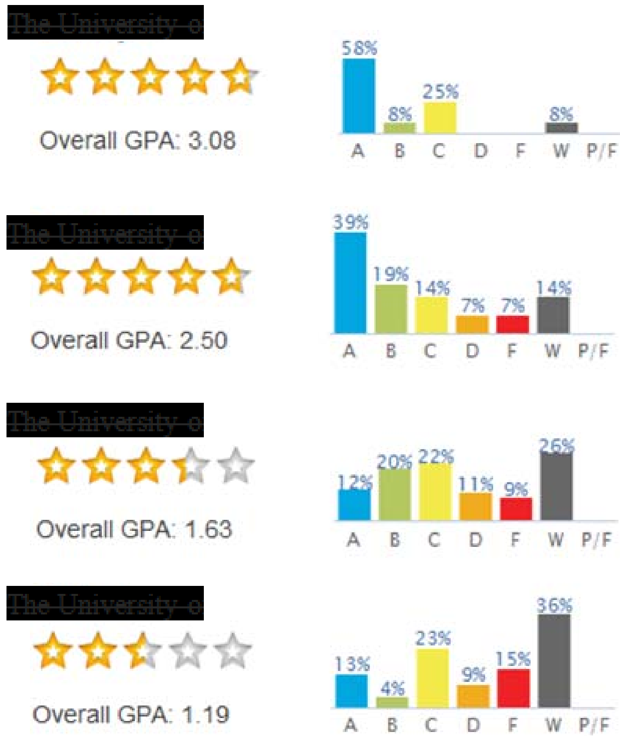


Figure 1. Grade distributions of four instructors who teach MAT 1214 Calculus I, from www.myedu.com

Figure 2 shows data described as "advanced grade metric" from the same website. This data indicate faculty are consistent from semester to semester and issue grades with nearly the same class GPA as previous semesters. When compared with other instructors, there are often distinct differences among faculty although they teach the same course at the same institution with the same pool of students. Some semester-to-semester variability does occur, but the variability seen in Figure 1 and the consistency of the data seen in Figure 2, strongly suggests that differences in grade distributions are primarily due to the instructor and not the course or topic.

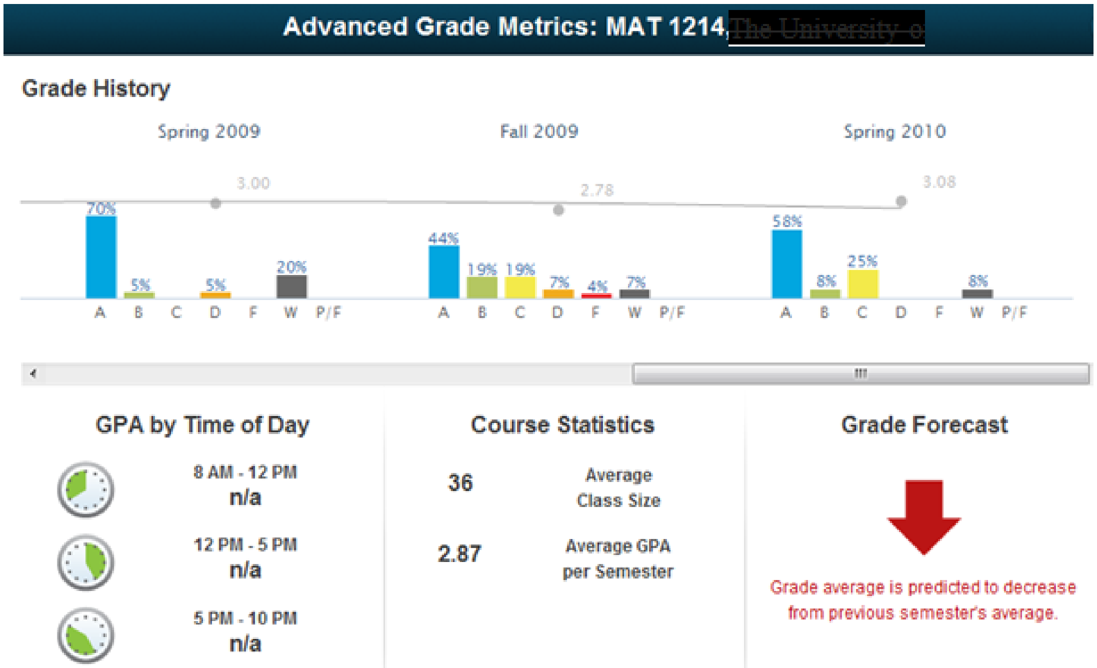


Figure 2. Detailed grade distribution data from one instructor teaching MAT 1214 Calculus I, from www.myedu.com

Examples of student comments for the faculty listed in Figure 1 are collected from www.ratemyprofessor.com and are included here:

> Easy Instructors: His test and quiz are pretty easy, and the way he curves it will make you feel happy for the rest of the day(lol). Final average end up with 100+. He offers generous curves to tests/quizzes, so making an A shouldn't be too difficult with some studying. Homework recommended but not required. Even if you don't get math he helps as much as possible and gives you the answers to the tests during the lectures. Tests are exactly as his examples and he even gives u a review for tests and final.
>
> Harsh Instructors: DO THE HOMEWORK! Tests are from the homework or slight variations of if they deviate. Before taking this professor: Memorize and know how to use every formula in Algebra and Pre-Cal. Know ALL the math definitions or else you won't understand what he's talking about. Make sure you have time to complete homework and quizzes 2-3 times a week, with short deadlines. Most students don't like him because you have to work in his class.

The compiled comments coupled with the grade distributions demonstrate that instructors who issue many "A" grades have made it "easy" to earn the high grade and not because students have a superior mastery of the material. The comments are often directed to other students who are trying to decide which instructor to take for the class, which can be interpreted as "shopping" for an instructor.[7] The comments often focus on the what it takes to get an "A", the benchmark of achievement. Students often give the impression that anything less than an "A" is unsatisfactory.

The comments go into detail regarding the predictability of assessment, how some have "extra-credit" opportunities to bump the grade into an "A". Some instructors clearly "broadcast" problems on exams while a less-accommodating instructor draws material from a spectrum of problems which is less predictable for students. Lastly, students talk about the relative effort needed to perform well. What is the minimum effort required to earn an "A"? If they earn their "A" then students are relatively happy with the instructor.

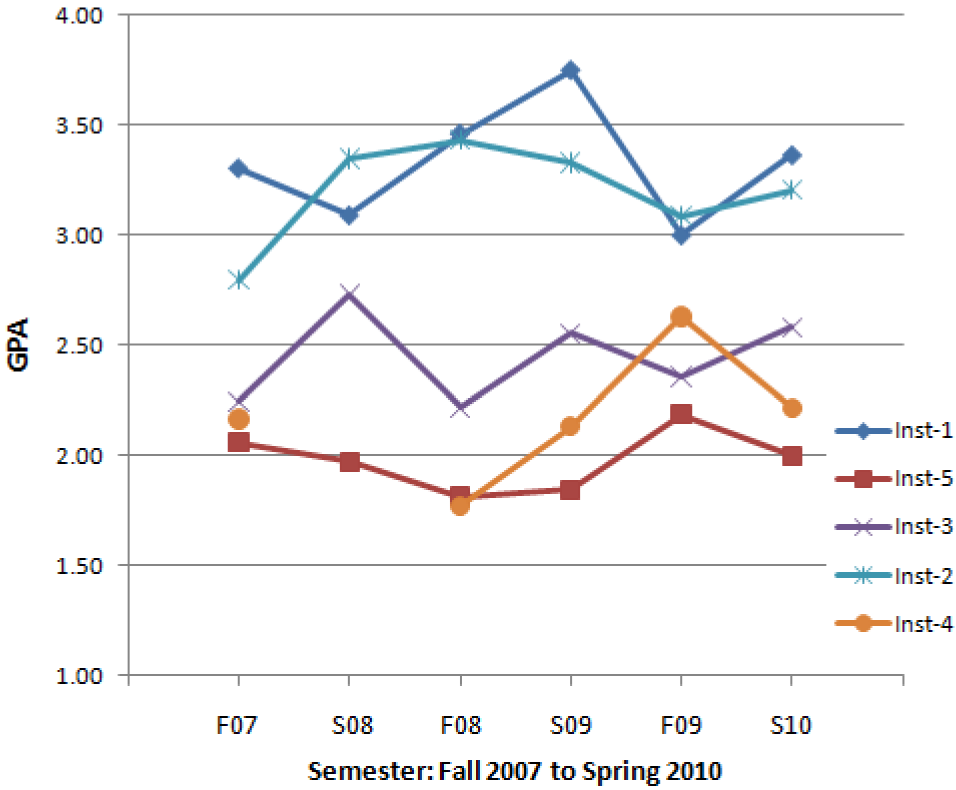


Figure 3. Semester to semester class GPA from five instructor who taught at MAT 1214 Calculus I, in five of six semesters in the past three years.

Figure 3 provides more data to support the assertion that grades issued by instructors are relatively uniform for each instructor while there are significant variations among instructors. Only five instructors taught in five or more of the six long semesters. Most taught in each of the past six semester, and only Inst-4 didn't teach in the Spring 2008 semester. The data shows two are consistently lenient. One could claim that Inst-3 is average and Inst-5 and Inst-4 are harsh instructors. Althought the difference in class GPA may nobe appear to be that significant, it truly is a staggering 1.0 GPA difference between the easy two and the harsh two.

Figure 4 shows that engineering faculty also have significant grading differences. The grades for three faculty for EGR 2103: Statics illustrate an almost unbelievable variation in grades issued in a key foundational class. One faculty issued 61% A grades in a class of about 50 students, while the other two faculty issued 33% and 27% A&B grades combined. The number of A for one instructor is twice the combined A and B of the other two instructors.

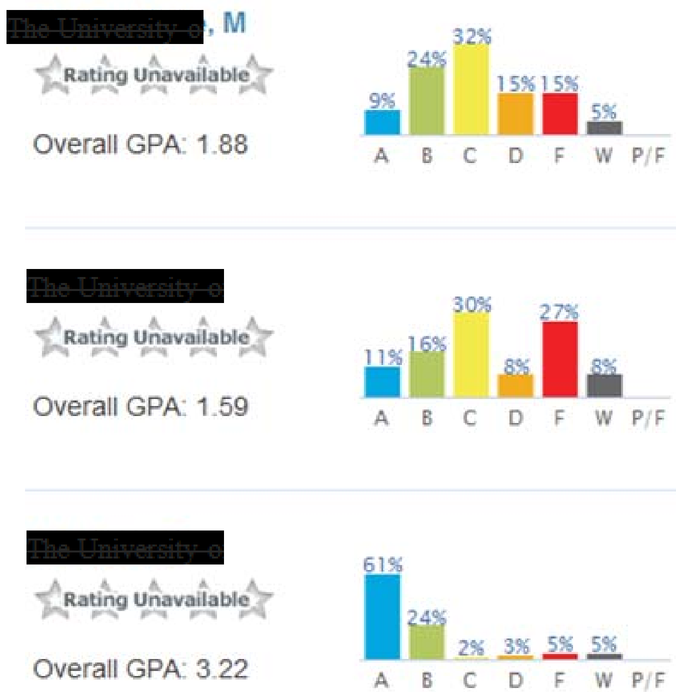
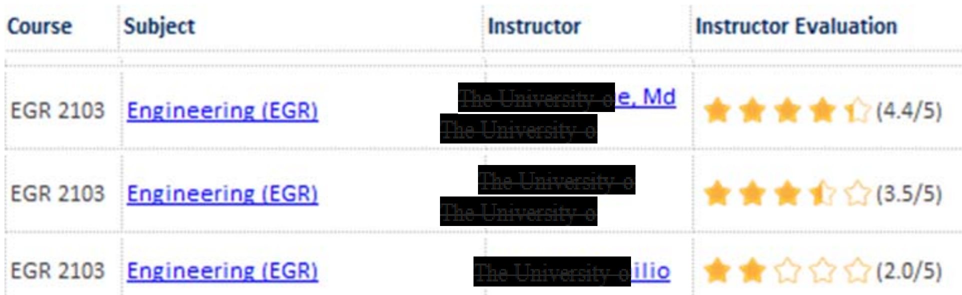


Figure 4. Three instructors who teach the first engineering mechanics (statics) course. from myedu.com assessed 1/10/2011.

It is believed that some faculty issued high grades to mask their poor performance as educators. This is suspected to be the case for the "easy" instructor in Figure 4. One can go to university web-pages to review student's assessment of their instructors. This information is increasingly being provided by the academic institution. In the state of Texas, the legislature passed a law in 2009 entitled:

> "HB 2054: An act relating to requiring a public institution of higher education to establish uniform standards for publishing cost of attendance information, to conduct student course evaluations of faculty, and to make certain information available on the Internet."

Because of HB 2054, the university releases student surveys of faculty. Figure 4 shows the data for the three instructors listed in the same order as in Figure 4 for EGR 2103, taught in the Spring 2010 semester. Clearly, students are relatively happy with the first instructor, with 4.4/5.0 overall rating although the class GPA is very low. The second instructor has respectable student survey results with 3.5/5.0, and this may be coupled with the fact that an class GPA of 1.59 should be considered extremely harsh by any standard. The third instructor has some of the lowest student surveys possible with 2.0/5.0, while the class GPA is far beyond what could be considered reasonable for this class at this institution. In over 15 years, no other instructor has come close to issuing 61% of grades in statics as "A". One can postulate reasons for such behavior. It is believed that the instructor attempted to appease students with high grades to offset poor instruction. One can image the intensity of complaints which might have been directed at the University had the third instructor coupled poor instruction (believed to the reflected in poor student evaluations) with harsh grading. Although the students were dissatisfied with the instructor, they probably weren't enraged after seeing their final grades in the class. They may have even felt a little guilty for having so harshly evaluated the instructor.



Course	Subject	Instructor	Instructor Evaluation
EGR 2103	Engineering (EGR)	[redacted]e, Md [redacted]	(4.4/5)
EGR 2103	Engineering (EGR)	[redacted]	(3.5/5)
EGR 2103	Engineering (EGR)	[redacted]ilio	(2.0/5)

Figure 4. End-of-semester student feedback in response to the question: "My overall rating of the teaching of this course is:" 1-poor to 5-excellent. from bluebook.[redacted].edu assessed 1/10/2011.

Evaluation of Grades

In this study, the grades of all sections of 37 undergraduate mechanical engineering classes from the Fall 2007 to the Summer 2010 semester were tracked. In addition the following foundational prerequisite physics and mathematics classes, as well as common foundational engineering courses were tracked:

PHY 1903 Engineering Physics I
PHY 1923 Engineering Physics II
MAT 1214 Calculus I
MAT 1223 Calculus II
MAT 2213 Calculus III
EGR 2103 Statics
EGR 2513 Dynamics
EGR 2323 Engineering Analysis I
EGR 3323 Engineering Analysis II

The grades were evaluated to detect major trends in the overall GPA based on the department, as shown in Table 1. The columns are A-F for each grade issued, W for withdrawal, N for the total number of grades issued, the grade point average (GPA) and standard deviation of grades (STD). Grades are tabulated for the foundational engineering courses (EGR), physics (PHY), mathematics (MAT) and mechanical engineering (ME) courses.

Table 1: Number of grades based on department.

	A	*B*	*C*	*D*	*F*	*W*	*N*	*GPA*	*STD*
EGR	574	822	747	395	495	434	3033	2.19	1.33
PHY	395	550	699	222	290	261	2156	2.25	1.25
MAT	1697	1604	1607	822	1060	1067	6790	2.30	1.37
ME	2563	1662	1308	415	440	442	6388	2.86	1.21

The withdrawals, W, are shown in the table but are not counted in the total number of grades issued, "N" nore in the department GPA or standard deviation (STD) of the grades. Because the university has a generous withdrawal policy, and the final date to withdraw is late in the semester, most students withdraw because of poor academic performance. One could argue that the "W" should be treated as equivalent to an "F". However, some withdrawals are based on personal or medical reasons and it is impossible to discern the reason for the withdrawal. The "W" are ignored in the GPA and STD computation. Foundational engineering courses are taught as EGR and are common to mechanical, electrical, and civil engineering majors.

Table 1 shows that the EGR courses have the lowest overall GPA: 2.19. This appears reasonable since many students have difficulty mastering these foundational courses. If there is a trend, it appears math and physics classes have lower GPA than engineering courses. The math and physics are freshmen and sophomore level courses and are prerequisites to EGR and ME classes. Largely because the GPA and STD are computed over such large numbers (2156 to 6790) there is little evidence of harsh or lenient grading. These provide the overall assessment of average GPA and STD for the university and its departments. The overall GPA is relatively modest and the STD are about the same for all four departments.

Table 2 shown how grades were further compared at the course level for PHY, MAT, EGR and ME courses. Most, but not all, ME courses are included in Table 2 since some elective course are rarely offered and have low enrollments. The titles of the PHY, MAT and EGR classes have already been shared in this paper. The titles of the ME courses are not considered relevant for this paper. The courses are organized so that 1000 level are freshmen, 2000 are sophomore, 3000 are junior, and 4000 senior level. Looking at the data, one notices significant course-to-course variation in grade distributions. Some courses have distinctly high course GPAs. In the ME program, there are some courses at the freshmen, junior and senior level with distinctly high GPAs. Having a high GPA (near 3.0 and above) is not reserved to only senior level classes. The freshmen classes ME 1301 and ME 1402 have high GPA with the most common grade issued being an "A".

Table 2: Summary of grades based on courses.

Dept	*Course*	*A*	*B*	*C*	*D*	*F*	*W*	*GPA*	*STD*
PHY	1903	254	296	427	147	159	145	2.26	1.25
PHY	1923	141	254	272	75	131	116	2.23	1.25
MAT	1214	992	844	735	416	526	573	2.39	1.39
MAT	1223	456	485	586	295	402	351	2.13	1.37
MAT	2213	249	275	286	111	132	143	2.38	1.29
EGR	2103	167	173	175	92	126	121	2.22	1.38
EGR	2323	168	238	227	151	261	209	1.91	1.42
EGR	2513	111	201	179	75	78	72	2.30	1.23
EGR	3323	128	210	166	77	30	32	2.54	1.10
ME	1301	487	139	50	13	33	55	3.43	1.02
ME	1402	333	90	37	10	38	43	3.32	1.17
ME	3113	14	83	76	36	14	46	2.21	1.00
ME	3173	98	79	58	10	12	8	2.94	1.09
ME	3241	258	19	7	2	16	16	3.66	0.97
ME	3243	52	108	113	34	27	18	2.37	1.11
ME	3263	29	26	15	3	2	0	3.03	0.99
ME	3293	57	72	125	67	83	98	1.88	1.31
ME	3323	29	47	57	16	22	21	2.26	1.22
ME	3513	42	121	74	20	16	12	2.56	1.03
ME	3593	17	16	13	3	1	0	2.90	1.00
ME	3663	88	75	82	15	19	23	2.71	1.16
ME	3813	62	132	149	74	60	33	2.13	1.20
ME	3823	32	93	111	23	18	9	2.35	1.01
ME	4183	45	26	13	2	13	4	2.89	1.36
ME	4293	39	77	84	36	13	30	2.37	1.07
ME	4313	38	64	96	19	8	4	2.47	0.98
ME	4523	65	80	38	4	15	6	2.87	1.11
ME	4702	114	61	13	1	1	4	3.51	0.69
ME	4802	122	61	8	2	5	0	3.48	0.83
ME	4811	144	40	21	1	3	2	3.54	0.81
ME	4813	169	26	4	1	1	0	3.80	0.54

Grade Adjustment Scheme

After reviewing grade data, a grade adjustment scheme is proposed based on the class grade distribution. The scheme adjusts the numeric value of an "A" grade, for example, but only if the class distribution of grades substantially deviates from a nominal preselected distribution. After some study, the nominal distribution was decide to be one with an average GPA of 2.5 with a standard deviation (STD) of 1.1. This was decided after looking at all of the grades and then looking at normal semester-to-semester variations for the same instructor. The GPA and STD are computed as follows:

$$GPA = 4f_A + 3f_B + 2f_C + 1f_D + 0f_F \qquad [1]$$

$$STD = sqrt\left(f_A(4-GPA)^2 + f_B(3-GPA)^2 + f_C(2-GPA)^2 + f_D(1-GPA)^2 + f_F(0-GPA)^2\right) \qquad [2]$$

where the f is the fraction (or percentage) of grades in the class issued for that letter.

Table 3 gives six typical grade distributions with the percentages of A, B, etc, and with the computed GPA and STD. For example, one can expect that if the GPA is 2.5, then about 20% of the grades will be "A", 85% passing (combination A, B, C), and 15% failing grades. As with most distributions shown in Table 3, it was decided to keep the "C" grade as the grade issued most frequently. In practice, however, the most common grade issued is often the "A" grade.

Table 3: Sample grade distributions with varying GPA and STD.

13%	A	IIIIIIIIIIIII		22%	A	IIIIIIIIIIIIIIIIIIIIII
22%	B	IIIIIIIIIIIIIIIIIIIIII		28%	B	IIIIIIIIIIIIIIIIIIIIIIIIIIII
32%	C	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII		33%	C	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
18%	D	IIIIIIIIIIIIIIIIII		12%	D	IIIIIIIIIIII
15%	F	IIIIIIIIIIIIIII		5%	F	IIIII
	GPA	2.00			GPA	2.50
	STD	1.23			STD	1.11
15%	A	IIIIIIIIIIIIIII		25%	A	IIIIIIIIIIIIIIIIIIIIIIIII
25%	B	IIIIIIIIIIIIIIIIIIIIIIIII		31%	B	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
35%	C	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII		32%	C	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
15%	D	IIIIIIIIIIIIIII		8%	D	IIIIIIII
10%	F	IIIIIIIIII		4%	F	IIII
	GPA	2.20			GPA	2.65
	STD	1.17			STD	1.06
20%	A	IIIIIIIIIIIIIIIIIIII		25%	A	IIIIIIIIIIIIIIIIIIIIIIIII
25%	B	IIIIIIIIIIIIIIIIIIIIIIIII		31%	B	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
33%	C	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII		32%	C	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
14%	D	IIIIIIIIIIIIII		8%	D	IIIIIIII
8%	F	IIIIIIII		4%	F	IIII
	GPA	2.35			GPA	2.80
	STD	1.18			STD	1.07

If the actual class GPA is substantially higher than 2.5, then the effective weight is computed and used to decrease the numeric value of each grade with exception to an F which remains at 0.0. Likewise, if the class GPA is distinctly below 2.5, then the effective grades are increased. The A grade could be limited to a maximum of 4.0, yet it was decided to allow the A to receive a number weight above 4.0 in those cases. This is consistent with the idea that an A grade earned in a class with 80% A is less meaningful than an A grade earned in a class where only 10% of the grades are A.

Figure 5 shows the grade adjustment factor based on the nominal 2.5 GPA and 1.1 STD. There is only one method used here but other schemes could work as well. The maximum grade adjustment factor was chosen to be +1.00. If the class GPA is less than 1.75, then all grades receive the addition of 1.00. The weight of an A would then be 5.0 instead of 4.0 in the renormalized GPA. Likewise, if the class GPA is greater than 3.25, then the grade adjustment factor (maximum reduction) is -1.00. If the difference between the class GPA and the nominal 2.5 is less than 0.25, (i.e., 2.25<GPA<2.75) then the adjustment is zero. This scheme was chosen to downgrade grade weights received in classes which had a high class GPA and upgrade grade weights in classes with a low class GPA.

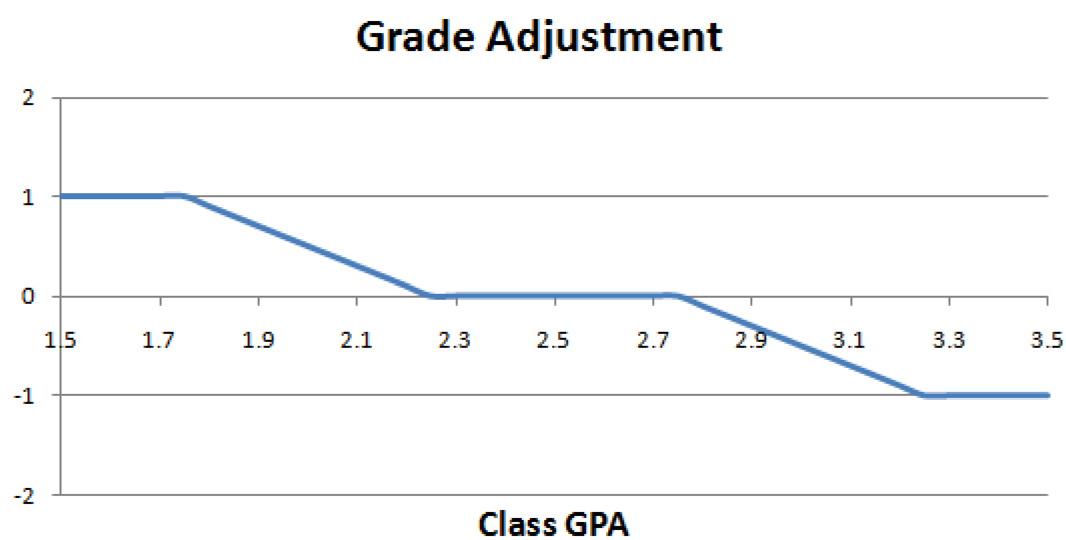


Figure 5: Grade adjustment based on class GPA.

Table 4 provides examples of a few classes with the GPA adjustment, although this procedure was applied to many more classes than shown in Table 4. The first entry in Table 4 is a prime example of a lenient instructor issuing many high grades. All of the 49 students enrolled in the one-hour junior-level ME laboratory class received “A” grades. No other grades were issued, hence the class GPA is 4.0. This is significantly above the 2.5 nominal GPA, hence an adjustment factor of -1.0 is applied to all grades. The new grade weights are 3.0 for “A”, 2.0 for “B”, etc. Because no student received less than an “A” grade, so those weights are never used. Only the new weights for the “A” are used.

Table 4: Adjusted Grades Based on Class Grades

SemesterClassInstructor	Distibution of Grades							Adjusted Grade Weights				
	A	B	C	D	F	GPA	Adj	A	B	C	D	F
200920ME3241Me[redacted]	49	0	0	0	0	4.00	-1.00	3	2	1	0	0
201020PHY1923K[redacted]	6	16	21	10	19	1.72	1.00	5	4	3	2	1
200920PHY1923K[redacted]	7	28	33	13	21	1.87	0.75	4.75	3.75	2.75	1.75	0.75
201020PHY1923C[redacted]	15	37	43	16	18	2.12	0.27	4.27	3.27	2.27	1.27	0.27
200830PHY1923C[redacted]	7	13	5	2	8	2.26	0.00	4	3	2	1	0
200930PHY1923C[redacted]	10	17	8	2	11	2.27	0.00	4	3	2	1	0
200810PHY1923K[redacted]	9	31	34	2	9	2.34	0.00	4	3	2	1	0
200820PHY1923B[redacted]	23	16	33	7	7	2.48	0.00	4	3	2	1	0
200910PHY1923C[redacted]	23	50	31	6	3	2.74	0.00	4	3	2	1	0
200810PHY1903B[redacted]	5	6	8	17	14	1.42	1.00	5	4	3	2	1
201010ME4813Si[redacted]	25	12	3	0	0	3.55	-1.00	3	2	1	0	0
201020ME4813Si[redacted]	35	9	1	1	0	3.70	-1.00	3	2	1	0	0
200910ME4813Si[redacted]	13	3	0	0	0	3.81	-1.00	3	2	1	0	0
200820ME4813Si[redacted]	39	0	0	0	1	3.90	-1.00	3	2	1	0	0
200820ME4553Ef[redacted]	23	4	3	2	1	3.39	-1.00	3	2	1	0	0
200910ME4313M[redacted]	5	15	15	6	2	2.35	0.00	4	3	2	1	0
200920ME4313M[redacted]	4	12	21	2	0	2.46	0.00	4	3	2	1	0
200910MAT1214C[redacted]	6	5	9	5	10	1.77	0.96	4.96	3.96	2.96	1.96	0.96
201020MAT1214H[redacted]	6	2	11	4	7	1.87	0.77	4.77	3.77	2.77	1.77	0.77
200910MAT1214H[redacted]	20	16	15	15	20	2.01	0.48	4.48	3.48	2.48	1.48	0.48
200920MAT1214C[redacted]	11	17	17	14	8	2.13	0.23	4.23	3.23	2.23	1.23	0.23
200810MAT1214C[redacted]	12	16	17	13	8	2.17	0.17	4.17	3.17	2.17	1.17	0.17
201010MAT1214H[redacted]	24	19	12	17	16	2.20	0.09	4.09	3.09	2.09	1.09	0.09
201020MAT1214C[redacted]	13	21	23	12	9	2.22	0.06	4.06	3.06	2.06	1.06	0.06
200920MAT1214R[redacted]	46	27	4	0	5	3.33	-1.00	3	2	1	0	0
200820MAT1214R[redacted]	36	27	7	2	0	3.35	-1.00	3	2	1	0	0
201020MAT1214S[redacted]	7	1	3	0	0	3.36	-1.00	3	2	1	0	0
200910MAT1214R[redacted]	49	14	11	1	1	3.43	-1.00	3	2	1	0	0
200910MAT1214S[redacted]	19	2	4	0	1	3.46	-1.00	3	2	1	0	0
200920MAT1214S[redacted]	14	1	0	1	0	3.75	-1.00	3	2	1	0	0

Also in Table 4.0, there are many adjustments applied to the junior and senior level engineering classes where many “A” grades are issued. Again, something appears amiss because the class GPA above 3.0 appears inconsistent with the program at this university. The university has: 1) an open-door admission policy, 2) modest reputation for its graduates with employers, 3) modest pass rates on the Fundamentals of Engineering exam (typically around 70%), and 4) modest acceptance rate of graduates into graduate engineering programs. In comparison, there are neighboring universities with stringent admission standards who routinely achieve high FE pass rates (nearly 100%) and have graduates with high GRE scores that are admitted to the best graduate engineering programs. This apparent contradiction demonstrates that instructors who regularly issue high grades are not necessarily recognizing excellence in the students, but are issuing grades with other motivations. If high grades are warranted, they should be linked to increased performance or preparedness of the students which should be verifiable beyond the assessment of the instructor issuing the grades.

The data relevant to the foundational Calculus classes shown in Table 4 receive both up- and down-grading adjustments. The adjustments corresponds to the faculty who teach the course. It is logical to question if the grades issued for the class are a good assessment of student achievement and mastery of the material. In some cases, it appears that grades are not reflective of actual student achievement.

Application of GPA Adjustment

Table 5 shows the grades of two students, and both the original GPA and adjusted GPA for engineering related classes. The first student is tracked in 24 relevant engineering classes and has a GPA of 2.31. With the adjustments, the GPA is increased to 2.43. This shows that the adjustments are not just directed at reducing GPAs, but is an attempt to more truly reflect academic performance by reducing the instructor-to-instructor variation in student's GPA. It is less common, however, that student GPA is increased. More often, the GPA is adjusted downward because of the high number of A grades issued in classes.

The second student tracked in Table 5 is tracked in 25 classes. The original GPA is an impressive 3.82, yet the adjusted is 3.55 which is a significant decrease. The adjustment is attributed to the fact that most students earned A's in the classes that this student earned an "A", so "A" level work is less distinctive. From the table, one sees where the "A" are inflated due to specific classes: ME 1301, ME 1402, ME 3173, ME 3241, ME 3243, ME 4183, ME 4523, ME 4811, ME 4813, ME 4913. In these courses, the majority of grades issued are "A", indicating that an "A" is not in recognition of outstanding achievement. Where class GPA is inflated, the student's numeric value of an "A" is reduced. This student does appear to be above average and the adjusted GPA of 3.55 still indicates this. In order to compensate for the easy "A" grades, the student need to earn more difficult "A" grades. Yet the student took only a few classes where the grading was rigorous (i.e., where few "A" were issued). In particular, increased GPA is due to only two classes: ME 3293 and ME 3323.

Table 5: Two students with original GPA and adjusted GPA computed.

	Student A						Student B				
	dept	crse	grad	nom	adj		dept	crse	grad	nom	adj
1	MAT	1214	C	2.00	2.42	1	ME	1301	A	4.00	3.00
2	ME	1402	B	3.00	3.00	2	ME	3241	A	4.00	3.00
3	PHY	1903	C	2.00	2.60	3	ME	4811	A	4.00	3.05
4	PHY	1923	C	2.00	2.00	4	ME	4802	C	2.00	1.00
5	EGR	2103	C	2.00	2.00	5	ME	4702	B	3.00	2.00
6	EE	2213	C	2.00	2.00	6	ME	1402	A	4.00	3.00
7	EGR	2323	B	3.00	3.07	7	ME	3823	B	3.00	3.00
8	EGR	2513	B	3.00	3.84	8	ME	4293	B	3.00	3.00
9	ME	3113	C	2.00	2.27	9	EE	2213	A	4.00	4.00
10	ME	3173	C	2.00	2.00	10	EGR	2323	A	4.00	4.18
11	ME	3241	A	4.00	3.00	11	EGR	2513	A	4.00	4.00
12	ME	3243	C	2.00	2.00	12	EGR	3323	A	4.00	4.00
13	ME	3293	B	3.00	3.75	13	ME	3113	A	4.00	4.14
14	ME	3323	C	2.00	2.24	14	ME	3173	A	4.00	3.00
15	EGR	3323	B	3.00	3.00	15	ME	3243	A	4.00	3.35
16	ME	3513	C	2.00	2.00	16	ME	3293	A	4.00	5.00
17	ME	3663	C	2.00	2.00	17	ME	3323	A	4.00	4.98
18	ME	3813	D	1.00	1.93	18	ME	3513	A	4.00	4.00
19	ME	3813	C	2.00	2.47	19	ME	3663	A	4.00	4.00
20	ME	3823	B	3.00	3.00	20	ME	3813	A	4.00	4.11
21	ME	4183	C	2.00	1.05	21	ME	4183	A	4.00	3.05
22	ME	4293	B	3.00	3.00	22	ME	4313	A	4.00	4.00
23	ME	4313	C	2.00	2.00	23	ME	4523	A	4.00	3.37
24	ME	4523	B	3.00	2.37	24	ME	4813	A	4.00	3.00
		GPA=		2.31	2.43	25	ME	4913	A	4.00	3.00
								GPA=		3.82	3.55

Discussion

In this paper, we provide the motivation for a GPA adjustment scheme largely because instructors issue significantly different grade distributions for no apparent reason. Class grade distribution data is shown with an almost unbelievable variation in grades. For an engineering statics class, one new instructor issued over 60% "A" grades, varying significantly from other instructors teaching the same class over multiple years. Classes have different grade distributions based almost exclusively on who is the instructor for the class. The majority of instructors are "easy" graders while few can be described as harsh. Hence, grade inflation appears to be more of a problem than grade deflation. Grading differences have profound effects on students and have motivated a "shopping" mentality when students plan their schedule and register for classes. They gravitate to easy and avoid harsh instructors.

A normalized GPA computation is proposed that is relatively easy to implement and understand. It is desirable to maintain the 4.0 scale for the adjusted GPA so that it can be compared with the existing 4.0 scale. Students, faculty, and employers understand the differences between numeric GPA scores, such as 3.8, 3.0 or 2.2 GPA. Employers often have hard cut-off values, and they will not consider an applicant unless their GPA is above a minimum value, often 3.0. Students often know their current GPA to three significant digits from memory. GPA is important and staying with the 4.0 scale would help make the system more acceptable. It would be more difficult to grasp the differences between students using a new grading scaled based on 100 points or 10 points, etc, so the proposed scheme is based on modest adjustments of the 4.0 scale. As proposed, the scheme takes the issued grade and adds an adjustment which can be either zero (no adjustment), positive or negative. The adjustment method can be viewed as taking all of the information provided by an instructor to assess each student's performance in the class. Currently, the GPA only looks at the grade assigned to the individual student. The adjusted GPA uses both the assigned grade as well as all of the other grades issued in the class. The class grade is the baseline and can also be shown on a transcript, yet the institution, not the individual instructor should compute an overall GPA based on adjusted numeric values, especially if the institution recognizes academic excellence based on the overall relative standing among students. It makes sense that the institution can be responsible for computing the metric by which student-to-student performance is compared, and a normalized GPA has merits for this purpose.

The authors give only a modest endorsement to the proposed adjusted GPA method described in this paper and realize there are other schemes which can achieve the same purpose. The goal of this paper is to look at the justification for an adjusted GPA and anticipate outcomes if one were adopted by applying it to a few student examples. If an adjusted GPA scheme is more seriously considered, the following should be considered: (1) picking a nominal grade distribution and deciding if it should be university-wide or dependent on the program and course level, (2) determining how different an actual grade distribution in a small class is from a nominal distribution, and (3) determining the method and maximum grade adjustment values. The authors believe a method of adjusting up or down the effective numerical weight each letter grade earns in a class, as shown in Table 4, is a logical scheme that is easy to implement and easy to understand.

There will be repercussions if an institution implements a GPA adjustment scheme. Students will continue to "shop" for faculty and courses, but the very good students may be less inclined to enroll in a class where the "A" is easy to earn. An easy "A" can decrease the GPA of excellent students because it may have the effect of a true "B" and contribute only 3.0 into the GPA computation. Highly motivated students may seek to enroll in classes offered by rigorous instructors where they may earn the "A" and receive a 5.0 contribution to the GPA. Similarly, if they earn a "B" in a rigorous instructor's class, this may count as a 4.0 in the GPA computation. Another potential consequence is that the value of a "C" grade may be restored. One can imagine that faculty must issue more "C" and "B" grades if they desire to issue fewer "A" grades. If more "C" are issued, this will help restore the integrity of the "C". Adjusted GPA computations could change the current grading landscape which is currently dominated by grade inflation and the easy "A".

Conclusions

Overall this paper proposes an alternative GPA computation which can be integrated into the current 4.0 system. The problem of grade inflation is a more common than deflation, but data suggests that deflation also exists in some classes. The proposed GPA adjustment scheme has minimal effect on some GPA because class grade distributions are balanced. The scheme will decrease the student's GPA if the student has taken more "easy" classes which have high class GPA. This scheme is not directed solely at stemming grade inflation, although grade inflation is more of a problem in academia than grade deflation. The scheme does attempt to provide a more balanced assessment of student achievement compared to their peers. If implemented, the proposed scheme will likely reduce the likelihood of students seeking to take classes from professors who are easy graders and the likelihood of instructors issuing high grades to appease students for the sake of improved student evaluations. Engineering education is not immune to either practice.

References

1. Bailey, R.T., "Shouldn't I get an A?," *Proceedings of the 2002 ASEE Southeastern Section Annual Meeting*, Gainesville , FL , April 4-5, 2002
2. Johnson, V.E., An alternative to traditional GPA for evaluating student performance, *Statistical Science*, 12(4): 251-278, 1997.
3. Felton, J. and P. T. Koper, Nominal GPA and Real GPA: A Simple Adjustment that Compensates for Grade Inflation, *Assessment & Evaluation in Higher Education*, 30(6):561–569, 2005.
4. Johnson, V. E., ***Grade Inflation: A Crisis in College Education***, Springer-Verlag, 2003.
5. Manhire, B., Grade Inflation, Ethics and Engineering Education, *American Society for Engineering Education Annual Conference and Exposition*, Salt Lake City, Utah. http://www.ent.ohiou.edu/~manhire/grade/2004-22_Final.pdf 2004.
6. Millet, I., Improving Grading Consistency through Grade Lift Reporting. *Practical Assessment, Research & Evaluation*, 15(4). Available online: http://pareonline.net/getvn.asp?v=15&n=4, 2010.
7. Felton, J., Mitchell, J., and Stinson, M., Web-based student evaluation of professors: the relations between perceived quality, easiness and sexiness, *Assessment and Evaluation in Higher Education*, 29(1):91-108, 2004.