Faculty Attitudes On Plus/Minus Grading System in CMU

36-303 Survey, Sampling, and Society
Final Paper

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Table of Content

I. Introduction

i. Research Question and Motivation

Every college and universities around the world have their own grading systems they follow. Regardless of other activities and life outside the academic world, people often summarize one's college career through a single value, GPA. Students try their best to receive the highest GPA as possible, and the grading system the institution implements may result in decreasing or increasing their GPA. Recently, at Carnegie Mellon University, investigation has been initiated for a possible transformation in the grading system to plus/minus grading system. Carnegie Mellon undergraduate currently implements a simple, alphabetical grading system (A, B, C, D, and R).

This possible change from the current to the new grading system can bring debates across the students and the faculty. As our survey is based, we wonder what the faculty's attitude toward implementing plus/minus grading system is. To answer this question, several hypotheses were tested based on the questions and the variables in our survey. Some of the hypotheses were regarding demographic information, such as school and gender. Others were regarding their previous experience with plus/minus grading system as well as their experience in teaching. We also examined what the faculty thinks the students prefer and the corresponding opinions of the faculty. Last but least, we looked at the relationship between the opinions on the current system and those on the new system.

The motivation of our research was aroused by the importance of GPA in college life, as it plays an important role in their lives even after college. GPA should not be the only factor that measures a student's academic career. However, it is true that many people ask about their GPA when they talk about the quality of college life. GPA usually becomes one of the standards to get into graduate school such as schools for PhD, Medical schools, Law schools and so on, and get jobs.

Carnegie Mellon University students may feel the disadvantage, since the average GPA of Carnegie Mellon University students are lower than that of the universities around the nation. We wondered why this was the case. We also found that other peer institutions using plus/minus grading system had a higher average GPA. This led to a question of the effect of implementing plus/minus grading system and the opinions of the faculty members at CMU regarding this matter.

ii. Citations to literature on this topic

The topic about which grading system is better fit for the students has been an issue for the past few years. An interesting research was done on the topic at Washington State University. The study found that the largest sample groups in favor of switching to the plus/minus grading system were students with grades primarily in the B Range. In addition, plus/minus grading had no effect on the average grade earned by students at college and that the majority of students and faculty preferred the current system where plus/minus was not implemented.

Another research result stated otherwise. Research done at Northern Arizona University by Jim Morgan, Gary Tallman, and Robert Williams showed that college students and faculty members viewed motivation for getting higher grades as an underlying factor for working harder. It analyzes various studies conducted in the field and come to a conclusion that students with higher GPAs are more strongly opposed to the system than other students. Faculty and other students that supported the plus/minus grading system believed that the system would help student GPA and be a strong motivational factor for students.

Finally, there was a research done on the same topic but with different target populations. Previous research was done to survey the views of students on how they think about plus/minus grading system. From 180 responses, the research showed that 67.6 percent of undergraduate students were against the implementation of plus/minus grading, 17.6 percent supported implementation of plus/minus grading system, and 14.5 percent were undecided.

iii. Summary of Results

Our result showed that 69.2% of the faculty supports the implementation of plus/minus grading system while 67.6% of the students disapproves of the new system. Regardless of several demographical variables, there is not much difference in their opinions regarding the implementation. More detailed analysis are provided in the Result section of this paper.

II. Methods

i. Target Population, Sampling Frame, and Sample Size

The target population of our study is faculty members at CMU who are teaching at least one undergraduate course in Spring 2011 semester. This does not include undergraduate or graduate student instructors and professors in Qatar. Our sampling frame is the Schedule of Classes website provided by CMU. We refined our samples from all listings in the Schedule of Class and ended up with 905 professors in our sampling pool. For our sampling method, simple random sampling is employed to ensure well-represented sample with less selection bias. If we were to distribute survey to all faculties in the sampling population, this may be subject to the self-selection bias, as we have no control over who decides to complete the survey. In this case, faculties who have strong opinions regarding plus/minus grading are more likely to respond faculty may lead to measurement bias as well.

The total number of faculty who are teaching at least one undergraduate course was 905 faculties. Under the assumption of simple random sampling with response rate of 50%, margin of error of 0.05and z value of 1.96, we can calculate the desired sample size.

We have $n \geq \frac{Nn_0}{N+n_0}$, where $n_0 = \frac{z^2_{\alpha/2}(SD)^2}{(ME)^2}$, and we get $n \geq 270$, which indicates that we should have at least 270 respondents. Since we have assumed 50% response rate of survey, the survey should be distributed to at least 540 faculties. Because our survey is

anonymous, we have no information on who have completed the survey. If the goal sample response is not met, a reminder email will be sent to all 540 faculties who were selected initially. During this process, we have randomly selected additional 104 faculties because response rate from initial 540 faculties was lower than our expected response rate of 50%.

ii. Survey Methodology

Sample Carnegie Mellon faculty were identified from the 2011 Spring Semester Course catalog through Simple Random Sampling without replacement. Originally we randomly selected 540 faculties from the pool of 905 total number of faculty members to achieve our sample selection calculation of at least 270 responses. In order to assure a random sample, we numbered each member of the faculty and used R to generate 540 numbers. We then matched the random numbers generated by R with a faculty member's name and checked it against the Carnegie Mellon online directory to ensure that they were in fact a current member of the Carnegie Mellon faculty for the Spring 2011 semester. Using the Carnegie Mellon online directory we obtained an Andrew e-mail address for each faculty member, which we used to send out our generic 22-question survey.

Since potential response rates could vary dramatically we conducted multiple mass survey e-mails to ensure a higher response rate. On April 1st we sent out our first e-mail to the 540 faculties selected by SRS, followed by reminder e-mail twelve days later. By sending out a follow-up e-mail to the same sample population we hoped to increase our response rate without having to increase total sample size. Unfortunately this two-phased approach fell short of our sample selection calculation goal of at least 270 responses. So we randomly selected an additional 104 faculties to increase our response sample size. After waiting two weeks for further responses the survey was closed on April 26th. Over our sampling time frame we contacted 664 faculties and received 198 responses, which is equivalent to a 30% response rate.

In any survey involving a questionnaire the surveyor has to worry about a variety of biases that may arise; the most significant of these biases being non-response. By definition non-response bias arises when the respondent data differs from the target population. In other terms, non-response bias is when the represented data does not accurately reflect the entire population because a segment of the population was not accounted for accurately, as a result of flaws in the survey design.

Common non-response challenges include failure to deliver the survey request and inability to participate in the survey. However we feel that our survey was designed to overcome these challenges. Since all teaching faculty are listed in the Carnegie Mellon directory we have had no problems with failing to deliver the survey. Furthermore the fact that all of the targeted respondents are Carnegie Mellon professors there should be no issues where they are unable to participate due to the language or literacy level of the questionnaire.

Our survey questionnaire also has a variety of instruments to reduce non-response. The survey questionnaire requires all necessary information to be filled in before it is submitted, so we do not have to distinguish if incomplete surveys are counted as non-responders. Furthermore if professors do not respond we have a follow up survey

reminder to persuade the interviewee to complete our survey. This is intended to reduce our non-response rate and as a result decrease our non-response bias.

what was the final sample size?

As mentioned earlier we randomly selected a total of 644 Carnegie Mellon faculty members from a pool of 905 Carnegie Mellon faculty members who are currently teaching a class during the Spring 2011 semester. From these faculty members we received a response rate of 30%, which adds up to ~~905~~ professors spread across 36 departments. For an online self-selecting questionnaire the response rate is typically around 30% so what seems like a low response rate is not a major concern. Furthermore when going through our eight demographic/experience questions, which included age, gender, and department, we could not identify a particular demographic that did not respond to our survey. Therefore we determined weighting by a demographic variable, such as age, gender, or department was unnecessary.

iii. Post-Survey Processing

Coding Information:

Gender: 1-Male, 2-Female
Degree: 0-Other, 1-Bachelors, 2-Masters, 3-PhD, 4-Doctorate
Attend: 1-Yes, 2-No
Attend_affect: 1-Positively Affected, 2-Negatively Affected, 3-Not Affected
Type: 1-Letter Grade, 2-Number Grade, 3-Both
TA: 1-Yes, 2-No
TA_work: 1-less than 10%, 2-10~30%, 3-30~50%, 4-50~70%, 5-More than 70%
Work: 1-Yes, 2-No, 3-Don't know
Implement: 1- Yes, 2-No
Bump: 1-Yes, 2-No
Effort: 1-Yes, 2-No, 3-Don't know
GPA: 1-Yes, 2-No, 3-Don't know
Job: 1-Yes, 2-No, 3-Don't know
Student: 1-Yes, 2-No, 3-Don't know
Current: 1-Disapprove, 2- Neutral, 3-Approve
New: 1-Disapprove, 2- Neutral, 3-Approve

Imputation:

We imputed one respondent who did not respond to the total number of years teaching (including other institutions) and the number of teaching years at CMU. We used hot-deck imputation by matching the demographic information, such as School, department, gender, degree, and experience to best match the respondent.

III. Results

i. Research Question

As our research question asks, we want to know faculty opinions on implementing plus/minus grading system at CMU and what factors determine their opinions. By looking at different demographic, experience, and opinion variables, we examined the relationship between several variables and the opinions. In addition, we want to see if the opinions of the students and those of the professors differ, using previous results from another survey.

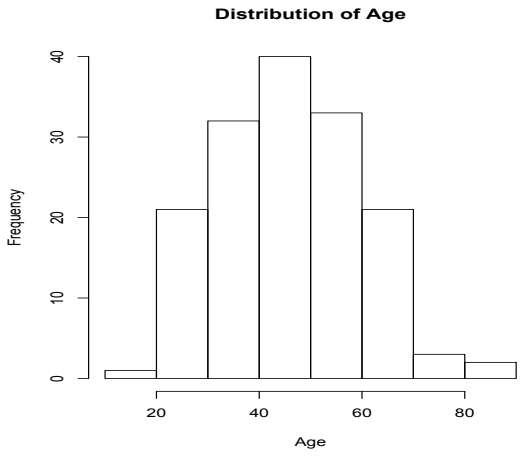
Specifically, we looked at whether or not opinions differ by school or gender. Moreover, we want to see if there is a positive relationship between the professors' opinions on whether or not the students in their class will prefer plus/minus grading system to the current on and their own opinions on implementing plus/minus grading system at CMU. Personal experience with plus/minus grading system and the effects on their GPA may or may not affect their opinions. Length of their teaching career may also be a significant variable as well as their opinions on the current grading system at CMU.

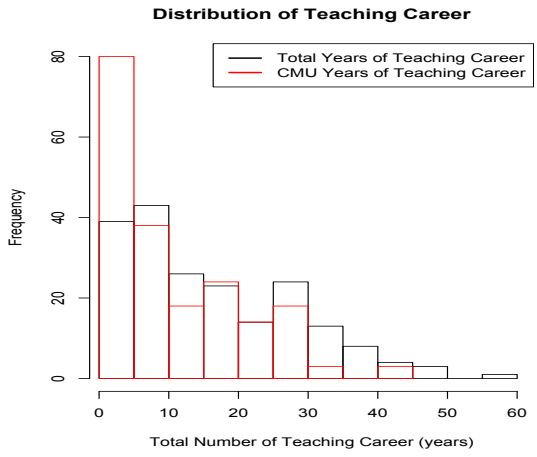
ii. Exploratory Descriptive Analysis

ok heres the sample size...

We have 198 respondents who completed our survey. There are three continuous variables that were open-ended questions, such as age, total number of years in their teaching career, and the total number of years teaching as a professor at CMU. We looked at the distribution of these three variables through a histogram. There were 45 missing values for the age variable. The histogram of the age of 153 professors shows a unimodal, normal distribution with a mean around 46.97 and a standard deviation of 13.6. The age ranges from 19 to 83.

Looking at the histogram of the years of their teaching career, the total number of years of their teaching career including other institutions ranges from 1 to 60 while years taught at CMU ranges from 1 to 44. The distributions are skewed to the right with the majority of the professors with a less than 10 years of teaching career.





The variable we are most interested about is the opinion of the professors on implementing plus/minus grading system. From 198 respondents, 21 disapprove

(10.6%), 40 are neutral (20.2%), and 137 (69.2%) approve of implementing plus/minus grading system in CMU. From the numbers, we can conclude that more faculty members approve of implementing plus/minus grading system at CMU.

	Count	Sample Proportion (%)
Opinion on plus/minus grading system		
Disapprove	21	10.6
Neutral	40	20.2
Approve	137	69.2

Although more faculty members approve than disapprove or are neutral on implementing plus/minus grading system at CMU, we also wanted to see the distribution of faculty members on their opinion regarding this issue by different variables. We looked at the distribution of the responses for each of the variables and the corresponding opinions on plus/minus grading system. There are 16 variables we want to look at, which are listed below. The counts for each sub-group are provided as well as the percentage of the counts in the sample. For each sub-group, the proportion of faculty members who disapprove, approve, or are neutral about the plus/minus grading system is also provided.

	Count	Sample Proportion (%)	Disapprove (%)	Neutral (%)	Approve (%)
School					
CIT	15	7.57	13.3	46.7	40
CFA	52	26.26	3.8	9.6	86.5
HSS	67	33.83	9	16.4	74.6
MCS	30	15.15	16.7	30	53.3
SCS	13	6.56	23.1	7.7	69.2
TSB	15	7.57	6.7	40	53.3
Other	6	3.03	33.3	16.7	50
Gender					
Male	127	64.1	11	24.4	64.6
Female	71	35.9	9.9	12.7	77.5
Degree					
Bachelors	13	6.8	0	30.8	69.2
Masters	56	29.2	8.9	10.7	80.4
PhD	103	53.6	12.6	24.3	63.1
Doctorate	11	5.7	0	18.2	81.8
Other	9	4.7	22.2	0	77.8
Attended an institution where plus/minus grading system was implemented?					
Yes	127	64.1	5.5	16.5	78

No	71	35.9	19.7	26.8	53.5
If you did attend, how did it affect your GPA?					
Positive	59	46.5	1.7	15.3	83
Negative	9	7	0	11.1	88.9
None	59	46.5	10.2	18.6	71.2
Type of grading system you use?					
Letter	46	24.2	6.5	13	80.4
Number	103	54.2	15.5	23.3	61.2
Both	41	21.6	0	19.5	80.5
Do you have TA?					
Yes	94	47.5	11.7	26.6	61.7
No	104	52.5	9.6	14.4	76
If you do have a TA, what is their workload?					
Less than 10%	19	20.2	5.3	10.5	84.2
10% ~ 30%	10	10.6	10	30	60
30% ~ 50%	20	21.3	10	30	60
50% ~ 70%	21	22.3	14.3	23.8	61.9
More than 70%	24	25.5	16.7	37.5	45.8
Do you think plus/minus grading system will create more work for you?					
Yes	13	7.3	61.5	38.5	0
No	155	87.1	5.8	16.1	78.1
Don't know	10	5.6	0	50	50
Have you implemented plus/minus grading in your course?					
Yes	152	76.8	5.9	15.1	78.9
No	46	23.2	26	37	37
Have you ever bumped up a grade?					
Yes	151	78.2	9.9	19.2	70.9
No	42	21.8	11.9	21.4	66.7
Do you think plus/minus system will affect student's effort?					
Yes	77	39.7	3.9	15.6	80.5
No	51	26.3	19.6	19.6	60.8
Don't know	66	34	10.6	25.8	63.6
Do you think plus/minus system will affect student's GPA?					
Yes	83	41.9	6	18.1	75.9
No	40	20.2	20	17.5	62.5
Don't know	75	37.9	10.7	24	65.3
Do you think plus/minus system will affect student's chance of getting a job?					
Yes	12	6.1	8.3	0	91.7

No	119	60.1	11.8	19.3	68.9
Don't know	67	33.8	8.9	25.4	65.7
Do you think your students prefer plus/minus system to the current on?					
Yes	83	43	2.4	13.3	84.3
No	26	13.5	30.8	23.1	46.1
Don't know	84	43.5	11.9	26.2	61.9
What is your opinion on the current grading system?					
Disapprove	75	37.9	2.7	1.3	96
Neutral	67	33.8	5.9	29.9	64.2
Approve	56	28.3	26.8	33.9	39.3

From the data, there are 6.8% of faculty member who has bachelor's degree, 29.2% with a master's degree, 53.6% with a PhD degree, 4.7% with a doctorate degree, and 4.7% stating other. 76.8% have implemented plus/minus grading in their course while 23.2% have not. Looking at the opinions of these professors, the experience of implementing plus/minus grading system during the course led to approving of the implementation of the new grading system.

From the question of faculty thinks plus/minus grading system will affect student's effort, 39.7% said "Yes", 26.3% said "No", and 34% said, "Don't know". It is interesting that for the faculty who answered "no" to the question, 60.7% approved implementing the plus/minus grading system.

Moreover, 41.9% believes that the new system will affect a student's GPA while 20.2% believes otherwise and the rest are uncertain. It is interesting that for the faculty who answered "no" to the question, 62.5% approved implementing the plus/minus grading system, and for faculty who said that they did not know of the effect of plus/minus grading on GPA, 65.3% approved implementing the plus/minus grading system.

Last but least, we also looked at the differences in the opinions by whether or not they think the grading system will affect the student's chance of getting a job. 6.1% said, "Yes", 60.1% said "No", and 33.8% said, "Don't know."

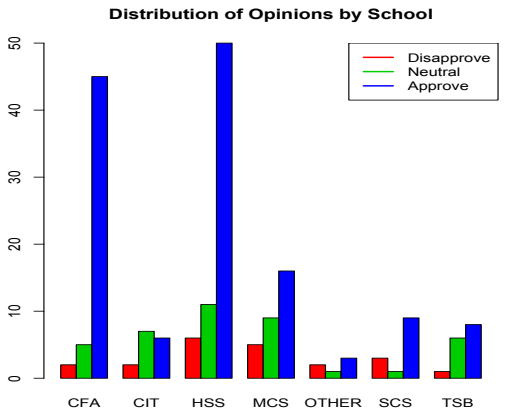
It is interesting to note that for the faculty who answered "no" to the question, 68.9% approved implementing the implementing grading system, and for faculty who answered, "Don't know" to the question, 65.7% approved implementing the plus/minus grading system.

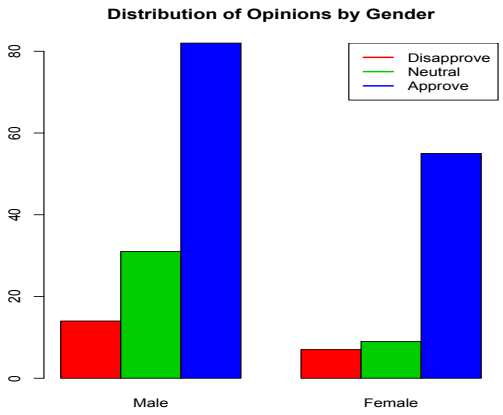
iii. Graphical Analysis

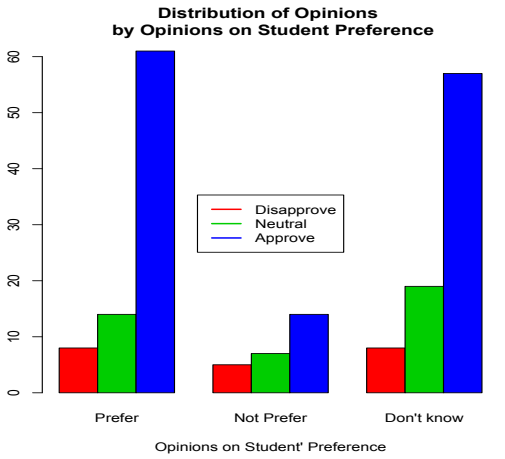
To better visualize the relationship between certain variables and the opinion of the professors on implementing plus/minus grading system at CMU, we made graphical displays and tested our hypotheses. Some of the hypotheses we want to test are as follows:

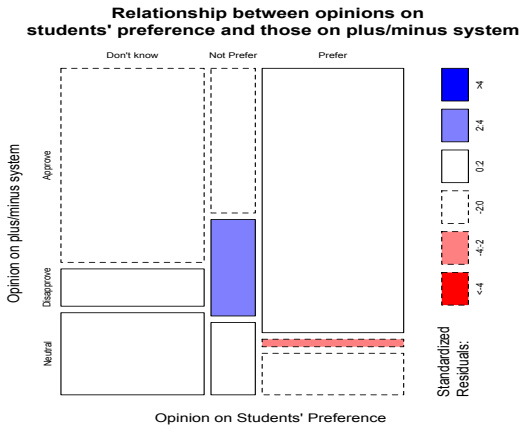
1. Are the opinions different by School? By Gender?

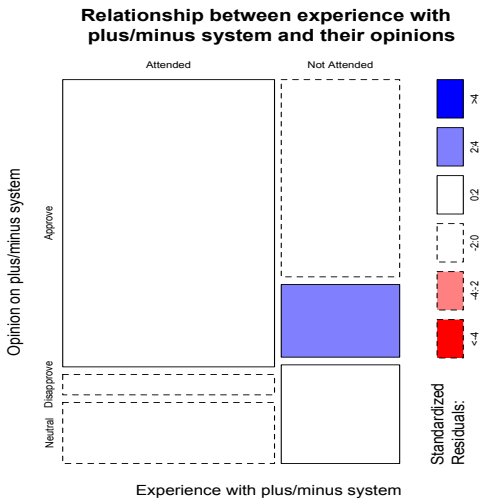
2. Is there a positive relationship between the professors' opinions on whether or not the students in their class will prefer plus/minus grading system to the current one and their own opinions on implementing plus/minus grading system at CMU?
3. Does whether or not the professor attended an institution where plus/minus grading system was implemented have an association with their opinions on implementing the system at CMU? Given that the professor attended an institution, does their experience on the effects of the system on their GPA independent of their opinions on implementing it?
4. Is the length of their teaching career associated with their opinions?
5. Finally, is there a relationship between their opinions on the current system and those on the new system?

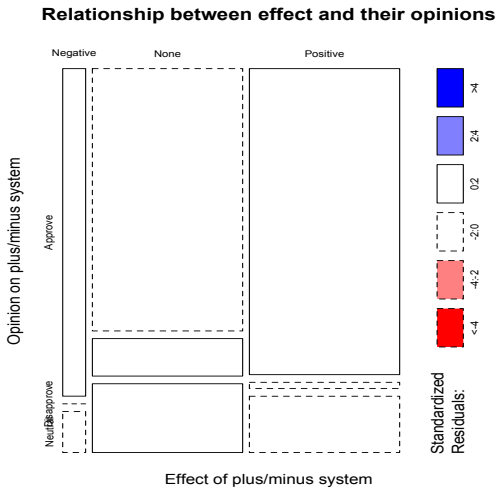


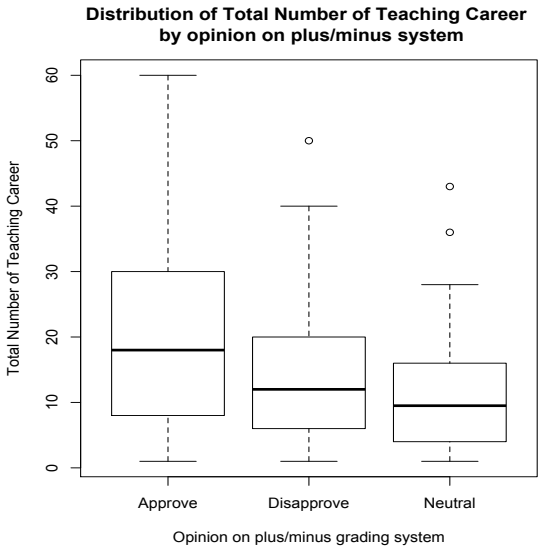


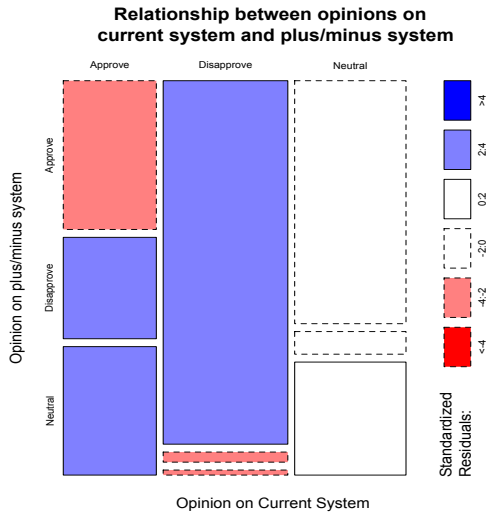












iv. Answers to Research Questions

Are the opinions different by School? By Gender?

Looking at our data almost every school at Carnegie Mellon has a higher approve rate of plus/minus grading than disapproval. The most noticeable differences were in CFA and HSS, which had approval rates for plus/minus grading of 86.5% (CFA) and 74.6% compared to disapproval rates of 3.8% and 9%. Only CIT did not have a majority approval rate with 46.7% neutral to plus/minus grading compared to 40% approval. While technical schools at Carnegie Mellon seem to have less support for plus/minus grading than humanities or arts, seven out of the eight schools have a preference of shifting towards a plus/minus grading system while CIT is neutral to the matter. Grouping the data by gender indicates a similar opinion among both males and females.

interesting

Both males and females approve of implementing a plus/minus grading system with 77.5% approval rating for women compared to 64.6% for males. While females have a slightly higher approval rating of plus/minus grading than males, the proportions of males that are neutral or favor plus/minus grading to women is nearly 1:1. 89% of men are neutral or favor plus/minus grading while 90.1% of women are neutral or favor plus/minus grading. This demonstrates that both sexes prefer plus/minus grading, but more males are indifferent than females.

Is there a positive relationship between the professors' opinions on whether or not the students in their class will prefer plus/minus grading system to the current one and their own opinions on implementing plus/minus grading system at CMU?

The histogram shows the number of faculties and their preference on plus/minus grading and their opinions on whether students will prefer plus/minus grading system. Whether the professors approve of the plus/minus system is categorized as "Prefer", "Not Prefer" and "Don't know". The professor's opinions whether students would prefer plus/minus system is categorized as "Prefer", "Not prefer" and "Don't know". The blue bars, represent the professors who approve of plus/minus system. For all three categories regarding the student preference on plus/minus grading professors who approves plus/minus system constitutes the highest number. We notice majority of professors who approve plus/minus system think students would prefer the plus/minus or not sure if they will. There are some professors who approve plus/minus system but do not think students will prefer it. From the mosaic plot, we see that there is higher number of professors than expected who disapprove plus/minus but think that students would not prefer the students. Also, the number of professors who disapprove plus/minus system and think that students prefer plus/minus system is lower than expected.

Does whether or not the professor attended an institution where plus/minus grading system was implemented have an association with their opinions on implementing the system at CMU? Given that the professor attended an institution, does their experience on the effects of the system on their GPA independent of their opinions on implementing it?

From the graph of Relationship between experience and opinion, the faculty member who experience plus/minus grading system showed agree of implementing plus/minus grading system. The faculty member who did not experienced plus/minus grading system also showed agreement of implementing plus/minus grading system, and higher than expected number of the neutral opinion of implementing the new system.
From the graph of Relationship between effect and opinion, faculty member, who think plus/minus grading system would have positive effect on students, shows approve of plus/minus grading system. However, one unexpected result is that the faculty member, who thinks plus/minus grading system would have negative effect on students, did not show disapprove of the plus/minus grading system.

Is the length of their teaching career associated with their opinions?

We looked at the distribution of the total years of their teaching career by different opinions. The range of the teaching career years for those who approve implementing plus/minus grading system is the largest, followed by those who disapprove and those who are neutral. The median years also follow the same pattern as the range. There is one outlier in the disapprove group and tow outliers in the neutral group. However, we can state that those who approve have more experience teaching than those who disapprove. Those who are neutral about implementing plus/minus grading system are fledgling professors who do not have much experience with different grading systems.

Finally, is there a relationship between their opinions on the current system and those on the new system?

We hypothesized that the opinions on the current grading system and those on implementing plus/minus grading system would have a negative relationship. The two variables are definitely dependent. For those professors who approve of the current grading system, there are fewer professors who approve the plus/minus system than expected, and more professors who disapprove or are neutral about the plus/minus system. Moreover, for those who disapprove of the current system, there are more professors who approve and fewer professors who disapprove or are neutral about the new system. The result supports our hypothesis that the two have a negative relationship. If you approve of the current, you are more likely to disapprove of the new and vice versa.

IV. Discussion

i. Discussion of Research Questions

The primary interest in our research was to find out Carnegie Mellon University professor's opinion on the implementation of plus/minus grading system. This study was motivated from previous research at CMU regarding student's perception of plus/minus grading system. The previous research found out that majority of the students preferred the current grading system to plus/minus grading system. We hypothesized that faculties will share similar opinions to students and oppose the implementation of plus/minus system.

Our hypothesis was proven wrong as we found that 69.2% of the sample approved, 33% were neutral and 37.8% opposed the implantation of plus/minus system. This result is very different from the previous finding that only 17.9% of students supported implementation of plus/minus system.

The percentage of professors from each demographic group in our sample was similar to the actual distribution in each demographic group. We had highest number of responses from H&SS followed by CFA, which seems analogous to the fact that there are highest number of professors in H&SS and CFA. Our findings that CIT and SCS professors did not prefer plus/minus as much as others is similar to the findings from previous research that students from CIT and SCS is opinion about plus/minus system.

The survey asked professors if students would approve of plus/minus system. We wanted to see if professors who think students would approve plus/minus also approved the implementation of plus/minus system. We found out that there are a lot of professors who approve plus/minus system and not sure if students prefer plus/minus system.

We also thought that professors' opinion regarding plus/minus would depend on how plus/minus system affected their GPA if they attended institution with plus/minus grading. Majority of professors who thought that plus/minus system had positive effect on their GPA approved the implementation of plus/minus at CMU. Interestingly, there were some professors who approved plus/minus but thought that their GPA was negatively affected by plus/minus system.

Another result that was interesting was that the longer their academic career, the more professors approved of the implementation of plus/minus grading system. Professors who neutral opinions about plus/minus system had the least academic years experience among the sample.

Professors who supported plus/minus system thought that it had better consistency as graduate programs are currently implementing plus/minus system and a lot of professors use plus/minus for mid-semester grades. They also think that it is more accurate measure. For instance, they think that the difference between students who get 80 and 89 is large and it is unfair that they both get a B for their final grades. They also think that the new grading system will motivate student to work harder as students will to receive better grades instead of settling at 90% and lose motivation of trying harder. Lastly, they think implementing plus/minus system can combat grade inflation.

Some reasoning behind faculties who do not support implementation of plus/minus system include that it is unnecessary and will cause more grade complaints from students. They also think that students' obsession over grades will increase and it may make the too focused on earning certain grades instead of learning the materials. Lastly, professors think that plus/minus system will negatively affect student's GPA.

ii. Interesting to Note

One unexpected result was that there are fewer number of faculty members who do not have TA than who does have TA. There are 47.5% who has TA in their course and 52.5% who do not. Among those faculty who have TA, there was an even distribution of the amount of work the TA puts on for the course, from less than 10%, 10%~30%, 30%~50%, 50%~70%, and more than 70%.

Adding to the previous analysis, 7.3% said that plus/minus grading system would create more work for them, 87.1$ said "no", and 5.6% said that they don't know. We expected that plus/minus grading would be more work for the faculty member if implemented, but the data showed otherwise.

iii. Strengths and Weaknesses & Recommendations

We had 22 survey questions. Our survey questions were mostly multiple-choice questions, with some having the option 'other' so that the appropriate answer not listed in the choices provided could be input there. We also had two questions where the

responses were recorded on a likert scale so as to understand the degree to which the participant approved or disapproved of the current system at Carnegie Mellon and plus/minus grading system.

We marked all the questions we necessarily wanted a response to with an asterisk. That way, we got all the data for the questions we thought to be important for our analysis. Also, for this reason no imputation of the data was necessary and our hypothesis could be tested with ease.

Our response rate (30%) was close to what we needed, despite the fact that there was no incentive provided (like most online surveyors provide to increase their response rate).

Our results are highly relevant to the Carnegie Mellon campus community. These results can be a definitive basis for further studies that test the opinions of faculty members regarding a plus minus grading institution. If it is found that an increasing majority favors the plus/minus grading system over the current system at Carnegie Mellon, this idea could even be presented to the Board of Directors at Carnegie Mellon University.

Since we sent our survey through a newly created Gmail account, we believe we did not get as many responses as we might have got had we sent out the link to the survey using our Andrew or Carnegie Mellon accounts.

For our analysis, we did not use the responses to all of the questions we had listed in our survey. We only used the ones we had made mandatory to answer. A few non-mandatory responses were somewhat helpful in tying together different hypothesis. However, a few were unnecessary and could have been done without. They just increased the length of the survey without adding any value to it.

Additionally, one of the questions that asked the number of years that the participant has spent teaching at Carnegie Mellon University, should have been more specific since we were looking for an approximate number of years, but got one or two responses saying "many years". This was not helpful in our analysis and these observations had to be removed in order to go on with the analysis. This further decreased our sample.

iv. Take-Home Message

While the previous 303-group found that students do not favor the implementation of a plus/minus grading system at Carnegie Mellon, we found that Carnegie Mellon faculty overwhelmingly support a plus/minus grading system. In total 69.2% of CMU faculty surveyed approve of a plus/minus grading system, while 20.2% were neutral and only 10.6% disapproved. Faculty favors such a system because it's consistent with the graduate program, which has plus/minus grading, more accurate of a student's effort, and will increase student effort and involvement in their classes. While CMU faculty does think implementing a plus/minus grading system will raise the overall QPA of Carnegie Mellon students their main reason of support is that it will increase student effort and more effectively reflect a student's body of work.

this is just fascinating to me...

V. References

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VI. Appendices

i. Appendix 1: Emails

We created a separate email account in Gmail, from which we sent and received all survey-related emails.

First Email:

Dear Professor,

We are members of the 36-303 class (Sampling, Survey, and Society) conducting a survey on faculty members' opinion on plus/minus grading system as our class project.

You are randomly selected from the list of faculty members teaching a course this semester.
The survey is conducted anonymously.

We would greatly appreciate if you could spare 5-10 minutes of your time to complete our survey.

Please follow the link below:

https://www.surveymonkey.com/s/6T85PJZ
(The required fields are marked with an asterisks(*))

Your input would be valuable for the success of our project. Please let us know if you have any questions/concerns regarding the survey either directly to this email or Andrew email found on the first page of the survey.

Thank you for your time and participation. We need your input from each one of you!

With much appreciation,
Hye Jung (Allie) Cho
Dong Seob Kim
John Shoup
Erica Choi
Aeina Garg

Reminder Email:
Dear Professor,

You were recently contacted because you were randomly selected by our research group

to complete a survey on faculty members' opinion on plus/minus grading system. For those of you who have already completed the survey, thank you very much for your input and please disregard this e-mail. Due to the confidentiality and anonymousness of our survey, everyone who has been randomly chosen is contacted again.

If you haven't had the chance yet, your help is crucial to the success of our class project. Before you head off to enjoy the carnival and the beautiful weather (I hope), we would greatly appreciate it if we could borrow **5-10 minutes** of your time.

Please follow the link below:

https://www.surveymonkey.com/s/6T85PJZ

(The required fields are marked with an asterisk (*))

As we mentioned previously, your input would be valuable for the success of our project. Please let us know if you have any questions/concerns regarding the survey either directly to this email or Andrew email found on the first page of the survey.

Thank you so much!

With much appreciation,
Hye Jung (Allie) Cho
Dong Seob Kim
John Shoup
Erica Choi
Aeina Garg

ii. Appendix 2: Informed Consent

Our group in 36-303 is conducting a survey on Carnegie Mellon University faculty members' opinions on plus/minus grading system. We hope to utilize the information collected to better understand the effects of plus/minus grading system and compare the differences in opinions between the students and the faculty members on this issue. This survey has been prepared for several weeks before implementation. Chosen participants were randomly selected from the list of all faculty members teaching at least one course this semester (Spring 2011). A link is provided via email, which contains 24 questions, mostly multiple choices. The survey will take about 5-10 minutes to complete, and the required fields are marked with an asterisk.

The risks and discomfort associated with participation in this study are no greater than those ordinarily encountered in daily life or during other online activities. The survey is done anonymously, so no personal information is required. There is no risk associated with completing the survey. There may be an indirect benefit to those for plus/minus grading system of a possible implementation of the plus/minus grading system in CMU. There is no

compensation for participation in this study, and there will be no cost to you if you participate in this study.

If you have any questions about this study, you should feel free to ask them by contacting any one of our group members listed below:

Dong Seob Kim: dongseok@andrew.cmu.edu
Hye Jung Cho: hyejungc@andrew.cmu.edu
Erica Choi: ejchoi@andrew.cmu.edu
Aiena Garg: aiena@cmu.edu
John Shoup: johnshou@andrew.cmu.edu

If you have questions later, desire additional information, or wish to withdraw your participation please contact the Principle Investigator by mail, phone or e-mail in accordance with the contact information listed above.

If you have questions pertaining to your rights as a research participant, or to report objections to this study, you should contact Brian Junker in the Statistics Department at brian@stat.cmu.edu.

By pressing "next" below, you read and agree to participate in the survey.

We greatly appreciate your participation in our survey!

iii. Appendix 3: Survey Questionnaire

* 1. Department you are associated with? (For example, Statistics, English, Chemistry, etc)?

2. Age?

* 3. Gender?
- Male
- Female

4. Highest degree earned?
- Bachelors Degree
- Masters Degree
- PhD
- Doctorate
- Other (please specify)

* 5. Years teaching (including years at institutions other than CMU)

* 6. How many years have you taught at CMU?

* 7. Number of courses currently teaching in spring 2011 semester?

* 8. Did you attend schools that implemented +/- grading?
- Yes
- No

9. If you said "yes" in the previous question, do you think +/- grading affected your GPA?
- Positively affected
- Negatively affected
- Not affected

10. Do you assign letter grades or number grades in each assignment (not the final grade but individual assignments)?
- Yes
- No

* 11. Do you have teaching assistant(s) for the course(s) you are currently teaching?
- Yes
- No

12. If you answered 'Yes' in the previous question, what range of percentage of grading do TA's do?
- Less than 10%
- 10% ~ 30%
- 30% ~ 50%
- 50% ~ 70%
- More than 70%

13. Do you think +/- grading system will create more work for you or TAs for grading?
- Yes
- No
- Don't know

* 14. Have you implemented +/- grading at CMU (for mid-semester grades or for students' reference, etc.)?
- Yes
- No

15. Have you ever bumped letter grades for students who are on the borderline between two different grades?
- Yes
- No

16. If you answered "Yes" in the previous question, what are your criteria for bumping a student's grade up? (For example, students' participation in class, continuous improvement in exams or homework)

17. Do you think +/- grading will affect students' efforts that they put into classes?
- Yes
- No
- Don't know

* 18. Do you think +/- grading will affect students' average GPA?
- Yes
- No
- Don't know

* 19. Do you think +/- grading will affect students' chances of getting a job?
- Yes
- No
- Don't know

20. Do you think your students in your class will prefer +/- grading system to the current system?
- Yes
- No
- Don't know

* 21. On a scale of 1 to 5, how would you rate your opinion on CMU's current grading system?
- 1 (strongly disapprove)
- 2 (disapprove)
- 3 (neutral)
- 4 (approve)
- 5 (strongly approve)

* 22. On a scale of 1 to 5, how would you rate your opinion on implementing +/- grading system at CMU?
- 1 (strongly disapprove)
- 2 (disapprove)
- 3 (neutral)
- 4 (approve)
- 5 (strongly approve)

23. If you want to provide more detailed view on +/- grading, please specify here.

iv. Appendix 4: Raw Data

Provided in a separate file.

v. Appendix 5: R Code

```
grading<-read.csv("rawdata.csv")
attach(grading)
head(grading)
nrow(grading)
apply(grading, 2, function(x)length(which(is.na(x))))

################### EDA ###################
summary(grading)
table(School); table(School)/length(School)*100
summary(dat.sub.age$Age)
table(Gender); table(Gender)/length(Gender)*100
table(Degree); table(Degree)/192*100
summary(TotalYears)
summary(CMUYears)
table(NumCourse)
table(Attend); table(Attend)/length(Attend)*100
table(Attend_affect); table(Attend_affect)/127*100
table(Type); table(Type)/190*100
table(TA); table(TA)/length(TA)*100
table(TA_work); table(TA_work)/94*100
table(Work); table(Work)/178*100
table(Implement); table(Implement)/length(Implement)*100
table(Bump); table(Bump)/193*100
table(Effort); table(Effort)/194*100
table(GPA); table(GPA)/length(GPA)*100
table(Job); table(Job)/length(Job)*100
table(Student); table(Student)/193*100
table(Current); table(Current)/length(Current)*100
table(New); table(New)/length(New)*100

opinion_new<-ifelse(New==1|New==2,1,ifelse(New==3,2,3))
table(opinion_new)
opinion_old<-ifelse(Current==1|Current==2,1,ifelse(Current==3,2,3))
table(opinion_old)/198*100

#School
table(School=="CIT",opinion_new)/15*100
table(School=="CFA",opinion_new)/52*100
table(School=="HSS",opinion_new)/67*100
table(School=="MCS",opinion_new)/30*100
table(School=="OTHER",opinion_new)/6*100
table(School=="SCS",opinion_new)/13*100
table(School=="TSB",opinion_new)/15*100
```

```
#Gender
table(Gender==1,opinion_new)/127*100
table(Gender==2,opinion_new)/71*100
#Degree
table(Degree==1,opinion_new)/13*100
table(Degree==2,opinion_new)/56*100
table(Degree==3,opinion_new)/103*100
table(Degree==4,opinion_new)/11*100
table(Degree==0,opinion_new)/9*100
#Attend
table(Attend==1,opinion_new)/127*100
table(Attend==2,opinion_new)/71*100
#Attend_yes
table(Attend_affect==1,opinion_new)/59*100
table(Attend_affect==2,opinion_new)/9*100
table(Attend_affect==3,opinion_new)/59*100
#Type
table(Type==1,opinion_new)/46*100
table(Type==2,opinion_new)/103*100
table(Type==3,opinion_new)/41*100
#TA
table(TA==1,opinion_new)/94*100
table(TA==2,opinion_new)/104*100
#TA_work
table(TA_work==1,opinion_new)/19*100
table(TA_work==2,opinion_new)/10*100
table(TA_work==3,opinion_new)/20*100
table(TA_work==4,opinion_new)/21*100
table(TA_work==5,opinion_new)/24*100
#Work
table(Work==1,opinion_new)/13*100
table(Work==2,opinion_new)/155*100
table(Work==3,opinion_new)/10*100
#Implement
table(Implement==1,opinion_new)/152*100
table(Implement==2,opinion_new)/46*100
#Bump
table(Bump==1,opinion_new)/151*100
table(Bump==2,opinion_new)/42*100
#Effort
table(Effort==1,opinion_new)/77*100
table(Effort==2,opinion_new)/51*100
table(Effort==3,opinion_new)/66*100
#GPA
table(GPA==1,opinion_new)/83*100
table(GPA==2,opinion_new)/40*100
```

```
table(GPA==3,opinion_new)/75*100
#Job
table(Job==1,opinion_new)/12*100
table(Job==2,opinion_new)/119*100
table(Job==3,opinion_new)/67*100
#Student
table(Student==1,opinion_new)/83*100
table(Student==2,opinion_new)/26*100
table(Student==3,opinion_new)/84*100
#Current
table(opinion_old==1,opinion_new)/75*100
table(opinion_old==2,opinion_new)/67*100
table(opinion_old==3,opinion_new)/56*100

#Histograms
par(mfrow=c(1,2))
dat.sub.age<-grading[!is.na(Age),]; nrow(dat.sub.age)
hist(dat.sub.age$Age,xlab="Age",main="Distribution of Age")
hist(TotalYears,xlab="Total Number of Teaching Career (years)",main="Distribution of
Teaching
Career",xlim=c(min(TotalYears),max(TotalYears)),ylim=c(0,80),border=1,breaks=15)
hist(CMUYears,border=2,add=T,breaks=15)
legend("topright",c("Total Years of Teaching Career","CMU Years of Teaching
Career"),col=c(1,2),lwd=2)

########################## Analysis ######################

#School vs opinion & Gender vs opinion
school.disapprove<-table(School[opinion_new==1])
school.neutral<-table(School[opinion_new==2])
school.approve<-table(School[opinion_new==3])
school.opinion<-rbind(school.disapprove,school.neutral,school.approve)
gender.disapprove<-table(Gender[opinion_new==1])
gender.neutral<-table(Gender[opinion_new==2])
gender.approve<-table(Gender[opinion_new==3])
gender.opinion<-rbind(gender.disapprove,gender.neutral,gender.approve)
par(mfrow=c(1,2))
barplot(school.opinion,beside=T,col=c(2,3,4),main="Distribution of Opinions by
School")
legend("topright",c("Disapprove","Neutral","Approve"),col=c(2,3,4),lwd=2)
barplot(gender.opinion,beside=T,col=c(2,3,4),main="Distribution of Opinions by
Gender",names=c("Male","Female"))
legend("topright",c("Disapprove","Neutral","Approve"),col=c(2,3,4),lwd=2)

#Opinion on students vs opinion
dat.sub.student<-grading[!is.na(Student),]
```

```
new_opinion<-
ifelse(dat.sub.student$New==1|dat.sub.student$New==2,"Disapprove",ifelse(dat.sub.stud
ent$New==3,"Neutral","Approve"))
student_c<-
ifelse(dat.sub.student$Student==1,"Prefer",ifelse(dat.sub.student$Student==2,"Not
Prefer","Don't know"))
student.disapprove<-table(dat.sub.student$Student[opinion_new==1])
student.neutral<-table(dat.sub.student$Student[opinion_new==2])
student.approve<-table(dat.sub.student$Student[opinion_new==3])
student.opinion<-rbind(student.disapprove,student.neutral,student.approve)
par(mfrow=c(1,2))
barplot(student.opinion,beside=T,col=c(2,3,4),xlab="Opinions on Student'
Preference",main="Distribution of Opinions \n by Opinions on Student
Preference",names=c("Prefer","Not Prefer","Don't know"))
legend("center",c("Disapprove","Neutral","Approve"),col=c(2,3,4),lwd=2)
mosaicplot(table(student_c,new_opinion),xlab="Opinion on Students'
Preference",ylab="Opinion on plus/minus system",main="Relationship between opinions
on \n students' preference and those on plus/minus system",shade=T)


#Attend vs Attend_affect vs opinion
attend<-ifelse(Attend==1,"Attended","Not Attended")
attend_affect<-
ifelse(Attend_affect==1,"Positive",ifelse(Attend_affect==2,"Negative","None"))
opinion<-
ifelse(opinion_new==1,"Disapprove",ifelse(opinion_new==2,"Neutral","Approve"))
par(mfrow=c(1,2))
mosaicplot(table(attend,opinion),xlab="Experience with plus/minus
system",ylab="Opinion on plus/minus system",main="Relationship between experience
with \n plus/minus system and their opinions",shade=T)
mosaicplot(table(attend_affect,opinion),xlab="Effect of plus/minus
system",ylab="Opinion on plus/minus system",main="Relationship between effect and
their opinions",shade=T)

# Teaching experience vs opinion
boxplot(TotalYears~opinion,xlab="Opinion on plus/minus grading system",ylab="Total
Number of Teaching Career",main="Distribution of Total Number of Teaching Career \n
by opinion on plus/minus system")

#current vs new
current<-
ifelse(opinion_old==1,"Disapprove",ifelse(opinion_old==2,"Neutral","Approve"))
mosaicplot(table(current,opinion),xlab="Opinion on Current System",ylab="Opinion on
plus/minus system",main="Relationship between opinions on \n current system and
plus/minus system",shade=T)
```