

Grade  
Forecasting As  
a Student  
Motivator

Daniel  
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What is Grade  
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A Case Study:  
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# Grade Forecasting As a Student Motivator

Daniel Swenson

University of California, Merced

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# Acknowledgement

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This presentation was adapted from a presentation that I previously gave in the spring 2015 semester for the “First Year Experience for Faculty” (now “Faculty Academy”) group at UC Merced.

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**Grade forecasting** (or **grade prediction**) is the prediction of someone's end-of-the-semester grade based on their current assignment grades.

Consequently, grade forecasting can be used as a form of feedback that informs the student whether their progress in the course so far is adequate, based on the grade that they wish to receive in the course.

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The grade forecasting tools described in this presentation are based on the end-of-the-semester grades and assignment grades of students who have previously taken the course.

When this type of tool is used, we anticipate that its prediction will be better calibrated prediction of a student's end-of-the-semester grade than their current grade is.

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Dr. Michael J. Armstrong is a business professor at Brock University in Canada who has used grade forecasting in many of his courses. What follows is based on Dr. Armstrong's 2015 article "A Grade Forecasting Strategy for Students," which is based on a study that he published in 2013.

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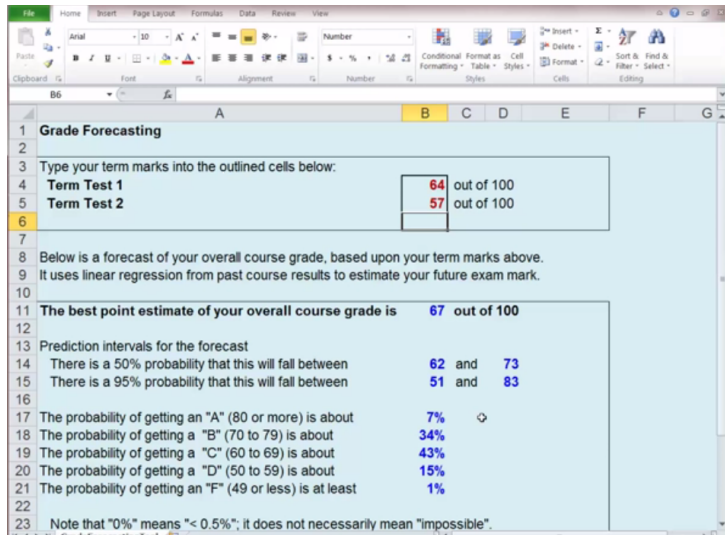


Figure: Dr. Armstrong's grade forecasting spreadsheet.

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- Of 465 students enrolled in his second-year undergraduate business course during 2010-2012, 282 completed the survey.
- Of those, 144 (51 percent) said they had tried the forecasting spreadsheet.

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- The rate of trial varied with academic performance. “A” students were 7.6 times more likely than “D” students to report trying the spreadsheet.
- Of those who did participate, 29 percent of them said the forecast grades were lower than they had expected, while only 6 percent said they were higher. Armstrong notes that “This imbalance indicates the degree to which students are overly optimistic about their course grade.”



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- 31 percent of the respondents said the forecasting experience made them feel more positive or confident about their course progress, while 35 percent said they felt more negative or worried.
- Fifty-six percent said their motivation had increased, while 7 percent said it had decreased.
- Forty-seven percent said they were subsequently studying more than they had previously planned, while 3 percent said they were studying less.
- And 74 percent recommended that grade forecasting continue to be offered in the course, while 6 percent recommended against it.

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Dr. Armstrong concludes "These results suggest that grade forecasting can be a useful addition to a course but that its effects on student motivation and effort are largely indirect. I am currently working with one of my colleagues on a follow-up study to better understand this relationship."

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In the spring 2015 semester, after mid-semester grades were submitted for the Math 32 course at UC Merced (a course in probability and statistics), a grade forecasting app was made available to the Math 32 students.

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In the Math 32 grade predictor, the students' end-of-the-semester grade was predicted using their first two homework grades and their first exam grade. A percentage was forecasted for the current student based on the assignment grades that they entered.

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In addition to a prediction of the semester grade, a visualization tool is available in this predictor.

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Colored points represent 184 students from a previous semester's Math 32 course, while the black point represents the assignment grades of the person currently taking Math 32.

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This visualization aspect allows the student to see whether their assignment grades are most similar to those of students who received high or low semester grades in the previous Math 32 course.

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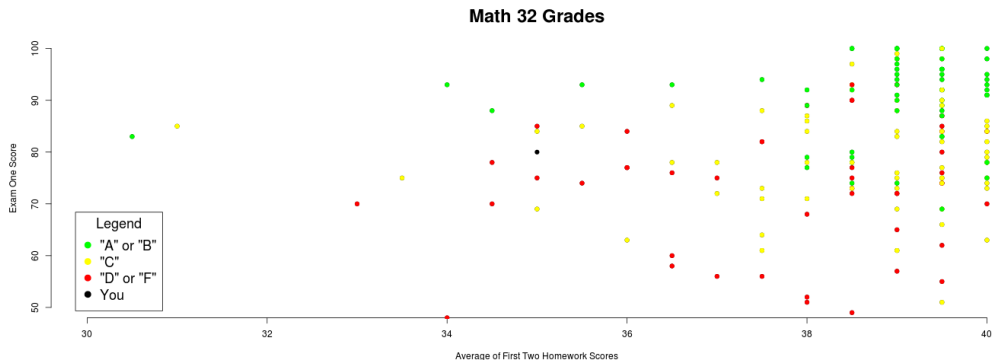
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Average of Your Two Homework Scores

35

Your Exam One Score

80



You are on track to receive a grade of approximately 72 % in this course.

Figure: The Math 32 grade predictor.

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The predicted grade is simply the average of the seven students from the previous Math 32 course with the grades that were most similar to the current student's assignment grades.<sup>1</sup>

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<sup>1</sup>The number seven was chosen because it yielded the most accurate results when used on the previous semester's end-of-the-semester grades. (Note that this predictor is an implementation of  $k$ -nearest-neighbor regression with  $k = 7$ .)

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The students were also offered a survey to take regarding the grade forecasting tool. 46 the 180 students in the course responded to the survey questions.



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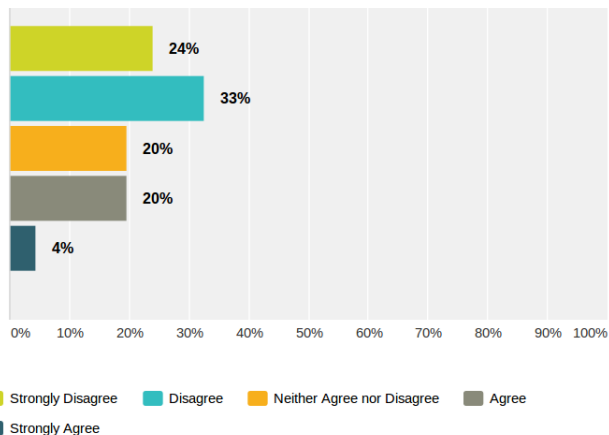
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**Figure:** Survey results for the question "My forecasted semester grade is higher than I expected it to be." We see that most (57%) of students who responded to the survey disagree (or strongly disagree) with this statement.

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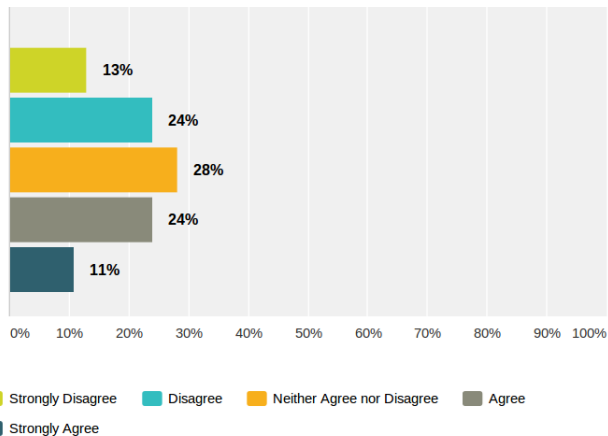
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**Figure:** Survey results for the question “The forecasting experience has made me feel more positive or confident about my course progress.” We see that about as many people agree or strongly agree with this statement (35%) as those who disagree or strongly disagree with the statement (37%).

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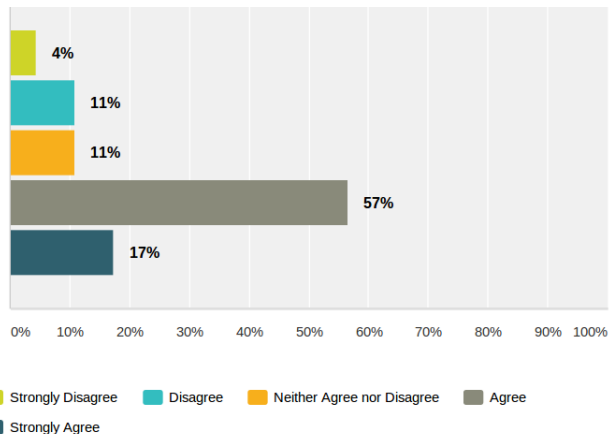
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**Figure:** Survey results for the question “As a result of the grade forecasting experience, I plan to study more than I had previously planned.” We see that a strong majority (74%) agree or strongly agree with this statement.

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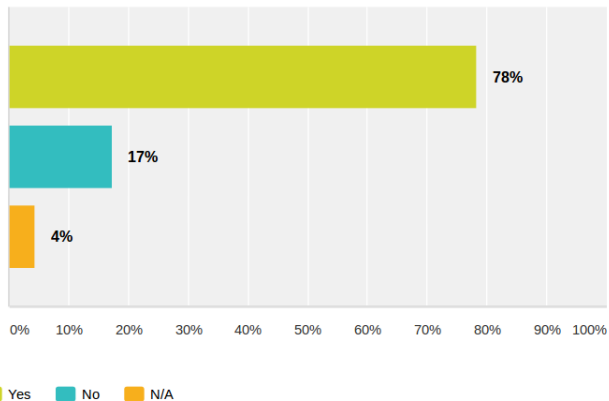
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**Figure:** Survey results for the question “Do you believe that grade forecasting should be offered in future Math 32 courses?” We see that a strong majority (78%) agreed with the statement, while only a modest percentage (17%) disagreed with the statement. (4% did not respond to this statement.)

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Statistical evidence is consistent with the hypothesis that the responses to the questions on this survey regarding “planning to study more” and the forecasted grade being “higher than expected” are independent, which is counterintuitive, since we would expect students whose grades were lower than they expected to be motivated to study more.<sup>2</sup> Dr. Armstrong, who encountered a similar result in his study, revisited this point in a more recent study which we will discuss momentarily.

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<sup>2</sup>Specifically, a  $p$ -value of 0.44 was observed for the chi-squared test for independence between the responses to these two questions, which is quite large; similarly, Fisher’s exact test for independence yielded a  $p$ -value of 0.35. (Unfortunately, one particular data point was not available for these computations; they were performed on a dataset of size  $n = 45$ .)

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In summary, the students' expectations regarding their end-of-the-semester grades seem to be, on the whole, overly optimistic.

Moreover, grade forecasting encouraged the Math 32 students to study more, regardless of whether or not the forecasted grade was higher than they expected it to be.

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The type of grade forecasting tool used here can also be adapted to display estimates of the probability of getting a particular end-of-the-semester grade, as Dr. Armstrong's tool does. (However, the students did not complete a survey regarding this version of the grade forecasting tool.)

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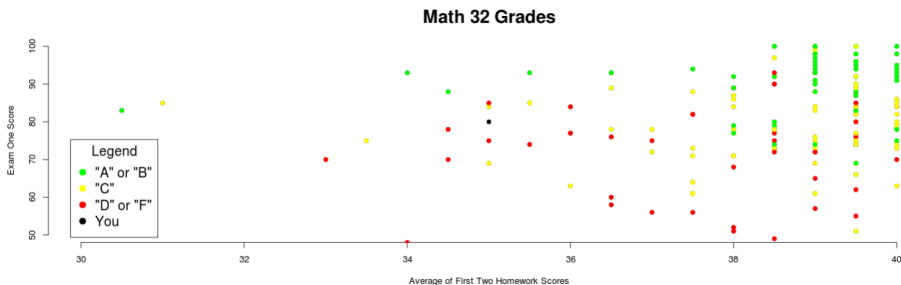
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Average of Your Two Homework Scores

35

Your Exam One Score

80



You are on track to receive a grade of approximately 72% in this course.

The probability that you will receive an "A" in Math 32 is 1%.

The probability that you will receive a "B" in Math 32 is 13%.

The probability that you will receive a "C" in Math 32 is 45%.

The probability that you will receive a "D" in Math 32 is 35%.

The probability that you will receive an "F" in Math 32 is 6%.

(A probability of "0%" should be understood as meaning "less than 0.5%", not "impossible".)

Figure: The updated Math 32 grade predictor.



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After the second Math 32 exam, a spreadsheet-based grade predictor that uses linear regression (as Armstrong's predictor does) was distributed to the students.

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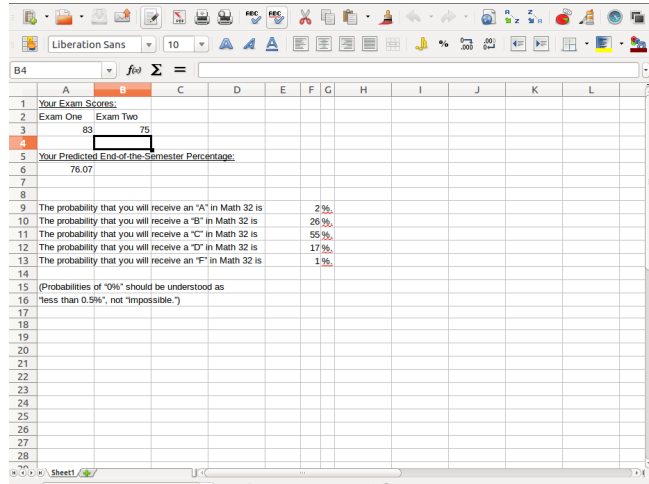


Figure: The spreadsheet-based grade predictor for Math 32.

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Although no survey data were collected regarding this version of the grade predictor, student response seemed generally favorable.

Some students desired the addition of the other assignment grades (quizzes and homework assignments) to the grade predictor, as they believed that this would make the predictor more accurate.

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This year, Dr. Armstrong has come out with a new study, "Influence of Anticipated and Actual Grades on Studying Intentions," that references my old presentation on grade forecasting.

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In his new study, he notes, “One surprise in Armstrong (2013) and Swenson (2015) was that the difference between participants objective grade forecasts and their own prior subjective grade expectations did not seem to influence studying intentions. For example, students whose forecast grade was lower than they had expected did not increase their studying; instead, students studied more after receiving a low forecast, even if it matched their prior expectations. This presents a puzzle. If students do not react to differences between the forecast grades and their prior expectations, as predicted by various learning theories, then to what do they react?”

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As a result of his new study, he concludes, "We found that undergraduate business students do respond to differences between the target grade they initially chose and their current actual grade, as well as to differences between their current grade and the final grade they expect to achieve. They increase their planned studying if their actual grades are below their initial and/or subsequent goals..."

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“... [b]y contrast, students do not adjust their studying in response to differences between their subjective expectation for the final grade and the quantitative forecast of that final grade. Even when they discover that their expectations are too high, they do not study more to compensate. This confirms the results from Armstrong (2013) and Swenson (2015). Since our methodology differs in several respects from those works, it also generalizes their findings.”

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In summary, from the limited data available thus far (from Dr. Armstrong's results and from Math 32), it appears that *grade forecasting is a tool that motivates students to study more*, regardless of whether or not the forecasted grade is lower than they expect it to be.

Grade forecasting can be implemented in a spreadsheet (including estimates of the probability of getting a particular grade, such as an "A", "B", and so forth) which can be distributed to students electronically, allowing them to engage in grade forecasting anonymously.



# Proposed Future Work

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Proposed future work includes investigating whether grade forecasting is better calibrated than students' current grades (say, at the mid-semester point) as an estimator of the students' end-of-the-semester grades in other courses at UC Merced.

Large courses which are implemented in a consistent way from semester to semester would be ideal candidates for grade forecasting.

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