COT 3100 Spring 2025 Study: Sections 1 and 2, 201H

Basic Class Information

In this semester I taught three sections of COT 3100: Section 1, Section 2 and Section 201H. Here is a list of their meeting times and the number of students in each section who completed the final exam and survey:

Class	Meeting Time	Number of Students
Section 201H	TR 9:00 am	23
Section 2	TR 1:30 pm	168
Section 1	TR 3:00 pm	105

Basic Motivation

What prompted this study was noticing that when I was returning papers to class for students who hadn't picked them up previously, a very high number of students in the group were absent. (Though we'd get close to 40% class attendance, something like 15% of the students whose papers I was attempting to return were actually present.) I actually created multiple exam questions about this scenario (had told the students in advance to think about the probability of this occurring if each student was equally likely to attend any class), mostly to prove that there wasn't actually independence between the two items. Namely, if a student wasn't in recitation to receive their paper, they were less likely to be in lecture; these two things were correlated which helped explain the extended bouts of silence we saw in class.

To that end, I wanted to understand why students don't come to class and also get some feedback about how I could improve course attendance and improve students using the resources that UCF already pays for (TAs, SI, SARC). These resources tend to be underutilized.

Also, I collected a bit of quantitative data so see if I could make some correlations between student performance and those quantitative measures.

Data I collected

1. Each student put their name on the survey (so I could link responses to course performance).
2. Number of hours the student spent on the course total per week.
3. Number of recitation problems (out of 8) that the student solved each week on average.
4. Frequency of skipping/missing class (recorded as 0 = missed 2 or less times, 1 = came unless I was legitimately sick or had something special going on, 2 = missed regularly)

Note: I didn't get IRB approval so I can't really formally publish this...no one looked at the survey or anything, I just wrote it.

Limitations of Data Collected

All three of the values I recorded were based on student perception at the end of the semester. It's likely that some students are better at estimating time than others, and it's also possible that some students didn't tell the truth to the best of their knowledge. I think the latter is largely unlikely (only a very few students might have done this), but based on the fact that one student said they spent 100 hours every week on the course, I am sure that some of the estimates are quite poor. I adjusted how I recorded these outlandish numbers using other clues on the survey. Luckily there were only 5 values I adjusted because they weren't believable.

For #3, it's likely the case that different students interpreted the question differently. My intent was for students to count only problems they completed correctly. It's possible that some students interpreted it as meaning, "problems seriously attempted."

For the last one, my question wasn't a numeric one. I asked them, if they missed class more than twice, why did they miss class. For everyone who answered, "N/A" or left it blank, I recorded 0, For everyone who gave me details of 1 or 2 times they missed, I also recorded 0. If someone gave me several details (more than 3) but were very specific about each individual reason they missed, I recorded it as 1. If someone gave me a general reason (I was lazy, I live far away, I thought it was more efficient to study at home), I assumed the behavior was habitual and recorded it as 2. If anyone said something like, "I stopped coming after Exam 2", I also recorded that as a 2. My interpretation was that the mindset of someone who generally came would be able to precisely recall each reason they missed, but if someone missed habitually, they were more likely to give a general reason than outline each specific instance.

Results

What Was Calculated

I attempted to correlate the survey data with the following data for each student in the course:

1) Overall class percentage
2) Exam 1 Grade
3) Exam 2 Grade
4) Final Exam Part B Grade

The first figure represents a combination of understanding the material (exam performance) AND responsibility/effort (homework, community service credit, lab attendance).

The second and third represent shorter term learning on pretty different subjects (Exam 1 is on logic and sets, thus is not numeric at all while Exam 2 is on number theory and mathematical induction, which is much more quantitative and algebra based.)

The last item represents what I call long term learning. It's impossible to cram all the information in the course, so these grades largely represent longer term learning by students (though I guess some students have very good cramming abilities...) To me, this is the best gauge of the efficacy of the class and what students actually learned. The first part of the final exam FEA, only had questions about 2 topics and most students didn't take it; they instead did 5 hours of community service to receive automatic full credit on it.

In addition, I computed one correlation between a measured grade from the first week of class and the four measures above. Namely, I gave a pre-test to all students during the first week of class. The pre-test is a set of 20 multiple choice questions each testing classic ideas from high school mathematics (for example, if you drive one way of a round trip and 40 miles and hour and the other way at 60 miles an hour, the average speed for the round trip isn't equal to the arithmetic mean of 40 and 60, but what is known as the harmonic mean. Though high schools don't use the word harmonic mean, they do teach the formula $d = rt$ in Algebra 1, and applying this formula is the correct way to solve the problem.) The students take the test during the first week of class on Webcourses (online) and are asked not to use online aids or a calculator. In my honors class, I gave this quiz in person on paper and was able to enforce these rules.

Attendance Correlations

Here is a chart showing the correlations between class skipping (0/1/2) with the four measures previously detailed.

Section	Class Percentage	Exam 1	Exam 2	Final Exam B
1	-0.38	-0.19	-0.36	-0.32
2	-0.42	-0.14	-0.26	-0.33
1 and 2 together	-0.41	-0.16	-0.31	-0.34
201H	-0.33	-0.38	-0.07	-0.17

In all of the sections, attendance correlates with each measure. The more students skip, the lower their class percentage, exam 1, exam 2 and final exam grades are. The Honors data had almost all students who attended all of the time (only 4 students missed occasionally out of 23) so these numbers are bound to be "unstable." But in the two large sections, course attendance and course percentage have a correlation coefficient of close to 0.4 and this correlation is a bit less for exams.

The way I interpret these results is simply to say that course attendance helps your exam grades some, but it likely reduces the chance that you miss due dates on homework and is 100% correlated with the lab attendance portion of the course grade.

The best line fit (collating section 1 and section 2 data together) for the data where x = 0,1,2 (how often skipped) to y = course percentage was

$y = -6.8765x + 67.018$

It's possible that a linear fit isn't the best choice for this data. Given the limitations of what I collected (0, 1 or 2), I decided this was the most reasonable fit to attempt. The interpretation here is that students who always attend have a 7% advantage over students who mostly attend (but skip for specific situations like work or being tired for a specific activity) and have close to a 14% advantage over students who regularly skip (say skip when they are tired in general).

Completing Recitation Problems Correlations

Here is a chart showing the correlations between the average number of recitation practice problems completed per week out of 8 total with the four measures previously detailed.

Section	Class Percentage	Exam 1	Exam 2	Final Exam B
1	0.30	0.16	0.30	0.30
2	0.16	0.04	0.09	0.07
1 and 2 together	0.22	0.10	0.19	0.16
201H	-0.05	-0.01	-0.27	0.14

It's rather interesting that for Honors students, the number of these problems completed was largely independent of any of the four measures listed. My suspicion here is that many of the Honors students already knew how to do the recitation problems, maybe glanced at them, and decided that they didn't need to do them and their assessment was accurate.

This leads me to believe that completing these problems only leads to gains in the course if you didn't previously know how to do them, but were able to figure out how to do them. I have some trouble explaining the difference between section 1 and section 2.

The best line fit (collating section 1 and section 2 data together) for the data where x = # of completed problems out of 8 per week to y = course percentage was

$y = 1.8522x + 54.356$

It's more likely that the line fit here is a good choice to model the data. The interpretation here is that each extra recitation problem you complete adds a little bit less than 2% to your course grade. Many students found these problems too difficult to complete, and most didn't attempt to continue working on them after recitation was over. Not all students who completed these problems did very well; there were outliers who did all 8 problems ever week but still had a poor grade in the class. So, it's not a guarantee that doing these problems will allow you to excel in the class. But, on average, doing them helps.

Number of Hours Per Week Spent on Course Correlations

Here is a chart showing the correlations between the total hours per week spent on the course with the four measures previously detailed.

Section	Class Percentage	Exam 1	Exam 2	Final Exam B
1	0.02	-0.06	0.03	-0.07
2	0.03	-0.21	-0.02	-0.04
1 and 2 together	0.04	-0.15	0.00	-0.02
201H	0.16	0.06	0.06	0.00

Although the correlation here is nearly non-existent, the trendline is still positive with the following best line fit (collating section 1 and section 2 data together) equation with x = # hours spent on the course per week and y = course percentage:

y = 0.142x + 59.439

The interpretation here is that even adding 10 hours a week only budges your grade by less than 2%. This is perhaps the most interesting finding of all. Common sense dictates that as students spend more time on something, they'll improve at it. While this is certainly true, what this shows is that it's not true the other way around. Namely, those that succeed don't necessarily spend more time than those that don't.

The last result coming up probably best helps explain this result.

Pre Test Score Course Correlations

Here is a chart showing the correlations between the student's pretest score with the four measures previously detailed.

Section	Class Percentage	Exam 1	Exam 2	Final Exam B
1	0.44	0.45	0.38	0.35
2	0.34	0.32	0.27	0.37
1 and 2 together	0.38	0.37	0.32	0.36
201H	0.57	0.02	0.61	0.65

This was the strongest correlation measured and is noticeably stronger in the Honors section. That is likely due to methodology. The Honors section pre-test results were verified to be accurate as the test was administered on paper with no electronic aids. In the regular section, I asked students to do this but some certainly didn't follow the guidelines. (This is highlighted by the one student who got all 20 questions on the pre-test but didn't pass the course. No student solved 19 problems on the pre-test...)

I suspect if I were able to give the pre-test on paper to the regular sections, their correlation coefficients to each of the measured would increase a good deal.

Here is the best line fit for sections 1 and 2 where x = # of pre-test questions answered correctly out of 20 and y = course percentage:

y = 1.6474x + 44.528

It's instructive to look at the Honors best line fit:

y = 1.918x + 54.765

The Honors students, even with similar pre-test scores, tend to have higher course averages. This likely reflects the idea that Honors students, on average, are more conscientious than the general UCF student population. (Also, it's worth noting that on average, Honors students have fewer impediments in their personal life than the general UCF population. They are less likely to be working and less likely to have a long commute to school.)

This means that a student's knowledge of high school math (focus on problem solving type problems) is more predictive of how they'll perform in this course than any of the other measures I looked at. If you are more accurate solving systems of equations and better at not making incorrect mathematical steps in Algebra I and Algebra II style problems, then you'll do better with the type of problems you have to solve for COT 3100. This likely shows that if students have these deficiencies before the course, they are unlikely to be able to improve them significantly during the course. In some sense, there simply isn't enough time to go back and solidify your understanding of FOILing and factoring AND learn all the new material presented in COT 3100.

Now, we can go back and look at the previous result, that time spent on the course does NOT correlate with a student's percentage in the course. Students who have a strong

mathematical/logical background coming into the course simply don't need to spend a lot of time on the course to succeed. They aren't trying to learn 3 semesters worth of material in one. When they're working on an induction problem, they don't get stuck for an hour factoring something. They can do it fairly quickly. Their previous understanding allows them to complete more work for the course quickly. There are a very few students who already know the material in the course so they have to learn even less new material. This allows them to completely focus on the creative problem solving in the course.

Number of Hours Per Week Spent on Course Correlations in batches by Pre-Test

To try to see if hours spent on the course matters, I decided to split the students into batches by their pre-test scores and then look at the correlation between the hours spent and course grade for all students who earned the same pre-test score (or in the same small range of pre-test scores. Here are the correlation coefficients between hours spent and course percentage. (I didn't run this for exams.) Here is the chart:

Pre Test Score Range	Correlation between Hours Spent and Course Percentage
[0, 5]	0.37
[6]	0.35
[7]	-0.10
[8]	0.16
[9]	-0.26
[10]	0.38
[11]	0.03
[12]	0.10
[13]	0.02
[14,18]	-0.02

Looks like the take home message here is that even when we try to "correct for" the pre-test results, we only find that spending more time on the course benefits students who came in with quite a poor background (6 or fewer questions out of 20). It's important to see that this proves that, particularly for struggling students, extra time spent can help improve their grades. The data is a bit bizarre after 6. But clearly for students who did well on the pre-test, there's still no correlation between time spent on the course and course percentage!

Class Attendance – Efficiency of Time Spent

A question to ask now is, given that two students spend the same amount of time total for a class, will the student who attends more often (but spends less time outside of class) do better than the student who doesn't attend as much (but spends more time outside of class)?

To answer this question, I sorted the student data into buckets based on how many hours a week they spent on the course total. For this sample, I just looked at students who spent 6 hours a week on the course. I then grouped them into separate buckets based on pre-test score:

1) Low Pre-test score [0, 8]
2) Medium Pre-test score [9, 11]
3) High Pre-test score [12,15]

Here is a chart with the three line fit equations for each group where x = 0,1,2 (how often the student missed class as previously described) and y = class percentage.

Pre-test score	Best line fit equation
[0, 8]	y = -9.4778x + 59.699
[9, 11]	y = -5.4214x + 71.368
[12, 15]	y = 3.9688x + 58.032

Again, keep in mind that ALL of these students spent the same amount of time working on the class. For students who scored poorly on the pretest, coming to class was the most efficient use of their time. In fact, for the same time spent, **they scored 20% higher in the class if they always came than if they came sporadically.** But for students with good pre-test results, the result had flipped!!! Their time was better spent outside of class (though the benefit wasn't quite as strong in this opposite direction.)

A similar phenomenon was seen for all students who spent 7 hours a week on the class. Here is the same chart for those students:

Pre-test score	Best line fit equation
[0, 8]	y = -3.6281x + 56.345
[9, 11]	y = -13.081x + 70.499
[12, 15]	y = 6.5653x + 49.021

Again, for students who did poor or average on the pre-test, coming to class was an efficient use of their time which improved their grade, but for students who did above average on the pre-test, it was more efficient for them not to come to class.

Let's look at the data for all students who spent 8 hours a week on the class:

Pre-test score	Best line fit equation
[0, 8]	y = -3.854x + 61.885
[9, 11]	y = -0.3325x + 60.863
[12, 15]	y = -17.092x + 85.288

In this group, the students who did well on the pre-test completely defied the previous groups. The granular data is small and as it turns out, for this bunch, there were a number of very high performers (multiple students who averaged over 90% in the course) who always came to class. Also, there were no students who spent 8 hours in the class a week and scored 12 or higher on the pre-test that sporadically came to class. If you carefully look at the line equations, what we see is that the y intercept for this group is much, much higher than the groups of students who spent 6 or 7 hours a week on the course. It's possible that if you are a capable student with a good background, 8 hours a week with coming to class, is the sweet spot to do very well in the course.

Let's keep going and look at 9, 10 and 11 hours.

9 hours chart:

Pre-test score	Best line fit equation
[0, 8]	y = -3.91x + 53.334
[9, 11]	y = -12.653x + 78.66
[12, 15]	y = -0.91x + 57.82

This only represents 14 students total (5, 5 and 4 respectively.) So, these results are a bit wacky. Bizarrely, all the students who did well on the pre-test but spent 9 hours a week on the class chose not to attend very much and each had a final course percentage in the 50s. Interestingly enough, the students in the class who spent 9 hours a week but scored lower on the pre-test came to class more often. Those who came all the time averaged over 70% in the course and those who didn't in this middle group averaged in the 50s.

10 hours chart:

Pre-test score	Best line fit equation
[0, 8]	y = -6.6895x + 66.302
[12, 15]	y = -3.2267x + 78.95

There were only 2 students who spent 10 hours/week on the course who had pre-test scores of 9, 10 or 11 and both of them always came to class.

11 hours chart:

Pre-test score	Best line fit equation
[5, 8]	y = -0.6583x + 59.145

There were 3 students all with the same x value with pre-test scores in between 9 and 11 and no students in this group with pre-test scores above 11.

For students who spend a lot of time on the class, it turns out that it's more efficient to come to class for all groups, regardless of how well they did on the pretest. Here is the equivalent data for students who spent 12 or more hours a week on the course:

Pre-test score	Best line fit equation
[0, 8]	y = -8.0007x + 64.847
[9, 11]	y = -9.4344x + 67.214
[12, 20]	y = -11.001x + 71.282

So, here's the takeaway message from this granular look:

For students who've decided they won't want to spend a lot of time on the class, if their pre-test score is average or below average (11 or less out of 20), then it's MORE EFFICIENT for them to come to class and spend less time outside of class than the other way around.

The opposite is true for students in this group (don't want to spend time on the class) but scored above average on the pre-test (12 or higher out of 20). For these students, it was slightly more efficient to not come to class and study on their own.

FOR ALL STUDENTS WHO'VE DECIDED THEY WANT TO SPEND A DECENT AMOUNT OF TIME ON THE COURSE (8 or more hours a week), IT'S MORE EFFICIENT TO COME TO CLASS.

So the only group for which it is a logical decision to skip class are students who come in with a high level of knowledge beforehand who have also decided that they want to spend 7 or fewer hours a week on the class. In all other situations, it's best to come to class.

Final Results Summary

1. Class Attendance robustly correlates with the final course percentage students earned. There's about a 14% average difference in final course percentage between the students who always attend (missed 2 or fewer classes) and those who sporadically attend (miss more than for specific 1 time reason).

2. Completing Recitation Practice Problems (not required) correlates with the final course percentage students earned. Roughly speaking each extra question out of 8 done per week added 1.8% to the student's course percentage. (Thus the difference between the end points of doing none of the problems and doing all 8 of the problems is also pretty close to 14%.)

3. Total Hours Spent on the Course does NOT correlate with the final course percentage earned. (Other factors create this independence of variables that seem to be connected.)

4. High school mathematics background matters a lot. The strongest correlation measured was between the pre-test results and the final class percentage. This correlation has nothing to do with the courses taken, but rather a firm accurate grasp of Algebra I and Algebra II problem solving techniques.

5. Given the results for 3 and 4, it's likely that they obscure actual truths. In fact, of the students who did poorly on the pretest (6 or fewer out of 20 questions), there was a strong correlation between time spent on the course and final course percentage. But this correlation disappeared for students with above average pre-test scores.

6. Finally, we addressed the question of whether or not class attendance is an efficient use of time. So given that a student is going to spend X hours per week on the course, do they maximize their grade by going to class and spending less time outside of class or skipping class and spending more time outside of class? For nearly all groups of students, the answer is that for the same anount of time investment, your course grade will be better if you come to class over spending time outside of class. The only exception to this is if you did well on the pre-test (12 or higher) but have decided to spend fewer than 8 hours per week on the course. In this case, self-study is slightly more efficient. But, if you're willing to spend 8 or more hours a week on the course, then it's most efficient to go ahead and come to class.