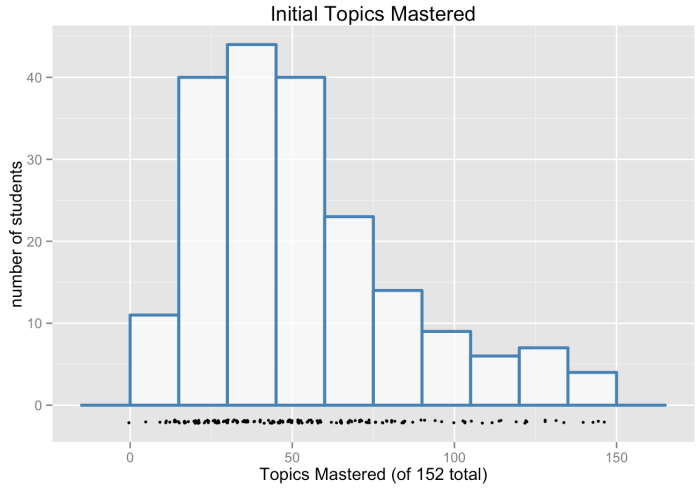
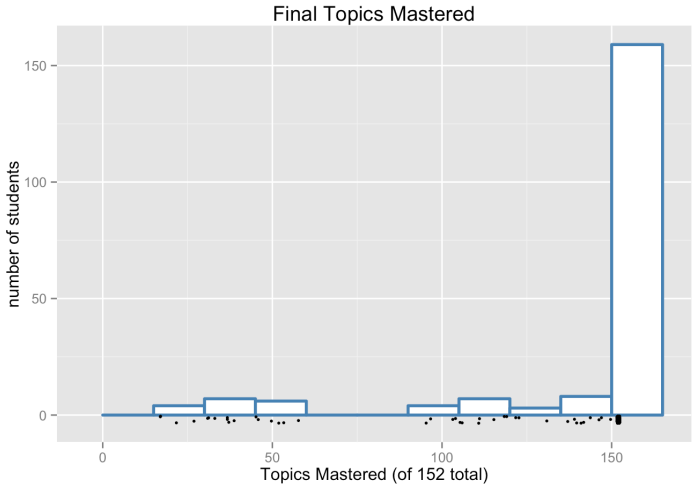
Overall Results

Participation rate = 198 of 209 students (94.7%) mastered at least one topic.
Initial mastery = 34.3% (or 52 of 152 total topics) overall (median initial mastery = 30%)
Final mastery = 91.3% (or 139 of 152 topics) overall (median final mastery = 100%)
Change in mastery during the program = 57% (or 87 of 152 topics)
Time spent in ALEKS = The average student spent a total of 27.4 hours
The average student who mastered 100% of the topics spent 29 hours

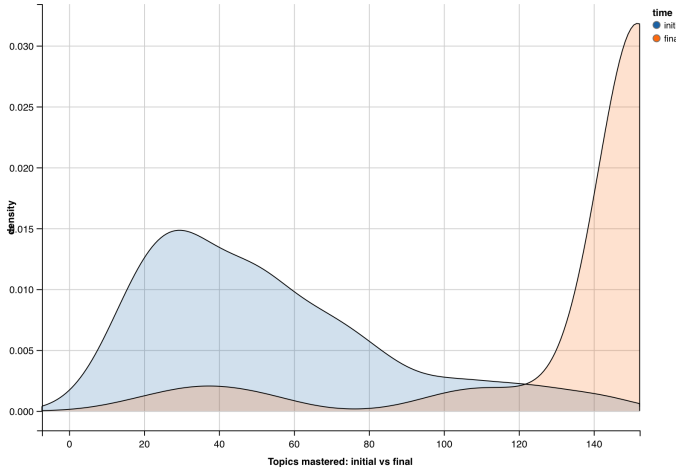
158 of students who participated (79.8%) **mastered all 152 topics**.
166 of students who participated (83.8%) **mastered at least 90% of the topics**.

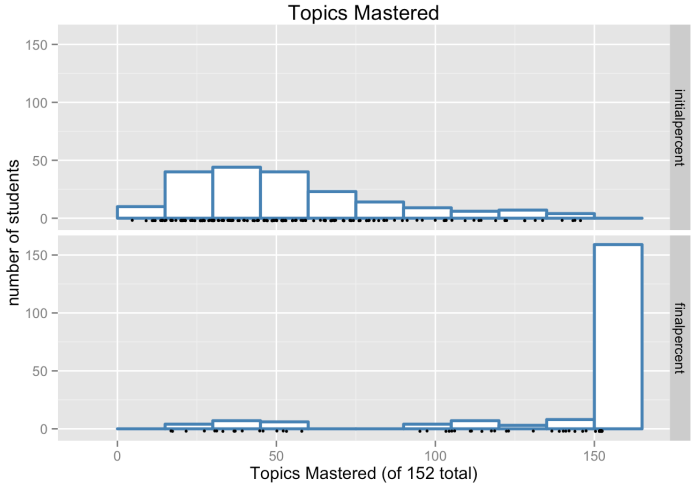
These graphs show the distribution of topics mastered by students initially and at the end of the program.
We did have a small group of students (2-5%) who, most likely, would have been ready for MATH 171 without this program.
The vast majority of students (64%), however, came in having mastered fewer than a third of the topics needed for MATH 171.

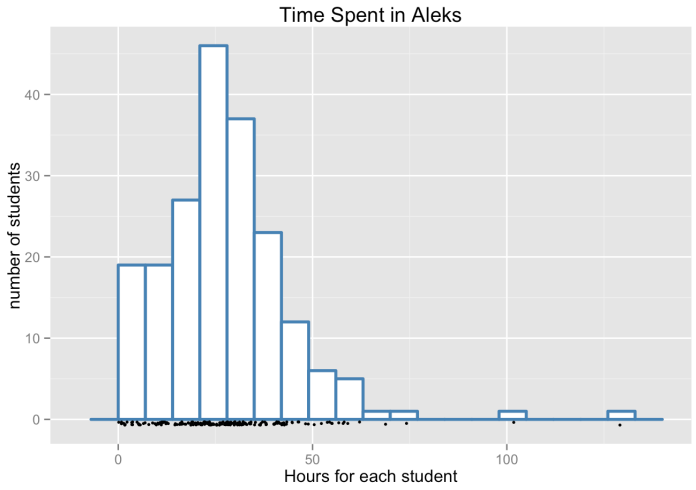




The following two graphs show the same information.
They're basically the two graphs above merged together to show the change in mastery as a result of the program.







The graph on the left shows the amount of time (in hours) each student spent in ALEKS.

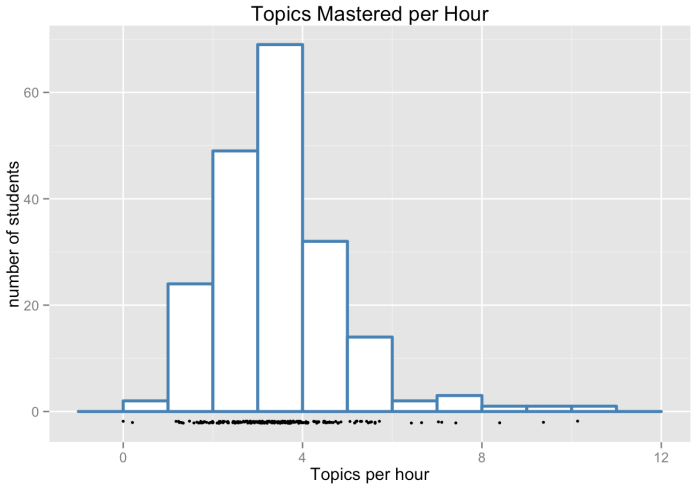
Minimum time = 48 minutes
Average time = 27.4 hours (37 min/day; 4.3 hours/week)
Median time = 26.4 hours (35 minutes per day)
Maximum time = 129 hours (172 minutes per day)

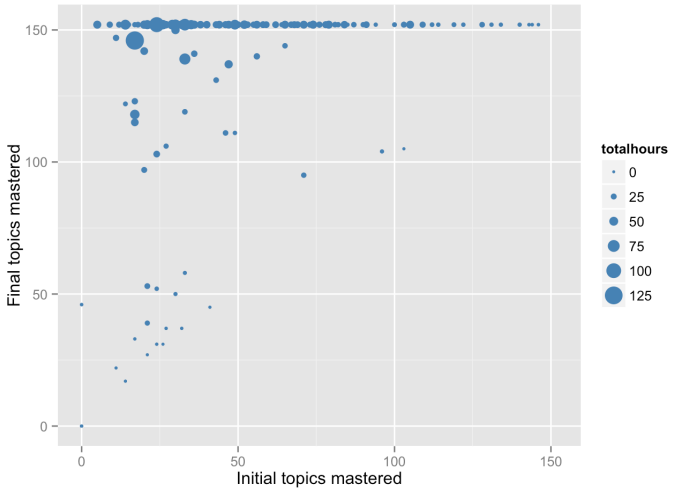
A few students spent an incredible amount of time, but the majority (79%) spent less than the equivalent of a 1-credit hour course (37.5 hours).

The graph on the right shows the number of topics mastered per hour by each student (once corrected for assessment issues in ALEKS*).

Average topics per hour = 3.5
Maximum topics per hour = 10.1

I corrected the ALEKS data by assuming students could have mastered these topics outside the ALEKS system. That lowered the maximum number from 135 to 10.1, but that is still an unusually high number (a pace 3 times higher than the average student in the program).

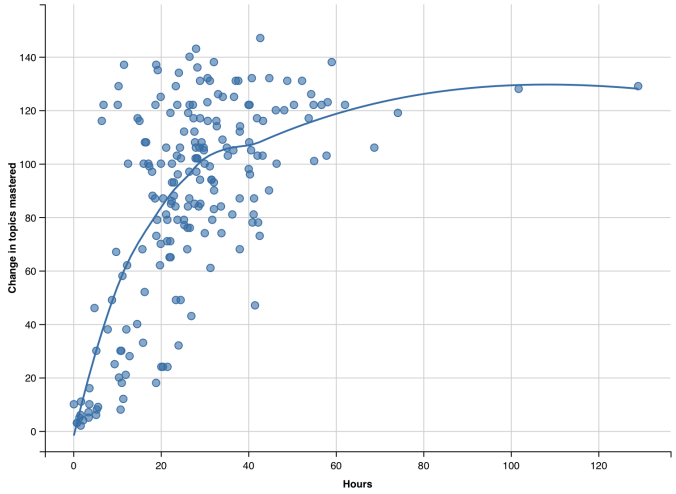




The graph on the left shows the relationship between initial and final topics mastered. With so many students mastering 100% of the topics, it's difficult to see anything.

If you focus on the students who did NOT master 100% (the students who are not along the top), you can see almost all of them started with initial mastery of 50 topics or fewer (33% mastery or lower).

The size of the dot represents the amount of time the student put into ALEKS.

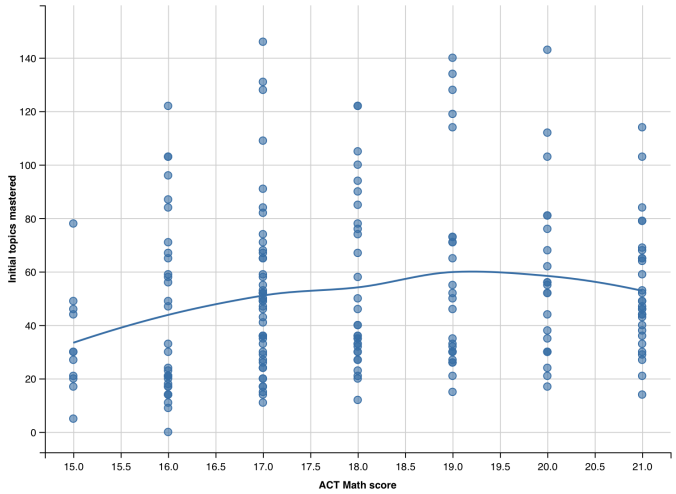


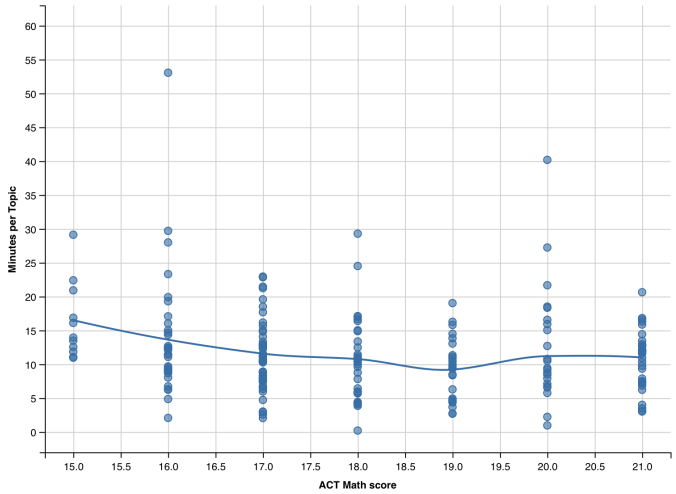
The graph on the left shows the relationship between the amount of time spent in ALEKS and the number of topics mastered from the beginning until the end.

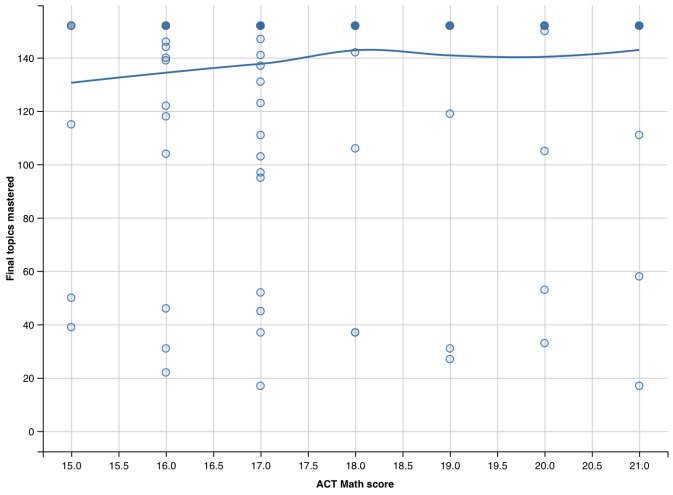
This could potentially be used to predict the amount of time a student would need to finish ALEKS. As an example, suppose we have a student who (after the initial assessment) needs to master 60 topics to finish. Going up the vertical axis to 60, then right to the curve, and then down to the horizontal axis will show that the student will probably spend 10 hours. On the other hand, a student who needs to master 100 topics will need around 30 hours.

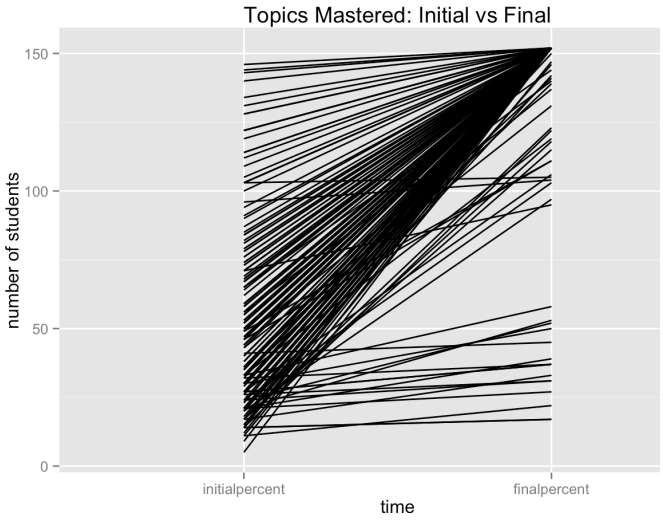
The graphs shown below display how ACT Math scores relate to performance in ALEKS.

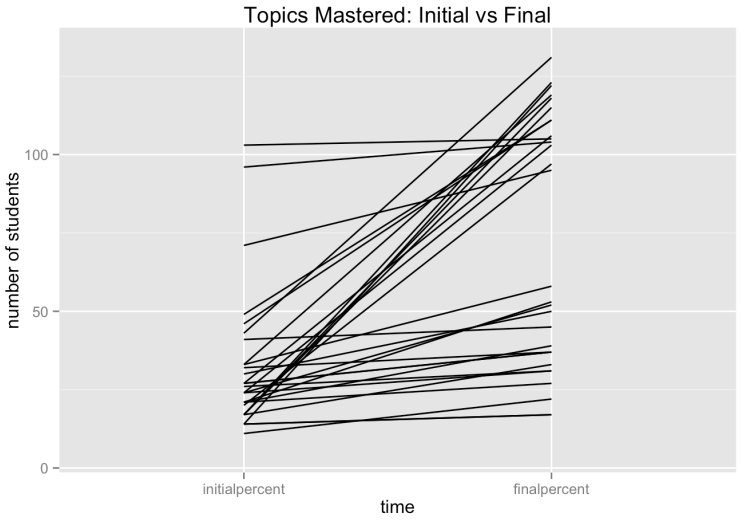
- The top-left graph shows how ACT scores relate to the initial mastery level for students. As expected, the general trend is that higher ACT scores are associated with higher initial mastery levels. It is interesting that even at ACT Math scores of 21, students have mastered (on average) around one-third of the topics identified as essential to MATH 171. It would be interesting to see how students with higher ACT scores perform.
- The top-right graph displays the relationship between ACT scores and the time it takes to master a single topic in ALEKS. Again, as expected, students with higher ACT scores spend less time per topic (move more quickly through the program).
- The graph at the bottom shows that students at all ACT scores were able to finish ALEKS with 100% mastery. Furthermore, it shows that students with higher ACT scores were more likely to finish ALEKS (as is to be expected).







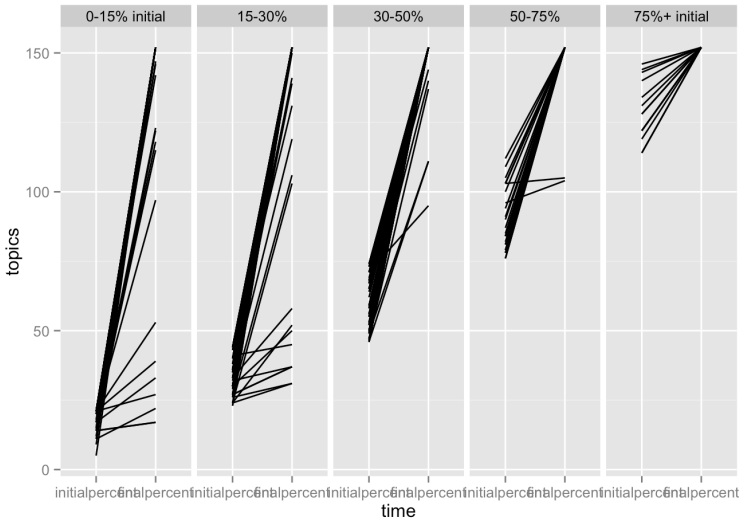


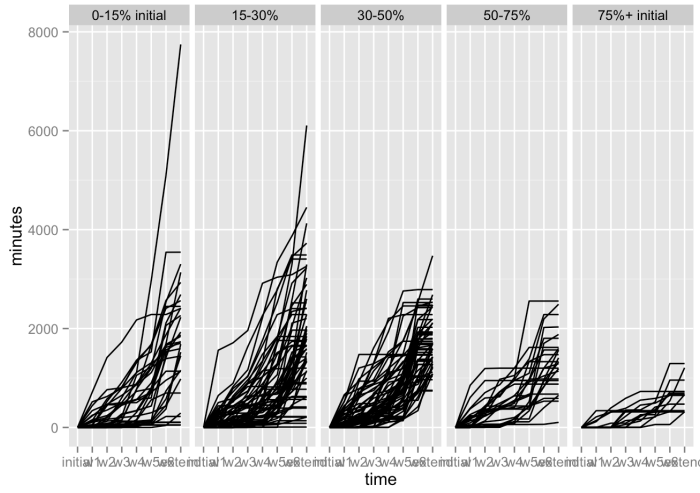


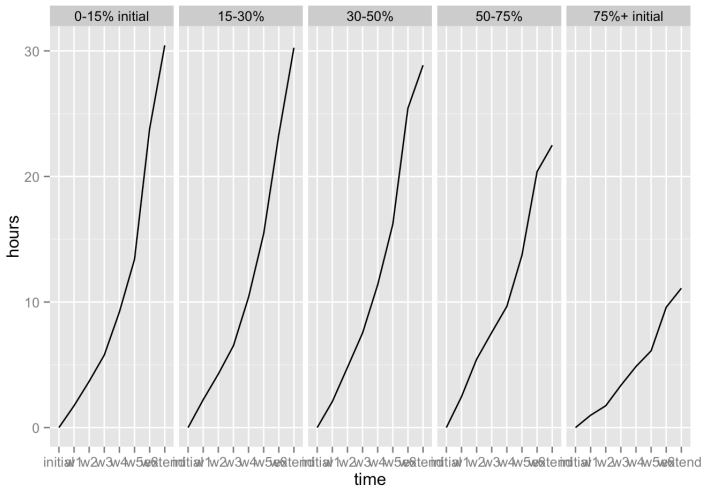
The two graphs displayed above show the change in mastery from the beginning until the end of ALEKS. The graph on the left clearly shows the majority of students were able to finish ALEKS with 100% mastery. The graph on the right shows the students who finished at less than 90% mastery. This graph shows that the students who did not finish fall into one of two categories:

- The steep lines represent students who started low, made significant progress, but just weren't able to finish.
- The nearly-horizontal lines represent the students who simply did not make much progress in ALEKS. These students could be low- or high-ability, as measured by initial mastery.

The graph displayed below shows this same information with students categorized by their initial mastery levels. All students who initially mastered at least 75% of the topics were able to finish. All but 2 of the students who initially mastered 50-75% of topics finished (and these two students have nearly-horizontal lines). The relative number of nearly-horizontal lines increases for lower-initial-scoring groups. This may indicate students with low initial mastery scores give up and do not try to complete the program.







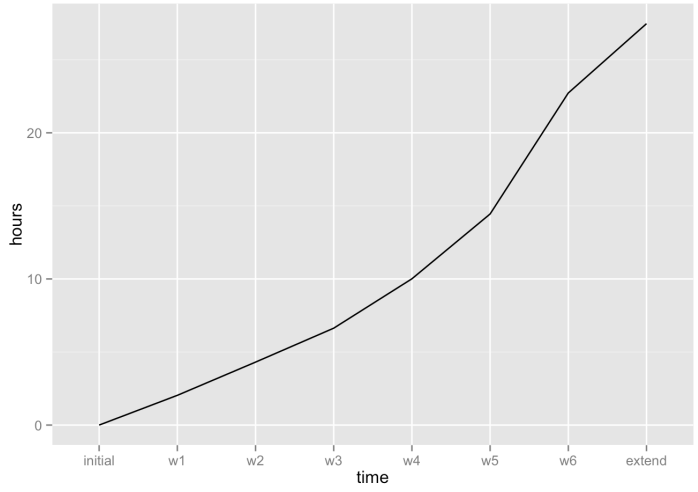
The above graphs show the cumulative amount of time (in minutes) spent by students (grouped by initial mastery level) each week. The graph on the left shows, as expected, students with lower initial mastery levels spend more time than students with higher initial mastery levels. The graph on the right shows the average amount of time spent each week by students in each group.

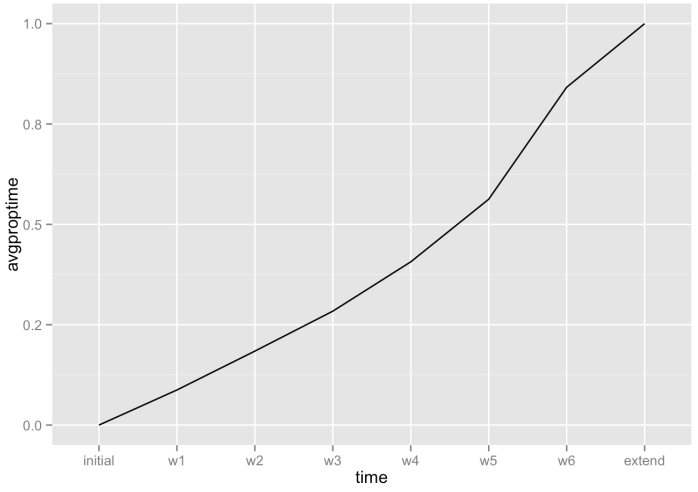
If students had spent an equal amount of time each week, these graphs would be straight diagonal lines connecting the bottom-left point to the top-right point. Because the lines are concave up (starting slow, but increasing in steepness each week), it indicates students procrastinated and spent the majority of their total ALEKS time in the last couple of weeks.

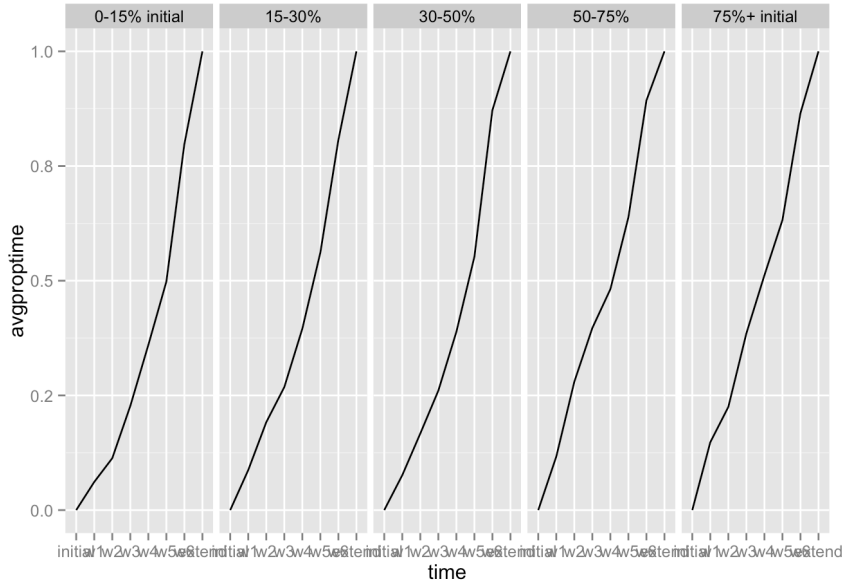
The graphs on the bottom collapse this information for all 198 students who participated in ALEKS. The graph on the left shows the cumulative number of hours spent by students each week. It shows, for example, that the average student spent a total of 10 hours in the first 4 weeks (28 days) of the program. The average student then spent 17 hours in the last 2 weeks (17 days, counting the extension). That includes students who had already mastered 100% of the topics by then and who had spent no time in the last two weeks.

The graph on the left, focused on total time spent in ALEKS, includes students who spent very little time and very much time. To count all students equally, we can focus on the proportion of time spent in ALEKS each week. As an example, suppose we have a student who spent a total of 10 hours in ALEKS and another student who spent 100 hours in ALEKS. If they both spent 1 hour in the first week, the first student would have spent 10% of his total time that week while the second student would have spent only 1% of his or her time. The graph on the right uses this "proportion of time" metric.

That graph on the right more clearly shows that students spent the greatest proportion of time in the last 10 days of the program. If you go up to a proportion of 0.50 and then right to the line, you can see students spent half their time in ALEKS in the first 4.5 weeks (31 days). The second half of their time was spent in the remaining 14 days. In fact, the average student spent 20% of their total time in ALEKS in the final 5 days of the program. We can, perhaps, focus on this to improve the program next year.







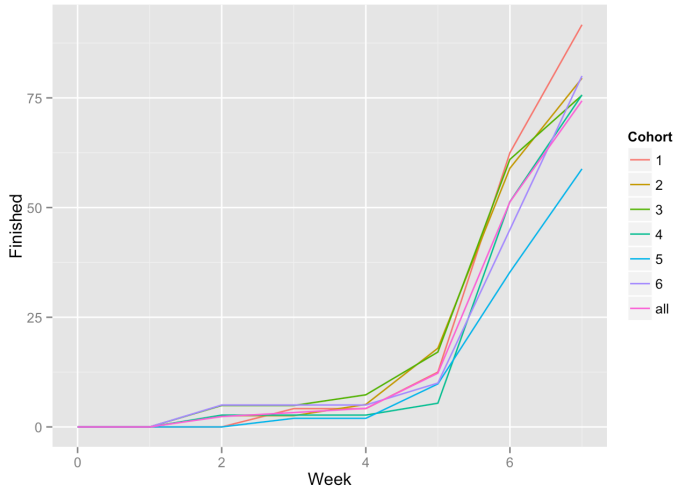
The graph on the right shows this "cumulative proportion of time" for students based on their initial mastery levels. It does show that students with 75% or greater initial mastery were less likely to procrastinate (the line is the most diagonal-like).

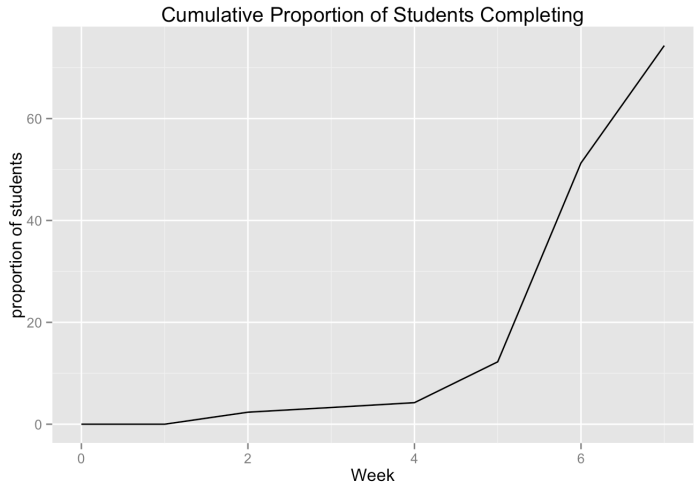
The graphs shown below display the cumulative proportion of students who completed ALEKS (mastered 100% of the topics) each week. One graph shows it separately for each cohort (orientation group), while the other graph shows the information for all 198 students who participated.

The performance of the cohorts did vary, but I don't know that it tells us anything. The graph on the right shows the vast majority of students finished in the last week (or 3-day extension). In fact…

At the end of week 1…	0% of students had mastered 100% of topics
At the end of week 2…	2% of students had mastered 100% of topics
At the end of week 3…	3% of students had mastered 100% of topics
At the end of week 4…	4% of students had mastered 100% of topics
At the end of week 5…	12% of students had mastered 100% of topics
At the end of week 6…	51% of students had mastered 100% of topics
With the 3-day extension:	74% of students had mastered 100% of topics

Without the 3-day extension (that students were unaware of), we would have had 46 fewer students finish the program.





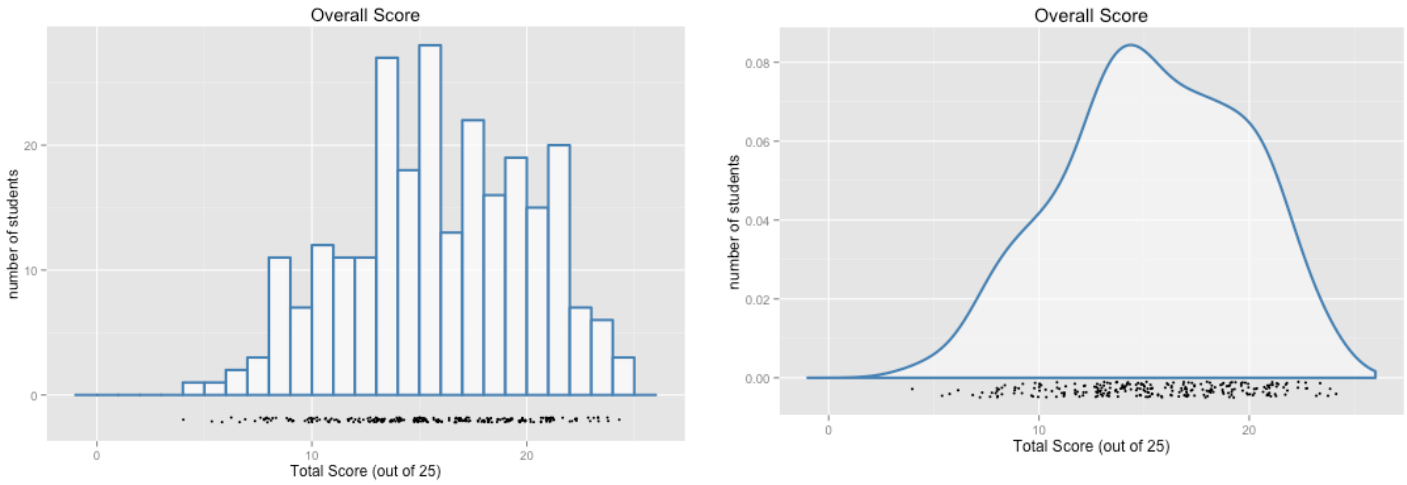
Performance in subsequent math class

At the beginning of the Fall 2014 semester, all students in MATH 171 were given a prerequisite skills test. This 25-question multiple-choice test, developed by faculty in the Department of Mathematics & Statistics, consisted of questions chosen to match the objectives of the summer developmental math program. Each of the 100 questions originally developed aligned with a single objective. Then, the final 25 questions were chosen by selecting the (perceived to be) easiest questions that assessed each objective.

After administering the test, but before grading it, two faculty members predicted average and median scores in the low 70% range.

The test was administered to 253 students (59 of whom completed the summer developmental math program).

The overall average score was 15.4 / 25 = 62% with a median of 60%. The following plots display the distribution of scores…



Since the test was given at the beginning of the semester – before any direct instruction was given in the class – scores shouldn't have varied much from instructor-to-instructor. The following table shows these average scores by instructor:

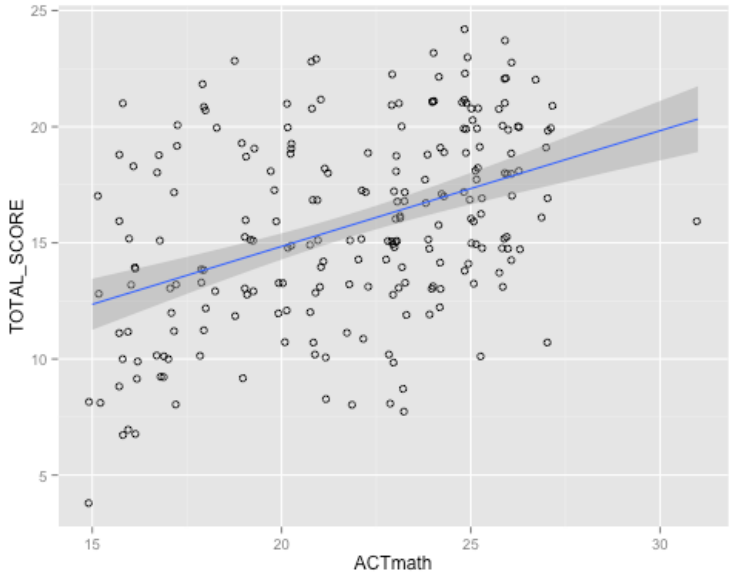
	Instructor	n	average	AvgPct
1	A	55	16.5	0.660
2	B	73	13.3	0.534
3	C	26	16.3	0.652
4	D	25	14.6	0.584
5	E	50	17.1	0.684
6	F	24	15.8	0.630

Because Instructor B was the only instructor identified on Beeline as students began registering for classes – and because this instructor's classes filled-up before any other sections – it's entirely possible that Instructor B's class may include a larger proportion of non-freshmen students. These students would, therefore, include weaker students who did not complete MATH 099 during their first semester at St. Ambrose and students who may have not taken a math class in several years.

Average score for the 59 students who did complete the summer math program: 15.1 (60%)
Average score for the 194 students who did not complete the summer math program: 15.5 (62%)

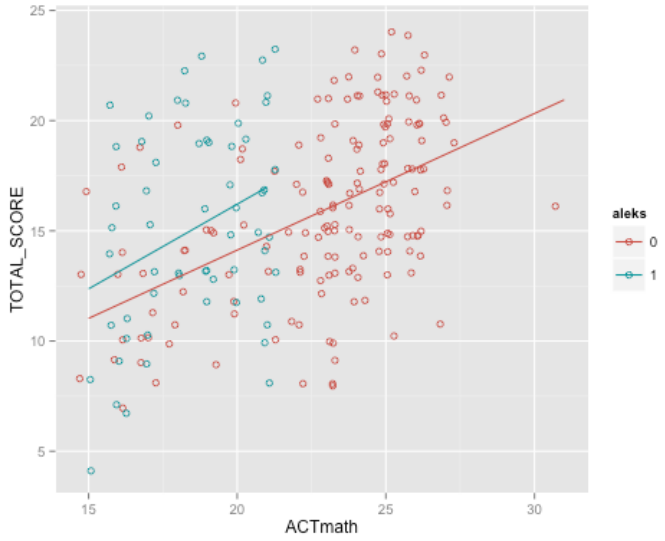
Based on these average scores, one might conclude the summer program did not prepare students for MATH 171. Keep in mind, however, that the students who completed the summer program had much lower ACT Math scores (21 or less), so they were expected to score lower on this test.

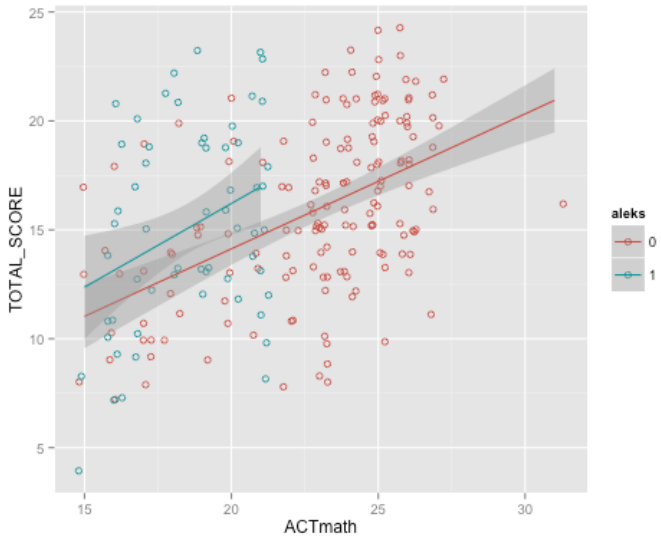
To determine the impact of the summer program, let's analyze the relationship between ACT Math scores and scores on this test for each group of students separately.



The above graphs displays the regression line of prerequisite test scores on ACT Math scores. As expected, students with higher ACT Math scores earned higher scores on the prerequisite test.

The graphs below display regression lines for the students who completed the summer program and those who did not.





Students who did not complete the summer program: Score = 1.7316 + 0.6197(ACT Math score). R-squared = 0.24, p<0.001.

Students who did complete the summer program: Score = 0.838 + 0.769(ACT Math score). R-squared = 0.11, p=0.0104.

The fact that the blue line is above the red line indicates the summer program did help students prepare for MATH 171. For a student with an ACT Math score of 21 (the cut-off for inclusion in the summer program), we would predict the following scores on the prerequisite test:

- 17 out of 25 (68%) if the student did complete the summer developmental program
- 14.8 out of 25 (59%) if the student did not complete the summer developmental program

Thus, we can estimate the effect of this program to be an 8% improvement on the prerequisite test.

Comparing nested regression models, we can find:

```
=========================================================================
Call:
lm(formula = TOTAL_SCORE ~ ACTmath, data = aleks171)

Residuals:
   Min     1Q Median     3Q    Max
-8.353 -2.838 -0.336  2.664  8.653

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)    4.880      1.613    3.03   0.0028 **
ACTmath        0.498      0.073    6.82  8.5e-11 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 3.77 on 219 degrees of freedom
  (32 observations deleted due to missingness)
Multiple R-squared:  0.175,      Adjusted R-squared:  0.172
F-statistic: 46.6 on 1 and 219 DF,  p-value: 8.53e-11
=========================================================================
Call:
lm(formula = TOTAL_SCORE ~ ACTmath + aleks, data = aleks171)

Residuals:
   Min     1Q Median     3Q    Max
-8.829 -2.660  0.015  2.738  7.617

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)    1.302      2.022    0.64   0.5205
ACTmath        0.638      0.087    7.34  4.3e-12 ***
aleks1         1.951      0.684    2.85   0.0047 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 3.71 on 218 degrees of freedom
  (32 observations deleted due to missingness)
Multiple R-squared:  0.205,      Adjusted R-squared:  0.198
F-statistic: 28.1 on 2 and 218 DF,  p-value: 1.37e-11
=========================================================================
```

Knowing if a student completed the summer program increases the R-squared value by approximately 3%. Additionally, students who do complete the program are predicted to have a higher prerequisite test score by 1.951 points (8%).

Conclusions:

- The program improved student preparation by 8% on a test of prerequisite skills for MATH 171.
- Even with the program, students have approximately 60% of the basic skills expected by math faculty teaching the course.
- It's too early to tell if the program will increase the proportion of students who pass MATH 171 (and other quantitative courses).