## First Semester Calculus Split Jane enturfield, chisis Easie, chi Kou

## Introduction

A broad study of calculus courses at North American institutions, conducted by the MAA, found that $67 \%$ of Calculus I students at PhD-granting institutions had been exposed to calculus by the end of high school. https://www.maa.org/sites/default/files/pdf/cspcc/lnsi ghtsandRecommendations.pdf

Starting in the 201609 term, the Department of Mathematics and Statistics replaced its existing Calculus I course (MATH 100) with two variations: MATH 109 for students with no previous calculus exposure and MATH 100 for students who had already taken a calculus course of some kind.

We investigate two questions:

1. Did students in 201609 have better Calculus I outcomes than students with a comparable background did in 201409 and 201509?
2. Did MATH 100 and MATH 109 both adequately prepare students for Calculus II, MATH 101?

We used final exam scores as a proxy for learning outcomes.

## Limitations

We considered only students whose previous exposure to calculus could be determined. For example, student whose high school math records were not available were discarded from the data set. This allowed us to compare 2016 students with past students, but did mean we had to ignore many students whose prior calculus exposure was indeterminate.

We used only one term of MATH 100/109 data, because this was the term in which the courses were most closely coordinated. For that reason we also considered only one term of MATH 101.

MATH 100 was run differently than usual in 2015, because one lecture section was used as a pilot for the split - all A04 students had prior calculus experience.

## MATH 100 \& MATH 109 outcomes

Both groups of students seem to have benefitted:
MATH 100 students with previous calculus experience performed slightly better in 2016 than students with previous calculus experience had historically in MATH 100.

MATH 109 students without previous calculus experience performed significantly better in 2016 than students without previous calculus experience had historically in MATH 100.

In both new courses, students with previous calculus experience performed better than students without previous calculus experience, but the "no experience" students and the

|  | 2014 | 2015 | 2016 |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- |
|  |  |  | M109 | M100 | Both |
|  |  |  |  |  |  |

Calculus 1 final exam score averages, as a percentage. Numbers in parentheses indicate total number of students. prior experience" students both performed better in 2016 than historically.

## MATH 101 outcomes

Final exam scores in MATH 100/109 were a very strong predictor of final exam scores in MATH 101.
Exposure to calculus before MATH 100/109 continued to have an influence on MATH 101 performance.
MATH 100 vs MATH 109 seemed to be a stronger predictor than was prior calculus exposure. This could be because the MATH 101 coordinator was also the MATH 100 coordinator; further study is necessary to determine whether this is a genuine difference between the two courses. Because this result was unexpected, we did not collect data on the historical relationship between MATH 100 and MATH 101 final exam scores, and so we cannot determine whether MATH 109 or MATH 100 was more usual.



Conclusions \&

## Recommendations

While the split seems to have benefitted students in their first semester, outcomes in second semester calculus are in second semester calcuius are
somewhat concerning (although further study is needed). We therefore recommend:
(1) That the MATH 101 coordinator should be the same person as the MATH 109 coordinator.
(2) That the MATH 100 and MATH 109 coordinators continue to take care to ensure that MATH 100 and MATH 109 maintain the same standards and level of difficulty.

## Next steps

Extend the study to include data from future course offerings.

Compare these results with historical MATH 100-to-MATH 101 correlation.


