MSAC and student success in Calculus 1

J. Butterfield and J. Manzer

Department of Mathematics & Statistics | Division of Learning & Teaching Support & Innovation

University of Victoria

? Does using the Math & Stats Assistance Centre improve course outcomes for students in Calculus 1?

✓ MSAC users in both MATH 100 and MATH 109 have better course outcomes than their peers.

MSAC users:

On at least **two different days** of the term, met with a tutor **to discuss Calculus 1**.

Why use this definition?

Consistent with the literature. One similar study considered as "users" only students who attended special sessions and did not consider their drop-in offerings at all [1]. Another compared students who visited "once or less" with students who visited "more than once" [2]. Pell and Croft put students into three groups [3], and Woodhouse used five groups [4]. Such fine-grained sieves result in very small group sizes, unsuitable for extrapolating results from the observed data to make a general statement about all Centre users, as we wish to do.

Preliminary analysis confirms weak MSAC impact for students who met with a tutor on only one day of the term. To verify our definition was sensible, we examined the apparent effect that the MSAC had on students who visited exactly once. Initial t-tests confirmed that impact was both small and statistically insignificant. For MATH 100, the mean grade for one-time users (264 records) was 1.10 higher than for nonusers (2820 records). For MATH 109, the mean grade out of 100 for one-time users (198 records) was 0.66 higher than for nonusers (1615 records). The p-values were not statistically significant (0.31 and 0.14, respectively).

Limitations:

Does not capture all users, such as students who work with a friend and do not sign up themselves. Some students who visited the MSAC for Calc 1 help could not be linked to a Calculus 1 grade record and are not captured by our data. This would include students who ask for Calculus 1 assistance in the MSAC but subsequently withdraw from the course.

Does not distinguish different types of user. A student who has multiple conversations with a tutor on one day is treated as identical to a student who has one conversation with a tutor on that day. The alternative would be to count the total number of conversations, which would cause a worse distinguishing problem by treating a one-day visitor who had many conversations the same as a regular visitor whose conversations were distributed over several days.

Course outcomes:

1. Final **course grade**.
2. Improved **class standing** between first in-class test and Final Exam.

Course grade includes pass/fail information, but N (incomplete) records excluded due to unknown circumstances.

Class standing defined by test score quintiles. To allow for comparisons between terms, grouped students based on their scores within their **cohort**: students in the same course in the same term, who wrote comparable test papers. Records excluded for cohorts with fewer than 50 students.

Why use these measures?

Option 1 easy to analyse, but inconclusive: students who choose to use the MSAC could simply be strong students.

Option 2 may control for this selection bias.

Limitations:

Test 1 not always 'pre intervention'. This study involved records from all in-person Fall and Spring courses 2016 – 2022, a large data set. We did not compare test dates with MSAC visit dates in order to exclude users whose MSAC interactions took place before their first test. Checking one sample term found 14 out of 299 "MSAC users" would have lost their status that term if we had. We did exclude courses that had their first mid-term written test too late in the term, records from students who had been excused from the test, and records from students who did not write a final exam.

More improvement on tests

We examined movement between quintiles from test one to the final exam.
- Top quintile: MSAC users and their peers are **similar**.
- Quintiles 2-4: strong evidence of **more positive outcomes and fewer negative outcomes** for MSAC users (Chi-squared test statistic 6.67, 8.00, 9.20 respectively, p<0.05).
- Bottom quintile: weak evidence of **more positive outcomes** for MSAC users (Chi-squared test statistic 1.18, p-0.28).

The table below gives the observed number of MSAC users from each Test 1 quintile whose final exam score put them in a worse quintile, a better quintile, or the same quintile. The expected number for each category, based on the probabilities from nonusers, is indicated (in brackets).

	Got worse	Stayed the same	Improved
Top quintile	74 (74)	85 (85)	N/A
Quintile 2	37 (50)	36 (29)	50 (36)
Quintile 3	32 (42)	30 (34)	50 (36)
Quintile 4	18 (31)	32 (30)	49 (38)
Bottom quintile	N/A	40 (45)	40 (35)

Better Course grades:

MATH 109 (2118 nonusers, **305 users**)
- Mean final course grade **4.66 points higher** for users (t-test, p<.001).
- Strong evidence of improved passing rate: **10 points higher** for users (Z-test statistic 4.45).

MATH 100 (3084 nonusers, **300 users**)
- Mean final course grade **3.39 points higher** for users (t-test, p<.001).
- Some evidence of improved passing rate: **4 points higher** for users (Z-test statistic 1.57).

Works Cited

[1]   R. H. Cuthbert and H. MacGillvray, "Investigation of Completion rates of Engineering students," 26-30 November 2007. [Online]. Available: http://www.mathcentre.ac.uk/resources/uploaded/delta-2007-cuthbert-macgillvray.pdf. [Accessed 11 08 2022].

[2]   C. Mac an Bhaird, T. Morgan and A. O'Seah, "The impact of the mathematics support centre on the grades of first year students at the National University of Ireland Maynoot," Teaching Mathematics and Its Applications, vol. 28, no. 3, pp. 117-122, 2009.

[3]   G. Pell and A. Croft, "Mathematics Support - support for all?," Teaching Mathematics and Its Applications, vol. 27, no. 4, pp. 167-173, 2008.

[4]   S. Woodhouse, "Developing Maths Support," MSOR Connections, vol. 4, no. 4, pp. 1-5, 2004.