

# An Evaluation of Students' Retention in STEM at the University of Wisconsin - River Falls

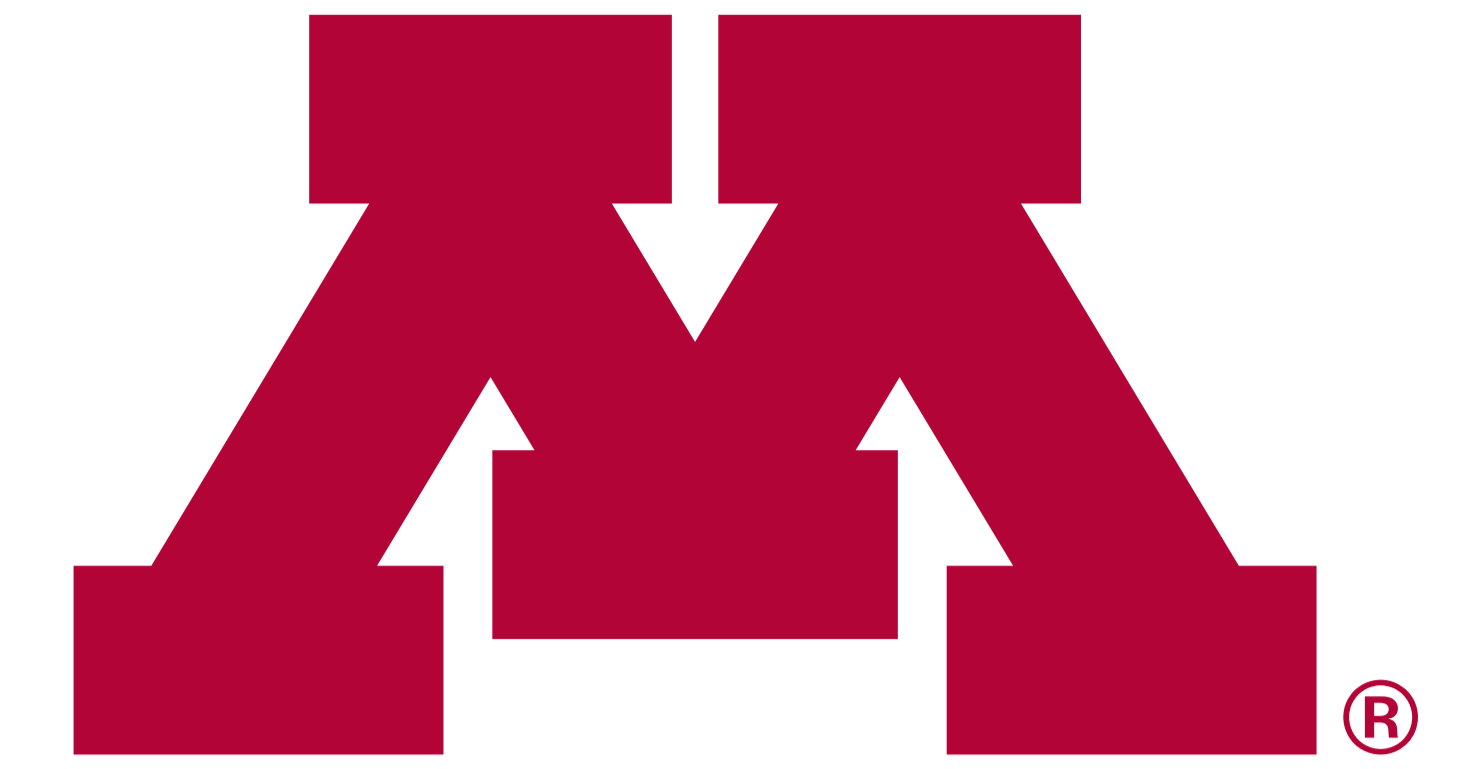
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## Abstract

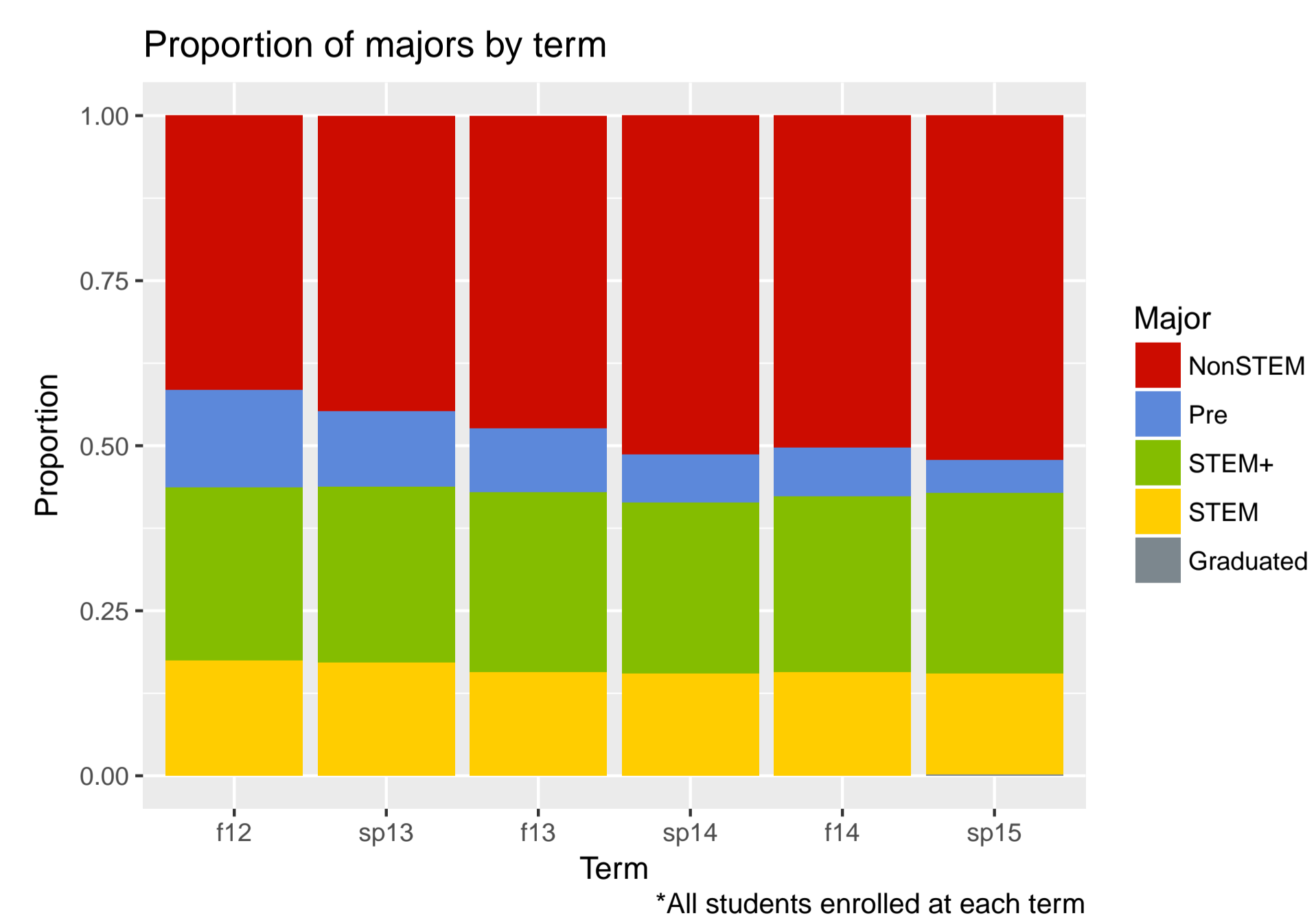
We use survival analysis methods to quantify student retention in STEM programs. The data analyzed are administrative data obtained from the University of Wisconsin - River Falls between Fall 2012 and Spring 2015. Our analysis shows that approximately *half* of the students who start a STEM degree will drop out prior to completion of their third year. Further evidence suggests that high school percentile and ethnicity are significant factors in students' immediate success in STEM programs.

## Introduction

The goal of this study is to gather insight into the retention of students in STEM programs and determine which variables (if any) are indicative of a student's choice to drop out (we denote as **event** = 1). We make use of both **Cox proportional hazards models** and non-parametric **Kaplan-Meier estimators**.

The data comprises 4,106 observations (students) and 42 unique variables. These variables include: gender, Pell eligibility, ACT scores, veteran status, major, GPA, and high school class rank, among others. For each term, and throughout the length of observation, students are grouped into four categories based on their declared major: STEM, Applied STEM, Pre-Major, and Non-STEM. STEM corresponds to students enrolled in one of biology, biotechnology, science education, chemistry, environmental science, geology, math, math education, and physics.

We define a *STEM student* as one who enrolled in any of the nine relevant majors at *any* time throughout the observation period. In total, we observe 750 STEM students.



## Survival Analysis

The event of interest is the *first initial* exit from a STEM program. That is, once a student enrolls in a STEM major, we are interested in the first time they exit the program regardless of circumstance or reason. **We found that 302 of the 750 STEM students were known to have an event (40%).**

time	n.risk	n.event	survival	std.err	lower 95% CI	upper 95% CI	
1	1	750	156	0.79	0.02	0.76	0.82
2	2	573	92	0.66	0.03	0.63	0.70
3	3	281	34	0.58	0.03	0.55	0.62
4	4	211	13	0.55	0.04	0.51	0.59
5	5	108	7	0.51	0.05	0.47	0.56

Table 1: Survival function for STEM students.

The previous table shows that of the 40% of students known to have had an event, more than half of those events (roughly) occurred immediately after the first semester in the program. **Further, our findings suggest that the probability of exiting the program (at least once) prior to students completing their sixth term is approximately 48.7%.**

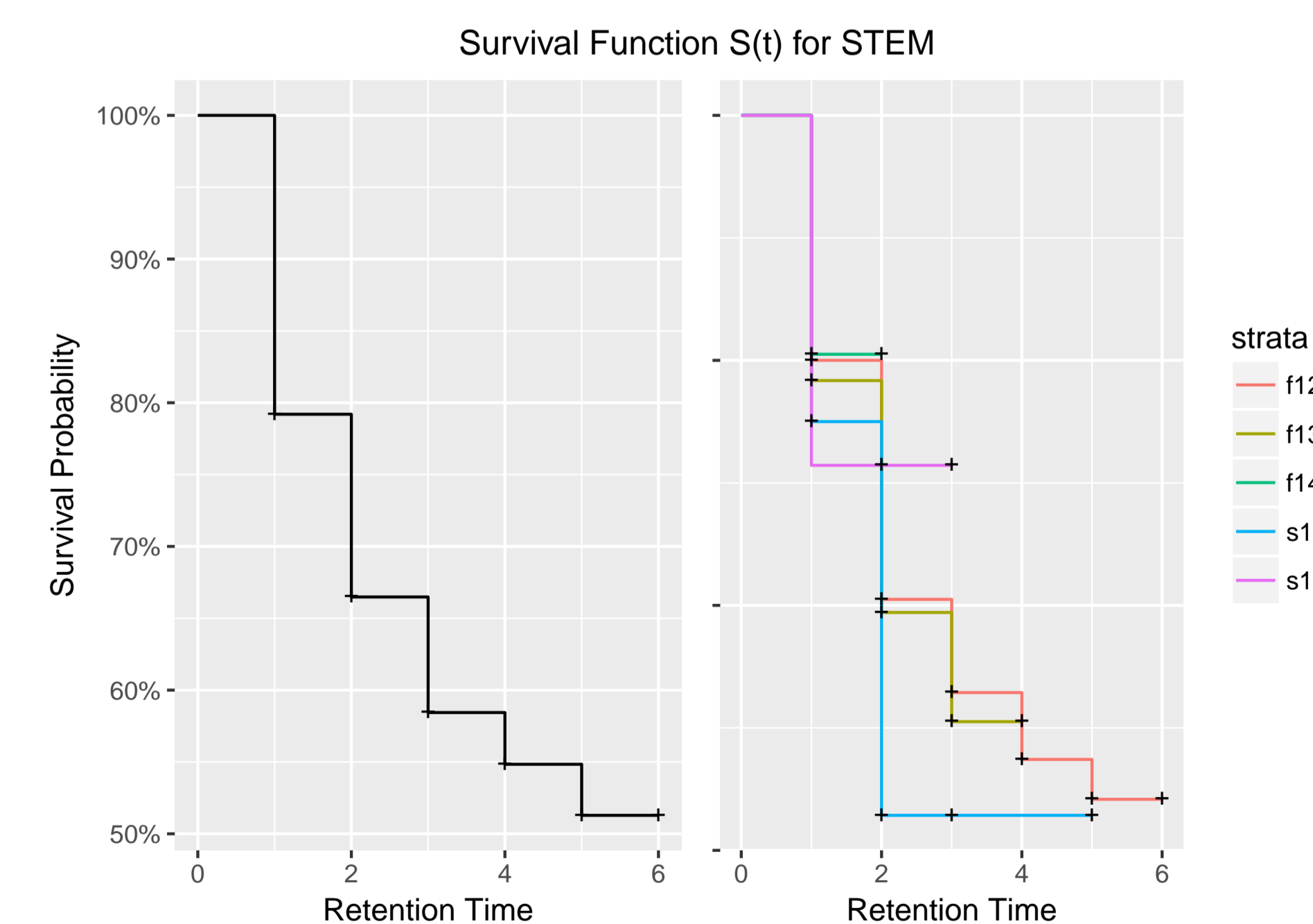


Figure 1: Survival function for STEM students by term.

## Indicators

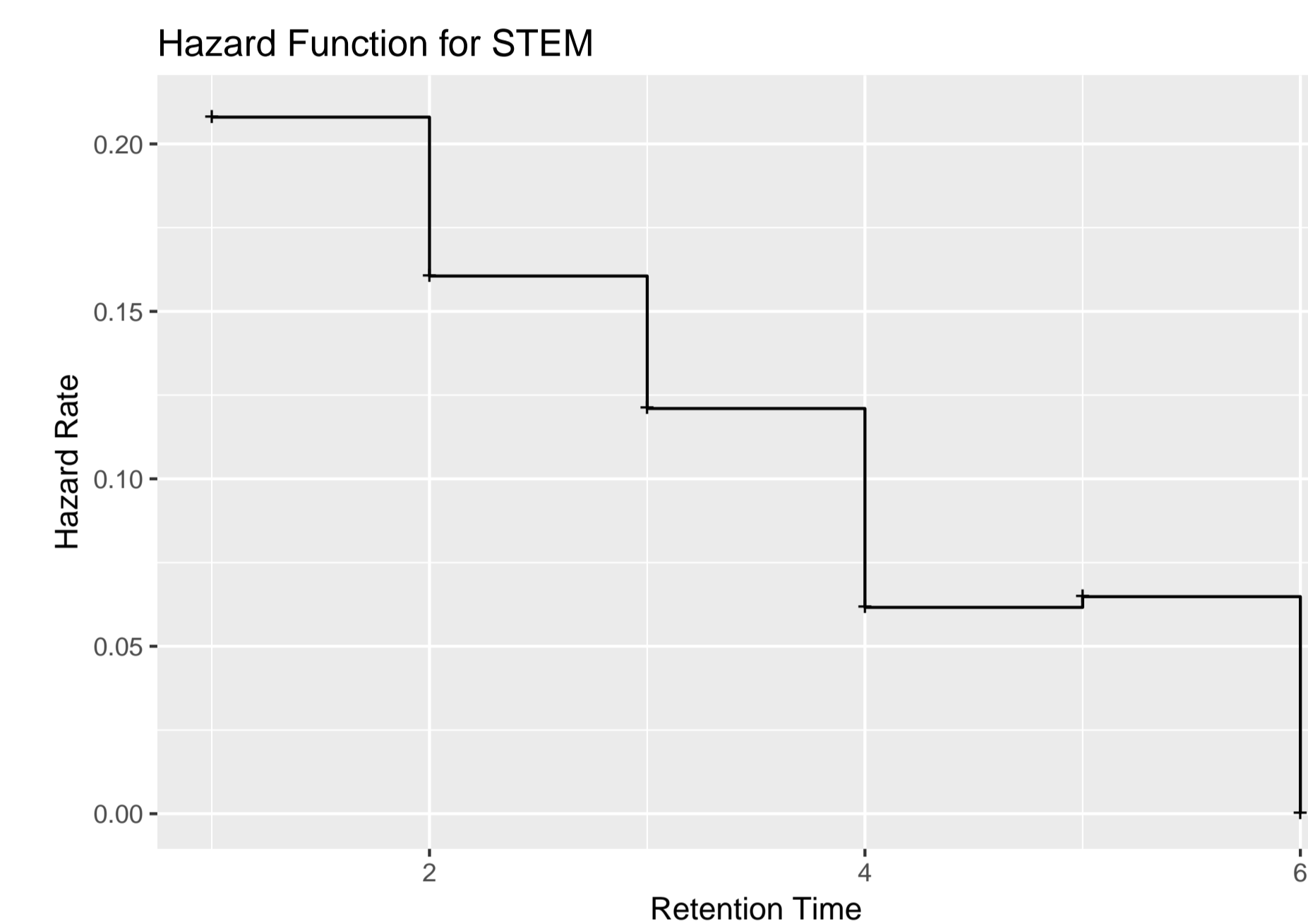


Figure 2: Hazard function for dropping out of a STEM-qualified major by term.

To determine factors that might be suggestive of at-risk students, we fit a proportional hazards regression model. Unsurprisingly, we find that the higher the GPA of students' first STEM semester, the less likely they are to exit the program. Further, the larger the high school class size, the greater the survival probability. A possible explanation for this is that more populated schools presumably have more funding are able to offer the students more resources, greater variety of coursework, and extra-curriculars.

	coef	exp(coef)	se(coef)	z	p
cohortf13	-0.06	0.94	0.16	-0.37	0.71
cohortf14	-0.97	0.38	0.22	-4.46	0.00
cohorts13	0.59	1.81	0.42	1.42	0.16
cohorts14	-0.17	0.84	0.42	-0.41	0.68
HS.Class.Size	-0.00	1.00	0.00	-3.62	0.00
first.STEM.gpa	-0.83	0.44	0.08	-10.23	0.00

Table 2: Fitting Proportional Hazards Regression Model:  $\text{Surv}(\text{survived}, \text{event}) = (\text{cohort} + \text{HS.Class.Size} + \text{first.STEM.gpa})$

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## Conclusions

- We find that approximately 20.8% of students will drop out of a STEM-qualified major after their first semester and approximately 48.7% of students will drop out (at least once) prior to the completion of their third academic year. Note that we define a drop-out as a student exiting the program for any reason.
- Prior to the fourth semester, the likelihood of exiting a STEM program decreases gradually throughout enrollment and plateaus thereafter.
- High school class size is indicative of a student's survival probability. The larger the high school class size, the less likely the student is to drop out of the program.
- First STEM term GPA is the most significant variable in the retention of students in STEM majors. The higher the first term GPA, the lower the probability of exiting the program. Further, both high school percentile and ethnicity are significant variables in predicting first term STEM GPA. Our findings suggest that a student from an under-represented minority population will, on average, perform worse in their first semester of a STEM-qualified major than non-minority students.

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	0.85	0.28	3.05	0.00
Ethnicity1	-0.44	0.12	-3.64	0.00
HS.Percentile	0.02	0.00	8.11	0.00

Table 3: Fitting Regression Model:  $\text{first.STEM.gpa} =$

## References

- [1] Cheng Zhang. An Evaluation of Students' Retention in STEM at the University of Wisconsin - River Falls. August 2016.

## Acknowledgements

This work is heavily influenced by Cheng Zhang's report *An Evaluation of Students' Retention in STEM at the University of Wisconsin - River Falls* and was completed in collaboration with Jamie Schneider, PhD (UWRF) and Frances Lawrenz, PhD (UMN).