Wyoming Statewide Longitudinal Education Data System

Post-Secondary Education
College Readiness Research Report

June 13, 2022

Abstract

Through Wyoming's collaborative Statewide Longitudinal Education Data System (SLEDS) initiative, Participating Entities utilize data to assess impacts on education and workforce outcomes. One of the preliminary research questions from the SLEDS Executive Governance Board relates to understanding the success of students taking developmental courses.

Every year post-secondary education stakeholders in Wyoming express a desire to understand the impacts of developmental coursework programs on a student's success. Data on developmental coursework is available at all school levels throughout the country. Yet, the SLEDS project team members only found a relatively small amount of research on impacts of developmental coursework across multiple institutions.

Researchers from Wyoming's community colleges, the Wyoming Community College Commission, and the University of Wyoming conducted research to better understand the success of students taking developmental courses. The researchers collected and analyzed developmental coursework from each Wyoming public post-secondary institution, focusing on all degree-seeking students who first enrolled at any Wyoming post-secondary college from Fall 2009 through Fall 2020. Researchers found that 45.8% of the degree seeking students were enrolled in developmental coursework. Furthermore, we determined that these students were less likely to successfully complete degree programs and coursework and more likely to drop out.

Preface

In 2019, the State of Wyoming was awarded a Statewide Longitudinal Data System grant from the U.S. Department of Education. This grant provided resources to meet a state legislative requirement to build a longitudinal data system. Through collaboration between Wyoming's community colleges, UW, and WCCC the first data sharing environment was created, allowing for partnership data to be combined and analyzed together for this specific research report. This inaugural research illustrated our abilities to share information, while highlighting areas that could be refined moving forward. The knowledge gained from this initial research opportunity was used to improve data sharing methods and accessibility.

We acknowledge that the research population and statistical analyses for this first research project were limited by the initial data environment, and may look different compared to similar research conducted in the future.

Contents

1   Introduction

The SLEDS research team explored associations between student success and college developmental coursework at the post-secondary level in the State of Wyoming. The researchers initially conducted extensive planning on required data elements, cohorts, and hypotheses over several years as the SLEDS infrastructure, legal framework, and policies and procedures were simultaneously developed and implemented. Researchers built the data dictionary foundation for this research and subsequent research requests.

The primary request for the research on developmental coursework came from the Executive Governance Board when the SLEDS initiative was in the initiation phase (in 2019). The research team followed the approved SLEDS research request process, resulting in this report.

Starting with the research proposal, we first identified core measurements of success. One of the core measures of student success in higher education is academic program completion. Possessing the necessary skills to complete college level work is often considered an underlying factor in the likelihood students persist to graduation. We consider this "college readiness". Each academic year, education stakeholders and policy makers regularly inquire on readiness of students arriving at community colleges and the University of Wyoming.

While interest in researching developmental course impacts is not new, SLEDS provides Wyoming with a more comprehensive and current analysis of these questions. Our research provided an opportunity to analyze outcomes of thousands of students attending post secondary education in Wyoming over more than a decade. Researchers aimed to gain insight on factors which affect outcomes of students taking developmental courses.

1.1   Research Questions

In 2019, the SLEDS Executive Governance Board identified the following questions related to post secondary education outcomes which are further distilled for this analysis.

1. How many students entering Wyoming community colleges and the University of Wyoming are college ready, and how many are taking developmental classes?

2. How successful are developmental students long-term?
   Based on these research questions, the SLEDS research workgroup formulated several hypotheses:

   - Students who take developmental classes are less likely to graduate with a Post-Secondary degree or credential than those who do not take developmental classes.

   - Students who enroll in developmental mathematics or English courses are more likely to pass subsequent college level mathematics or English classes.

   - Students who take developmental classes have a lower ratio of credit hours completed to credit hours taken in comparison to students that do not take developmental classes.

1.2   Key Terms

Courses
A unit of teaching covering an individual subject that typically lasts one academic term, has one or more instructors, and has a fixed roster of students. For this request, courses that fulfill English general education requirements are categorized as English courses, and courses that fulfill mathematics general education requirements, including mathematics and statistics, are categorized as mathematics courses (Appendix 8.1).

Developmental Courses
Courses designated by each institution with the intent of developing basic skills and providing support for students who are otherwise unprepared for college level coursework in mathematics and English. Developmental courses were broken out into remedial and co-requisite courses. A remedial course is taken at least one semester prior to the required college-level course and has a course number less than 1000. A co-requisite course is taken during the same semester as the required college-level course.

College-Level Courses
Any nondevelopmental course with a course number of 1000 or higher.

College Ready Student
Someone who did not enroll in a developmental course, but enrolled in at least one college-level course during the study timeframe.

Not College Ready Student
Someone who has been enrolled in at least one developmental course.

Earned Credit
Credit that is applied toward a degree program.

Successful Course Completion
Student received a course grade of A, B, C, or Satisfactory (S).

Unsuccessful Course Completion
Student received a course grade of D, F, Unsatisfactory (U), or Withdrawal (W). Students earned credits for D grades.

Dropout Student
A student who left college during the study timeframe without a certificate or degree and was not enrolled in any of the next five subsequent semesters after the first developmental or college-level course.

Academic Year
The span of a year in which an institution holds courses, starting with summer and ending the following spring.

1.3 Data Sources

The research workgroup utilized data from the Wyoming Statewide Longitudinal Education Data System (SLEDS) for this research. The University of Wyoming extracted data from its Banner Operational Data Store (ODS) and the colleges extracted data from the Wyoming Community College Commission's (WCCC) Data Management and Reporting System (DMARS). DMARS maintains data from all seven of Wyoming's community colleges. The researchers utilized records starting with students enrolled at census for the study timeframe. Researchers also utilized live data from each of the institutions since most of the Wyoming community colleges did not start capturing static data until 2016. In addition to the SLEDS environment, we utilized data from the National Student Clearinghouse (NSC) to gather information about a student's post-secondary education outside of Wyoming.

1.4 Study Sample

Our research team initially obtained a sample size of 96,276 degree-seeking students who were first enrolled at any Wyoming public post-secondary college during Fall 2009 through Fall 2020. We focused on students enrolled in at least one English or mathematics course during the study period at a Wyoming public post-secondary college. Therefore, we removed students without mathematics or English course records (16,959 students). This reduced the sample of students to 79,317. Removing these students may have resulted in underestimating the number of college ready students since some students may have received English and mathematics credits through dual and concurrent enrollment or transfer enrollment. Without a comprehensive record on students and courses taken, the teams made a prudent decision to exclude these students from the analysis.

1.5 Limitations and Assumptions

The SLEDS team acknowledges several limitations and assumptions related to the research and federated model for collecting, mapping, and analyzing data across Wyoming's higher education institutions. Several of these limitations substantiate the transition to a more efficient model with the high availability data system going forward. We highlight some of the key limitations and assumptions below:

1. **Some key measures of college readiness were not included in this research.** We did not have access to comprehensive student records across all institutions, such as standardized test scores, which limited researchers' abilities to analyze key measures of student success. Therefore, college ready students in our study may include students who have low placement scores and may be unprepared for college-level work but did not take a developmental English or mathematics course.

2. **Comparing not college ready students with college ready students has inherent bias.** Not college ready students may have other factors or preconditions such as demographic factors or socioeconomic status which affect student outcomes. Comparing student groups with similar characteristics could control selection bias. However, without access to these characteristic variables, we relied upon simple bivariate comparisons.

3. **Bivariate comparisons do not adhere to simple random samplings which cause possible selection bias.** The two-sample test for equality proportions and the Wilcoxon signed-rank test both assume use of simple random sampling. Since we conducted an observational study, we cannot randomly select students enrolled in developmental courses. Consequently, we can make associations with student groups, but we cannot make causal conclusions.

4. **We have some data inconsistencies since each institution has autonomous policies, systems, and data dictionaries.** For example, each institution has a different semester start date. Further, 4% of total students have credits that count towards cumulative earned credit hours for the term data but are not in the cumulative attempted hours. While we removed transfer credits, some non-course credits remained in our data set since we didn't have access to full records from each source system. Given the limited variables, we couldn't remove them from the SLEDS environment.

5. **Students may take a course twice from the same institution within the same semester with different grades.** We utilized the best grade within a given semester for this analysis. Consequently, we could be overestimating the percentage of courses being passed.

6. **Our research focuses on degree-seeking undergraduate students.** Students may take courses at multiple schools and transfer the courses back to the degree-seeking institution. Additionally, some students take courses outside of Wyoming or during high school and some gain course credits through placement tests. When taking individual courses, students are oftentimes classified as non-degree students. None of these courses were included in our research.

7. **Students enrolled at the University of Wyoming are considered English college ready, according to admission standards, and mathematics readiness is measured through standardized test scores.** University of Wyoming students who were not prepared for the University of Wyoming's mathematics courses were enrolled in at least one mathematics developmental course from Laramie County Community College, LCCC.

2 College Ready

Based on our analysis, 54% of the study population were identified as college ready, while 46% took some form of developmental English or mathematics course from Fall 2009 through Fall 2020. We further categorized not college ready students by type of developmental course. We also observed a larger number of remedial courses (n=69,122) compared to co-requisite courses (n=4,727). Figure 2.1 illustrates the percentage of college ready students versus not college ready students from all Wyoming institutions. For Wyoming institutions, remedial courses represent the traditional approach to preparatory courses compared to co-requisite courses which are becoming more pervasive in both practice and literature in recent years (Logue, 2018).

Note: We included a student's full post-secondary experience at any Wyoming institution in this study. A student taking a developmental course at any Wyoming post-secondary institution is classified as a not college ready student for the student's whole post-secondary career.
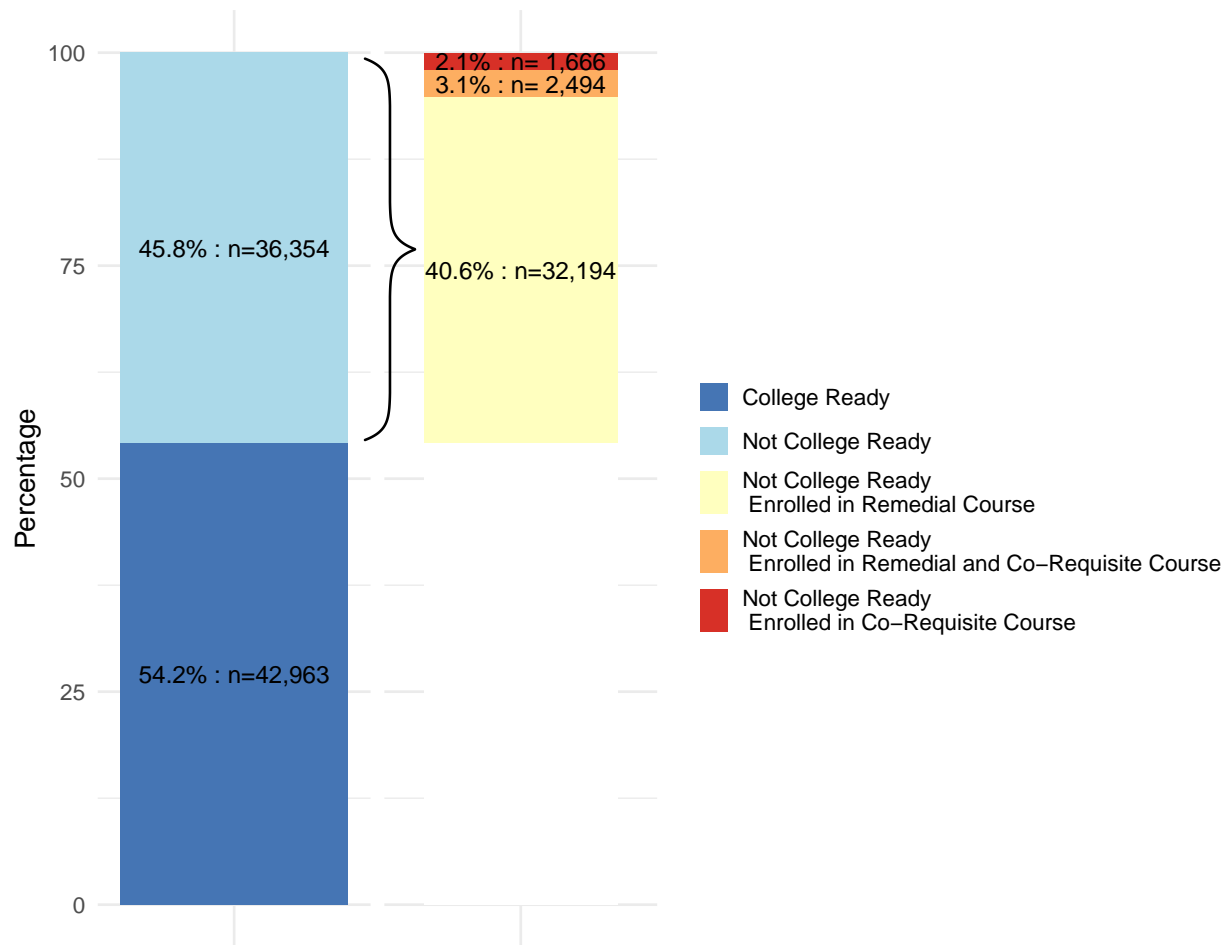

Figure 2.1: Percentage of Students by College Ready and Not College Ready

2.1 College Ready By Year

Based on our analysis, the number of college ready students fluctuated by year with an overall trend of increasing readiness over time. Figure 2.2 below shows the relationship between the percentage of college ready students by academic year.

Note: Data from Summer 2020 and Fall 2020 were excluded from all the figures broken down by academic year because Spring 2021 data was not provided for this study. Therefore, without Spring 2021 the proportion of students that were college ready for the academic year of 2020-2021 would be misleading.
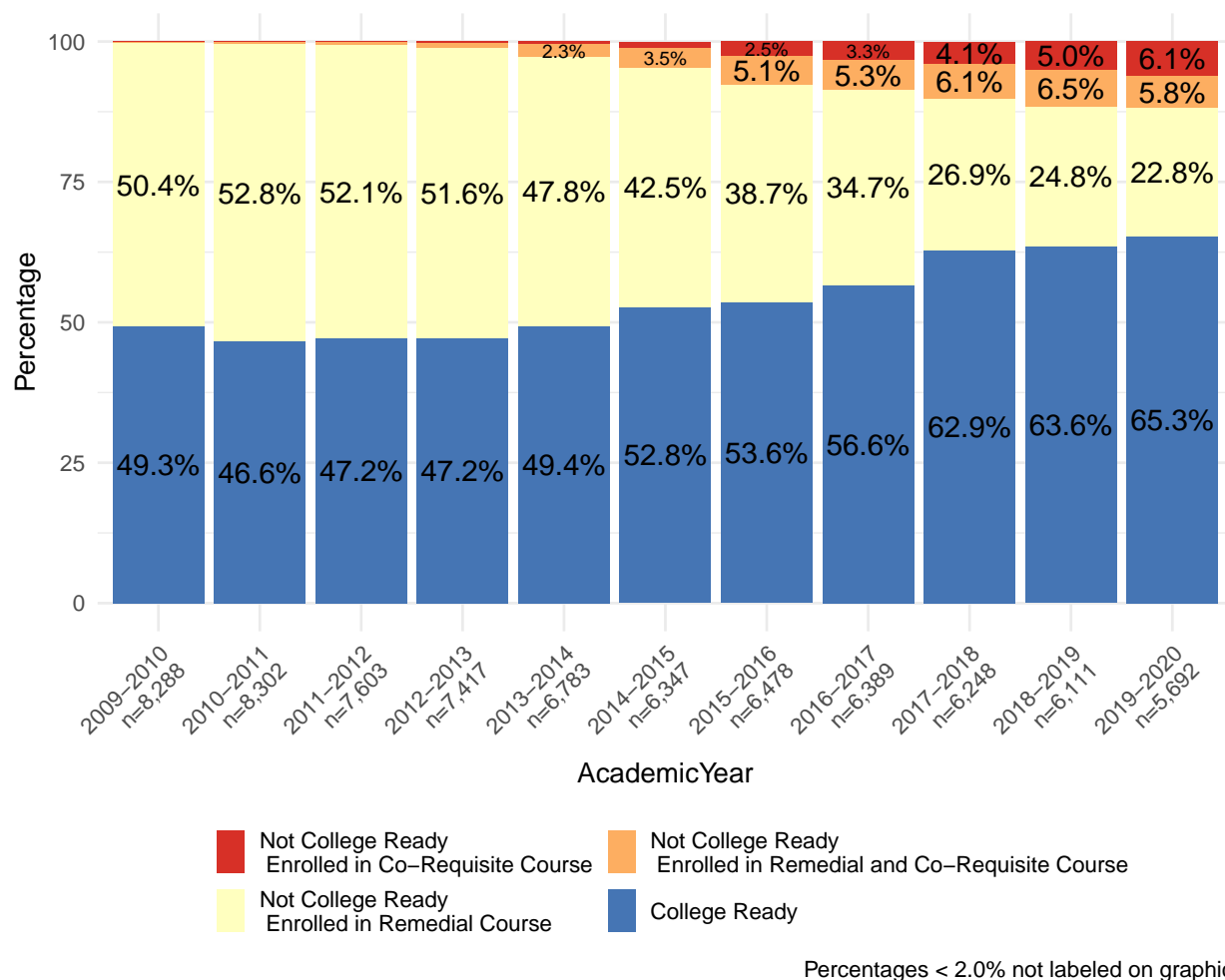

Figure 2.2: Percentage of Students by College Ready and Not College Ready Per Academic Year

2.2 College Ready By Course Subject

To further explore differences in college ready students by course subject, we subsetted data as follows: an English group and a Mathematics group. The English group consisted of students who enrolled in at least one English course while the Mathematics group consisted of students who enrolled in at least one Mathematics course. We then recalculated the percentage of college ready students for both groups. This showed the English group had a higher percentage of college ready students when compared to the Mathematics group. Table 2.1 provides the total number of students and the percentage of college ready students for each group. We further analyzed readiness by each group over time in subsequent subsections.

Table 2.1: Percentage of Students by Course Subject who were College Ready and Not College Ready

Classification	Number of Students	Percentage of Students (%)
English and Mathematics		
College Ready	42,963	54.2
Not College Ready	36,354	45.8
Not College Ready: Enrolled in Remedial Course	32,194	40.6
Not College Ready: Enrolled in Co-Requisite Course	1,666	2.1
Not College Ready: Enrolled in Remedial and Co-Requisite Course	2,494	3.1
Total	79,317	100.0
English		
College Ready	49,670	78.8
Not College Ready	13,349	21.2
Not College Ready: Enrolled in Remedial Course	9,814	15.6
Not College Ready: Enrolled in Co-Requisite Course	3,188	5.1
Not College Ready: Enrolled in Remedial and Co-Requisite Course	347	0.6
Total	63,019	100.0
Mathematics		
College Ready	36,823	52.7
Not College Ready	33,051	47.3
Not College Ready: Enrolled in Remedial Course	32,173	46.0
Not College Ready: Enrolled in Co-Requisite Course	501	0.7
Not College Ready: Enrolled in Remedial and Co-Requisite Course	377	0.5
Total	69,874	100.0

2.2.1 English

Over time, we didn't observe a strong increase in the percentage of college ready students for the English group with each academic year. However, we did observe a decrease in remedial English courses with a corresponding increase in co-requisite English courses over time. Figure 2.3 breaks the English group down by academic year.
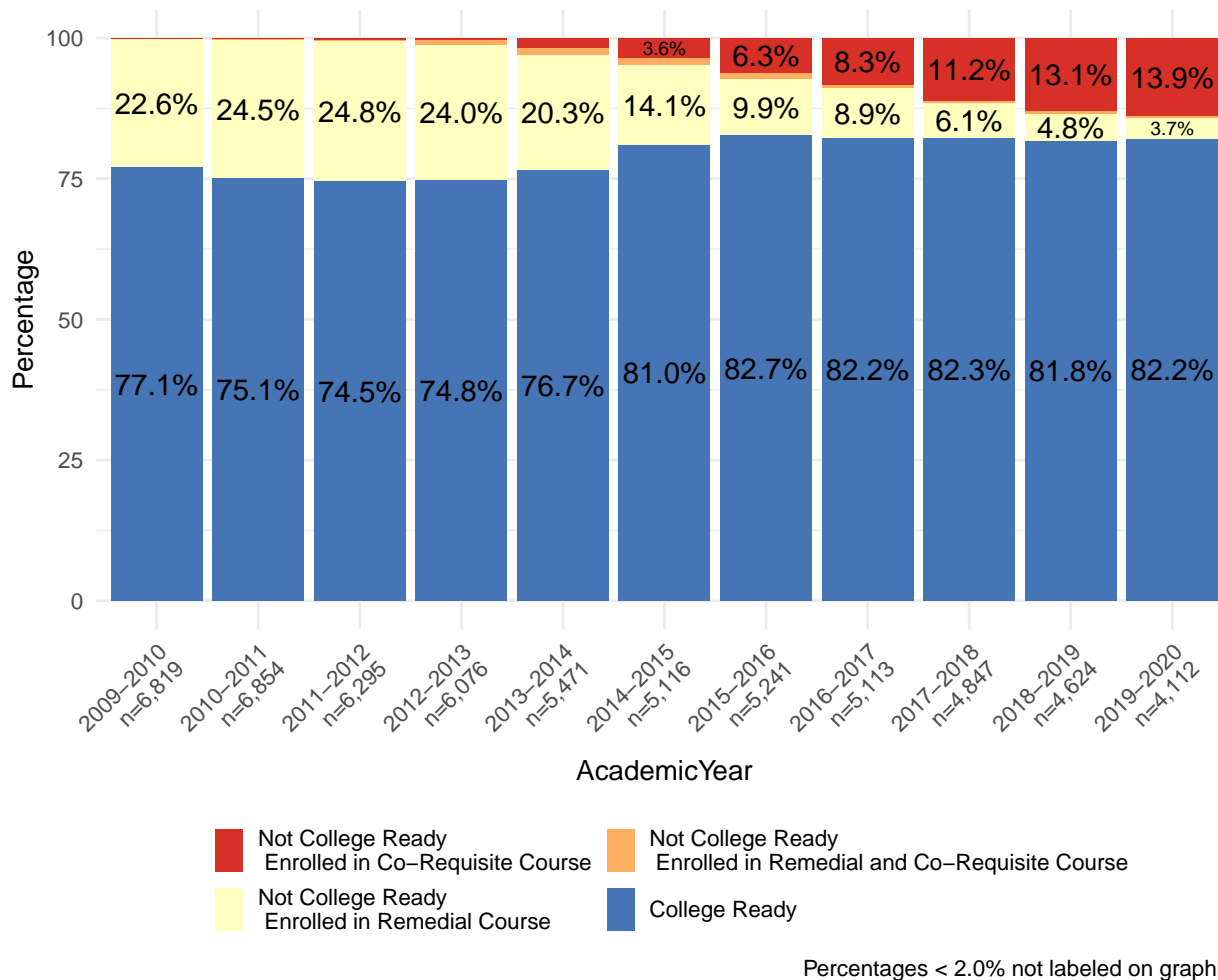
Figure 2.3: English: Percentage of Students by College Ready and Not College Ready Per Academic Year

2.2.2 Mathematics

We analyzed the Mathematics group using the same methods applied to the English group. The Mathematics group had an overall lower proportion of college ready students compared to the English group when analyzed by academic year (Figure 2.4). The not college ready students were consistently enrolled in remedial mathematics courses instead of co-requisite courses.
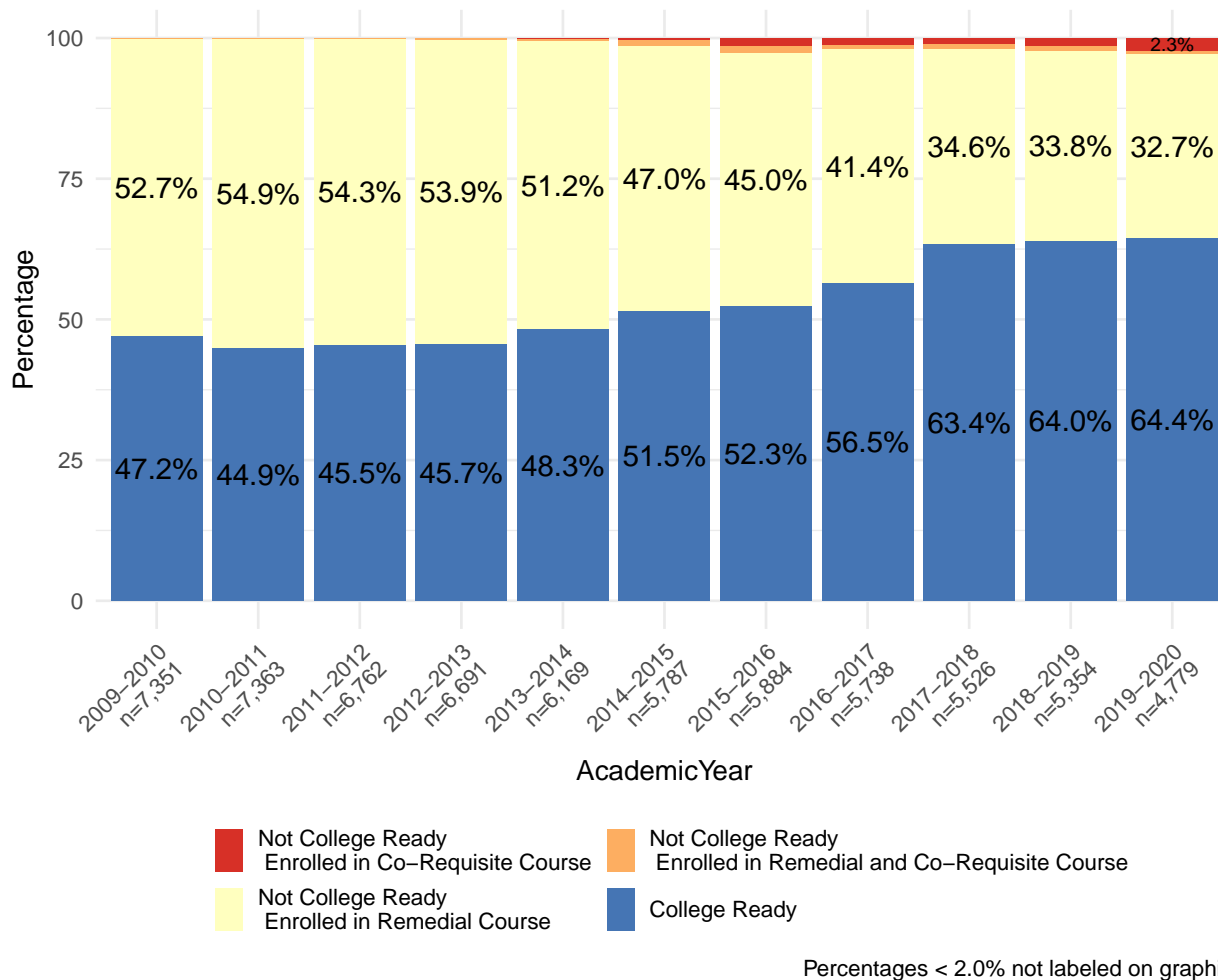
Figure 2.4: Mathematics: Percentage of Students by College Ready and Not College Ready Per Academic Year

The percentage of college ready students varies considerably by course subject. The proportion of college ready students fluctuates by year with an overall slight increase each academic year. This applies to both course subject groups, which suggests future developmental research should analyze results by course subject, or allow for statistical modeling variances by course subject. We may also consider exploring the relationship between remedial and co-requisite by course subject.

Our study focused on students' full experience across all Wyoming institutions. However, we also conducted exploratory analysis of the proportion of college ready students comparing the Wyoming Community Colleges and the University of Wyoming. Examining college readiness by institution type demonstrates that the University of Wyoming had the largest number of college ready students (Appendix A: College Ready Comparing the Wyoming Community Colleges and the University of Wyoming 7).

3 Long-Term Success

3.1 Graduation

Out of 79,317 unduplicated students, 37.4% graduated with a post-secondary degree or credential from a Wyoming institution. Among all the college ready students, 44.7% graduated with a post-secondary degree or credential while only 28.6% of not college ready students graduated with a post-secondary degree or credential within the study analysis time frame (Figure 3.1).

We assumed the probability of graduation in not college ready students would be less than college ready students. The test's confidence interval includes zero CI: [-1,-0.16]. We have enough variation to conclude that the proportion of college ready students who graduated was significantly greater than the proportion of not college ready students who graduated ($\alpha = 0.05$).
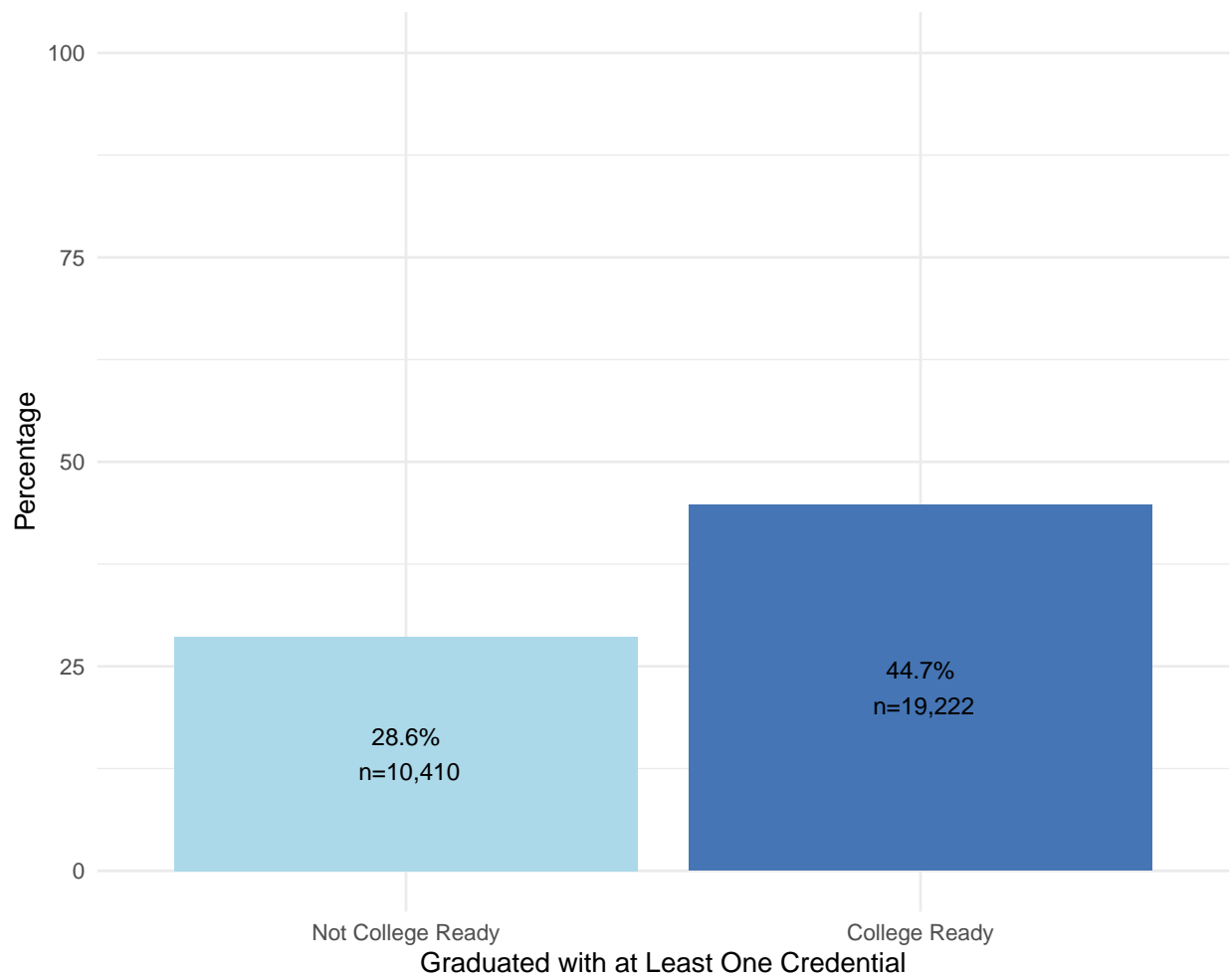

Figure 3.1: Percent of Students that Graduated with at Least One Credential from a Wyoming Institution

4 Short-Term Success

4.1 English and Mathematics Course Completion

We pulled 310,769 total course records for this analysis. The research showed that 76.2% of these courses were labeled as college-level and the remaining 23.8% were labeled as developmental courses. Figure 4.1 illustrates that there was a higher percentage of successful completions for college-level courses. Students who successfully completed college-level English or mathematics courses from outside the State of Wyoming, or through a placement test, were unavailable for this analysis. Therefore, there is a chance that the number of college-level completions could be underrepresented.
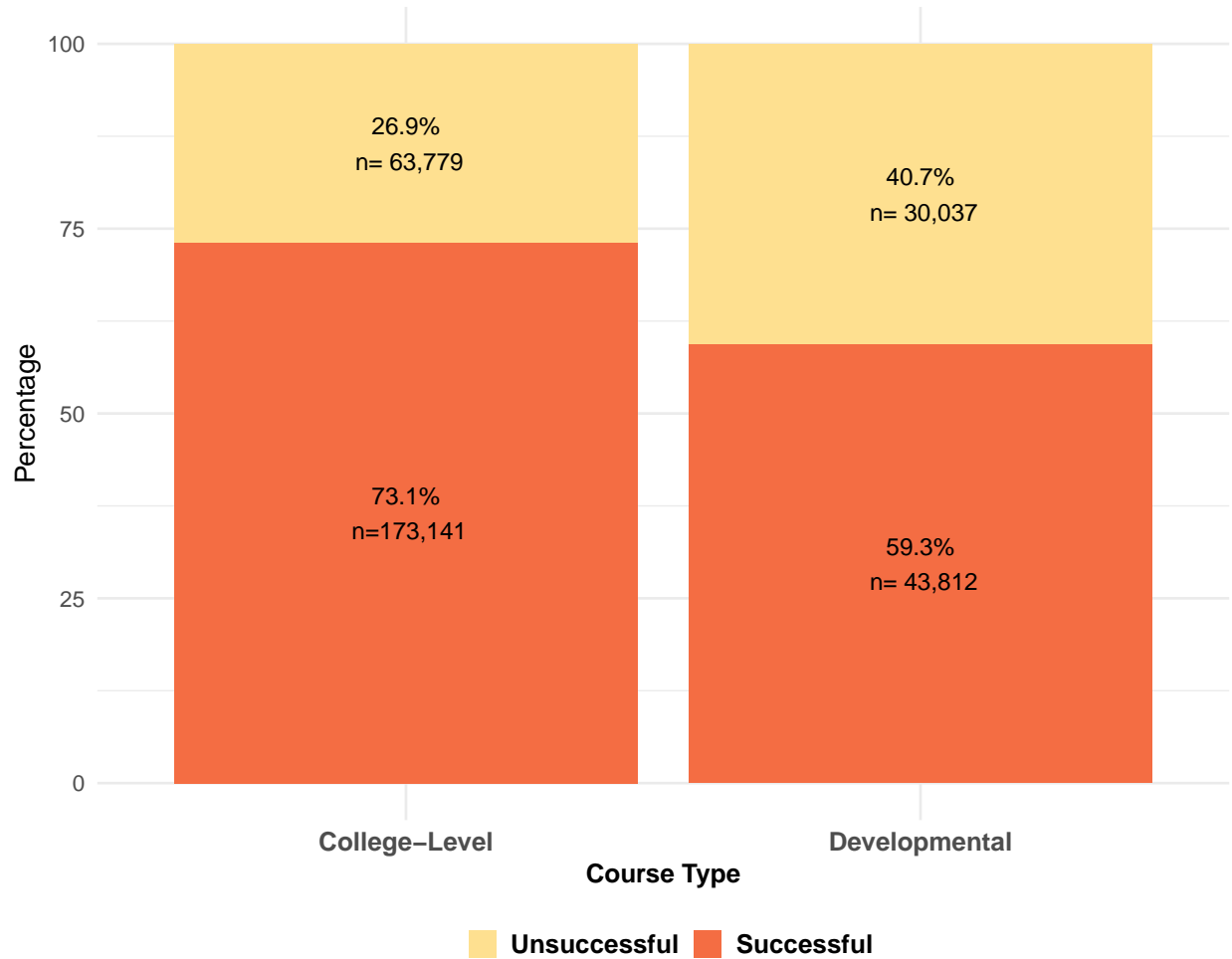

Figure 4.1: Percent of Students with Successful versus Unsuccessful Course Completion

All the Wyoming post-secondary institutions require most students to take at least one college-level English course for degree completion. Short-term developmental course enrollment success was measured by comparing college-level English success between college ready students and not college ready students. The study analyzed whether students who enrolled in a developmental English course were less likely to pass a subsequent or concurrent college-level English course. The researchers subsetted data to 58,585 unduplicated students who took at least one college-level English course. The data demonstrated that the proportion of courses successfully completed from college ready students was greater than that of the not college ready students CI: [0.11,1]. Again, we acknowledge the possibility of selection bias. We applied the same approach

to college-level mathematics courses. There were 54,566 unduplicated students who took at least one college-level mathematics course. The proportion of successfully completed college-level mathematics courses from college ready students was greater than that of the not college ready students CI: [0.08,1].
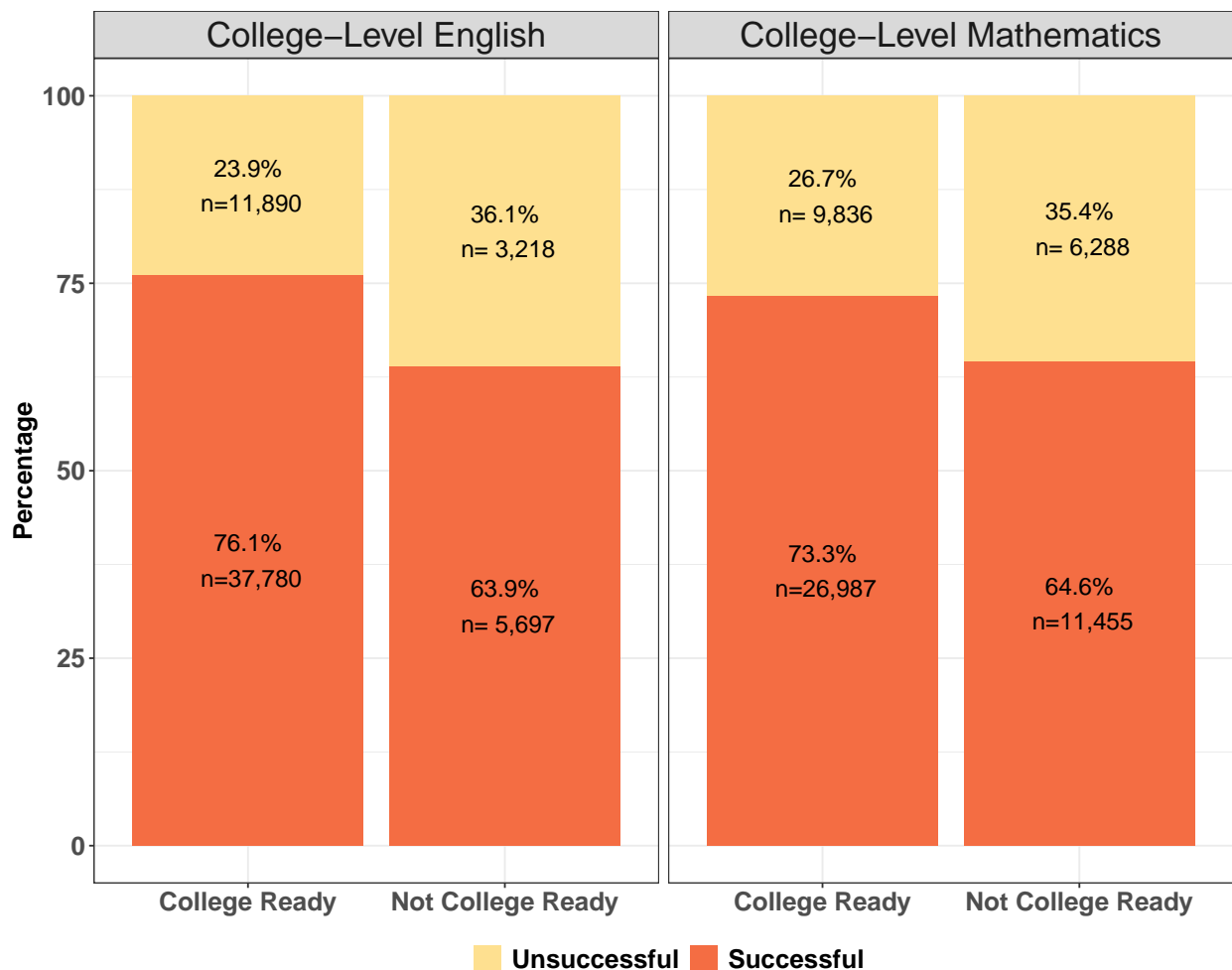

Figure 4.2: Percent of Students with Successful versus Unsuccessful First College-Level English and Mathematics Course Record

4.2 Persistence

Persistence is a key measurement of success for a student who takes developmental courses. We explored dropout rates between not college ready students versus college ready students. To analyze this, we removed students who obtained a bachelor's degree or associate degree prior to their first recorded English or mathematics course. To allow for tracking of five subsequent semesters, we removed any student who was enrolled in Summer of 2019 through Fall of 2020. Data from the National Student Clearinghouse, NSC, was used as an additional check of whether a student obtained a credential or degree outside Wyoming following their first course record. In addition, NSC data with an enrollment status of full-time, half-time, less than half-time, or three-quarter time was used to check if a student continued course work outside of Wyoming. Figure 4.3 illustrates that 65.7% of the dropout students were not college ready students. Acknowledging selection bias, we can conclude that the proportion of dropout students who were not college ready is greater than the proportion of dropout students that were college ready CI: [0.3,1].
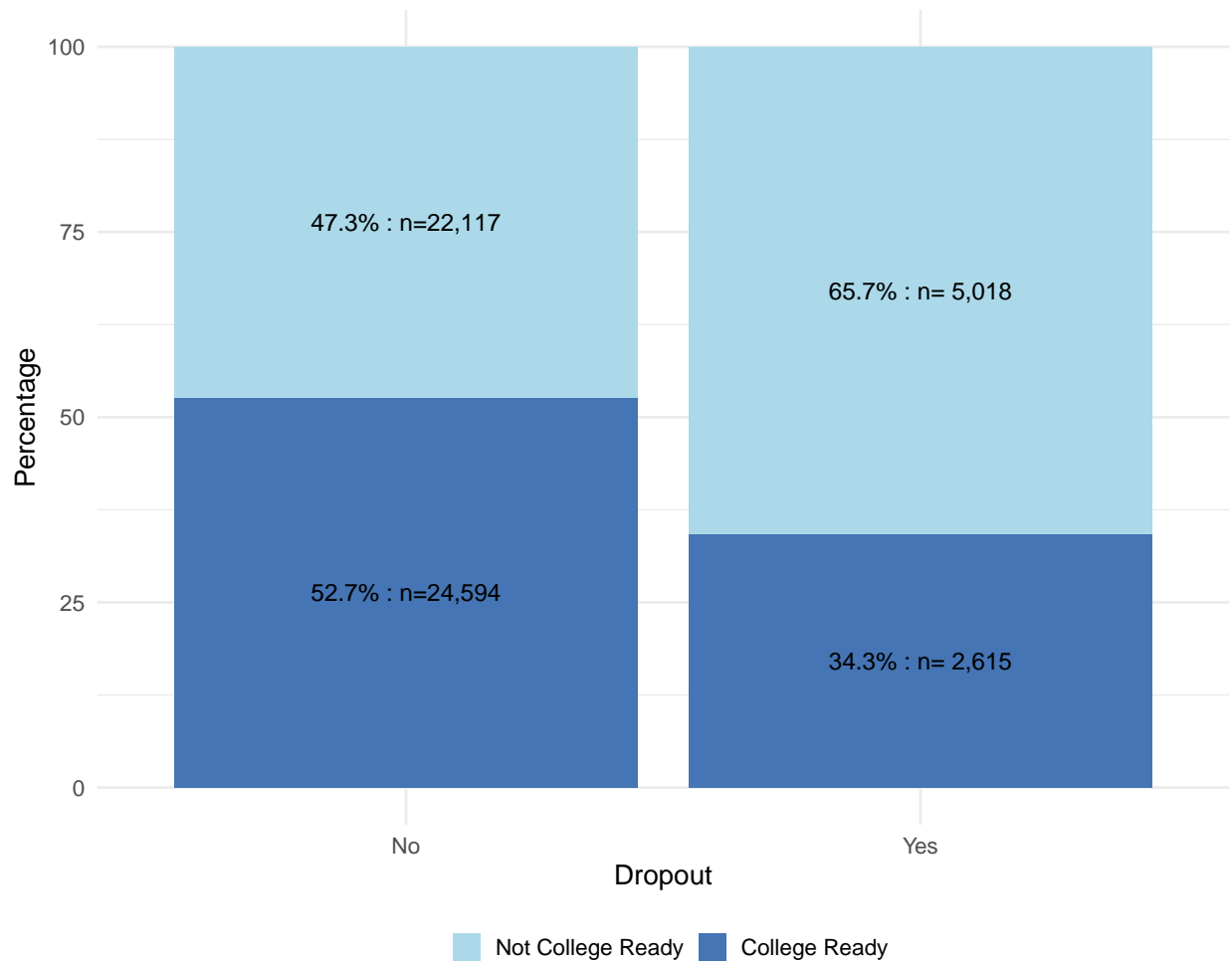
Figure 4.3: Percent of Dropout Students by College Ready and Not College Ready

Evidence from literature suggests that other demographic factors, such as socioeconomic background, can have an influence on dropout rates (Hanson, 2021). Therefore, the difference in dropout rates between college ready and not college ready students may be explained by some unmeasured attributes, such as socioeconomic factors. Due to limited data access, sex was the only demographic variable available to measure against dropout rates for this study. Figure 4.4 suggests that the sex of the student did not have an influence on whether a student drops out, but was associated with persistence with 54.4% of females persisting versus only 45.6% of males.
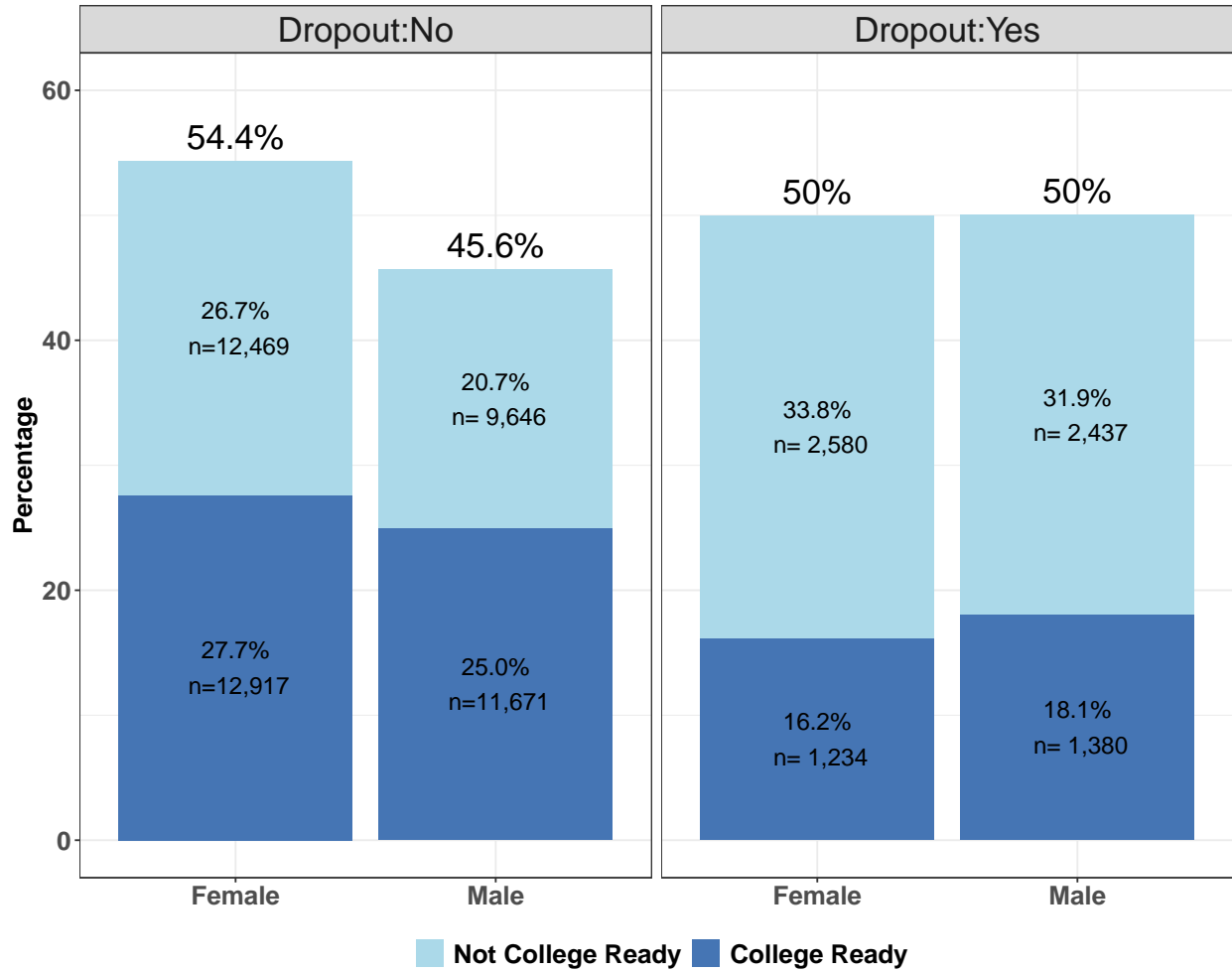
Figure 4.4: Percent of Dropout Students by Sex and by College Ready and Not College Ready

4.3 Credit Hours

Credit completion is another way to measure a student's success. The credit completion ratio represents the proportion of cumulative credit hours earned to cumulative credit hours attempted. For this analysis, we explored if not college ready students have a lower completion ratio in comparison to college ready students. In order to compare students of similar levels of education, we calculated the completion ratios for students who obtained a bachelor's degree or doctorate of pharmacy at the University of Wyoming. Again, acknowledging the possibility of sample bias, the Wilcoxon Signed-Ranks Test indicated that the completion ratio was higher for college ready students than the completion ratio for not college ready students ($p < 0.001$). This indicates that not college ready students attempted more credits without completing them than college ready students.
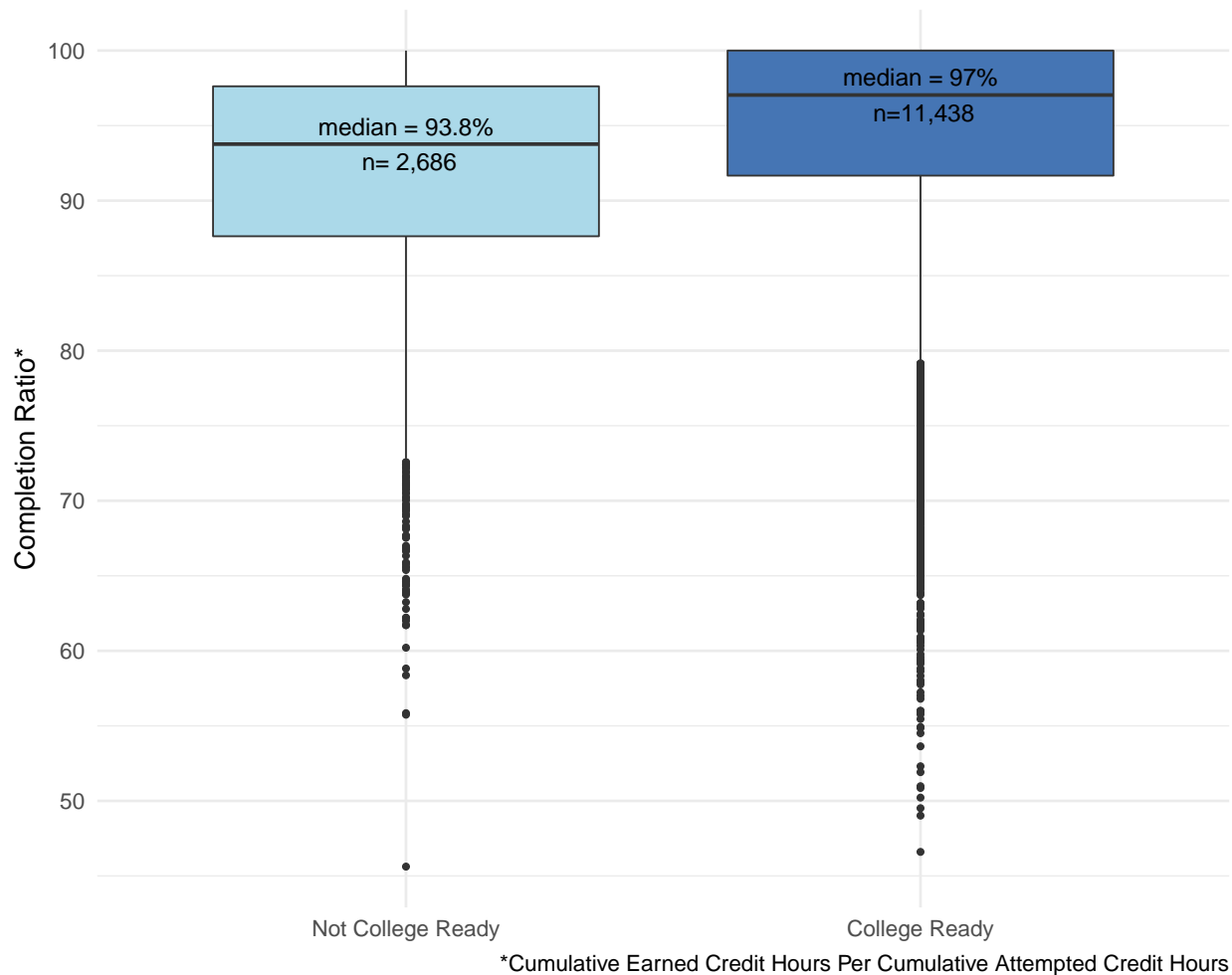
Figure 4.5: Credit Completion Ratio by College Ready and Not College Ready Students of Students who Obtained a Bachelor's Degree or Doctorate of Pharmacy

5   Summary

In summary, the study identified the following trends in primarily degree-seeking students who enroll in development courses at Wyoming institutions over the ten year period:

1. We observed a decline in the number of enrollments in development courses. There are a number of possible reasons for the decline, but identifying those reasons is beyond the scope of this research.

2. More students are prepared for college-level English courses compared to college-level mathematics courses.

3. Colleges are increasingly offering English developmental courses as a corequisite as opposed to a prerequisite course.

4. Students who enrolled in developmental courses are less likely to successfully complete degree programs and coursework, and more likely to drop out than peers without developmental coursework.

6   Potential Future Considerations

We identified a few key considerations for future SLEDS research on developmental courses and students. We hope that future considerations could resolve limitations listed in the Limitations and Assumptions 1.5 section and serve as enhancements to new research as part of SLEDS. We have the following recommendations:

1. **Include additional key measures of college readiness for subsequent studies.** Utilize additional measures of academic preparation, including high school grade point average (GPA) and college admission test (ACT and SAT) scores instead of solely focusing on developmental course enrollment.

2. **Collect additional demographic and socioeconomic data to conduct enhanced statistical modeling, including analysis of an experimental comparison group of college ready students.** This could help control selection bias (Chen & Xianglei, 2016).

3. **Use a modeling approach instead of a bivariate comparison when possible.** Bivariate comparisons do not adhere to simple random samplings, which causes possible selection bias. A model can attempt to statistically control for any observed or measurable pre-existing characteristics unlike bivariate comparisons.

4. **Authorize use of additional data elements and utilize data straight from source records when possible.** Accessing data directly alleviates misunderstanding of data, and allows for tailored calculations in the SLEDS environment.

5. **Include course section number and course start date to create a unique id for each course within the SLEDS environment.** This allows us to better track when students take a course more than once from the same institution within the same semester.

6. **Provide both degree-seeking and non-degree students and allow for subsetting and matching within the SLEDS environment.** This will enhance our overall understanding of trends for future research.

7   Appendix A: College Ready Comparing the Wyoming Community Colleges and the University of Wyoming

7.1   College Ready By Institution Type

The University of Wyoming had the largest number of college ready students compared to the Wyoming community colleges. We noted a few differences between the Wyoming community colleges and the University of Wyoming which affected this. All of the community colleges have open enrollment while the University of Wyoming has admission standards. Note that all students are reported under each school they attended.
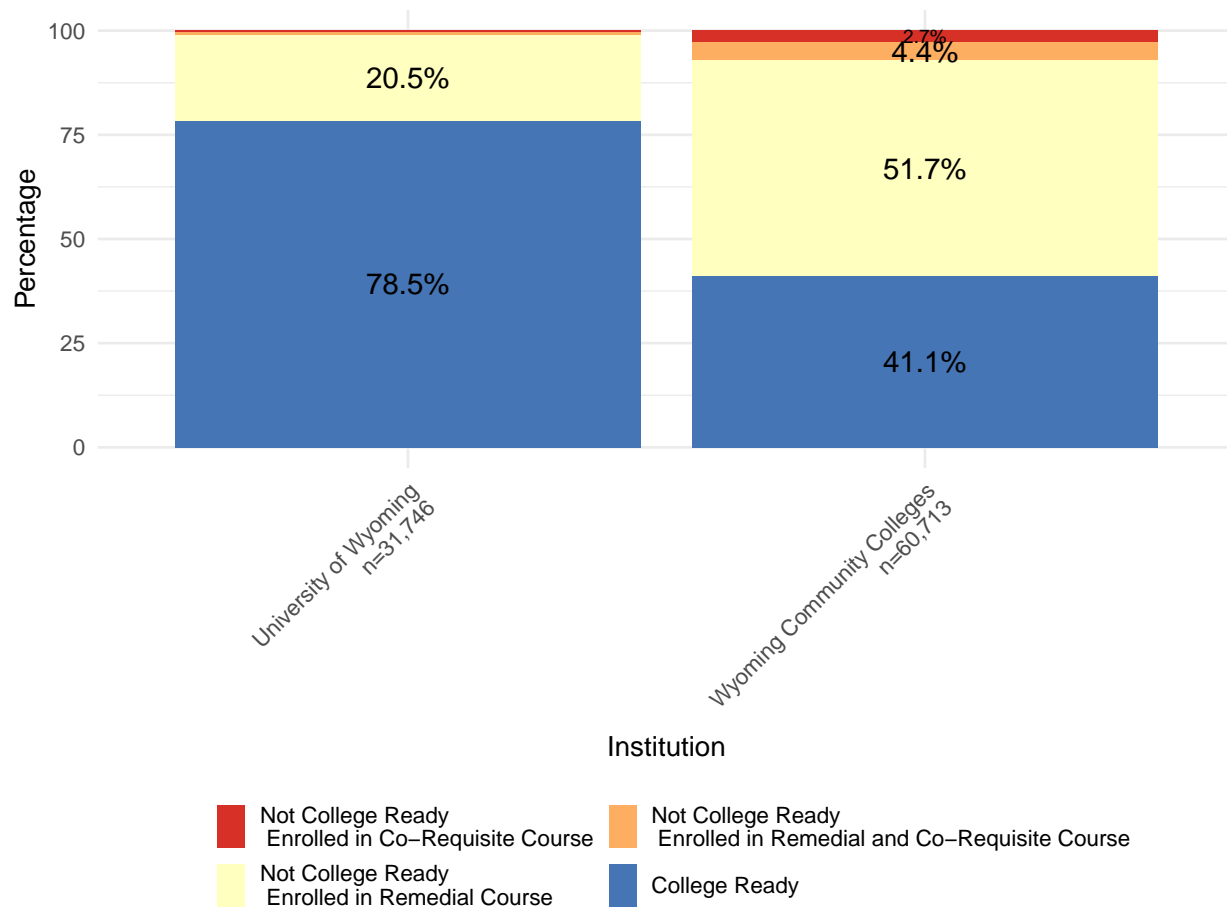
Figure 7.1: Percentage of Students by College Ready and Not College Ready Per Institution Type

As we stated in the Limitations and Assumptions section, the University of Wyoming does not evaluate English college readiness. If students meet the University of Wyoming's admission standards, they are considered English college ready. However, students enrolled at the University of Wyoming who were not prepared for higher education mathematics courses were enrolled in at least one developmental mathematics course from Laramie County Community College, LCCC. These developmental mathematics courses at LCCC counted towards the University of Wyoming proportion of not college ready students.

7.2 College Ready By Institution Type and Course Subject

To further express the differences of college ready students between the University of Wyoming and Wyoming community colleges, the English group and Mathematics group were both broken down into three institution groups: University of Wyoming, Wyoming Community Colleges, and Wyoming Community Colleges and University of Wyoming.

7.2.1 English

Figure 7.2 illustrates the influence the University of Wyoming had on the proportion of college ready students who enrolled in at least one English course. Note that the University of Wyoming's admission standards

suggest that students admitted are English college ready and do not require further testing of English college readiness. Since students are reported in each school they attended, the students who were not college ready in English and transferred to the University of Wyoming are reflected in the University of Wyoming numbers below.
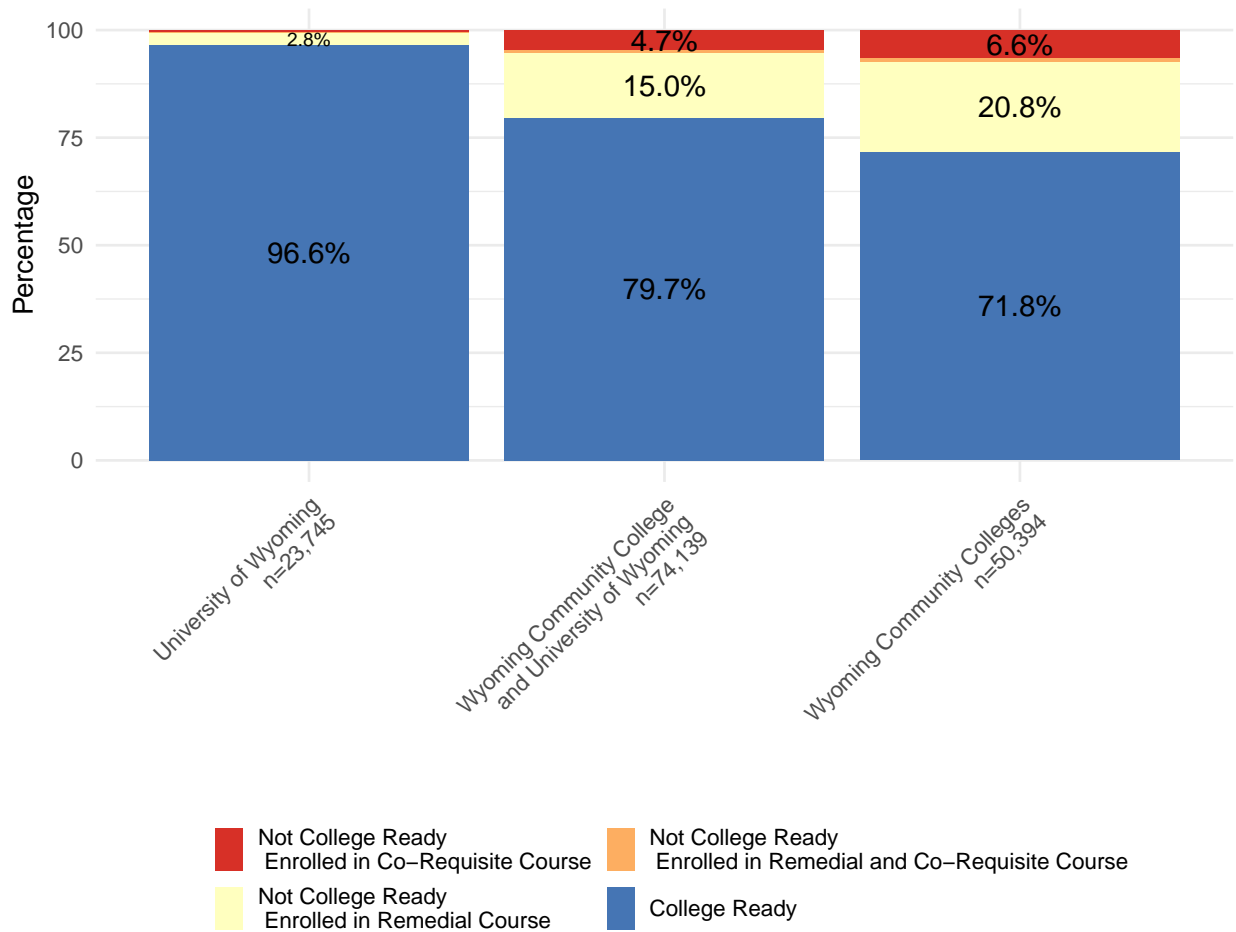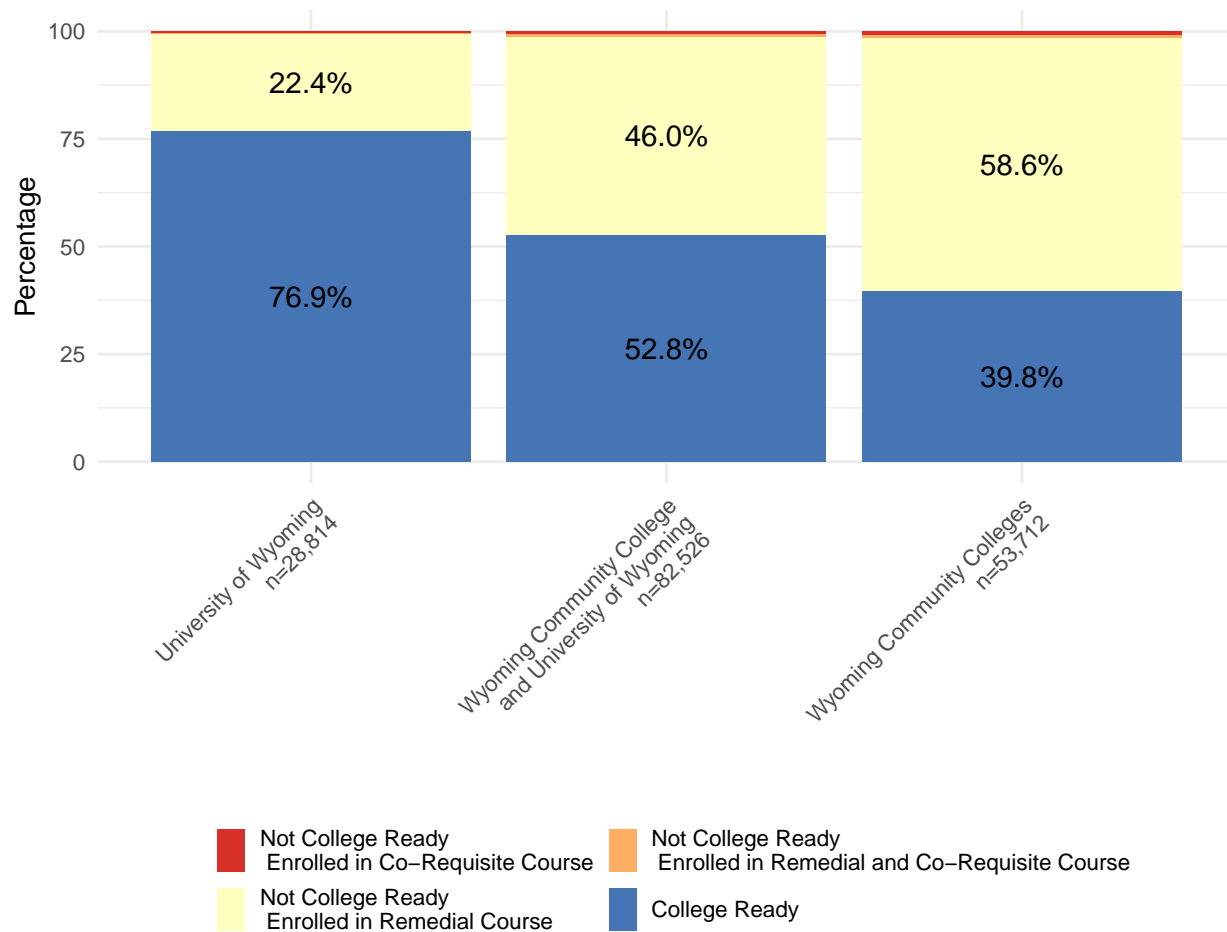

Figure 7.2: English: Percentage of Students by College Ready and Not College Ready Per Institution Group

7.2.2 Mathematics

The University of Wyoming does not make assumptions on student preparedness for college-level mathematics courses. Despite all Wyoming institutions sharing similar standards on not college ready students for college-level mathematics courses, the University of Wyoming increases the proportion of college ready students.

Figure 7.3: Mathematics: Percentage of Students by College Ready and Not College Ready Per Institution Group

8 Appendix B: Reference Tables

Table 8.1: Courses Included in Study, Grouped by Subject

	English	Mathematics
Communication	137	0
Education Elementary	388	0
English	125,237	0
English as a Second Language	149	0
Honors Program	1,308	0
Technology	712	0
Business Administration	0	1,385
Mathematics	0	155,717
Statistics	0	25,278
Veterinary Tech	0	458

Table 8.2: R Packages Used For Data Exploratory and Analysis

Package	Version	Maintainer
pacman	0.5.1	Tyler Rinker <tyler.rinker@gmail.com>
RColorBrewer	1.1.3	Erich Neuwirth <erich.neuwirth@univie.ac.at>
pBrackets	1.0.1	Andreas Schulz <ades-s@web.de>
bookdown	0.27	Yihui Xie <xie@yihui.name>
kableExtra	1.3.4	Hao Zhu <haozhu233@gmail.com>
knitr	1.39	Yihui Xie <xie@yihui.name>
forcats	0.5.1	Hadley Wickham <hadley@rstudio.com>
stringr	1.4.0	Hadley Wickham <hadley@rstudio.com>
dplyr	1.0.9	Hadley Wickham <hadley@rstudio.com>
purrr	0.3.4	Lionel Henry <lionel@rstudio.com>
readr	2.1.2	Jennifer Bryan <jenny@rstudio.com>
tidyr	1.2.0	Hadley Wickham <hadley@rstudio.com>
tibble	3.1.7	Kirill Müller <krlmlr+r@mailbox.org>
ggplot2	3.3.6	Thomas Lin Pedersen <thomas.pedersen@rstudio.com>
tidyverse	1.3.2	Hadley Wickham <hadley@rstudio.com>

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Table 9.1: Revision History

Revision Number	Revision Date	Summary of Changes	Changes Marked

Table 9.2: Approvals

Name	Date Approved
Security Subcommittee	June 2, 2022
Data Governance Committee	June 13, 2022

10 References

Chen, X. (2016). Remedial Coursetaking at US Public 2-and 4-Year Institutions:Scope, Experiences, and Outcomes. Statistical Analysis Report. NCES 2016-405. *National Center for Education Statistics*.

Hanson, Melanie. "College Dropout Rates" EducationData.org, November 22, 2021, https://educationdata.org/college-dropout-rates

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R Core Team (2021). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.