MARK THAT DOWN!

How R Markdown Can Enhance Reporting, Data Analysis, and Visualization

Daniel Kuzbary, Tri-County Technical College

Alan Lam, Central Carolina Technical College

OUTLINE

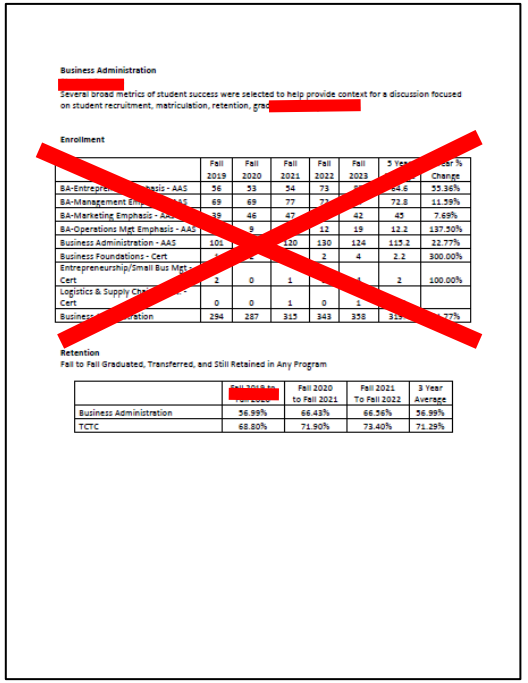
Introduction to R Markdown

Common IR tasks in R Markdown

Getting started in R Markdown

INTRODUCTION TO R MARKDOWN

TASK #1: “I need a revised annual report for this year with updated numbers.”



Business Administration

Several broad metrics of student success were selected to help provide context for a discussion focused on student recruitment, matriculation, retention, grad

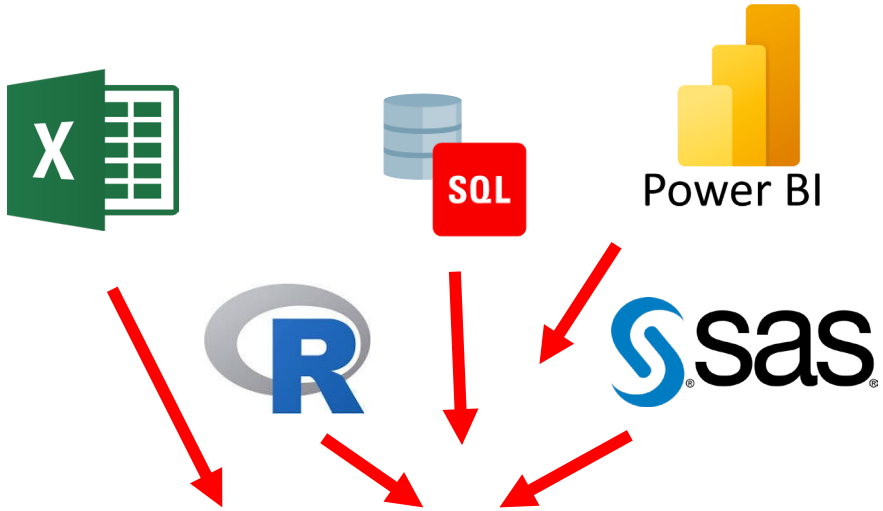
Enrollment

	Fall 2019	Fall 2020	Fall 2021	Fall 2022	Fall 2023	5 Ye	ar % Change
BA-Entrepre sis - AAS	56	53	54	73		64.6	55.36%
BA-Management E AS	69	69	77	77		72.8	11.59%
BA-Marketing Emphasis - AAS	39	46	47		42	45	7.69%
BA-Operations Mgt Emphasis - AAS		9		12	19	12.2	137.50%
Business Administration - AAS	101		120	130	124	115.2	22.77%
Business Foundations - Cert				2	4	2.2	300.00%
Entrepreneurship/Small Bus Mgt Cert	2	0	1		4	2	100.00%
Logistics & Supply Cha Cert	0	0	1	0	1		
Busines ation	294	287	315	343	358	31	.77%

Retention

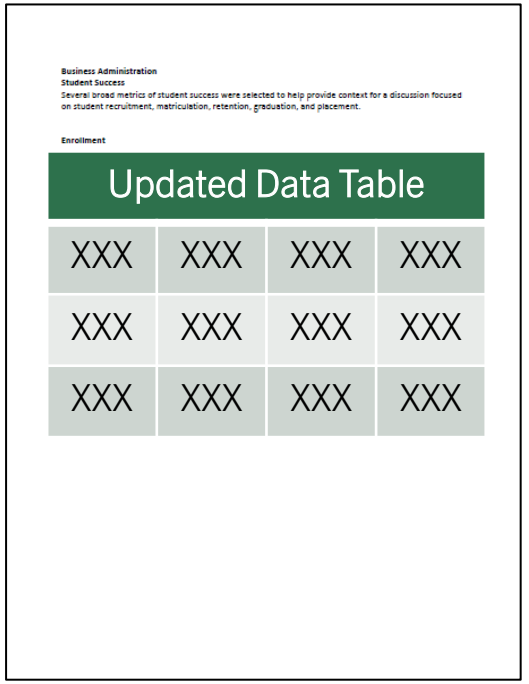
Fall to Fall Graduated, Transferred, and Still Retained in Any Program

	Fall 2019 to Fall 2020	Fall 2020 to Fall 2021	Fall 2021 To Fall 2022	3 Year Average
Business Administration	56.99%	66.43%	66.56%	56.99%
TCTC	68.80%	71.90%	73.40%	71.29%



Updated Data Table

XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX



Business Administration

Student Success

Several broad metrics of student success were selected to help provide context for a discussion focused on student recruitment, matriculation, retention, graduation, and placement.

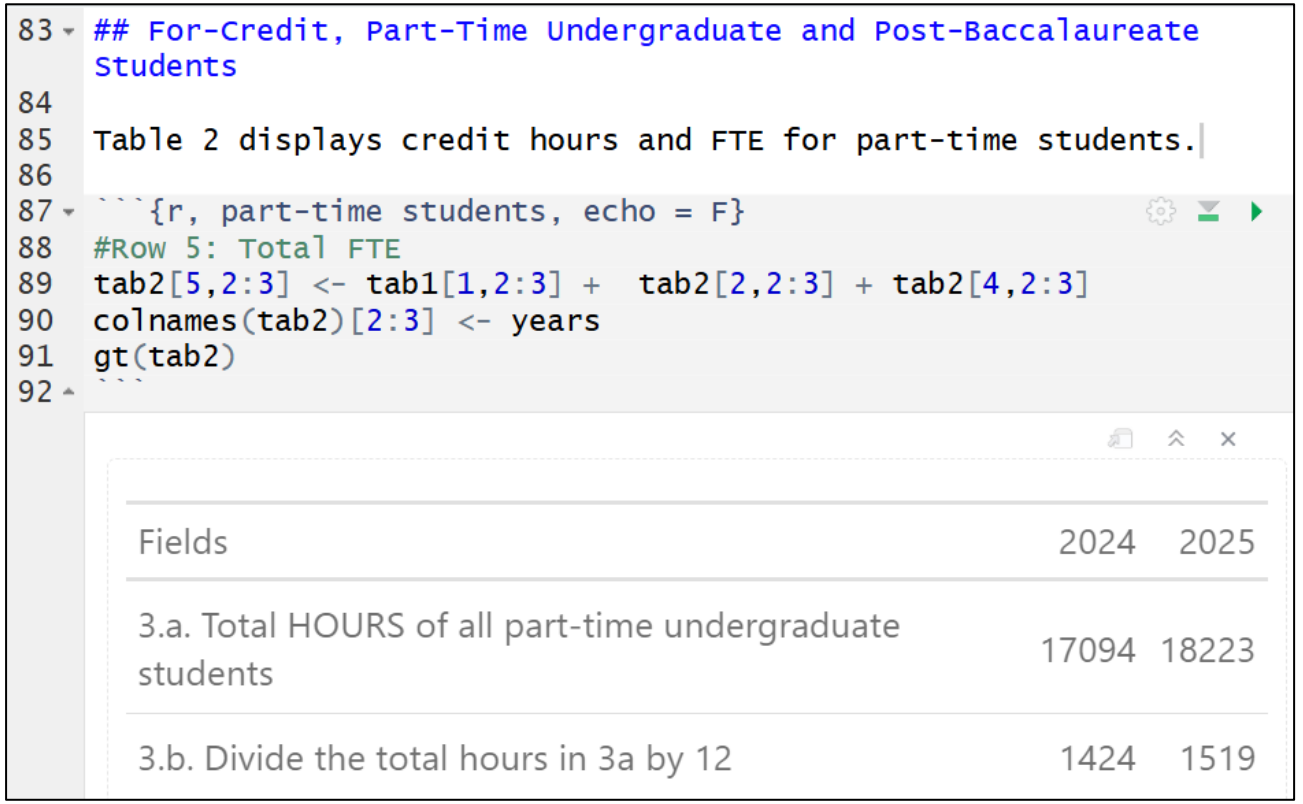
Enrollment

Updated Data Table

XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX

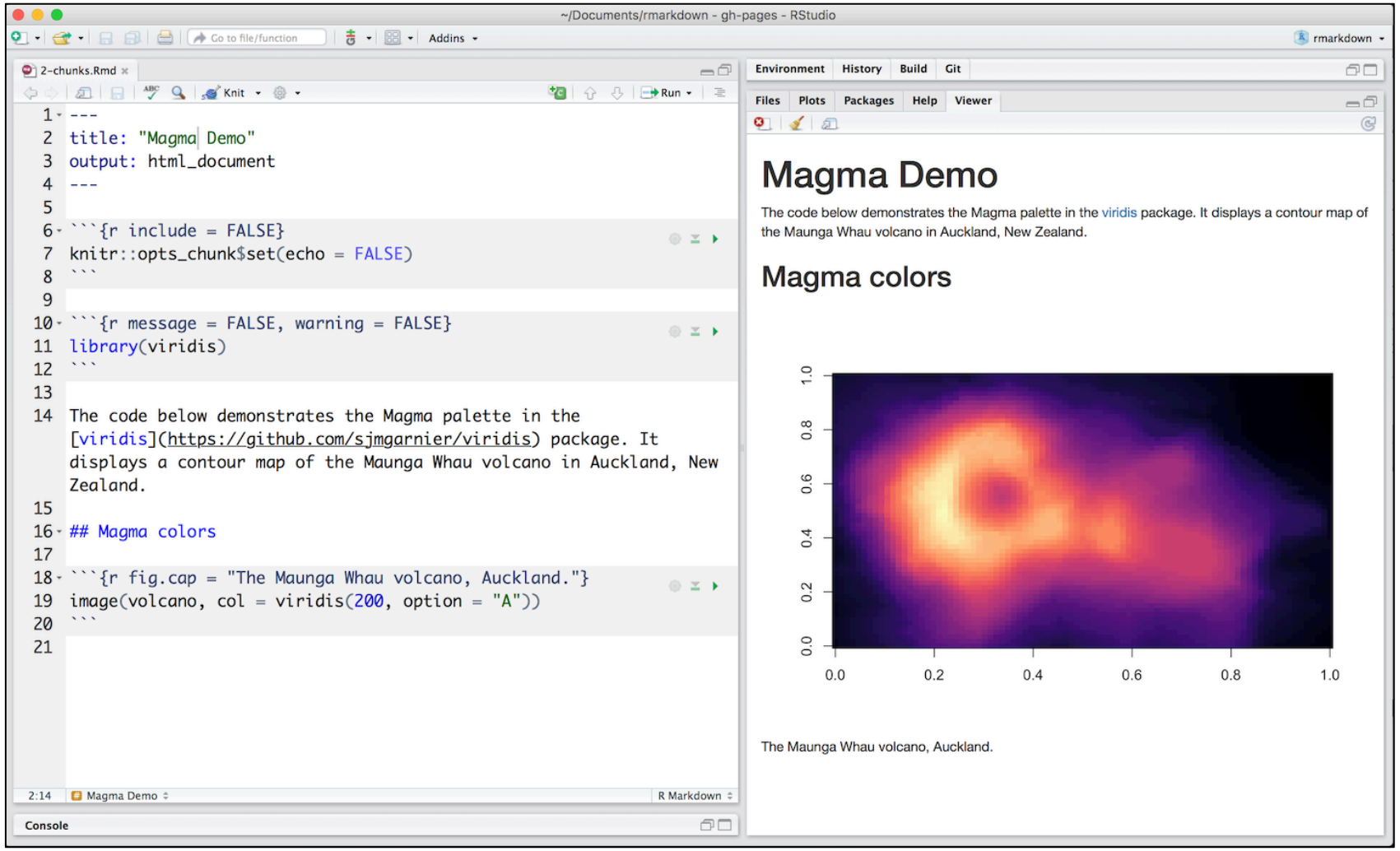
What is R Markdown?

- A single document that combines narrative text, background code, and data visualizations.
- Built upon R programming language.
- Versatile: Can be used to create .html, PDF, and Microsoft Word documents.



```
83  ## For-Credit, Part-Time Undergraduate and Post-Baccalaureate
    Students
84
85  Table 2 displays credit hours and FTE for part-time students.
86
87  ```{r, part-time students, echo = F}
88  #Row 5: Total FTE
89  tab2[5,2:3] <- tab1[1,2:3] +  tab2[2,2:3] + tab2[4,2:3]
90  colnames(tab2)[2:3] <- years
91  gt(tab2)
92  ```
```

Fields	2024	2025
3.a. Total HOURS of all part-time undergraduate students	17094	18223
3.b. Divide the total hours in 3a by 12	1424	1519



How to write an R Markdown document

- Write plain text to craft a narrative.
- Develop executable code "chunks" that display output OR run in the background.

Image source: rmarkdown.rstudio.com

2025 SACSCOC Enrollment Worksheet

2026-01-15

Please report your institution's Full-Time Equivalent (FTE) enrollment for the 2025 fall term. When tabulating the total, include all degree and non-degree students, wherever instruction occurs. This applies to students enrolled in course work delivered at the main campus, off-campus instructional sites, branch campuses, and course work delivered electronically, including dual-enrollment students.

Please use the following definitions for your computation of FTE and not your institution's definition: - A full-time undergraduate student is one enrolled for 12 or more credit hours. - A full-time post-baccalaureate/graduate student is one enrolled for 9 or more credit hours.

FTE

For-Credit, Full-Time Undergraduate and Post-Baccalaureate Students

Fields	2024	2025
1. Total number of full-time undergraduate students	3401	3391
2. Total number of full-time post-baccalaureate students	0	0

For-Credit, Part-Time Undergraduate and Post-Baccalaureate Students

Fields	2024	2025
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4.a. Total HOURS of all part-time post-baccalaureate students	0	0
4.b. Divide total hours in 4a by 9	0	0
5. Total For-Credit FTE	4825	4910

Non-Credit

(Include continuing education. Do not include non-credit courses taken by for-credit students as part of a for-credit program such as labs, chapels, student success courses, remedial courses, etc. Count these under for-credit.)

Fields	2024	2025
6.a. For each non-credit course, multiply the total number of contact hours by the total number of student results. Then add.	103260	111718
6.b. Total Non-Credit continuing education. Divide 6a by 168.	615	665

Title
Subtitle
Date

Plain text
Optional formatting (size, bold, underline)

Section title
Subsection title

R code chunks

- Read in enrollment data
- Create summary table
- Format and display table

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55
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   full-time post-baccalaureate/graduate student is one enrolled for 9 or more credit hours.
```

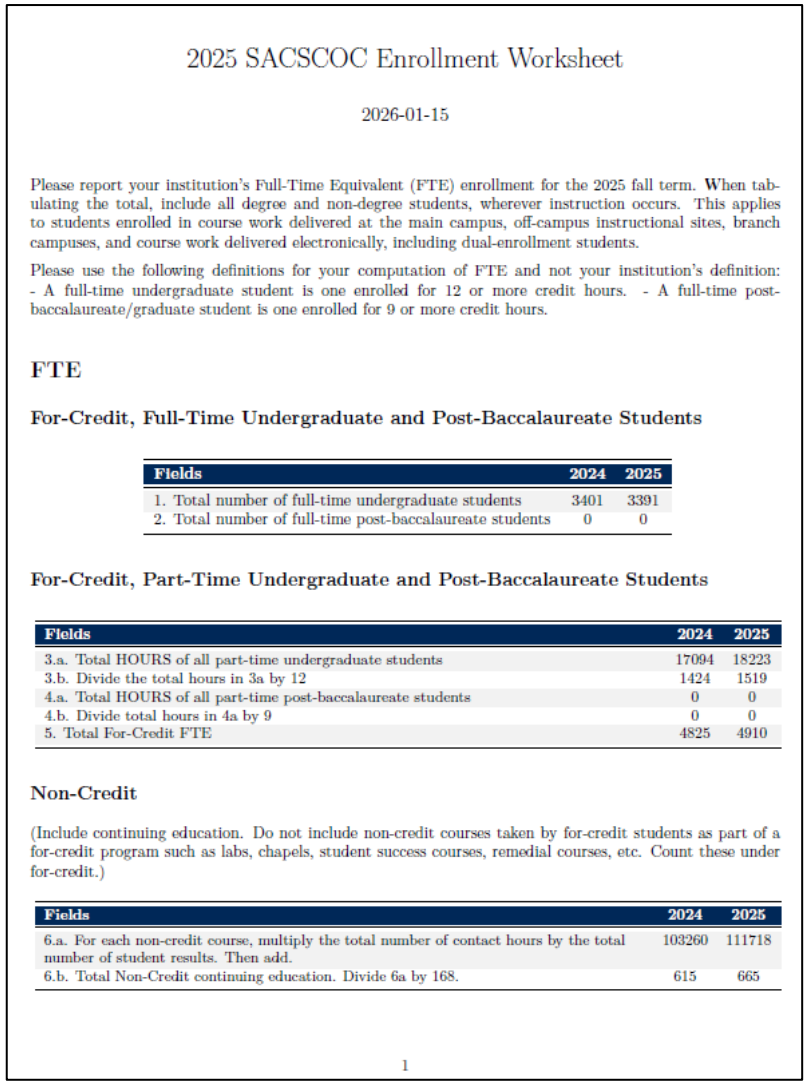
```
58 # FTE
59
60 ## For-Credit, Full-Time Undergraduate and Post-Baccalaureate Students
61
62 ```{r full-time students, echo = F}
63
64 tab1 <- data.frame(Fields = character(2),
65                    Year1 = numeric(2),
66                    Year2 = numeric(2))
67 tab1$Fields <- c("1. Total number of full-time undergraduate students",
68                  "2. Total number of full-time post-baccalaureate students")
69
70 #Calculating number of full-time students
71 tab1[1,2:3] <- c(nrow(subset(y1, FULLPART=="Full-time")),
72                  nrow(subset(y2, FULLPART=="Full-time")))
73 tab1[2,2:3] <- c(0,0)
74
75 colnames(tab1)[2:3] <- years
76
77 kable(tab1, format = "latex", booktabs = TRUE,align = c("l","c","c"),
78           row.names = F) %>%
79       kable_styling(latex_options = c("striped", "H","scale_down")) %>%
80       #column_spec(1, width = "5.5in") %>%
81       row_spec(0, background = "#002858", color = "white", bold = TRUE)
82 ```
```

```
84 ## For-Credit, Part-Time Undergraduate and Post-Baccalaureate Students
85
86 ```{r, part-time students, echo = F}
87 kable(tab2, format = "latex", booktabs = TRUE,align = c("l","c","c"),
88           row.names = F) %>%
89       kable_styling(latex_options = c("striped", "H","scale_down")) %>%
90       column_spec(1, width = "5.5in") %>%
91       row_spec(0, background = "#002858", color = "white", bold = TRUE)
92 ```
```

TASK #1: “I need a revised annual report for this year with updated numbers.”

Why R Markdown?

- Report narrative completed in R Markdown.
  - Data processing steps programmed in R.
    - Document, table, and graph formatting set up in R Markdown.
      - Attractive PDF report or dynamic HTML notebook.



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1

COMMON IR TASKS IN R MARKDOWN

TASK #2: “I need to report institutional data on a variety of outcomes coming from different sources.”

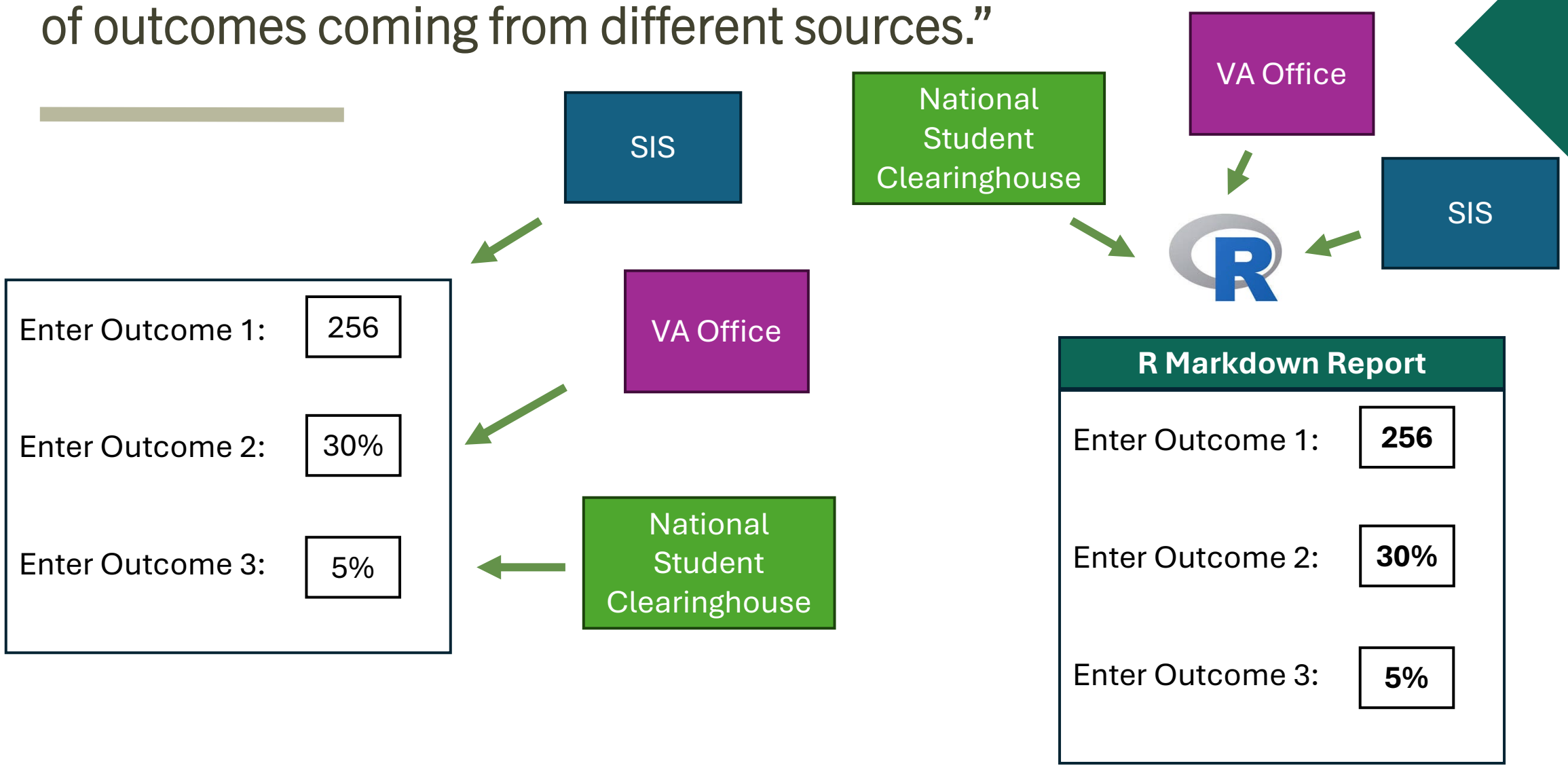

R Markdown can read in data from a variety of sources.

- Read in common data file formats (.txt, .csv., .xlsx).
- R Markdown handles a variety of languages, including
  - Python
  - SQL
  - JavaScript
  - …and more!
- R Markdown can embed images and PDFs.
- Customize R Markdown to suit your reporting needs.

Load in data from a variety of sources into R Markdown

SQL Chunk: (Direct ODBC access to SIS)

```
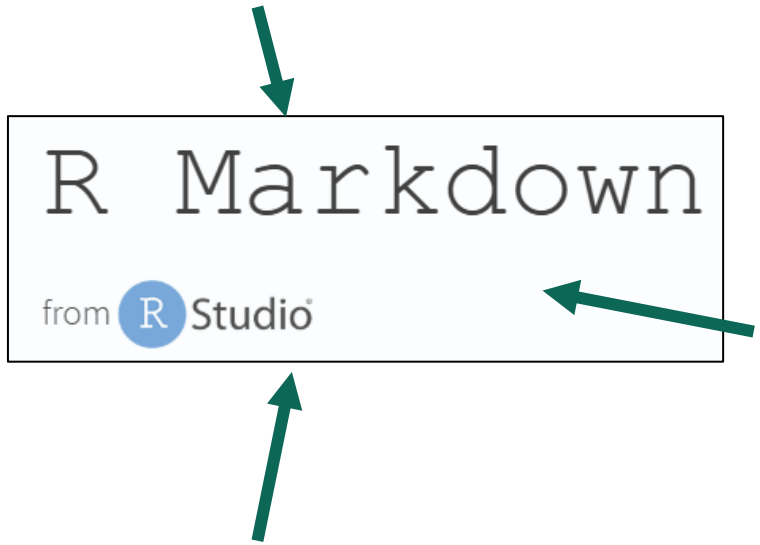
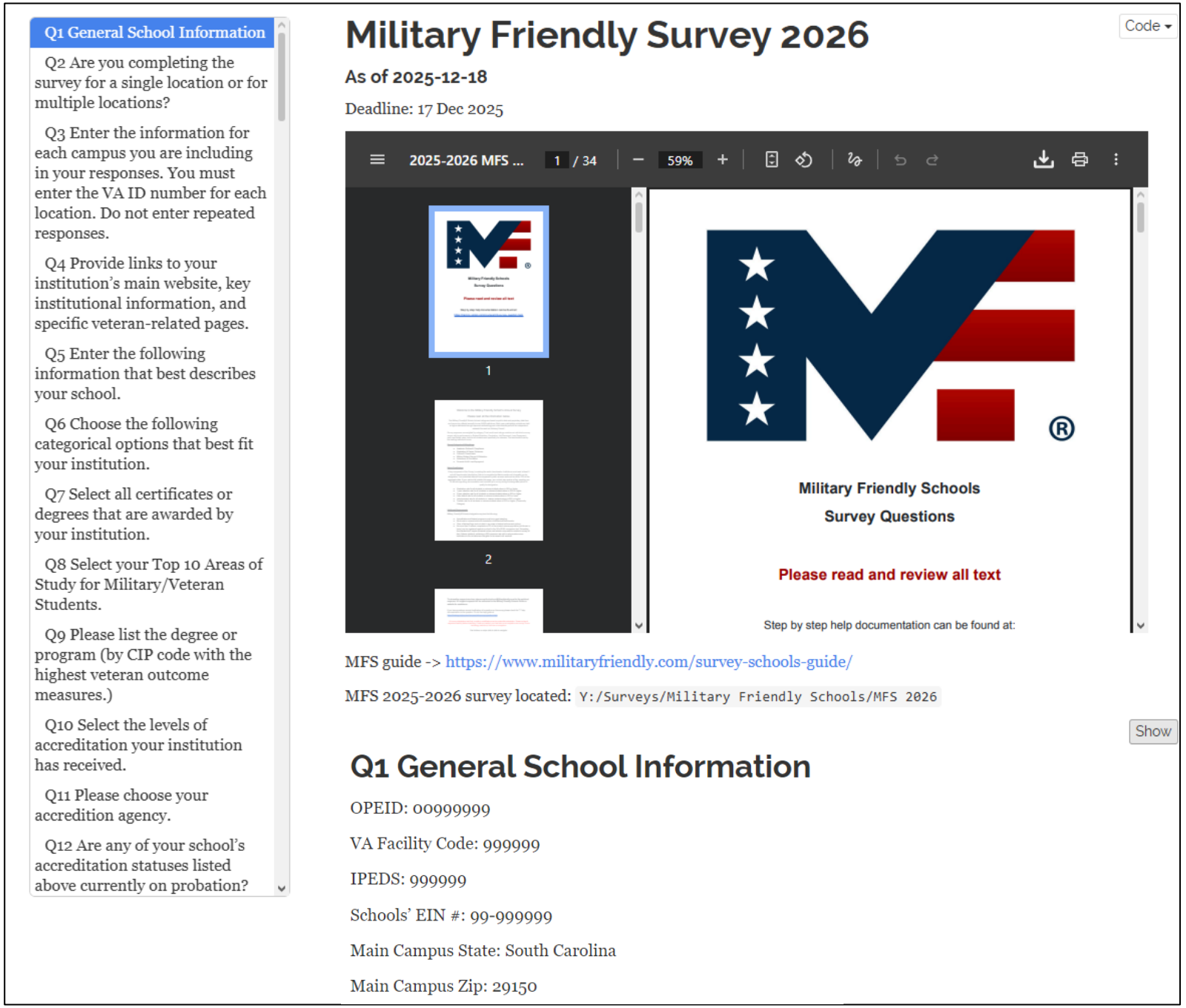
![](2025-2026%20MFS%20PDF%20of%20Survey.pdf){width="800" height="500"}
```

Read in PDF file




```
```{sql,connection=banner,output.var='SQL.2.Enrollment'}

SELECT SFRSTCR_TERM_CODE,STVTERM_DESC,SFRSTCR_PIDM,STVMAJR_DESC

FROM SFRSTCR

LEFT JOIN SGBSTDN
ON SFRSTCR_PIDM = SGBSTDN_PIDM

LEFT JOIN STVMAJR
ON SGBSTDN_MAJR_CODE_1 = STVMAJR_CODE

AND SFRSTCR_TERM_CODE >= 202410
AND SFRSTCR_TERM_CODE <= 202430

ORDER BY SFRSTCR_TERM_CODE
```
```

Read in Excel file

```
```{r}
library(readxl)

CIP_code = read_excel('Y:/Surveys/Military Friendly Schools/MFS 2026/CIP2020_SOC2018_Crosswalk.xlsx',sheet
= 'CIP-SOC') |>
  mutate(CIP = str_replace(CIP2020Code,"\\.", "")) |>
  distinct(CIP,CIP2020Title,.keep_all = T)
```
```

The Result: A single document for reporting.

- R Markdown contains all reporting elements.
- Clickable table of Contents easy to build and helps with organization.
- Embedded PDF for additional documentation.



Military-Friendly Schools Website

General School Information

Q1 General School Information

Please enter your school's information below. If unsure, use the GIBill comparison tool at the bottom of your school's profile. This data helps compare your submission with Public Information, and inaccuracies may affect your eligibility.

ONLY ENTER NUMERIC FORM. DO NOT USE TEXT UNLESS INSTRUCTED.

Help: Link to the GIBill Comparison Tool https://www.va.gov/gi-bill-comparison-tool/

ENTER ONLY THE INFORMATION FOR YOUR MAIN CAMPUS> IF YOU INCLUDE MULTIPLE NUMBERS YOU WILL DISQUALIFY YOUR RESPONSE. You can enter the additional information in the following questions.

The Following Questions Are Mandatory

- **Enter OPEID (Only enter 1)** *_____
- **ENTER VA Facility Code (Only enter 1)** This can be found on your schools profile on the GIBill Comparison tool. _____
- **IPEDS (Enter only 1)** Enter 1 if your school does not have an IPEDS Number _____
- **Enter Schools EIN Number in the following format (XX-XXXXXXX)**_____
- **Main Campus is located in what state**: _____
- **Main Campus Zip Code** _____

R Markdown

MFS guide -> https://www.militaryfriendly.com/survey-schools-guide/

MFS 2025-2026 survey located: `Y:/Surveys/Military Friendly Schools/MFS 2026`

Q1 General School Information

OPEID: 00999999

VA Facility Code: 999999

IPEDS: 999999

Schools' EIN #: 99-999999

Main Campus State: South Carolina

Main Campus Zip: 29150

TASK #2: “I need to report institutional data on a variety of outcomes coming from different sources.”

Why R Markdown?

- Consolidate all data sources within the R Markdown file.
  - Design a report that makes the reporting process easier.
    - Report can be easily updated with next year’s data.

MFS guide -> https://www.militaryfriendly.com/survey-schools-guide/

MFS 2025-2026 survey located: `Y:/Surveys/Military Friendly Schools/MFS 2026`

Q1 General School Information

OPEID: 00999999

VA Facility Code: 999999

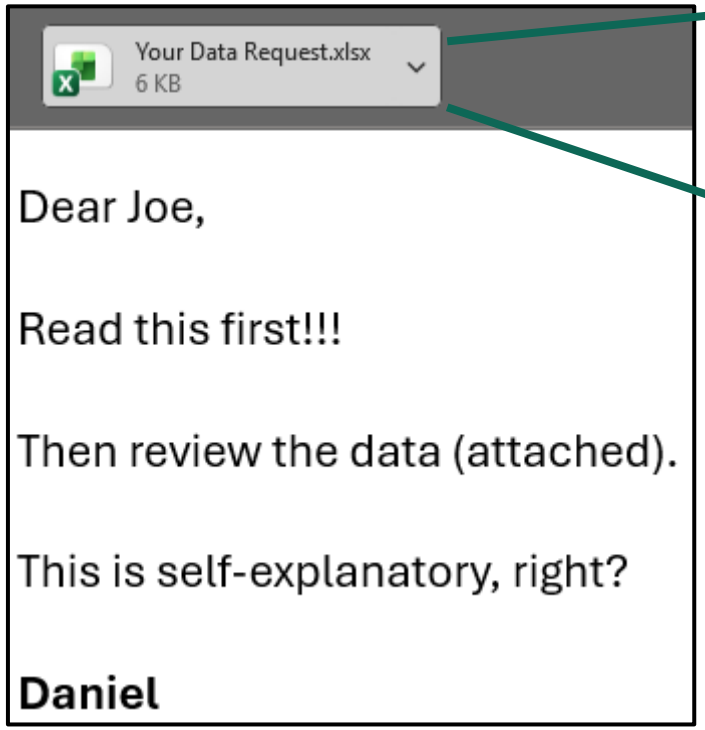
IPEDS: 999999

Schools’ EIN #: 99-999999

Main Campus State: South Carolina

Main Campus Zip: 29150

TASK #3: “I need to provide data for a request and given an understandable explanation of means for the requestor.”



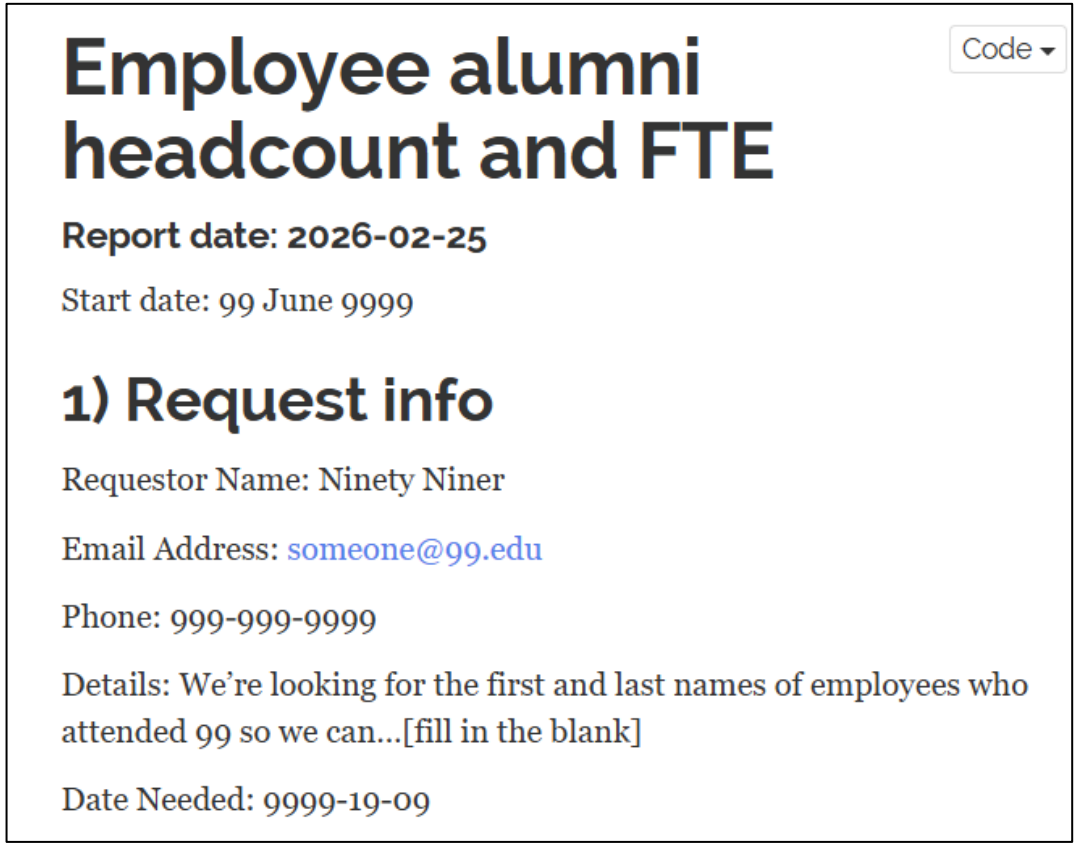
Your Data Request			
Term	Enrl	Max	Max_Rate
XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX

R Markdown *Data Request Example*

TASK #3: “I need to provide data for a request and given an understandable explanation of means for the requestor.”

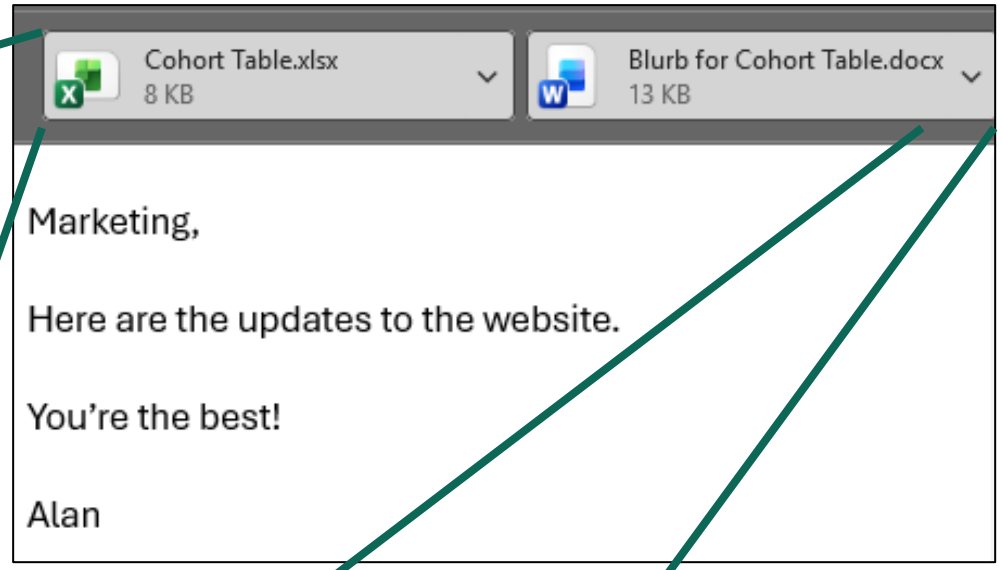
Why R Markdown?

- Description of data and tables/graphs are all in one place.
  - Exportable dataset as an Excel spreadsheet from within the document.
    - Good way to document entire data request from start to finish.



TASK #4: “I need to format or update a data summary on a public web page.”

Updated Data Summary			
Term	Enrl	Retention Rate	Graduation Rate
XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX



UPDATED NARRATIVE

*“**Table 1** displays the retention rate of the **Fall 2023** full-time, first-time freshmen cohort, the retention rate as of **Fall 2024**, and the graduation rate as of **Fall 2025**.”*

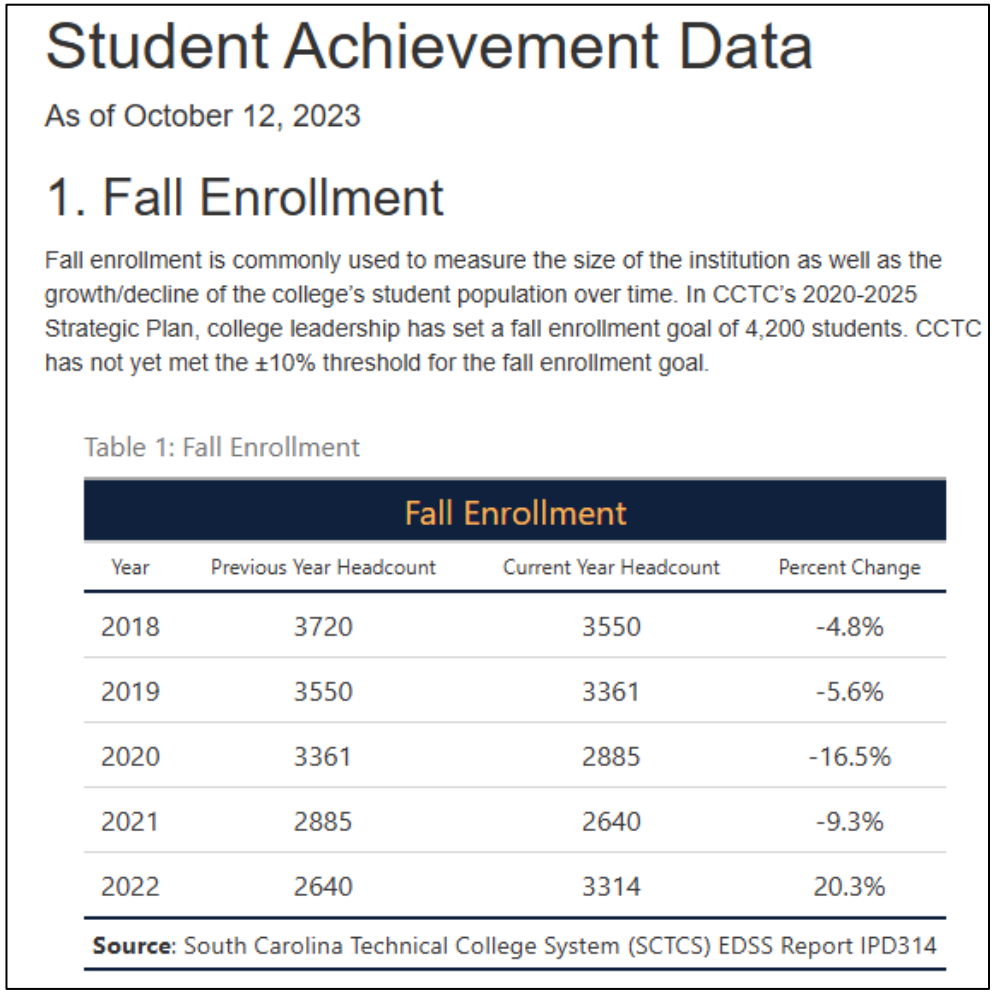
Website Example
Student Achievement Data

Website Example
Factbook

TASK #4: “I need to format or update a data summary on a public web page.”

Why R Markdown?

- Webpages can contain dynamic, searchable tables.
  - Formatting can be simple or complex.
    - Easy addition of table of contents.
      - Can export to PDF for printing.



Student Achievement Data

As of October 12, 2023

1. Fall Enrollment

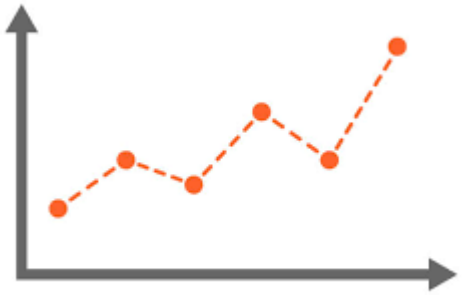
Fall enrollment is commonly used to measure the size of the institution as well as the growth/decline of the college’s student population over time. In CCTC’s 2020-2025 Strategic Plan, college leadership has set a fall enrollment goal of 4,200 students. CCTC has not yet met the ±10% threshold for the fall enrollment goal.

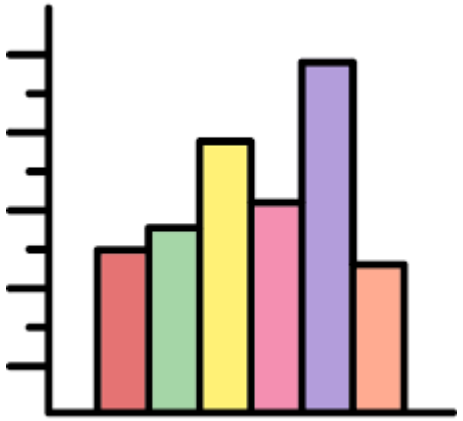
Table 1: Fall Enrollment

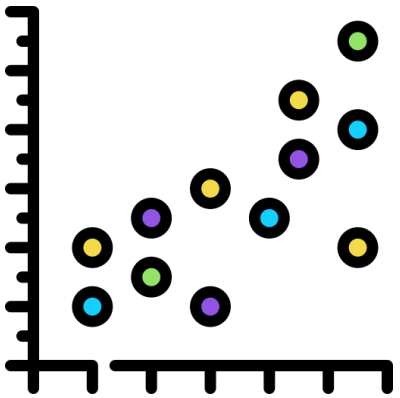
Fall Enrollment			
Year	Previous Year Headcount	Current Year Headcount	Percent Change
2018	3720	3550	-4.8%
2019	3550	3361	-5.6%
2020	3361	2885	-16.5%
2021	2885	2640	-9.3%
2022	2640	3314	20.3%

Source: South Carolina Technical College System (SCTCS) EDSS Report IPD314

TASK #5: “I have a data request involving a new data set I’ve never worked with before. I need to visualize these data to explore what is going on.”





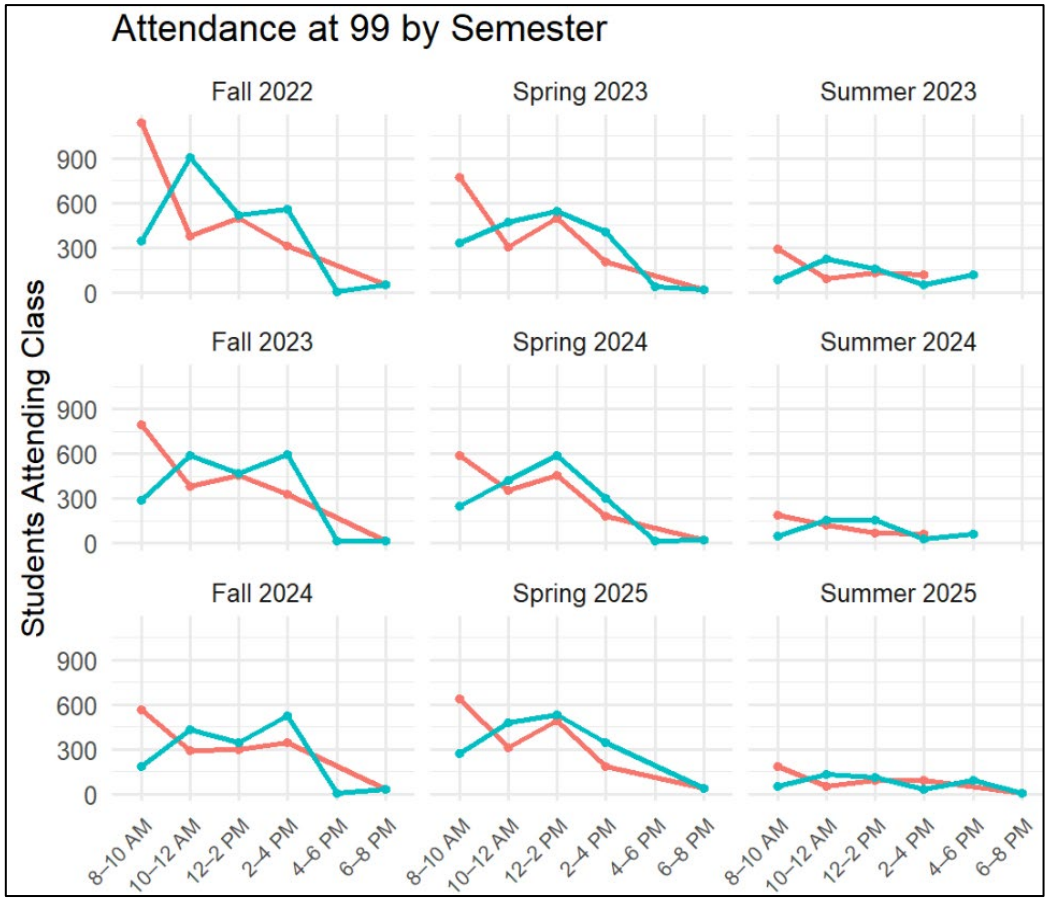


R Markdown Visualization Example

TASK #5: “I have a data request involving a new data set I’ve never worked with before. I need to visualize these data to explore what is going on.”

Why R Markdown?

- R visualizations are versatile and attractive.
  - Graph “chunks” are easy to integrate into document.
    - Accessibility for sharing visualizations either as standalone images or as part of a larger report.



GETTING STARTED IN R MARKDOWN

Getting Set Up for R Markdown

To run R Markdown effectively, you generally need three layers of software:

1. R (the base coding language)
2. RStudio (integrated developer environment)
3. RMarkdown (an add-on or extension package)

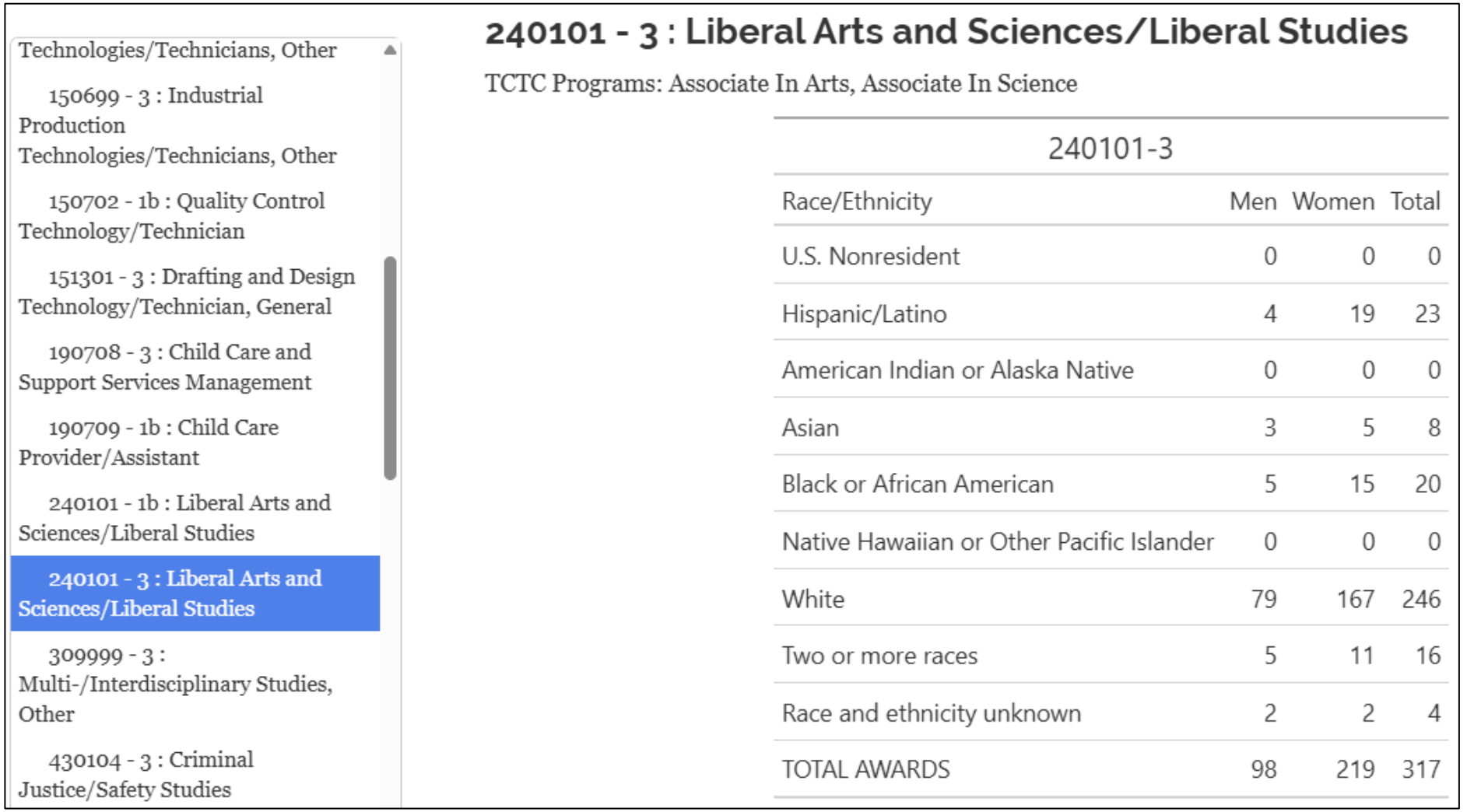
```
install.packages("rmarkdown")
```

** Additional Packages for Visualization

Helpful Packages for Data Visualization:

Package	Best For...	Why we like it...
gt	**Static Tables (HTML/PDF)**	It produces incredibly clean, professional-looking tables. Great for static reports or web pages.
DT	**Interactive HTML Tables**	Allows users to search, filter, and sort data directly in the report. Perfect for situations for which the user wants to explore the table.
kableExtra	**Complex PDF Styling**	If you need specific formatting (like striped rows, grouped headers, conditional formatting) in a PDF report, this is a powerful tool.
ggplot2	**Visualizations**	Versatile and extremely customizable graphs. Will suit most of your data visualization needs.

The gt Package



gt()

- Clean, professional-looking tables.

The DT Package

- Minimizes view of long tables.
- Sortable, searchable.

datatable()

3. Pass (Completion) Rates

The tables in this section display the following:

- **Enrolled:** The number of students who enrolled in (attempted) the given class in the given term.
- **Passed:** The number of students who received a grade of "S" in the given program in the given term.
- **Pass_Rate:** The number of students enrolled in the given class who received a grade of "S" in that program in the given term.

Table 3a: Annual Pass Rates by Course (2023-24 Academic Year)

Table 3a displays pass rates by course in the 2023-24 academic year.

Show

Show 10 entries Search:

Program	Course	Enrolled	Passed	Pass_Rate
Course Name 1	Course Code 1	10	0	0%
Course Name 2	Course Code 2	9	5	56%
Course Name 3	Course Code 3	17	13	76%
Course Name 4	Course Code 4	15	15	100%
Course Name 5	Course Code 5	14	14	100%
Course Name 6	Course Code 6	1	1	100%
Course Name 7	Course Code 7	4	1	25%
Course Name 8	Course Code 8	3	2	67%
Course Name 9	Course Code 9	20	15	75%
Course Name 10	Course Code 10	36	36	100%

Showing 1 to 10 of 37 entries Previous 1 2 3 4 Next

Nursing Program Outcomes

Pass Rates

Outcome: National Council of State Boards of Nursing Licensing Exam (NCLEX) Pass Rates for First-Time Candidates

Expected Level of Achievement: 80% of first-time NCLEX-RN and NCLEX-PN test-takers will pass.

Associate Degree Nursing: NCLEX-ADN Pass Rates

Reporting Year	Exam Takers	Exam Passers	Pass Rate
2015-16	115	102	89%
2016-17	88	81	92%
2017-18	108	90	83%
2018-19	105	90	86%
2019-20	112	100	89%
2020-21	118	107	91%
2021-22	156	140	90%
2022-23	242	216	89%
2023-24	99	98	99%
2024-25	92	87	95%

Pass rates of graduates' first attempt at licensure exam. Pass rates come from the South Carolina Technical College System (SCTCS) which calculates the rates from data provided in the CHE Licensure Exam report.

Practical Nursing: NCLEX-PN Pass Rates

Reporting Year	Exam Takers	Exam Passers	Pass Rate
2015-16	64	59	92%
2016-17	68	67	99%
2017-18	54	48	89%
2018-19	57	53	93%
2019-20	60	53	88%
2020-21	48	45	94%
2021-22	97	87	90%
2022-23	136	110	81%
2023-24	68	66	97%
2024-25	57	56	98%

Pass rates of graduates' first attempt at licensure exam. Pass rates come from the South Carolina Technical College System (SCTCS) which calculates the rates from data provided in the CHE Licensure Exam report.

The kableExtra Package

kable()

kable()

- Formatting options for printed tables.
- Accommodates cross-page tables.

The ggplot2 Package

- Intricately-designed graphs.
- Fit seamlessly within your document.

ggplot()

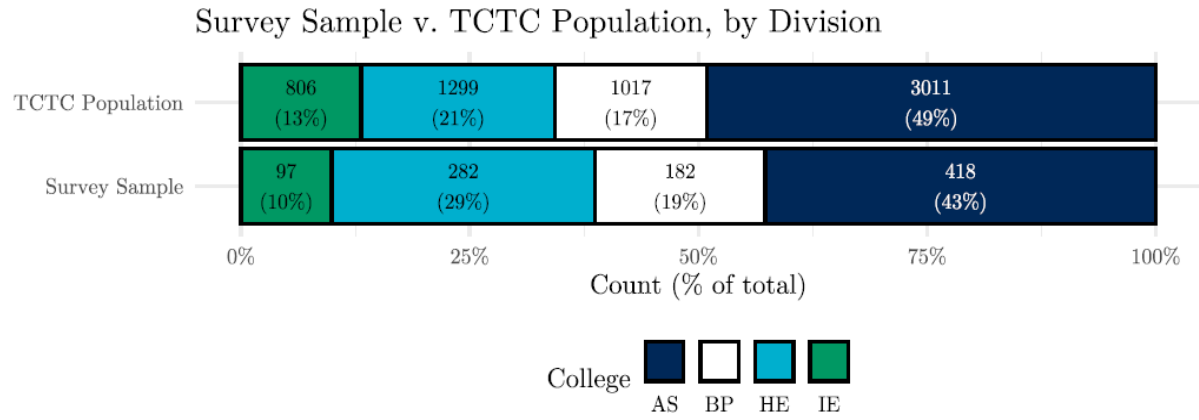
Introduction

The Fall Student Survey is designed to collect student feedback on the wide variety of support services offered by the college. TCTC uses this student feedback to improve programs and services and assist departments with annual planning and reporting.

Sampling Methodology and Response Rate

The 2025 survey was administered via SurveyMonkey in Fall 2025 to all enrolled students. All students received multiple emails soliciting their participation in the survey. Students also had the opportunity to complete the survey via a QR code. This code was circulated on digital monitors across all campuses, several Student Wave announcements, and a MyTCTC banner. Any student who completed the survey was entered into a raffle to receive one of three $50 gift cards.

The 2025 Fall Student Survey received 982 student responses yielding a 16% response rate. The figures below show the Fall Student Survey sample by division and by distance education status, compared to the entire TCTC population.



The Fall Student Survey saw a slight oversampling of the Health Education (HE) students and a slight undersampling of Arts and Sciences (AS) students. Online Only student participation was acceptable despite the challenges with engaging this population.

Conclusion:

Why R Markdown?

- Helpful for consolidating multiple data sources to create a single, unified document.
- Useful for data requests, reporting, analysis, and more.
- Great for creating high-quality, reproducible reports.
- Flexibility for reproducing in different formats (webpages and PDFs, and Word doc).
- Customizable visualization options through R packages.

Helpful References

- Introduction to R Markdown:
  The basics of R Markdown provided by creators of RStudio (now Posit).
  https://rmarkdown.rstudio.com/lesson-1.html

- R Markdown: The Definitive Guide:
  The comprehensive manual by Yihui Xie. It's searchable and free online.
  https://bookdown.org/yihui/rmarkdown/

- Posit's R Markdown Cheatsheet:
  A high-density PDF that summarizes syntax. It serves as a quick point of reference.
  https://rstudio.github.io/cheatsheets/html/rmarkdown.html

R Markdown Examples

- Alumni Data Request Example:
  https://rpubs.com/alanhlam/Employee_Alumni_99

- Student Achievement Data:
  https://www.cctech.edu/wp-content/uploads/Student-Achievement-Data.html#1_Fall_Enrollment

- Factbook:
  https://www.cctech.edu/about/institutional-effectiveness/institutional-research/

- Library Hours Visualization Example:
  https://rpubs.com/alanhlam/library_hours_99

QUESTIONS?

THANK YOU

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