THE POPULARITY OF BOOKS ON GOODREADS

DATA 606 Final Project

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Abstract

This is a statistical analysis of some of the factors that contribute to the popularity of books on Goodreads. The observational dataset posted on Kaggle was originally sourced from Goodreads' Top 100 lists of the most popular books for each year from 1980 to 2023. In particular, the focus will be to answer the question:

Are serials, or books that are part of multi-volume series, associated with higher ratings and a larger readership than standalone books? In other words, is there a relationship between the independent variables (standalone books vs serials, and first in series vs sequel) and the dependent variables (mean user ratings, number of current readers and potential readership counts)?

Using summary statistics, visualizations and regression modeling, the results indicate that serials do not have significantly different mean user ratings; and sequels also do not show notable difference in average ratings than a first published installment. However, there are more current and potential Goodreads users for standalone book titles than books in a series. This analysis could provide potentially valuable insights for publishers, authors, and marketers for data-driven decision-making.

Data Preparation

The explanatory variables are created from text fields in the raw data. Each of the 4399 rows is given a value in a new categorical column with two levels (TRUE or FALSE) called `serial` based on whether there are non-empty strings under `series_title` and `series_release_number`.

Then, in a second data frame for only those books with `serial` set to TRUE, each observation is marked in a new `first_book` column with a TRUE if it is the first book published in its series or FALSE for sequels and prequels. The determination here is that since prequels are published *after* the initial volume, they should not be considered the first in a series.

The response variables are numerical: `rating_score`, `num_ratings`, `current_readers`, `want_to_read`.

```r
library(tidyverse)

raw_books <- read.csv(file = "goodreads_top100.csv")

# select relevant columns
books <- raw_books |>
  select("isbn",
         "title",
         "series_title",
         "series_release_number",
         "rating_score",
         "num_ratings",
         "current_readers",
         "want_to_read")
```

```
# convert blank strings to NAs in text columns
books <- books |>
  mutate(isbn = na_if(isbn, "")) |>
  mutate(series_title = na_if(series_title, "")) |>
  mutate(series_release_number = na_if(series_release_number, ""))

# remove duplicate ISBN numbers / repeated books
books <- books |>
  distinct(isbn, .keep_all = TRUE)

# add column to indicate if the book in series
books <- books |>
  mutate(serial = !is.na(books$series_title) & !is.na(books$series_release_number))

knitr::kable(head(books))
```

isbn	title	series_title	series_release_number	rating_score	num_ratings	current_readers	want_to_read	serial
9780689830594	Summer Story	Brambly Hedge	2	4.45	1017	7	512	TRUE
9780375704970	The Lake of Darkness	NA	NA	3.76	1388	77	623	FALSE
9780345446671	Beyond the Blue Event Horizon	Heechee Saga	2	3.95	13307	181	3961	TRUE
9780446403016	St. Peter's Fair	Chronicles of Brother Cadfael	4	4.12	10493	1298	2502	TRUE
9780425198773	Twice Shy	NA	NA	3.92	4188	162	642	FALSE
9780698119604	The Door in the Hedge	NA	NA	3.70	9657	395	6643	FALSE

```
# create a 2nd table for series-only analysis
series <- filter(books, serial == TRUE)

# add column for if it is the first release of its series
series <- series |>
  mutate(first_book = ifelse(grepl("^1(?!\\d)", series$series_release_number, perl = TRUE),
                             TRUE,
                             FALSE)) |>
  subset(select = -c(serial))

knitr::kable(head(series))
```

isbn	title	series_title	series_release_number	rating_score	num_ratings	current_readers	want_to_read	first_book
9780689830594	Summer Story	Brambly Hedge	2	4.45	1017	7	512	FALSE
9780345446671	Beyond the Blue Event Horizon	Heechee Saga	2	3.95	13307	181	3961	FALSE

isbn	title	series_title	series_release_number	rating_score	num_ratings	current_readers	want_to_read	first_book
9780446403016	St. Peter's Fair	Chronicles of Brother Cadfael	4	4.12	10493	1298	2502	FALSE
9780345468642	Pawn of Prophecy	The Belgariad	1	4.16	105412	1777	52200	TRUE
9780553276329	Pacific Vortex!	Dirk Pitt	1	3.80	23332	350	11900	TRUE
9780786915743	Dragons of Autumn Twilight	Dragonlance: Chronicles	1	4.01	116639	4499	52800	TRUE

Summary Statistics & Data Visualizations

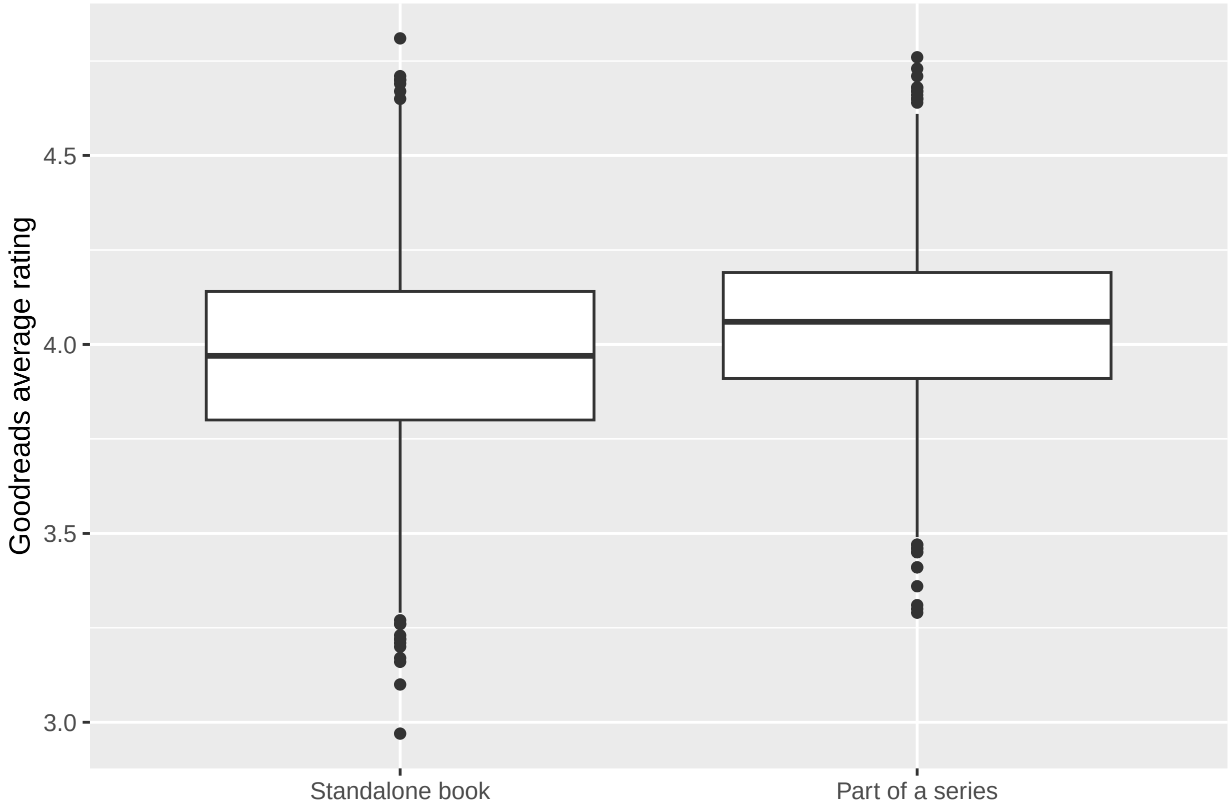
Mean Ratings: Series vs Standalone Books

Comparing the average ratings shows a slight a preference by Goodreads users for serials over standalone books.

```
rating_summary <- books |>
  group_by(serial) |>
  reframe(
    count = n(),
    mean = mean(rating_score),
    sd = sd(rating_score),
    median = median(rating_score),
    min = min(rating_score),
    max = max(rating_score),
  )

rating_summary
```

```
## # A tibble: 2 x 7
##   serial count  mean    sd median   min   max
##   <lgl>  <int> <dbl> <dbl>  <dbl> <dbl> <dbl>
## 1 FALSE   1813  3.96 0.256   3.97  2.97  4.81
## 2 TRUE    1805  4.06 0.216   4.06  3.29  4.76
```

```
ggplot(books, aes(x = serial, y = rating_score)) +
  geom_boxplot() +
  scale_x_discrete(labels = c("FALSE" = "Standalone book", "TRUE" = "Part of a series")) +
  labs(y = "Goodreads average rating", x= "")
```



Since each book is an independent observation and the sample sizes for each group are comfortably large, the conditions for inference are satisfied; a hypothesis test for the difference of the two means can determine any association.

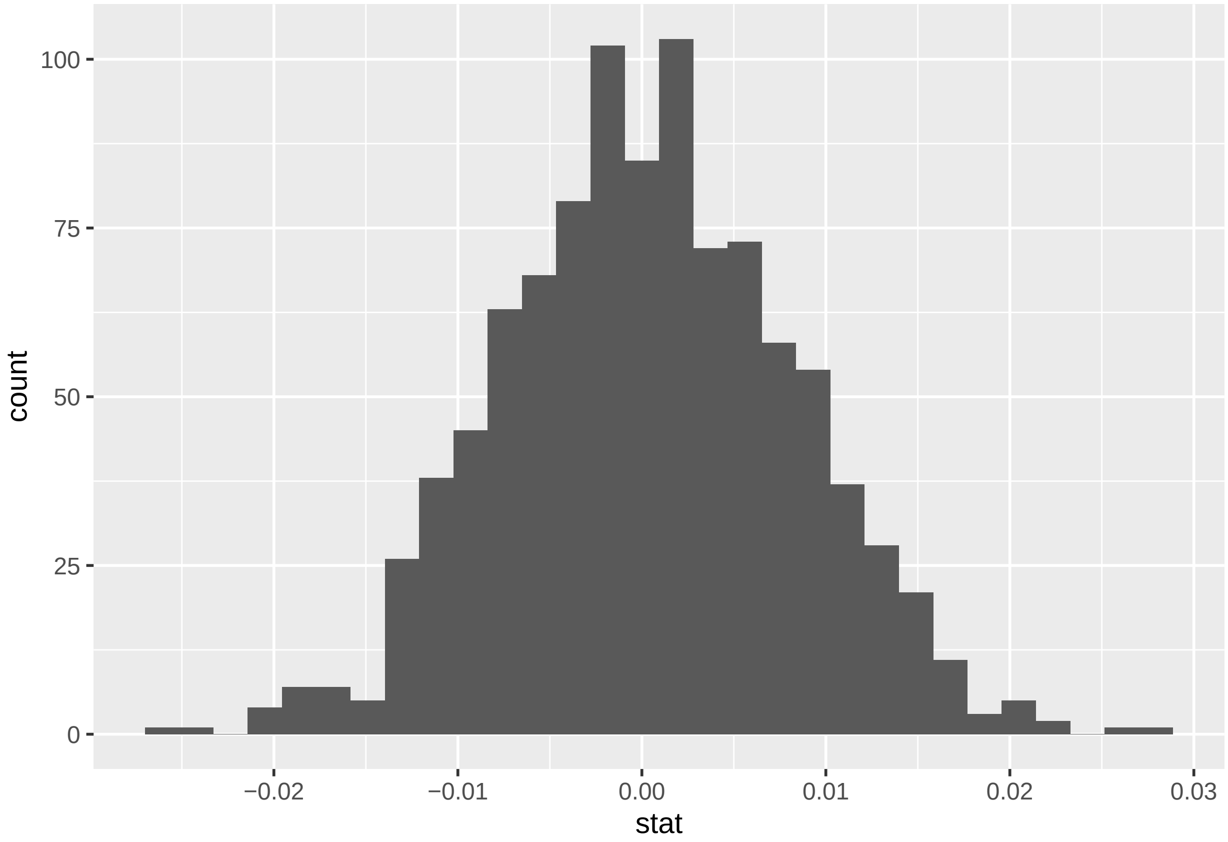
- The null hypothesis H0: There is no relationship between being part of a series and average rating.
- The alternative hypothesis H1: The average ratings are significantly different for serials.

Below, the difference in means is calculated in the order of TRUE - FALSE != 0. The test is then simulated on the null distribution and plotted.

```
library(infer)
set.seed(99)

series_obs_diff <- books |>
  specify(rating_score ~ serial) |>
  calculate(stat = "diff in means", order = c(TRUE, FALSE))

series_obs_diff
```

```
## Response: rating_score (numeric)
## Explanatory: serial (factor)
## # A tibble: 1 x 1
##     stat
##    <dbl>
## 1 0.0932
```

```
series_null_dist <- books |>
  specify(rating_score ~ serial) |>
  hypothesize(null = "independence") |>
  generate(reps = 1000, type = "permute") |>
  calculate(stat = "diff in means", order = c(TRUE, FALSE))

ggplot(data = series_null_dist, aes(x = stat)) +
  geom_histogram()
```



```
series_null_dist |>
  get_p_value(obs_stat = series_obs_diff, direction = "two_sided")
```

```
## # A tibble: 1 x 1
##   p_value
##     <dbl>
## 1       0
```

```
series_diff_ci <- series_null_dist |> get_ci(level = 0.95)

series_diff_ci
```

```
## # A tibble: 1 x 2
##   lower_ci upper_ci
##      <dbl>    <dbl>
## 1  -0.0139   0.0154
```

At a confidence level of 95%, the difference in mean ratings between series and standalone books should fall between -0.014 to 0.015. Since this contains 0, we can fail to reject the null hypothesis. There is no significant difference in average rating for serials.

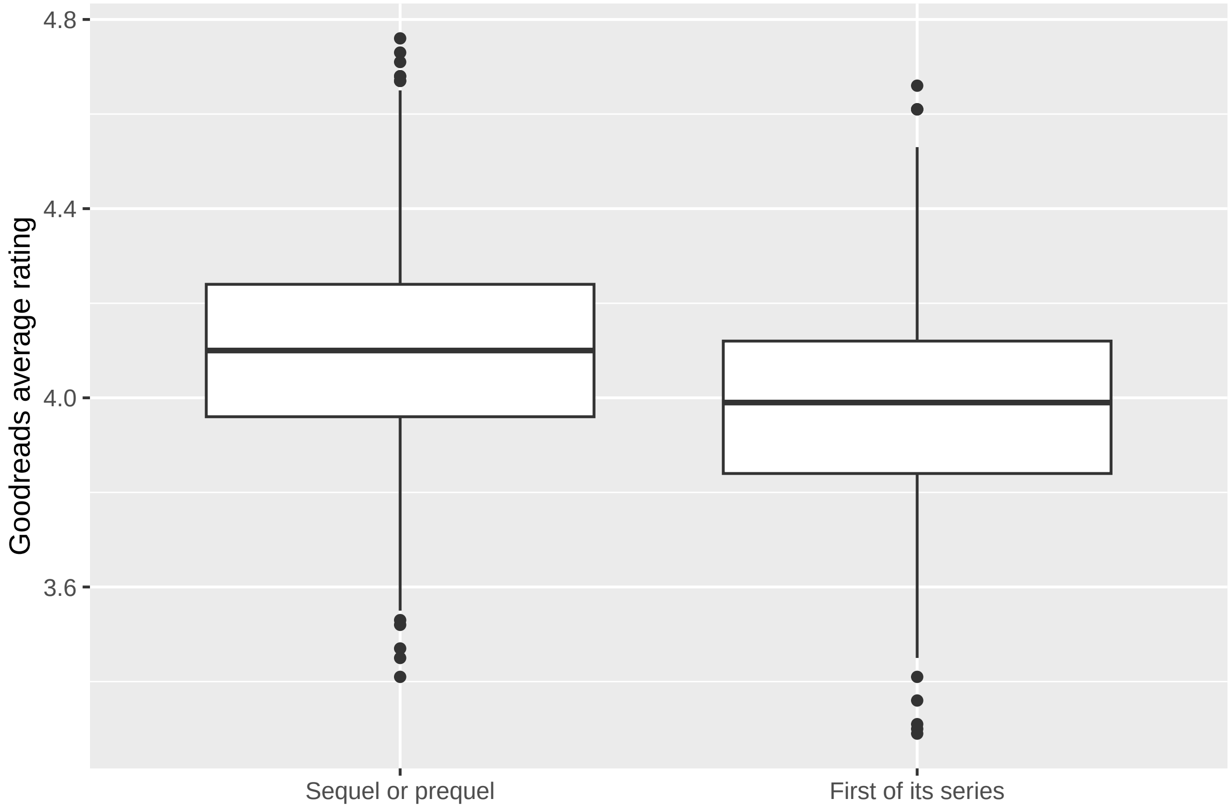
Average Ratings: Firsts vs Sequels

Within series, there is a somewhat more noticeable bump in ratings for sequels over the first book.

```
rating_summary_sequels <- series |>
  group_by(first_book) |>
  reframe(
    count = n(),
    mean = mean(rating_score),
    sd = sd(rating_score),
    median = median(rating_score),
    min = min(rating_score),
    max = max(rating_score),
  )

rating_summary_sequels
```

```
## # A tibble: 2 x 7
##   first_book count  mean    sd median   min   max
##   <lgl>      <int> <dbl> <dbl>  <dbl> <dbl> <dbl>
## 1 FALSE       1141  4.10 0.206   4.1   3.41  4.76
## 2 TRUE         664  3.98 0.209   3.99  3.29  4.66
```

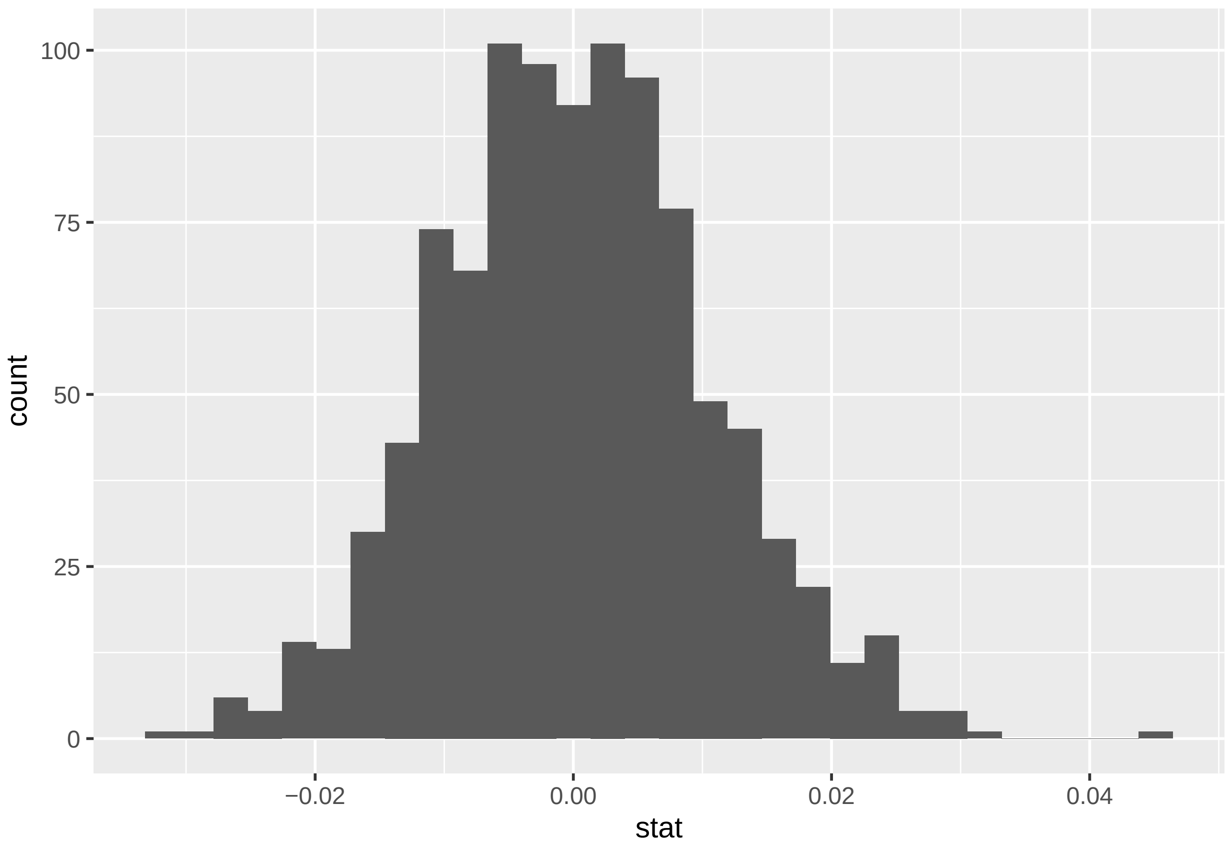
```
ggplot(series, aes(x = first_book, y = rating_score)) +
  geom_boxplot() +
  scale_x_discrete(labels = c("FALSE" = "Sequel or prequel",
                              "TRUE" = "First of its series")) +
  labs(y = "Goodreads average rating", x = "")
```



The hypothesis test for serials alone is as follows:

The null hypothesis H0: There is no relationship between being a sequel and average rating. The alternative hypothesis H1: The average ratings are significantly different for sequels than first books.

```r
set.seed(99)

first_obs_diff <- series |>
  specify(rating_score ~ first_book) |>
  calculate(stat = "diff in means", order = c(TRUE, FALSE))

first_null_dist <- series |>
  specify(rating_score ~ first_book) |>
  hypothesize(null = "independence") |>
  generate(reps = 1000, type = "permute") |>
  calculate(stat = "diff in means", order = c(TRUE, FALSE))

ggplot(data = first_null_dist, aes(x = stat)) +
  geom_histogram()
```



```
first_null_dist |>
  get_p_value(obs_stat = first_obs_diff, direction = "two_sided")
```

```
## # A tibble: 1 x 1
##   p_value
##     <dbl>
## 1       0
```

```
first_diff_ci <- first_null_dist |> get_ci(level = 0.95)

first_diff_ci
```

```
## # A tibble: 1 x 2
##   lower_ci upper_ci
##      <dbl>    <dbl>
## 1  -0.0200   0.0220
```

With the confidence level set to 95%, the difference in mean ratings between first books and sequels/prequels should fall between -0.02 to 0.02. Since this contains 0, we can fail to reject the null hypothesis. There is no significant difference in average rating for sequels.

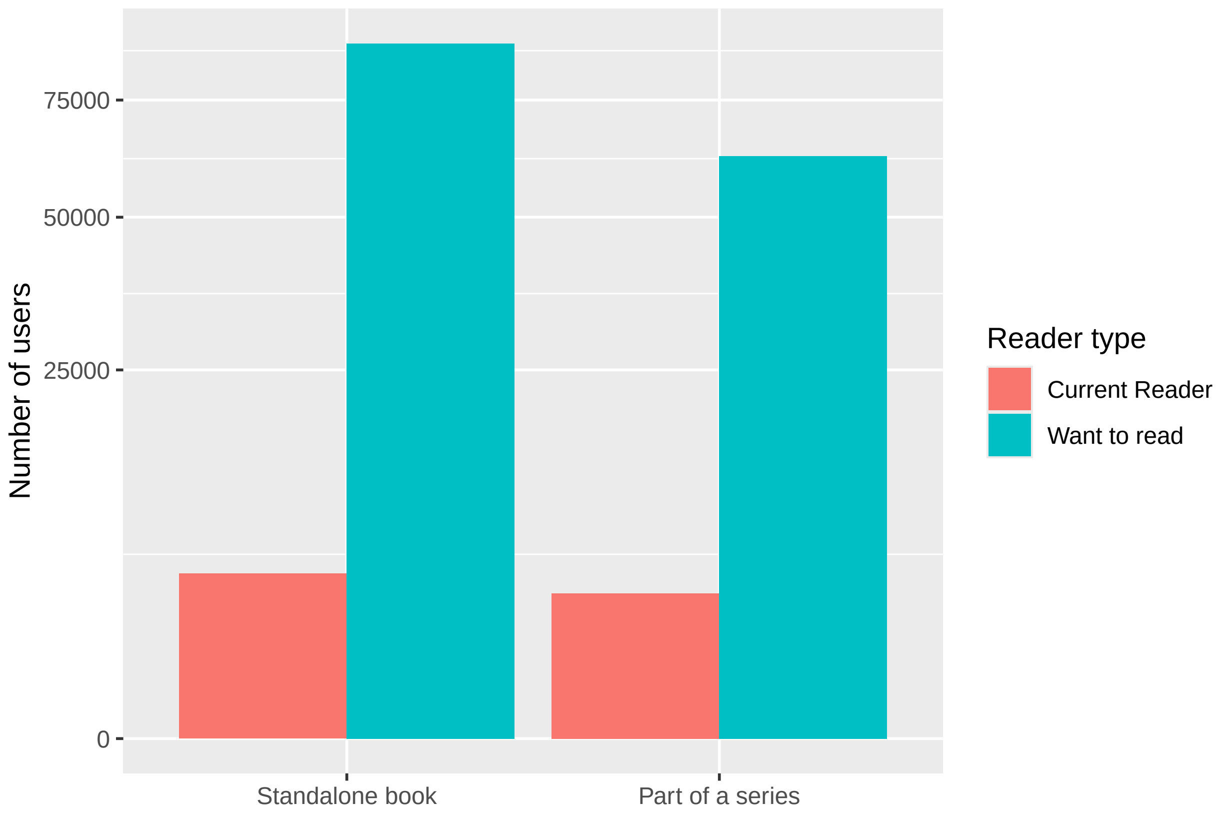
Readership

Here is a comparison of users who marked themselves as current readers of a title vs interested/potential readers. The average number of users who are either currently reading or `want_to_read` a standalone book is much higher than for series.

```r
books_readership <- books |>
  pivot_longer(cols = c("current_readers", "want_to_read"),
               names_to = "reader_type",
               values_to = "readership")

readership_summary <- books_readership |>
  group_by(serial, reader_type) |>
  summarize(mean_readership = mean(readership, na.rm = TRUE))

readership_summary
```

```
## # A tibble: 4 x 3
## # Groups:   serial [2]
##   serial reader_type     mean_readership
##   <lgl>  <chr>                     <dbl>
## 1 FALSE  current_readers           5013.
## 2 FALSE  want_to_read             88904.
## 3 TRUE   current_readers           3874.
## 4 TRUE   want_to_read             62413.
```

```r
ggplot(readership_summary, aes(fill = reader_type, x = serial, y = mean_readership)) +
  geom_bar(position = "dodge", stat = "identity") +
  scale_y_sqrt() +
  labs(y = "Number of users", x= "") +
  scale_x_discrete(labels = c("FALSE" = "Standalone book", "TRUE" = "Part of a series")) +
  scale_fill_discrete(name = "Reader type", labels = c("Current Reader", "Want to read"))
```



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Conclusion

Why is this analysis important? Limitations of the analysis? - Conclusion includes a clear answer to the statistical question that is consistent with the data analysis and the method of data collection.