Case Study: Cyclistic bike-share analysis

Capstone Project: Cyclistic

Stakeholders

- Cyclistic executive team
- Lily Moreno: The director of marketing and my manager.

Marketing Campaign Objectives

Design marketing strategies aimed at converting casual riders into annual members. In order to do that, however, the marketing analyst team needs to better understand how annual members and casual riders differ, why casual riders would buy a membership, and how digital media could affect their marketing tactics.

My task is to focus on (What is the question): How do annual members and casual riders use Cyclistic bikes differently?

My deliverables for the campaign are:

1. A clear statement of the business task
2. A description of all data sources used
3. Documentation of any cleaning or manipulation of data
4. A summary of your analysis
5. Supporting visualizations and key findings
6. Your top three recommendations based on your analysis

Data

The data is the historical bike usage data provided by the client. It is their monthly usage spreadsheets (excel) for the past twelve month (organized by quarters). I have stored the data in its own sub-directory within the case study directory:

`(~\Documents\Coursera\Google Data Analytics\Capstone\Case Study Cyclistic\Data).`

The data will need to be formatted into proper data types such as numbers, dates, and text. There are missing data but more EDA is needed to determine if it will affect the overall analysis. Prior to any EDA there will be ETL needed in order to provide a tidy, coherent data source for analysis.

I will be using R to transform and load the data as well as conduct EDA and descriptive and inferential analyses. I am using the R script designed by Google's Kevin Hartman with some modifications.

Extract Transform and Load (ETL)

```r
#install.packages('tidyverse')  #only need to install once
#install.packages('lubridate')
#install.packages('ggplot2')
library(tidyverse)  #helps wrangle data
```

Step 1. Install the required packages and upload the data

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --

## v ggplot2 3.3.6     v purrr   0.3.4
## v tibble  3.1.7     v dplyr   1.0.9
## v tidyr   1.2.0     v stringr 1.4.0
## v readr   2.1.2     v forcats 0.5.1

## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(lubridate)  #helps wrangle date attributes
```

```
##
## Attaching package: 'lubridate'

## The following objects are masked from 'package:base':
##
##     date, intersect, setdiff, union
```

```
library(ggplot2)  #helps visualize data
#getwd() #displays my working directory
#setwd("~Documents/Coursera/Google Data Analytics/Capstone/Case Study Cyclistic/Data") #sets my working
```

```
# Upload Cyclistic datasets (csv files) here
q2_2019 <- read_csv("Divvy_Trips_2019_Q2.csv")
```

```
## Rows: 1108163 Columns: 12
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr  (4): 03 - Rental Start Station Name, 02 - Rental End Station Name, User...
## dbl  (5): 01 - Rental Details Rental ID, 01 - Rental Details Bike ID, 03 - R...
## dttm (2): 01 - Rental Details Local Start Time, 01 - Rental Details Local En...
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
q3_2019 <- read_csv("Divvy_Trips_2019_Q3.csv")
```

```
## Rows: 1640718 Columns: 12
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr  (4): from_station_name, to_station_name, usertype, gender
## dbl  (5): trip_id, bikeid, from_station_id, to_station_id, birthyear
## dttm (2): start_time, end_time
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
q4_2019 <- read_csv("Divvy_Trips_2019_Q4.csv")
```

```
## Rows: 704054 Columns: 12
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr  (4): from_station_name, to_station_name, usertype, gender
## dbl  (5): trip_id, bikeid, from_station_id, to_station_id, birthyear
## dttm (2): start_time, end_time
```

```
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
q1_2020 <- read_csv("Divvy_Trips_2020_Q1.csv")
```

```
## Rows: 426887 Columns: 13
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr  (5): ride_id, rideable_type, start_station_name, end_station_name, memb...
## dbl  (6): start_station_id, end_station_id, start_lat, start_lng, end_lat, e...
## dttm (2): started_at, ended_at
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```

# Compare column names each of the files
# While the names don't have to be in the same order, they DO need to
#match perfectly before we can use a command to join them into one file
colnames(q3_2019)
```

STEP 2: WRANGLE DATA AND COMBINE INTO A SINGLE FILE

```
##  [1] "trip_id"           "start_time"        "end_time"
##  [4] "bikeid"            "tripduration"      "from_station_id"
##  [7] "from_station_name" "to_station_id"     "to_station_name"
## [10] "usertype"          "gender"            "birthyear"
```

```
colnames(q4_2019)
```

```
##  [1] "trip_id"           "start_time"        "end_time"
##  [4] "bikeid"            "tripduration"      "from_station_id"
##  [7] "from_station_name" "to_station_id"     "to_station_name"
## [10] "usertype"          "gender"            "birthyear"
```

```
colnames(q2_2019)
```

```
##  [1] "01 - Rental Details Rental ID"
##  [2] "01 - Rental Details Local Start Time"
##  [3] "01 - Rental Details Local End Time"
##  [4] "01 - Rental Details Bike ID"
##  [5] "01 - Rental Details Duration In Seconds Uncapped"
##  [6] "03 - Rental Start Station ID"
##  [7] "03 - Rental Start Station Name"
##  [8] "02 - Rental End Station ID"
##  [9] "02 - Rental End Station Name"
## [10] "User Type"
## [11] "Member Gender"
## [12] "05 - Member Details Member Birthday Year"
```

```
colnames(q1_2020)
```

```
##  [1] "ride_id"            "rideable_type"      "started_at"
##  [4] "ended_at"           "start_station_name" "start_station_id"
##  [7] "end_station_name"   "end_station_id"     "start_lat"
## [10] "start_lng"          "end_lat"            "end_lng"
## [13] "member_casual"
```

We will now rename the columns to make them consistent with q1_2020 (this is going-forward table design for Cyclistic)

```
(q4_2019 <- rename(q4_2019
                   ,ride_id = trip_id
                   ,rideable_type = bikeid
                   ,started_at = start_time
                   ,ended_at = end_time
                   ,start_station_name = from_station_name
                   ,start_station_id = from_station_id
                   ,end_station_name = to_station_name
                   ,end_station_id = to_station_id
                   ,member_casual = usertype))
```

```
## # A tibble: 704,054 x 12
##     ride_id started_at          ended_at            rideable_type tripduration
##       <dbl> <dttm>              <dttm>                      <dbl>        <dbl>
##  1 25223640 2019-10-01 00:01:39 2019-10-01 00:17:20          2215          940
##  2 25223641 2019-10-01 00:02:16 2019-10-01 00:06:34          6328          258
##  3 25223642 2019-10-01 00:04:32 2019-10-01 00:18:43          3003          850
##  4 25223643 2019-10-01 00:04:32 2019-10-01 00:43:43          3275         2350
##  5 25223644 2019-10-01 00:04:34 2019-10-01 00:35:42          5294         1867
##  6 25223645 2019-10-01 00:04:38 2019-10-01 00:10:51          1891          373
##  7 25223646 2019-10-01 00:04:52 2019-10-01 00:22:45          1061         1072
##  8 25223647 2019-10-01 00:04:57 2019-10-01 00:29:16          1274         1458
##  9 25223648 2019-10-01 00:05:20 2019-10-01 00:29:18          6011         1437
## 10 25223649 2019-10-01 00:05:20 2019-10-01 02:23:46          2957         8306
## # ... with 704,044 more rows, and 7 more variables: start_station_id <dbl>,
## #   start_station_name <chr>, end_station_id <dbl>, end_station_name <chr>,
## #   member_casual <chr>, gender <chr>, birthyear <dbl>
```

```
(q3_2019 <- rename(q3_2019
                   ,ride_id = trip_id
                   ,rideable_type = bikeid
                   ,started_at = start_time
                   ,ended_at = end_time
                   ,start_station_name = from_station_name
                   ,start_station_id = from_station_id
                   ,end_station_name = to_station_name
                   ,end_station_id = to_station_id
                   ,member_casual = usertype))
```

```
## # A tibble: 1,640,718 x 12
##     ride_id started_at          ended_at            rideable_type tripduration
##       <dbl> <dttm>              <dttm>                      <dbl>        <dbl>
##  1 23479388 2019-07-01 00:00:27 2019-07-01 00:20:41          3591         1214
##  2 23479389 2019-07-01 00:01:16 2019-07-01 00:18:44          5353         1048
##  3 23479390 2019-07-01 00:01:48 2019-07-01 00:27:42          6180         1554
##  4 23479391 2019-07-01 00:02:07 2019-07-01 00:27:10          5540         1503
##  5 23479392 2019-07-01 00:02:13 2019-07-01 00:22:26          6014         1213
##  6 23479393 2019-07-01 00:02:21 2019-07-01 00:07:31          4941          310
##  7 23479394 2019-07-01 00:02:24 2019-07-01 00:23:12          3770         1248
##  8 23479395 2019-07-01 00:02:26 2019-07-01 00:28:16          5442         1550
##  9 23479396 2019-07-01 00:02:34 2019-07-01 00:28:57          2957         1583
## 10 23479397 2019-07-01 00:02:45 2019-07-01 00:29:14          6091         1589
## # ... with 1,640,708 more rows, and 7 more variables: start_station_id <dbl>,
## #   start_station_name <chr>, end_station_id <dbl>, end_station_name <chr>,
## #   member_casual <chr>, gender <chr>, birthyear <dbl>
```

```
(q2_2019 <- rename(q2_2019
                   ,ride_id = "01 - Rental Details Rental ID"
                   ,rideable_type = "01 - Rental Details Bike ID"
                   ,started_at = "01 - Rental Details Local Start Time"
                   ,ended_at = "01 - Rental Details Local End Time"
                   ,start_station_name = "03 - Rental Start Station Name"
                   ,start_station_id = "03 - Rental Start Station ID"
                   ,end_station_name = "02 - Rental End Station Name"
                   ,end_station_id = "02 - Rental End Station ID"
                   ,member_casual = "User Type"))
```

```
## # A tibble: 1,108,163 x 12
##     ride_id started_at          ended_at            rideable_type
##       <dbl> <dttm>              <dttm>                      <dbl>
##  1 22178529 2019-04-01 00:02:22 2019-04-01 00:09:48          6251
##  2 22178530 2019-04-01 00:03:02 2019-04-01 00:20:30          6226
##  3 22178531 2019-04-01 00:11:07 2019-04-01 00:15:19          5649
##  4 22178532 2019-04-01 00:13:01 2019-04-01 00:18:58          4151
##  5 22178533 2019-04-01 00:19:26 2019-04-01 00:36:13          3270
##  6 22178534 2019-04-01 00:19:39 2019-04-01 00:23:56          3123
##  7 22178535 2019-04-01 00:26:33 2019-04-01 00:35:41          6418
##  8 22178536 2019-04-01 00:29:48 2019-04-01 00:36:11          4513
##  9 22178537 2019-04-01 00:32:07 2019-04-01 01:07:44          3280
## 10 22178538 2019-04-01 00:32:19 2019-04-01 01:07:39          5534
## # ... with 1,108,153 more rows, and 8 more variables:
## #   `01 - Rental Details Duration In Seconds Uncapped` <dbl>,
## #   start_station_id <dbl>, start_station_name <chr>, end_station_id <dbl>,
## #   end_station_name <chr>, member_casual <chr>, `Member Gender` <chr>,
## #   `05 - Member Details Member Birthday Year` <dbl>
```

```
# Inspect the dataframes and look for inconsistencies
str(q1_2020)
```

```
## spec_tbl_df [426,887 x 13] (S3: spec_tbl_df/tbl_df/tbl/data.frame)
##  $ ride_id           : chr [1:426887] "EACB19130B0CDA4A" "8FED874C809DC021" "789F3C21E472CA96" "C9A3
##  $ rideable_type     : chr [1:426887] "docked_bike" "docked_bike" "docked_bike" "docked_bike" ...
##  $ started_at        : POSIXct[1:426887], format: "2020-01-21 20:06:59" "2020-01-30 14:22:39" ...
##  $ ended_at          : POSIXct[1:426887], format: "2020-01-21 20:14:30" "2020-01-30 14:26:22" ...
##  $ start_station_name: chr [1:426887] "Western Ave & Leland Ave" "Clark St & Montrose Ave" "Broadway
##  $ start_station_id  : num [1:426887] 239 234 296 51 66 212 96 96 212 38 ...
##  $ end_station_name  : chr [1:426887] "Clark St & Leland Ave" "Southport Ave & Irving Park Rd" "Wilto
##  $ end_station_id    : num [1:426887] 326 318 117 24 212 96 212 212 96 100 ...
##  $ start_lat         : num [1:426887] 42 42 41.9 41.9 41.9 ...
##  $ start_lng         : num [1:426887] -87.7 -87.7 -87.6 -87.6 -87.6 ...
##  $ end_lat           : num [1:426887] 42 42 41.9 41.9 41.9 ...
##  $ end_lng           : num [1:426887] -87.7 -87.7 -87.7 -87.6 -87.6 ...
##  $ member_casual     : chr [1:426887] "member" "member" "member" "member" ...
##  - attr(*, "spec")=
##   .. cols(
##   ..   ride_id = col_character(),
##   ..   rideable_type = col_character(),
##   ..   started_at = col_datetime(format = ""),
##   ..   ended_at = col_datetime(format = ""),
##   ..   start_station_name = col_character(),
##   ..   start_station_id = col_double(),
##   ..   end_station_name = col_character(),
##   ..   end_station_id = col_double(),
##   ..   start_lat = col_double(),
##   ..   start_lng = col_double(),
##   ..   end_lat = col_double(),
##   ..   end_lng = col_double(),
##   ..   member_casual = col_character()
##   .. )
##  - attr(*, "problems")=<externalptr>
```

```
str(q4_2019)
```

```
## spec_tbl_df [704,054 x 12] (S3: spec_tbl_df/tbl_df/tbl/data.frame)
##  $ ride_id           : num [1:704054] 25223640 25223641 25223642 25223643 25223644 ...
##  $ started_at        : POSIXct[1:704054], format: "2019-10-01 00:01:39" "2019-10-01 00:02:16" ...
##  $ ended_at          : POSIXct[1:704054], format: "2019-10-01 00:17:20" "2019-10-01 00:06:34" ...
##  $ rideable_type     : num [1:704054] 2215 6328 3003 3275 5294 ...
##  $ tripduration      : num [1:704054] 940 258 850 2350 1867 ...
##  $ start_station_id  : num [1:704054] 20 19 84 313 210 156 84 156 156 336 ...
##  $ start_station_name: chr [1:704054] "Sheffield Ave & Kingsbury St" "Throop (Loomis) St & Taylor St
##  $ end_station_id    : num [1:704054] 309 241 199 290 382 226 142 463 463 336 ...
##  $ end_station_name  : chr [1:704054] "Leavitt St & Armitage Ave" "Morgan St & Polk St" "Wabash Ave &
##  $ member_casual     : chr [1:704054] "Subscriber" "Subscriber" "Subscriber" "Subscriber" ...
##  $ gender            : chr [1:704054] "Male" "Male" "Female" "Male" ...
##  $ birthyear         : num [1:704054] 1987 1998 1991 1990 1987 ...
##  - attr(*, "spec")=
##   .. cols(
##   ..   trip_id = col_double(),
##   ..   start_time = col_datetime(format = ""),
##   ..   end_time = col_datetime(format = ""),
##   ..   bikeid = col_double(),
##   ..   tripduration = col_number(),
##   ..   from_station_id = col_double(),
##   ..   from_station_name = col_character(),
##   ..   to_station_id = col_double(),
##   ..   to_station_name = col_character(),
##   ..   usertype = col_character(),
##   ..   gender = col_character(),
##   ..   birthyear = col_double()
##   .. )
##  - attr(*, "problems")=<externalptr>
```

```
str(q3_2019)
```

```
## spec_tbl_df [1,640,718 x 12] (S3: spec_tbl_df/tbl_df/tbl/data.frame)
##  $ ride_id           : num [1:1640718] 23479388 23479389 23479390 23479391 23479392 ...
##  $ started_at        : POSIXct[1:1640718], format: "2019-07-01 00:00:27" "2019-07-01 00:01:16" ...
##  $ ended_at          : POSIXct[1:1640718], format: "2019-07-01 00:20:41" "2019-07-01 00:18:44" ...
##  $ rideable_type     : num [1:1640718] 3591 5353 6180 5540 6014 ...
##  $ tripduration      : num [1:1640718] 1214 1048 1554 1503 1213 ...
##  $ start_station_id  : num [1:1640718] 117 381 313 313 168 300 168 313 43 43 ...
##  $ start_station_name: chr [1:1640718] "Wilton Ave & Belmont Ave" "Western Ave & Monroe St" "Lakevie
##  $ end_station_id    : num [1:1640718] 497 203 144 144 62 232 62 144 195 195 ...
##  $ end_station_name  : chr [1:1640718] "Kimball Ave & Belmont Ave" "Western Ave & 21st St" "Larrabee
##  $ member_casual     : chr [1:1640718] "Subscriber" "Customer" "Customer" "Customer" ...
##  $ gender            : chr [1:1640718] "Male" NA NA NA ...
##  $ birthyear         : num [1:1640718] 1992 NA NA NA NA ...
##  - attr(*, "spec")=
##   .. cols(
##   ..   trip_id = col_double(),
##   ..   start_time = col_datetime(format = ""),
##   ..   end_time = col_datetime(format = ""),
##   ..   bikeid = col_double(),
##   ..   tripduration = col_number(),
##   ..   from_station_id = col_double(),
##   ..   from_station_name = col_character(),
##   ..   to_station_id = col_double(),
##   ..   to_station_name = col_character(),
##   ..   usertype = col_character(),
##   ..   gender = col_character(),
##   ..   birthyear = col_double()
##   .. )
##  - attr(*, "problems")=<externalptr>
```

```
str(q2_2019)
```

```
## spec_tbl_df [1,108,163 x 12] (S3: spec_tbl_df/tbl_df/tbl/data.frame)
##  $ ride_id                                        : num [1:1108163] 22178529 22178530 22178531 22178
##  $ started_at                                     : POSIXct[1:1108163], format: "2019-04-01 00:02:2
##  $ ended_at                                       : POSIXct[1:1108163], format: "2019-04-01 00:09:4
##  $ rideable_type                                  : num [1:1108163] 6251 6226 5649 4151 3270 ...
##  $ 01 - Rental Details Duration In Seconds Uncapped: num [1:1108163] 446 1048 252 357 1007 ...
##  $ start_station_id                               : num [1:1108163] 81 317 283 26 202 420 503 260 2
##  $ start_station_name                             : chr [1:1108163] "Daley Center Plaza" "Wood St &
##  $ end_station_id                                 : num [1:1108163] 56 59 174 133 129 426 500 499 2
##  $ end_station_name                               : chr [1:1108163] "Desplaines St & Kinzie St" "Wal
##  $ member_casual                                  : chr [1:1108163] "Subscriber" "Subscriber" "Subsc
##  $ Member Gender                                  : chr [1:1108163] "Male" "Female" "Male" "Male" .
##  $ 05 - Member Details Member Birthday Year       : num [1:1108163] 1975 1984 1990 1993 1992 ...
##  - attr(*, "spec")=
##   .. cols(
##   ..   `01 - Rental Details Rental ID` = col_double(),
##   ..   `01 - Rental Details Local Start Time` = col_datetime(format = ""),
##   ..   `01 - Rental Details Local End Time` = col_datetime(format = ""),
##   ..   `01 - Rental Details Bike ID` = col_double(),
##   ..   `01 - Rental Details Duration In Seconds Uncapped` = col_number(),
##   ..   `03 - Rental Start Station ID` = col_double(),
##   ..   `03 - Rental Start Station Name` = col_character(),
##   ..   `02 - Rental End Station ID` = col_double(),
##   ..   `02 - Rental End Station Name` = col_character(),
##   ..   `User Type` = col_character(),
##   ..   `Member Gender` = col_character(),
##   ..   `05 - Member Details Member Birthday Year` = col_double()
##   .. )
##  - attr(*, "problems")=<externalptr>
```

```
# Convert ride_id and rideable_type to character so that they can stack correctly
q4_2019 <-  mutate(q4_2019, ride_id = as.character(ride_id)
                   ,rideable_type = as.character(rideable_type))
q3_2019 <-  mutate(q3_2019, ride_id = as.character(ride_id)
                   ,rideable_type = as.character(rideable_type))
q2_2019 <-  mutate(q2_2019, ride_id = as.character(ride_id)
                   ,rideable_type = as.character(rideable_type))

# Stack individual quarter's data frames into one big data frame
all_trips <- bind_rows(q2_2019, q3_2019, q4_2019, q1_2020)

# Remove lat, long, birthyear, and gender fields as this data was dropped beginning in 2020
all_trips <- all_trips %>%
  select(-c(start_lat, start_lng, end_lat, end_lng, birthyear, gender, "01 - Rental Details Duration In
```

STEP 3: CLEAN UP AND ADD DATA TO PREPARE FOR ANALYSIS We need to inspect the new table and determine its accuracy

```
colnames(all_trips)  #List of column names
```

```
## [1] "ride_id"            "started_at"         "ended_at"
## [4] "rideable_type"      "start_station_id"   "start_station_name"
## [7] "end_station_id"     "end_station_name"   "member_casual"
```

```
nrow(all_trips)  #How many rows are in data frame?
```

```
## [1] 3879822
```

```
dim(all_trips)  #Dimensions of the data frame?
```

```
## [1] 3879822       9
```

```
head(all_trips)  #See the first 6 rows of data frame.  Also tail(all_trips)
```

```
## # A tibble: 6 x 9
##   ride_id started_at          ended_at            rideable_type start_station_id
##   <chr>   <dttm>              <dttm>              <chr>                    <dbl>
## 1 221785~ 2019-04-01 00:02:22 2019-04-01 00:09:48 6251                        81
## 2 221785~ 2019-04-01 00:03:02 2019-04-01 00:20:30 6226                       317
## 3 221785~ 2019-04-01 00:11:07 2019-04-01 00:15:19 5649                       283
## 4 221785~ 2019-04-01 00:13:01 2019-04-01 00:18:58 4151                        26
## 5 221785~ 2019-04-01 00:19:26 2019-04-01 00:36:13 3270                       202
## 6 221785~ 2019-04-01 00:19:39 2019-04-01 00:23:56 3123                       420
## # ... with 4 more variables: start_station_name <chr>, end_station_id <dbl>,
## #   end_station_name <chr>, member_casual <chr>
```

```
str(all_trips)  #See list of columns and data types (numeric, character, etc)
```

```
## tibble [3,879,822 x 9] (S3: tbl_df/tbl/data.frame)
##  $ ride_id           : chr [1:3879822] "22178529" "22178530" "22178531" "22178532" ...
##  $ started_at        : POSIXct[1:3879822], format: "2019-04-01 00:02:22" "2019-04-01 00:03:02" ...
##  $ ended_at          : POSIXct[1:3879822], format: "2019-04-01 00:09:48" "2019-04-01 00:20:30" ...
##  $ rideable_type     : chr [1:3879822] "6251" "6226" "5649" "4151" ...
##  $ start_station_id  : num [1:3879822] 81 317 283 26 202 420 503 260 211 211 ...
##  $ start_station_name: chr [1:3879822] "Daley Center Plaza" "Wood St & Taylor St" "LaSalle St & Jacks
##  $ end_station_id    : num [1:3879822] 56 59 174 133 129 426 500 499 211 211 ...
##  $ end_station_name  : chr [1:3879822] "Desplaines St & Kinzie St" "Wabash Ave & Roosevelt Rd" "Canal
##  $ member_casual     : chr [1:3879822] "Subscriber" "Subscriber" "Subscriber" "Subscriber" ...
```

```
summary(all_trips)  #Statistical summary of data. Mainly for numerics
```

```
##    ride_id            started_at
##  Length:3879822     Min.   :2019-04-01 00:02:22.00
##  Class :character   1st Qu.:2019-06-23 07:49:09.25
##  Mode  :character   Median :2019-08-14 17:43:38.00
##                     Mean   :2019-08-26 00:49:59.38
##                     3rd Qu.:2019-10-12 12:10:21.00
##                     Max.   :2020-03-31 23:51:34.00
##
##     ended_at                      rideable_type      start_station_id
##  Min.   :2019-04-01 00:09:48.00   Length:3879822     Min.   :  1.0
##  1st Qu.:2019-06-23 08:20:27.75   Class :character   1st Qu.: 77.0
##  Median :2019-08-14 18:02:04.00   Mode  :character   Median :174.0
##  Mean   :2019-08-26 01:14:37.06                      Mean   :202.9
##  3rd Qu.:2019-10-12 12:36:16.75                      3rd Qu.:291.0
##  Max.   :2020-05-19 20:10:34.00                      Max.   :675.0
##
##  start_station_name end_station_id  end_station_name   member_casual
##  Length:3879822     Min.   :  1.0   Length:3879822     Length:3879822
##  Class :character   1st Qu.: 77.0   Class :character   Class :character
##  Mode  :character   Median :174.0   Mode  :character   Mode  :character
##                     Mean   :203.8
##                     3rd Qu.:291.0
##                     Max.   :675.0
##                     NA's   :1
```

We have discovered several issues and inconsistencies that need to be corrected:

1. There are two names for members ("member" and "Subscriber") and two names for casual riders ("Customer" and "casual") In the `member_casual` column. We will need to consolidate that from four to two labels.

2. The data can only be aggregated at the ride-level, which is too granular. We will want to add some additional columns of data – such as day, month, year – that provide additional opportunities to aggregate the data.

3. We will want to add a calculated field for length of ride since the 2020Q1 data did not have the `tripduration` column. We will add `ride_length` to the entire dataframe for consistency.

4. There are some rides where `tripduration` shows up as negative, including several hundred rides where Cyclistic took bikes out of circulation for Quality Control reasons. These should be deleted as they are negative outliers for the dataset.

```
# In the "member_casual" column, replace "Subscriber" with "member" and "Customer" with "casual"
# Before 2020, Cyclistic used different labels for these two types of riders ... we will want to make o
# N.B.: "Level" is a special property of a column that is retained even if a subset does not contain an
# Begin by seeing how many observations fall under each usertype
table(all_trips$member_casual)
```

```
##
##     casual   Customer     member Subscriber
##      48480     857474     378407    2595461
```

```
# Reassign to the desired values (we will go with the current 2020 labels)
all_trips <-  all_trips %>%
  mutate(member_casual = recode(member_casual
                           ,"Subscriber" = "member"
                           ,"Customer" = "casual"))

# Check to make sure the proper number of observations were reassigned
table(all_trips$member_casual)
```

```
##
##  casual  member
##  905954 2973868
```

```
# Add columns that list the date, month, day, and year of each ride
# This will allow us to aggregate ride data for each month, day, or year ... before completing these op
# https://www.statmethods.net/input/dates.html more on date formats in R found at that link
all_trips$date <- as.Date(all_trips$started_at) #The default format is yyyy-mm-dd
all_trips$month <- format(as.Date(all_trips$date), "%m")
all_trips$day <- format(as.Date(all_trips$date), "%d")
all_trips$year <- format(as.Date(all_trips$date), "%Y")
all_trips$day_of_week <- format(as.Date(all_trips$date), "%A")

# Add a "ride_length" calculation to all_trips (in seconds)
# https://stat.ethz.ch/R-manual/R-devel/library/base/html/difftime.html
all_trips$ride_length <- difftime(all_trips$ended_at,all_trips$started_at)

# Inspect the structure of the columns
str(all_trips)
```

```
## tibble [3,879,822 x 15] (S3: tbl_df/tbl/data.frame)
##  $ ride_id           : chr [1:3879822] "22178529" "22178530" "22178531" "22178532" ...
##  $ started_at        : POSIXct[1:3879822], format: "2019-04-01 00:02:22" "2019-04-01 00:03:02" ...
##  $ ended_at          : POSIXct[1:3879822], format: "2019-04-01 00:09:48" "2019-04-01 00:20:30" ...
##  $ rideable_type     : chr [1:3879822] "6251" "6226" "5649" "4151" ...
##  $ start_station_id  : num [1:3879822] 81 317 283 26 202 420 503 260 211 211 ...
##  $ start_station_name: chr [1:3879822] "Daley Center Plaza" "Wood St & Taylor St" "LaSalle St & Jacks
##  $ end_station_id    : num [1:3879822] 56 59 174 133 129 426 500 499 211 211 ...
##  $ end_station_name  : chr [1:3879822] "Desplaines St & Kinzie St" "Wabash Ave & Roosevelt Rd" "Canal
##  $ member_casual     : chr [1:3879822] "member" "member" "member" "member" ...
##  $ date              : Date[1:3879822], format: "2019-04-01" "2019-04-01" ...
##  $ month             : chr [1:3879822] "04" "04" "04" "04" ...
##  $ day               : chr [1:3879822] "01" "01" "01" "01" ...
##  $ year              : chr [1:3879822] "2019" "2019" "2019" "2019" ...
##  $ day_of_week       : chr [1:3879822] "Monday" "Monday" "Monday" "Monday" ...
##  $ ride_length       : 'difftime' num [1:3879822] 446 1048 252 357 ...
##   ..- attr(*, "units")= chr "secs"
```

```
# Convert "ride_length" from Factor to numeric so we can run calculations on the data
is.factor(all_trips$ride_length)
```

```
## [1] FALSE
```

```
all_trips$ride_length <- as.numeric(as.character(all_trips$ride_length))
is.numeric(all_trips$ride_length)
```

```
## [1] TRUE
```

```r
# Remove "bad" data
# The dataframe includes a few hundred entries when bikes were taken out of docks and checked for quali
# We will create a new version of the dataframe (v2) since data is being removed
# https://www.datasciencemadesimple.com/delete-or-drop-rows-in-r-with-conditions-2/
all_trips_v2 <- all_trips[!(all_trips$start_station_name == "HQ QR" | all_trips$ride_length<0),]
```

Exploratory Data Analysis

```r
# Descriptive analysis on ride_length (all figures in seconds)
mean(all_trips_v2$ride_length) #straight average (total ride length / rides)
```

STEP 4: CONDUCT DESCRIPTIVE ANALYSIS

```
## [1] 1479.139
```

```r
median(all_trips_v2$ride_length) #midpoint number in the ascending array of ride lengths
```

```
## [1] 712
```

```r
max(all_trips_v2$ride_length) #longest ride
```

```
## [1] 9387024
```

```r
min(all_trips_v2$ride_length) #shortest ride
```

```
## [1] 1
```

```r
# You can condense the four lines above to one line using summary() on the specific attribute
summary(all_trips_v2$ride_length)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
##       1     412     712    1479    1289 9387024 
```

We will now begin our comparative analysis between members and casual riders.

```r
aggregate(all_trips_v2$ride_length ~ all_trips_v2$member_casual, FUN = mean)
```

```
##   all_trips_v2$member_casual all_trips_v2$ride_length
## 1                     casual                3552.7502
## 2                     member                 850.0662
```

```r
aggregate(all_trips_v2$ride_length ~ all_trips_v2$member_casual, FUN = median)
```

```
##   all_trips_v2$member_casual all_trips_v2$ride_length
## 1                     casual                     1546
## 2                     member                      589
```

```r
aggregate(all_trips_v2$ride_length ~ all_trips_v2$member_casual, FUN = max)
```

```
##   all_trips_v2$member_casual all_trips_v2$ride_length
## 1                     casual                  9387024
## 2                     member                  9056634
```

```r
aggregate(all_trips_v2$ride_length ~ all_trips_v2$member_casual, FUN = min)
```

```
##   all_trips_v2$member_casual all_trips_v2$ride_length
## 1                     casual                        2
## 2                     member                        1
```

```
# See the average ride time by each day for members vs casual users
aggregate(all_trips_v2$ride_length ~ all_trips_v2$member_casual + all_trips_v2$day_of_week, FUN = mean)
```

```
##    all_trips_v2$member_casual all_trips_v2$day_of_week all_trips_v2$ride_length
## 1                      casual                   Friday                3773.8351
## 2                      member                   Friday                 824.5305
## 3                      casual                   Monday                3372.2869
## 4                      member                   Monday                 842.5726
## 5                      casual                 Saturday                3331.9138
## 6                      member                 Saturday                 968.9337
## 7                      casual                   Sunday                3581.4054
## 8                      member                   Sunday                 919.9746
## 9                      casual                 Thursday                3682.9847
## 10                     member                 Thursday                 823.9278
## 11                     casual                  Tuesday                3596.3599
## 12                     member                  Tuesday                 826.1427
## 13                     casual                Wednesday                3718.6619
## 14                     member                Wednesday                 823.9996
```

```
# Notice that the days of the week are out of order. Let's fix that.
all_trips_v2$day_of_week <- ordered(all_trips_v2$day_of_week, levels=c("Sunday", "Monday", "Tuesday", "

# Now, let's run the average ride time by each day for members vs casual users
aggregate(all_trips_v2$ride_length ~ all_trips_v2$member_casual + all_trips_v2$day_of_week, FUN = mean)
```

```
##    all_trips_v2$member_casual all_trips_v2$day_of_week all_trips_v2$ride_length
## 1                      casual                   Sunday                3581.4054
## 2                      member                   Sunday                 919.9746
## 3                      casual                   Monday                3372.2869
## 4                      member                   Monday                 842.5726
## 5                      casual                  Tuesday                3596.3599
## 6                      member                  Tuesday                 826.1427
## 7                      casual                Wednesday                3718.6619
## 8                      member                Wednesday                 823.9996
## 9                      casual                 Thursday                3682.9847
## 10                     member                 Thursday                 823.9278
## 11                     casual                   Friday                3773.8351
## 12                     member                   Friday                 824.5305
## 13                     casual                 Saturday                3331.9138
## 14                     member                 Saturday                 968.9337
```

We can provide an overall analysis of ridership trends by type and weekday

```
all_trips_v2 %>%
  mutate(weekday = wday(started_at, label = TRUE)) %>%  #creates weekday field using wday()
  group_by(member_casual, weekday) %>%  #groups by usertype and weekday
  summarise(number_of_rides = n()                           #calculates the number of rides and average
  ,average_duration = mean(ride_length)) %>%        # calculates the average duration
  arrange(member_casual, weekday)                               # sorts
```

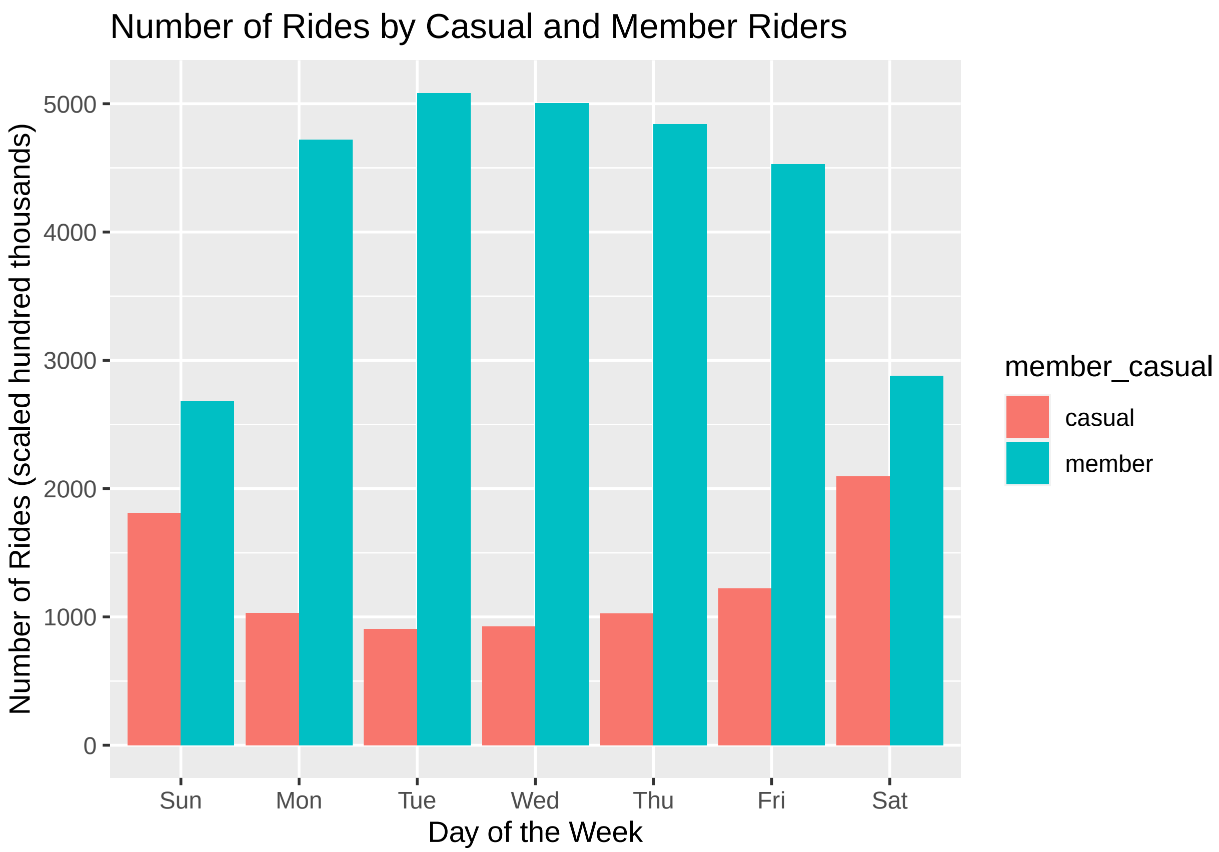
```
## `summarise()` has grouped output by 'member_casual'. You can override using the
## `.groups` argument.

## # A tibble: 14 x 4
## # Groups:   member_casual [2]
##    member_casual weekday number_of_rides average_duration
##    <chr>         <ord>             <int>            <dbl>
##   1 casual        Sun              181293            3581.
##   2 casual        Mon              103296            3372.
##   3 casual        Tue               90510            3596.
##   4 casual        Wed               92457            3719.
##   5 casual        Thu              102679            3683.
##   6 casual        Fri              122404            3774.
##   7 casual        Sat              209543            3332.
##   8 member        Sun              267965             920.
##   9 member        Mon              472196             843.
##  10 member        Tue              508445             826.
##  11 member        Wed              500329             824.
##  12 member        Thu              484177             824.
##  13 member        Fri              452790             825.
##  14 member        Sat              287958             969.
```

```
# Let's visualize the number of rides by rider type
all_trips_v2 %>%
  mutate(weekday = wday(started_at, label = TRUE)) %>%
  group_by(member_casual, weekday) %>%
  summarise(number_of_rides = n()/100
            ,average_duration = mean(ride_length/60)) %>%
  arrange(member_casual, weekday)  %>%
  ggplot(aes(x = weekday, y = number_of_rides, fill = member_casual)) +
  geom_col(position = "dodge") +
labs(title = 'Number of Rides by Casual and Member Riders', x = "Day of the Week", y = 'Number of Rides
```

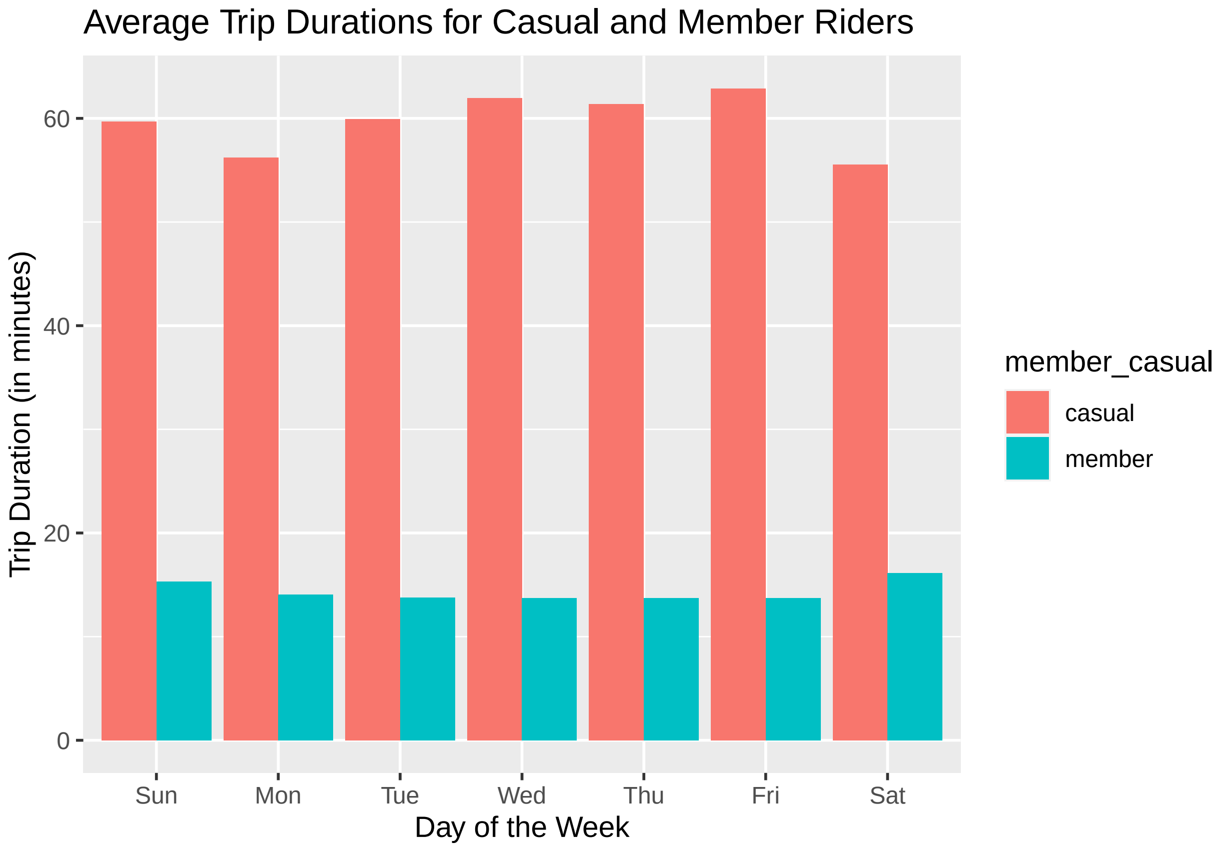
Step 5: Create Data Visulations to inspect the data more thoroughly

```
## `summarise()` has grouped output by 'member_casual'. You can override using the
## `.groups` argument.
```



```
# Let's create a visualization for average duration
all_trips_v2 %>%
  mutate(weekday = wday(started_at, label = TRUE)) %>%
  group_by(member_casual, weekday) %>%
  summarise(number_of_rides = n()
            ,average_duration = mean(ride_length/60)) %>%
  arrange(member_casual, weekday)  %>%
  ggplot(aes(x = weekday, y = average_duration, fill = member_casual)) +
  geom_col(position = "dodge") +
  labs(title = 'Average Trip Durations for Casual and Member Riders', x = "Day of the Week", y = 'Trip
```

```
## `summarise()` has grouped output by 'member_casual'. You can override using the
## `.groups` argument.
```



STEP 6: EXPORT SUMMARY FILE FOR FURTHER ANALYSIS WE will create a csv file that we will visualize in Excel, Tableau, or Kevin Hatman's presentation software for alternatives to R. However we will continue in R for the analysis.

```
counts <- aggregate(all_trips_v2$ride_length ~ all_trips_v2$member_casual + all_trips_v2$day_of_week, FU
write.csv(counts, file = "C:/Users/Jack's PC/Documents/Coursera/Google Data Analytics/Capstone/Case Stu
```

```
View(counts)
glimpse(counts)
```

```
## Rows: 14
## Columns: 3
## $ `all_trips_v2$member_casual` <chr> "casual", "member", "casual", "member", "~
## $ `all_trips_v2$day_of_week`   <ord> Sunday, Sunday, Monday, Monday, Tuesday, ~
## $ `all_trips_v2$ride_length`   <dbl> 3581.4054, 919.9746, 3372.2869, 842.5726,~
```

```
all_trips_v2 %>%
  filter(member_casual == 'member') %>%
  group_by(member_casual) %>%
  summarise(member_casual = n())
```

```
## # A tibble: 1 x 1
##   member_casual
##           <int>
## 1       2973860
```

```
all_trips_v2 %>%
  filter(member_casual == 'casual') %>%
  group_by(member_casual) %>%
  summarise(member_casual = n())
```

```
## # A tibble: 1 x 1
##   member_casual
##           <int>
## 1        902182
```

The aggregated spreadsheet confirms what we discovered in the first visualizations, the members ride much more often than do casual riders, but casual riders have much higher ride lengths.

Conclusion

One can infer from the data that members and casual riders use the bike services for different reasons. The member cohort uses the service much more frequently but with small average trip times. This indicates that this cohort uses the service for more utilitarian purposes such as work commutes and running errands.

Conversely the casual cohort does not use the service regularly but their trip duration are ~ 3times that of the members. This indicates this cohort is doing more of a sightseeing or touring a more leisurely pace.

Cyclisitc should focus the campaign on showing the casual cohort the benefits of being members and that it ultimately would save them money. A cost benefit analysis to persuade them that they would get the "best of both worlds" with an annual membership rather than piece meal sign ups.

We will need more data to provde greater confidence and rigor such as financial data, customer surveys, and other preferences but this initial analysis does show how each cohort uses the service and how the company can move ahead to try to convince the casual group.