Cyclistic Bike Sharing in the Windy City – Chicago, IL

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The Case Study Scenario as provided by Google/Coursera

"You are a data analyst working in the marketing analyst team at Cyclistic, a bike-share company in Chicago. The director of marketing believes the company's future success depends on maximizing the number of annual memberships. Therefore, your team wants to understand how casual riders and annual members use Cyclistic bikes differently. From these insights, your team will design a new marketing strategy to convert casual riders into annual members. But first, Cyclistic executives must approve your recommendations, so they must be backed up with compelling data insights and professional data visualizations."

Phase 1: Ask Questions to Make Data-Driven Decisions

Three questions will guide the future marketing program: 1. How do annual members and casual riders use Cyclistic bikes differently? 2. Why would casual riders buy Cyclistic annual memberships? 3. How can Cyclistic use digital media to influence casual riders to become members?

I have been assigned the first question to answer.

Action Steps: Collaborate with stakeholders to define the business problem, establish communication preferences, view context of the problem, and establish expectations. Agree on Scope of Work.

Ask SMART Questions to develop business task and Scope of Work:

- Specific
- Measurable
- Action-Oriented
- Relevant
- Time-Bound

Business Task: How do annual members and casual riders use Cyclistic bikes differently?

Phase 2: Prepare Data for Exploration

Action steps: Decide what data is necessary to address business task, locate the data, create any security measures to protect the data, and decide on key metrics to use when completing the business task.

Does the data ROCCC? Is the data…

- Reliable - At a glance, our data seems to unbiased and complete.
- Original - We are assuming that we (Cyclistic) have collected our own data and is First Party data.
- Comprehensive - The data contains information we need to answer the business question.
- Current- Yes. The data is from December 2021.
- Cited - This data is made available from Motivate International
- Download data and store it appropriately - Files were originally contained in zip files, then saved as .csv files. See *Collect Data*
- Identity how the data is organized - Data is organized into long data, observe data types and metadata, structure. See *Preview Data*
- Sort and filter data - there are many 00:00:00 (HH:MM:SS) values as well as negative values - more on the implications of this in the analyze phase.
- Determine the credibility of the data - as outlined above, this data ROCCC's.

Install required packages/Load Libraries

install.packages("tidyverse") install.packages("lubridate") install.packages("ggplot") install.packages("skimr") install.packages("janitor")

getwd() #displays the working directory setwd(...) #sets the working directory to simplify calls to data

```
library(tidyverse)  # helps transform/clean data
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.
3.1 --
```

```
## v ggplot2 3.3.5     v purrr   0.3.4
## v tibble  3.1.6     v dplyr   1.0.7
## v tidyr   1.1.4     v stringr 1.4.0
## v readr   2.1.1     v forcats 0.5.1
```

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

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

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

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

library(ggplot2)    # helps visualize data
library(readr)      #
library(skimr)      #
library(janitor)    #

##
## Attaching package: 'janitor'

## The following objects are masked from 'package:stats':
##
##     chisq.test, fisher.test

library(dplyr)      #
```

COLLECT DATA

Upload Divvy datasets (csv files) here from the tidyverse package and readr library

```
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, Us
er...
## 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 m
essage.

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 m
essage.
```

```
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 m
essage.
```

```
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, me
mb...
## 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 m
essage.
```

PREVIEW DATAFRAMES

Replace the file and column names as desired to preview all 4 dataframes.

```
skim_without_charts(q3_2019) #dyplr
```

Data summary

Name	q3_2019
Number of rows	1640718
Number of columns	12

_____

Column type frequency:	
character	4
numeric	6
POSIXct	2
———————————	
Group variables	None

Variable type: character

skim_variable	n_missing	complete_rate	min	max	empty	n_unique	whitespace
from_station_name	0	1.00	10	43	0	612	0
to_station_name	0	1.00	10	43	0	613	0
usertype	0	1.00	8	10	0	2	0
gender	287350	0.82	4	6	0	2	0

Variable type: numeric

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100
trip_id	0	1.00	24364471.07	499548.45	23479388	23935498	24367416	24797401	25223639
bikeid	0	1.00	3349.86	1888.88	1	1713	3419	4997	6471
tripduration	0	1.00	1741.74	38503.44	61	465	813	1460	9056633
from_station_id	0	1.00	202.40	156.72	2	77	174	289	673
to_station_id	0	1.00	203.90	156.70	2	80	176	291	673
birthyear	278094	0.83	1984.90	10.61	1888	1980	1988	1992	2003

Variable type: POSIXct

skim_variable	n_missing	complete_rate	min	max	median	n_unique
start_time	0	1	2019-07-01 00:00:27	2019-09-30 23:59:37	2019-08-14 07:11:50	1372358

skim_variable	n_missing	complete_rate	min	max	median	n_unique
end_time	0	1	2019-07-01 00:07:31	2019-11-04 08:09:47	2019-08-14 07:28:07	1344539

```
glimpse(q3_2019) #dyplr
```

```
## Rows: 1,640,718
## Columns: 12
## $ trip_id           <dbl> 23479388, 23479389, 23479390, 23479391, 23479392
, 23~
## $ start_time        <dttm> 2019-07-01 00:00:27, 2019-07-01 00:01:16, 2019-
07-0~
## $ end_time          <dttm> 2019-07-01 00:20:41, 2019-07-01 00:18:44, 2019-
07-0~
## $ bikeid            <dbl> 3591, 5353, 6180, 5540, 6014, 4941, 3770, 5442,
2957~
## $ tripduration      <dbl> 1214, 1048, 1554, 1503, 1213, 310, 1248, 1550, 1
583,~
## $ from_station_id   <dbl> 117, 381, 313, 313, 168, 300, 168, 313, 43, 43,
511,~
## $ from_station_name <chr> "Wilton Ave & Belmont Ave", "Western Ave & Monro
e St~
## $ to_station_id     <dbl> 497, 203, 144, 144, 62, 232, 62, 144, 195, 195,
84, ~
## $ to_station_name   <chr> "Kimball Ave & Belmont Ave", "Western Ave & 21st
St"~
## $ usertype          <chr> "Subscriber", "Customer", "Customer", "Customer"
, "C~
## $ gender            <chr> "Male", NA, NA, NA, NA, "Male", NA, NA, NA, NA,
NA, ~
## $ birthyear         <dbl> 1992, NA, NA, NA, NA, 1990, NA, NA, NA, NA, NA,
NA, ~
```

```
head(q3_2019)
```

```
## # A tibble: 6 x 12
##    trip_id start_time          end_time            bikeid 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
## # ... with 7 more variables: from_station_id <dbl>, from_station_name <chr
>,
## #   to_station_id <dbl>, to_station_name <chr>, usertype <chr>, gender <ch
r>,
## #   birthyear <dbl>
```

```
q3_2019 %>%
  select(trip_id) # Only view the specified columns in the dataframe from dyp
lr
```

```
## # A tibble: 1,640,718 x 1
##     trip_id
##       <dbl>
##  1 23479388
##  2 23479389
##  3 23479390
##  4 23479391
##  5 23479392
##  6 23479393
##  7 23479394
##  8 23479395
##  9 23479396
## 10 23479397
## # ... with 1,640,708 more rows
```

```
# OR
tibble(q3_2019$trip_id)
```

```
## # A tibble: 1,640,718 x 1
##    `q3_2019$trip_id`
##                <dbl>
##  1          23479388
##  2          23479389
##  3          23479390
##  4          23479391
##  5          23479392
##  6          23479393
##  7          23479394
##  8          23479395
##  9          23479396
## 10          23479397
## # ... with 1,640,708 more rows
```

Phase 3: Process Data from Dirty to Clean

Action steps: Decide what tools to use for analysis, ensure data integrity, clean data, document cleaning, and verify that data is ready for analysis.

- Choose tools for cleaning - using R because it can handle large amounts of data in file, comes with useful cleaning packages.
- Check the data for errors - looking for duplicate data, inconsistent data types, incomplete data, and inaccurate/incorrect data
- Transform data - checking for spelling errors, changing the case of text, and remove unnecessary spaces/trim.
- Document cleaning process - documented using R Markdown

KEY LIMITATION

q2_2019, q3_2019, and q4_2019 NOT have a "rideable_type" column to distinguish between "docked_bike", "electric_bike, and "classic_bike". Therefore, in the Tableau report from the analyze/share phase, there will be a dashboard analysis with only q1_2020 regarding "rideable_type".

PREPARE DATA AND COMBINE INTO A SINGLE FILE

Compare column names each of the files the names need to match perfectly before using the bind_rows command to join them into one file

```
colnames(q3_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(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"
```

Rename columns to make them consistent with q1_2020 (this is the most recent table design) from the tidyverse package and dyplr library

```
(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 tripdura
tion
##       <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 tripdura
tion
##       <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 <db
l>,
##   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>
```

Check and clean column names post rename for characters, numbers, and underscores only with clean_names from the janitor package

```
clean_names(q2_2019)
```

```
## # 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:
## #   x01_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>,
## #   x05_member_details_member_birthday_year <dbl>

clean_names(q3_2019)

## # A tibble: 1,640,718 x 12
##     ride_id started_at          ended_at            rideable_type tripdura
tion
##       <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 <db
l>,
## #   start_station_name <chr>, end_station_id <dbl>, end_station_name <chr>
,
## #   member_casual <chr>, gender <chr>, birthyear <dbl>

clean_names(q4_2019)

## # A tibble: 704,054 x 12
##     ride_id started_at          ended_at            rideable_type tripdura
tion
##       <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>

clean_names(q1_2020)

## # A tibble: 426,887 x 13
##    ride_id          rideable_type started_at          ended_at
##    <chr>            <chr>         <dttm>              <dttm>
##  1 EACB19130B0CDA4A docked_bike   2020-01-21 20:06:59 2020-01-21 20:14:30
##  2 8FED874C809DC021 docked_bike   2020-01-30 14:22:39 2020-01-30 14:26:22
##  3 789F3C21E472CA96 docked_bike   2020-01-09 19:29:26 2020-01-09 19:32:17
##  4 C9A388DAC6ABF313 docked_bike   2020-01-06 16:17:07 2020-01-06 16:25:56
##  5 943BC3CBECCFD662 docked_bike   2020-01-30 08:37:16 2020-01-30 08:42:48
##  6 6D9C8A6938165C11 docked_bike   2020-01-10 12:33:05 2020-01-10 12:37:54
##  7 31EB9B8F406D4C82 docked_bike   2020-01-10 13:07:35 2020-01-10 13:12:24
##  8 A2B24E3F9C9720E3 docked_bike   2020-01-10 07:24:53 2020-01-10 07:29:50
##  9 5E3F01E1441730B7 docked_bike   2020-01-31 16:37:16 2020-01-31 16:42:11
## 10 19DC57F7E3140131 docked_bike   2020-01-31 09:39:17 2020-01-31 09:42:40
## # ... with 426,877 more rows, and 9 more variables: start_station_name <ch
r>,
## #   start_station_id <dbl>, end_station_name <chr>, end_station_id <dbl>,
## #   start_lat <dbl>, start_lng <dbl>, end_lat <dbl>, end_lng <dbl>,
## #   member_casual <chr>
```

Inspect the dataframes and look for incongruencies

```
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" "C9A388DAC6ABF313" ...
##  $ 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" "2
020-01-30 14:22:39" ...
##  $ ended_at          : POSIXct[1:426887], format: "2020-01-21 20:14:30" "2
020-01-30 14:26:22" ...
##  $ start_station_name: chr [1:426887] "Western Ave & Leland Ave" "Clark St
& Montrose Ave" "Broadway & Belmont Ave" "Clark St & Randolph St" ...
##  $ 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 A
ve & Irving Park Rd" "Wilton Ave & Belmont Ave" "Fairbanks Ct & Grand Ave" ..
.
##  $ 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" "2
019-10-01 00:02:16" ...
##  $ ended_at          : POSIXct[1:704054], format: "2019-10-01 00:17:20" "2
019-10-01 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" "Thro
op (Loomis) St & Taylor St" "Milwaukee Ave & Grand Ave" "Lakeview Ave & Fulle
rton Pkwy" ...
##  $ 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 & Grand Ave" "Kedzie Ave & Palmer Ct" ...
##  $ member_casual     : chr [1:704054] "Subscriber" "Subscriber" "Subscribe
r" "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" "Lakeview Ave & Fullerton Pkwy" "Lakeview Ave & Fullerton Pk
wy" ...
##  $ end_station_id    : num [1:1640718] 497 203 144 144 62 232 62 144 195 1
95 ...
##  $ end_station_name  : chr [1:1640718] "Kimball Ave & Belmont Ave" "Wester
n Ave & 21st St" "Larrabee St & Webster Ave" "Larrabee St & Webster Ave" ...
##  $ 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] 22178
529 22178530 22178531 22178532 22178533 ...
##  $ started_at                                       : POSIXct[1:1108163], f
ormat: "2019-04-01 00:02:22" "2019-04-01 00:03:02" ...
##  $ ended_at                                         : POSIXct[1:1108163], f
ormat: "2019-04-01 00:09:48" "2019-04-01 00:20:30" ...
##  $ rideable_type                                    : num [1:1108163] 6251
6226 5649 4151 3270 ...
##  $ 01 - Rental Details Duration In Seconds Uncapped: num [1:1108163] 446 1
048 252 357 1007 ...
##  $ start_station_id                                 : num [1:1108163] 81 31
7 283 26 202 420 503 260 211 211 ...
##  $ start_station_name                               : chr [1:1108163] "Dale
y Center Plaza" "Wood St & Taylor St" "LaSalle St & Jackson Blvd" "McClurg Ct
& Illinois St" ...
##  $ end_station_id                                   : num [1:1108163] 56 59
174 133 129 426 500 499 211 211 ...
##  $ end_station_name                                 : chr [1:1108163] "Desp
laines St & Kinzie St" "Wabash Ave & Roosevelt Rd" "Canal St & Madison St" "K
ingsbury St & Kinzie St" ...
##  $ member_casual                                    : chr [1:1108163] "Subs
criber" "Subscriber" "Subscriber" "Subscriber" ...
##  $ 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 using mutate from the dyplr library so that they can stack correctly in the new dataframe

```
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 using bind_rows from tidyverse package and dyplr library

```
all_trips <- bind_rows(q2_2019, q3_2019, q4_2019, q1_2020)
```

Check structure of new table

```
colnames(all_trips)
```

```
##  [1] "ride_id"
##  [2] "started_at"
##  [3] "ended_at"
##  [4] "rideable_type"
##  [5] "01 - Rental Details Duration In Seconds Uncapped"
##  [6] "start_station_id"
##  [7] "start_station_name"
##  [8] "end_station_id"
##  [9] "end_station_name"
## [10] "member_casual"
## [11] "Member Gender"
## [12] "05 - Member Details Member Birthday Year"
## [13] "tripduration"
## [14] "gender"
## [15] "birthyear"
## [16] "start_lat"
## [17] "start_lng"
## [18] "end_lat"
## [19] "end_lng"
```

```
str(all_trips)
```

```
## spec_tbl_df [3,879,822 x 19] (S3: spec_tbl_df/tbl_df/tbl/data.frame)
##  $ ride_id                                          : chr [1:3879822] "2217
8529" "22178530" "22178531" "22178532" ...
##  $ started_at                                       : POSIXct[1:3879822], f
ormat: "2019-04-01 00:02:22" "2019-04-01 00:03:02" ...
##  $ ended_at                                         : POSIXct[1:3879822], f
ormat: "2019-04-01 00:09:48" "2019-04-01 00:20:30" ...
##  $ rideable_type                                    : chr [1:3879822] "6251
" "6226" "5649" "4151" ...
##  $ 01 - Rental Details Duration In Seconds Uncapped: num [1:3879822] 446 1
048 252 357 1007 ...
##  $ start_station_id                                 : num [1:3879822] 81 31
```

```
7 283 26 202 420 503 260 211 211 ...
##  $ start_station_name                              : chr [1:3879822] "Dale
y Center Plaza" "Wood St & Taylor St" "LaSalle St & Jackson Blvd" "McClurg Ct
& Illinois St" ...
##  $ end_station_id                                  : num [1:3879822] 56 59
174 133 129 426 500 499 211 211 ...
##  $ end_station_name                                : chr [1:3879822] "Desp
laines St & Kinzie St" "Wabash Ave & Roosevelt Rd" "Canal St & Madison St" "K
ingsbury St & Kinzie St" ...
##  $ member_casual                                   : chr [1:3879822] "Subs
criber" "Subscriber" "Subscriber" "Subscriber" ...
##  $ Member Gender                                   : chr [1:3879822] "Male
" "Female" "Male" "Male" ...
##  $ 05 - Member Details Member Birthday Year        : num [1:3879822] 1975
1984 1990 1993 1992 ...
##  $ tripduration                                    : num [1:3879822] NA NA
NA NA NA NA NA NA NA NA ...
##  $ gender                                          : chr [1:3879822] NA NA
NA NA ...
##  $ birthyear                                       : num [1:3879822] NA NA
NA NA NA NA NA NA NA NA ...
##  $ start_lat                                       : num [1:3879822] NA NA
NA NA NA NA NA NA NA NA ...
##  $ start_lng                                       : num [1:3879822] NA NA
NA NA NA NA NA NA NA NA ...
##  $ end_lat                                         : num [1:3879822] NA NA
NA NA NA NA NA NA NA NA ...
##  $ end_lng                                         : num [1:3879822] NA NA
NA NA NA NA NA NA NA NA ...
##  - 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>

tibble(all_trips)

## # A tibble: 3,879,822 x 19
##    ride_id  started_at          ended_at            rideable_type
```

```
##    <chr>    <dttm>              <dttm>              <chr>
##  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 3,879,812 more rows, and 15 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>, tripduration <dbl>,
## #   gender <chr>, birthyear <dbl>, start_lat <dbl>, start_lng <dbl>,
## #   end_lat <dbl>, end_lng <dbl>
```

Remove birthyear, tripduration, and gender fields as this data was dropped beginning in 2020

```
all_trips <- all_trips %>%
  select(-c( birthyear, gender, "01 - Rental Details Duration In Seconds Unca
pped", "05 - Member Details Member Birthday Year", "Member Gender", "tripdura
tion"))
```

Inspect the new table that has been created

```
clean_names(all_trips) # Clean column names post rename for characters, numbe
rs, and underscores only with clean_names from the *janitor* package
```

```
## # A tibble: 3,879,822 x 13
##    ride_id  started_at          ended_at            rideable_type
##    <chr>    <dttm>              <dttm>              <chr>
##  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 3,879,812 more rows, and 9 more variables: start_station_id <db
l>,
## #   start_station_name <chr>, end_station_id <dbl>, end_station_name <chr>
,
## #   member_casual <chr>, start_lat <dbl>, start_lng <dbl>, end_lat <dbl>,
## #   end_lng <dbl>
```

```
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"
## [10] "start_lat"          "start_lng"          "end_lat"
## [13] "end_lng"
```

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

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

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

```
## [1] 3879822      13
```

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

```
## # A tibble: 6 x 13
##   ride_id started_at          ended_at            rideable_type start_stat
ion_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 8 more variables: start_station_name <chr>, end_station_id <dbl
>,
## #   end_station_name <chr>, member_casual <chr>, start_lat <dbl>,
## #   start_lng <dbl>, end_lat <dbl>, end_lng <dbl>
```

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

```
## tibble [3,879,822 x 13] (S3: tbl_df/tbl/data.frame)
##  $ ride_id           : chr [1:3879822] "22178529" "22178530" "22178531" "2
2178532" ...
##  $ 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 2
```

```
11 ...
##  $ start_station_name: chr [1:3879822] "Daley Center Plaza" "Wood St & Tay
lor St" "LaSalle St & Jackson Blvd" "McClurg Ct & Illinois St" ...
##  $ end_station_id    : num [1:3879822] 56 59 174 133 129 426 500 499 211 2
11 ...
##  $ end_station_name  : chr [1:3879822] "Desplaines St & Kinzie St" "Wabash
Ave & Roosevelt Rd" "Canal St & Madison St" "Kingsbury St & Kinzie St" ...
##  $ member_casual     : chr [1:3879822] "Subscriber" "Subscriber" "Subscrib
er" "Subscriber" ...
##  $ start_lat         : num [1:3879822] NA NA NA NA NA NA NA NA NA NA ...
##  $ start_lng         : num [1:3879822] NA NA NA NA NA NA NA NA NA NA ...
##  $ end_lat           : num [1:3879822] NA NA NA NA NA NA NA NA NA NA ...
##  $ end_lng           : num [1:3879822] NA NA NA NA NA NA NA NA NA NA ...

summary(all_trips)  # Statistical summary of data. Mainly for numeric values

##    ride_id            started_at                    ended_at
##  Length:3879822     Min.   :2019-04-01 00:02:22   Min.   :2019-04-01 00:09
:48
##  Class :character   1st Qu.:2019-06-23 07:49:09   1st Qu.:2019-06-23 08:20
:27
##  Mode  :character   Median :2019-08-14 17:43:38   Median :2019-08-14 18:02
:04
##                     Mean   :2019-08-26 00:49:59   Mean   :2019-08-26 01:14
:37
##                     3rd Qu.:2019-10-12 12:10:21   3rd Qu.:2019-10-12 12:36
:16
##                     Max.   :2020-03-31 23:51:34   Max.   :2020-05-19 20:10
:34
##
##  rideable_type      start_station_id start_station_name end_station_id
##  Length:3879822     Min.   :  1.0    Length:3879822     Min.   :  1.0
##  Class :character   1st Qu.: 77.0    Class :character   1st Qu.: 77.0
##  Mode  :character   Median :174.0    Mode  :character   Median :174.0
##                     Mean   :202.9                       Mean   :203.8
##                     3rd Qu.:291.0                       3rd Qu.:291.0
##                     Max.   :675.0                       Max.   :675.0
##                                                         NA's   :1
##  end_station_name   member_casual        start_lat         start_lng
##  Length:3879822     Length:3879822     Min.   :42        Min.   :-88
##  Class :character   Class :character   1st Qu.:42        1st Qu.:-88
##  Mode  :character   Mode  :character   Median :42        Median :-88
##                                        Mean   :42        Mean   :-88
##                                        3rd Qu.:42        3rd Qu.:-88
##                                        Max.   :42        Max.   :-88
##                                        NA's   :3452935   NA's   :3452935
##     end_lat           end_lng
##  Min.   :42        Min.   :-88
##  1st Qu.:42        1st Qu.:-88
##  Median :42        Median :-88
```

```
##  Mean   :42        Mean   :-88
##  3rd Qu.:42        3rd Qu.:-88
##  Max.   :42        Max.   :-88
##  NA's   :3452936   NA's   :3452936
```

Issues to address regarding the new dataframe:

In the "member_casual" column, there are two names for members ("member" and "Subscriber") and two names for casual riders ("Customer" and "casual"). I will consolidate the data from four to two labels and use the same structure as q1_2020, by replacing "Subscriber" with "member", and "Customer" with "casual". In order to complete the business task effectively and compare members and casual riders, I need to add some additional columns of data (day, month, year, hour) that I can derive from "started_at" and "ended_at", to provide additional opportunities to aggregate the data for analysis. I will add a column for length of ride since the q1_2020 data did not have the "tripduration" column. For consistency, I will add "ride_length" to the entire dataframe, using "started_at" and "ended_at". There are some rides where tripduration shows up as negative, including several hundred rides where I am making the assumption that Divvy took bikes out of circulation for Quality Assurance reasons. I will delete these rides in our new file.

Preview 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 (using the q1_2020 labels)

```
all_trips <-  all_trips %>%
  mutate(member_casual = recode(member_casual
                                ,"Subscriber" = "member"
                                ,"Customer" = "casual"))
```

Verify that the proper number of observations were reassigned

```
table(all_trips$member_casual)
```

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

Add columns that list the date, month, day, year, and hour of each ride

This will allow us to aggregate ride data for each month, day, or year

```
all_trips$date <- as.Date(all_trips$started_at) #The default format is yyyy-mm-dd
tibble(all_trips$date)
```

```
## # A tibble: 3,879,822 x 1
##    `all_trips$date`
##    <date>
```

```
##  1 2019-04-01
##  2 2019-04-01
##  3 2019-04-01
##  4 2019-04-01
##  5 2019-04-01
##  6 2019-04-01
##  7 2019-04-01
##  8 2019-04-01
##  9 2019-04-01
## 10 2019-04-01
## # ... with 3,879,812 more rows
```

```
all_trips$month <- format(as.Date(all_trips$date), "%m")
head(all_trips$month)
```

```
## [1] "04" "04" "04" "04" "04" "04"
```

```
all_trips$day <- format(as.Date(all_trips$date), "%d")
glimpse(all_trips$day)
```

```
##  chr [1:3879822] "01" "01" "01" "01" "01" "01" "01" "01" "01" "01" "01" ..
.
```

```
all_trips$year <- format(as.Date(all_trips$date), "%Y")
head(all_trips$year)
```

```
## [1] "2019" "2019" "2019" "2019" "2019" "2019"
```

```
all_trips$day_of_week <- format(as.Date(all_trips$date), "%A")
glimpse(all_trips$day_of_week)
```

```
##  chr [1:3879822] "Monday" "Monday" "Monday" "Monday" "Monday" "Monday" ...
```

```
all_trips$hour_of_day <- hour(all_trips$started_at)
head(all_trips$hour_of_day)
```

```
## [1] 0 0 0 0 0 0
```

Add a "ride_length" calculation to all_trips (in seconds)

```
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 20] (S3: tbl_df/tbl/data.frame)
##  $ ride_id           : chr [1:3879822] "22178529" "22178530" "22178531" "2
2178532" ...
##  $ 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 2
11 ...
##  $ start_station_name: chr [1:3879822] "Daley Center Plaza" "Wood St & Tay
lor St" "LaSalle St & Jackson Blvd" "McClurg Ct & Illinois St" ...
##  $ end_station_id    : num [1:3879822] 56 59 174 133 129 426 500 499 211 2
11 ...
##  $ end_station_name  : chr [1:3879822] "Desplaines St & Kinzie St" "Wabash
Ave & Roosevelt Rd" "Canal St & Madison St" "Kingsbury St & Kinzie St" ...
##  $ member_casual     : chr [1:3879822] "member" "member" "member" "member"
...
##  $ start_lat         : num [1:3879822] NA NA NA NA NA NA NA NA NA NA ...
##  $ start_lng         : num [1:3879822] NA NA NA NA NA NA NA NA NA NA ...
##  $ end_lat           : num [1:3879822] NA NA NA NA NA NA NA NA NA NA ...
##  $ end_lng           : num [1:3879822] NA NA NA NA NA NA NA NA NA NA ...
##  $ 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"
...
##  $ hour_of_day       : int [1:3879822] 0 0 0 0 0 0 0 0 0 0 ...
##  $ ride_length       : 'difftime' num [1:3879822] 446 1048 252 357 ...
##   ..- attr(*, "units")= chr "secs"
```

Convert "ride_length" from Factor to numeric to 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
```

Remove "incomplete/bad" data

The dataframe includes a few hundred entries when bikes were taken out of docks and checked for quality by Divvy or ride_length was negative

Create a new version of the dataframe (v2) since data is being removed/dropped

```
all_trips_v2 <- all_trips[!(all_trips$start_station_name == "HQ QR" | all_tri
ps$ride_length<0),]
```

Phase 4: Analyze Data to Answer Questions

Summary Statistics/Descriptive analysis on ride_length (all figures in seconds)

```
mean(all_trips_v2$ride_length) #average (total ride length / rides)
```

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

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

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

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

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

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

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

Alternatively, use 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
```

Compare members and casual users

```
all_trips_v2 %>% group_by(member_casual) %>% summarize(mean_ride_length = mea
n(ride_length))
```

```
## # A tibble: 2 x 2
##   member_casual mean_ride_length
##   <chr>                   <dbl>
## 1 casual                  3553.
## 2 member                   850.
```

```
all_trips_v2 %>% group_by(member_casual) %>% summarize(mode_ride_length = mod
e(ride_length))
```

```
## # A tibble: 2 x 2
##   member_casual mode_ride_length
##   <chr>         <chr>
## 1 casual        numeric
## 2 member        numeric
```

```
all_trips_v2 %>% group_by(member_casual) %>% summarize(max_ride_length = max(
ride_length))
```

```
## # A tibble: 2 x 2
##   member_casual max_ride_length
##   <chr>                   <dbl>
## 1 casual                9387024
## 2 member                9056634
```

```
all_trips_v2 %>% group_by(member_casual) %>% summarize(min_ride_length = min(
ride_length))
```

```
## # A tibble: 2 x 2
##   member_casual min_ride_length
##   <chr>                   <dbl>
```

```
## 1 casual                       2
## 2 member                       1
```

OR

```
all_trips_v2 %>% group_by(member_casual) %>% summarize(mean_ride_length = mea
n(ride_length)
                                                       ,mode_ride_length = mo
de(ride_length)
                                                       ,max_ride_length = max
(ride_length)
                                                       ,min_ride_length = min
(ride_length))
```

```
## # A tibble: 2 x 5
##   member_casual mean_ride_length mode_ride_length max_ride_length
##   <chr>                    <dbl> <chr>                      <dbl>
## 1 casual                   3553. numeric                  9387024
## 2 member                    850. numeric                  9056634
## # ... with 1 more variable: min_ride_length <dbl>
```

Observe the average ride time by each day for members vs casual users

```
all_trips_v2 %>% group_by(member_casual, day_of_week) %>% summarize(mean_ride
_length = mean(ride_length))
```

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

```
## # A tibble: 14 x 3
## # Groups:   member_casual [2]
##    member_casual day_of_week mean_ride_length
##    <chr>         <chr>                  <dbl>
##  1 casual        Friday                 3774.
##  2 casual        Monday                 3372.
##  3 casual        Saturday               3332.
##  4 casual        Sunday                 3581.
##  5 casual        Thursday               3683.
##  6 casual        Tuesday                3596.
##  7 casual        Wednesday              3719.
##  8 member        Friday                  825.
##  9 member        Monday                  843.
## 10 member        Saturday                969.
## 11 member        Sunday                  920.
## 12 member        Thursday                824.
## 13 member        Tuesday                 826.
## 14 member        Wednesday               824.
```

Order the days of the week

```
all_trips_v2$day_of_week <- ordered(all_trips_v2$day_of_week, levels=c("Sunda
y", "Monday", "Tuesday", "Wednesday", "Thursday", "Friday", "Saturday"))
```

Observe the average ride time by each day for members vs casual users with ordered week

```
all_trips_v2 %>% group_by(member_casual, day_of_week) %>% summarize(mean_ride
_length = mean(ride_length))
```

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

```
## # A tibble: 14 x 3
## # Groups:   member_casual [2]
##    member_casual day_of_week mean_ride_length
##    <chr>         <ord>                  <dbl>
##  1 casual        Sunday                 3581.
##  2 casual        Monday                 3372.
##  3 casual        Tuesday                3596.
##  4 casual        Wednesday              3719.
##  5 casual        Thursday               3683.
##  6 casual        Friday                 3774.
##  7 casual        Saturday               3332.
##  8 member        Sunday                  920.
##  9 member        Monday                  843.
## 10 member        Tuesday                 826.
## 11 member        Wednesday               824.
## 12 member        Thursday                824.
## 13 member        Friday                  825.
## 14 member        Saturday                969.
```

analyze ridership data by type and weekday

```
all_trips_v2 %>%
  group_by(member_casual, day_of_week) %>%                #groups by usertype
and weekday
  summarize(number_of_rides = n()                                          #calc
ulates the number of rides and average duration
            ,avg_ride_length = mean(ride_length)) %>%       # calculates the
average duration
  arrange(member_casual, day_of_week)                                      # sor
ts
```

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

```
## # A tibble: 14 x 4
## # Groups:   member_casual [2]
##    member_casual day_of_week number_of_rides avg_ride_length
##    <chr>         <ord>                 <int>           <dbl>
##  1 casual        Sunday               181293           3581.
##  2 casual        Monday               103296           3372.
##  3 casual        Tuesday               90510           3596.
##  4 casual        Wednesday             92457           3719.
##  5 casual        Thursday             102679           3683.
##  6 casual        Friday               122404           3774.
##  7 casual        Saturday             209543           3332.
```

```
##  8 member        Sunday               267965            920.
##  9 member        Monday               472196            843.
## 10 member        Tuesday              508445            826.
## 11 member        Wednesday            500329            824.
## 12 member        Thursday             484177            824.
## 13 member        Friday               452790            825.
## 14 member        Saturday             287958            969.
```

analyze riders by time of day

```
all_trips_v2 %>%
  group_by(member_casual, hour_of_day) %>%
  summarize(number_of_rides = n()
            ,avg_ride_length = mean(ride_length)) %>%
  arrange(member_casual, hour_of_day)
```

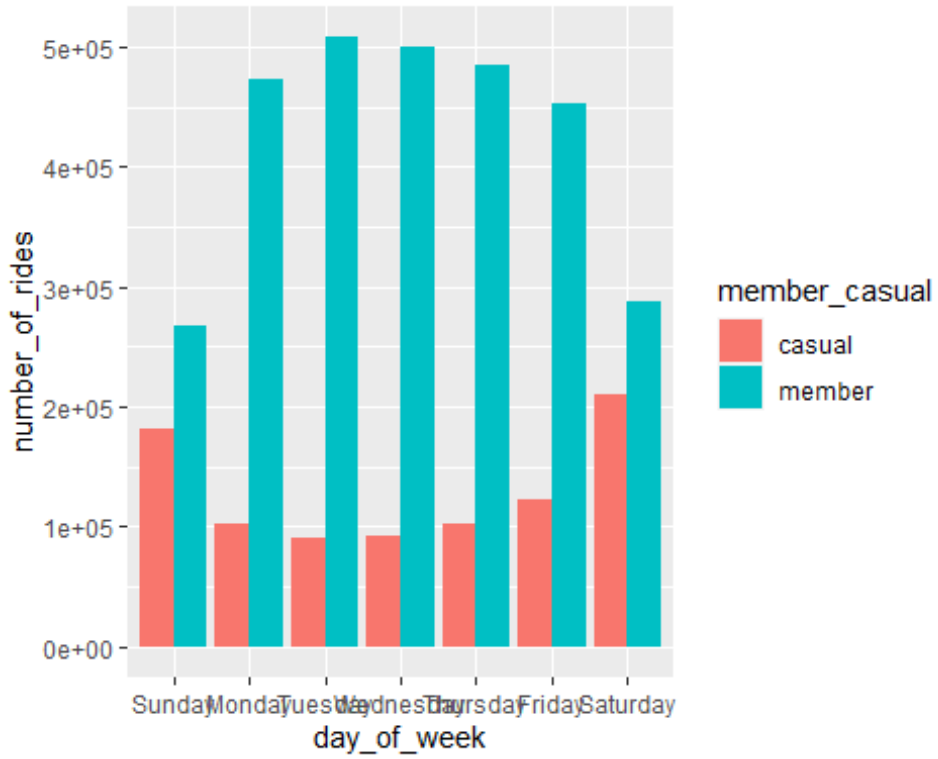
```
## `summarise()` has grouped output by 'member_casual'. You can override usin
g the `.groups` argument.
```

```
## # A tibble: 48 x 4
## # Groups:   member_casual [2]
##    member_casual hour_of_day number_of_rides avg_ride_length
##    <chr>               <int>           <int>           <dbl>
##  1 casual                  0            8363           6256.
##  2 casual                  1            5495           6229.
##  3 casual                  2            3361           6232.
##  4 casual                  3            1982          10213.
##  5 casual                  4            1196           7592.
##  6 casual                  5            2690           5941.
##  7 casual                  6            6291           3984.
##  8 casual                  7           13302           1932.
##  9 casual                  8           22304           3289.
## 10 casual                  9           29057           4092.
## # ... with 38 more rows
```

Viz for the number of rides by rider type - bar

```
all_trips_v2 %>%
  group_by(member_casual, day_of_week) %>%
  summarize(number_of_rides = n()
            ,avg_ride_length = mean(ride_length)) %>%
  arrange(member_casual, day_of_week)  %>%
  ggplot(aes(x = day_of_week, y = number_of_rides, fill = member_casual)) +
  geom_col(position = "dodge")
```

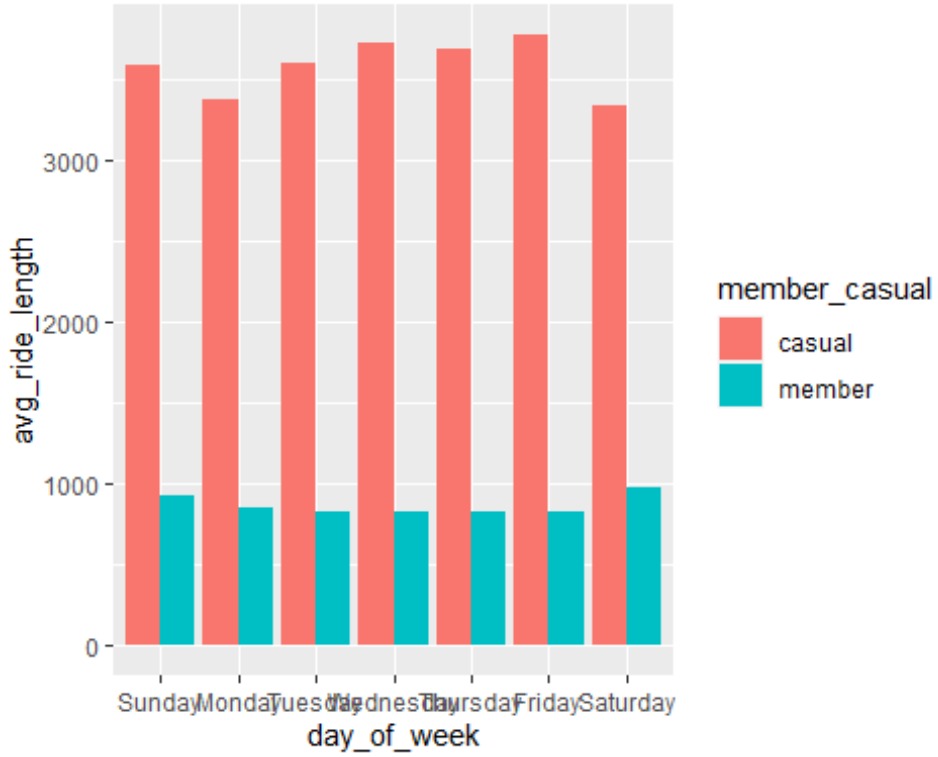
```
## `summarise()` has grouped output by 'member_casual'. You can override usin
g the `.groups` argument.
```



Viz for the avg ride length - bar

```
all_trips_v2 %>%
  group_by(member_casual, day_of_week) %>%
  summarize(number_of_rides = n()
            ,avg_ride_length = mean(ride_length)) %>%
  arrange(member_casual, day_of_week)  %>%
  ggplot(aes(x = day_of_week, y = avg_ride_length, fill = member_casual)) +
  geom_col(position = "dodge")
```

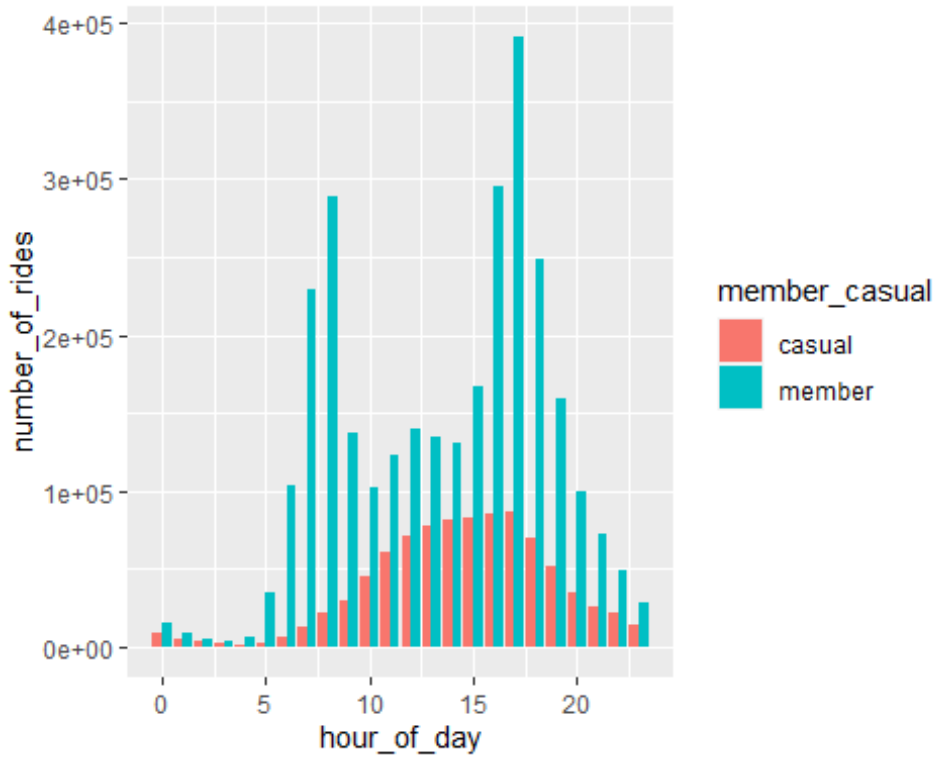
```
## `summarise()` has grouped output by 'member_casual'. You can override usin
g the `.groups` argument.
```



Viz for number of riders by rider type and hour of day - bar

```
all_trips_v2 %>%
  group_by(member_casual, hour_of_day) %>%
  summarize(number_of_rides = n()
            ,avg_ride_length = mean(ride_length)) %>%
  arrange(member_casual, hour_of_day) %>%
  ggplot(aes(x = hour_of_day, y = number_of_rides, fill = member_casual)) +
  geom_col(position = "dodge")
```

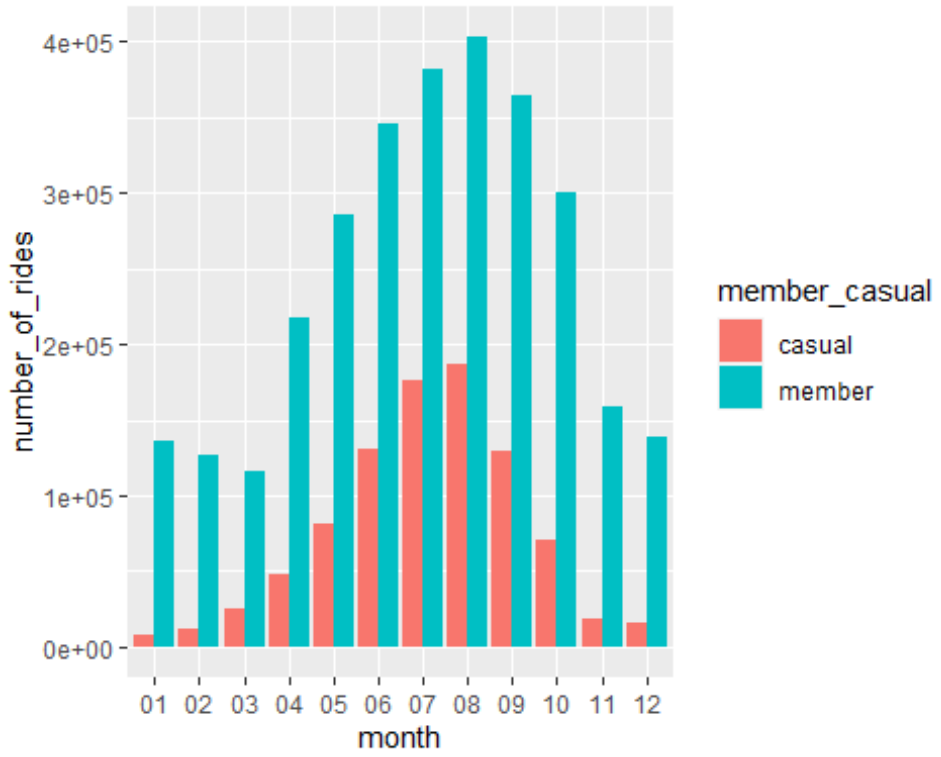
```
## `summarise()` has grouped output by 'member_casual'. You can override usin
g the `.groups` argument.
```



Viz by seasonality - bar

```
all_trips_v2 %>%
  group_by(member_casual, month) %>%
  summarize(number_of_rides = n()
            ,avg_ride_length = mean(ride_length)) %>%
  arrange(member_casual, month) %>%
  ggplot(aes(x = month, y = number_of_rides, fill = member_casual)) +
  geom_col(position = "dodge")
```

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



EXPORT CSV FILE FOR FURTHER ANALYSIS/SHARE PHASE IN TABLEAU

Create a csv file