

Exploratory Data Analysis - Chicago Taxi Trips

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A in-depth exploratory data analysis for the Chicago taxi dataset. In order to efficiently perform exploratory data analysis, we used a subset containing 1% of the data for each of the provided training datasets so that our subset's yearly proportions were the same as those of the full data's. Hourly, daily, monthly and yearly trends were compared over repeated subsets to demonstrate that the trends in each subset were representative of the full data's trends. It should be noted that the EDA plots and summary statistics examined in this section of the report are all run on the same 1% subset.

Data

```
library(data.table)
library(dplyr)
library(magrittr)
library(MASS)
library(ggplot2)
library(gridExtra)
library(kableExtra)

taxi_2013 <- fread('subset_2013.csv')
taxi_2014 <- fread('subset_2014.csv')
taxi_2015 <- fread('subset_2015.csv')
taxi_2016 <- fread('subset_2016.csv')
taxi_2017 <- fread('subset_2017.csv')

taxi_2013[, 12 := NULL]
names(taxi_2014) <- names(taxi_2013)
names(taxi_2015) <- names(taxi_2013)
names(taxi_2016) <- names(taxi_2013)
names(taxi_2017) <- names(taxi_2013)

taxi_df <- data.table(rbindlist(list(taxi_2013, taxi_2014, taxi_2015, taxi_2016)),
                      Year = rep(c(2013, 2014, 2015, 2016), times = c(nrow(taxi_2013), nrow(taxi_2014),
                      nrow(taxi_2015), nrow(taxi_2016)))

taxi_df <- na.omit(taxi_df)
taxi_2017 <- na.omit(taxi_2017)
```

Note that we have an extra column in the taxi_2013 data so we removed it.

Previewing the data

Trip ID	Taxi ID
8c98866acf97e2d43363c1e62d408dfb63368a8b	6b50c5bb5761c3cb4853a8ca215dee42e63e922c7ebb0ce74cd52a2b3076c37ed38
8c98ba8af921ff20f80b4a64ea5d4b130f5360c0	ed7090d32800eec667900e884a935a298e55efaaea9d66f2753858efee1178aeb3a8
8c98f469ae3f77d7ab46e41e3ae0491aba8d7ebc	bf426bcd9e203d196e477b945f87932c33c7f177d884ab76aad30e26723e7b5e1f62
8c9a454a2e2fe9f04471f266c71d4a19ec413f29	c0250f358cae01c5319aeb7b39827e53f9a2259eb32e4c2fba048fd9e7d0a69ebc41c
8c9a71715c08f9be6b70f6ccdbdb55e8b64c725d	8b07f9156e568a37d362463c84dbd1118b4eeb753bae502fded3dd7ba0040f5476e
8c9b5278159c4c8a3fba3292b4bb326fc927fed1	d5ca4708ec7536df92968ff54683f27934c4c48beb482f831315a48b6e116dac3b944

Analysis of predictors over time

Before we begin let's create some datetime variables for our time.

```
date_time_2013 <- strftime(taxi_2013$`Trip Start Timestamp`, format = '%m/%d/%Y %I:%M:%S %p')
date_time_2014 <- strftime(taxi_2014$`Trip Start Timestamp`, format = '%m/%d/%Y %I:%M:%S %p')
date_time_2015 <- strftime(taxi_2015$`Trip Start Timestamp`, format = '%m/%d/%Y %I:%M:%S %p')
date_time_2016 <- strftime(taxi_2016$`Trip Start Timestamp`, format = '%m/%d/%Y %I:%M:%S %p')
date_time <- strftime(taxi_df$`Trip Start Timestamp`, format = '%m/%d/%Y %I:%M:%S %p')
date_time2 <- strftime(taxi_df$`Trip End Timestamp`, format = '%m/%d/%Y %I:%M:%S %p')

# Add month column
taxi_df[, Month := as.numeric(strftime(date_time, '%m'))]
```

By Month

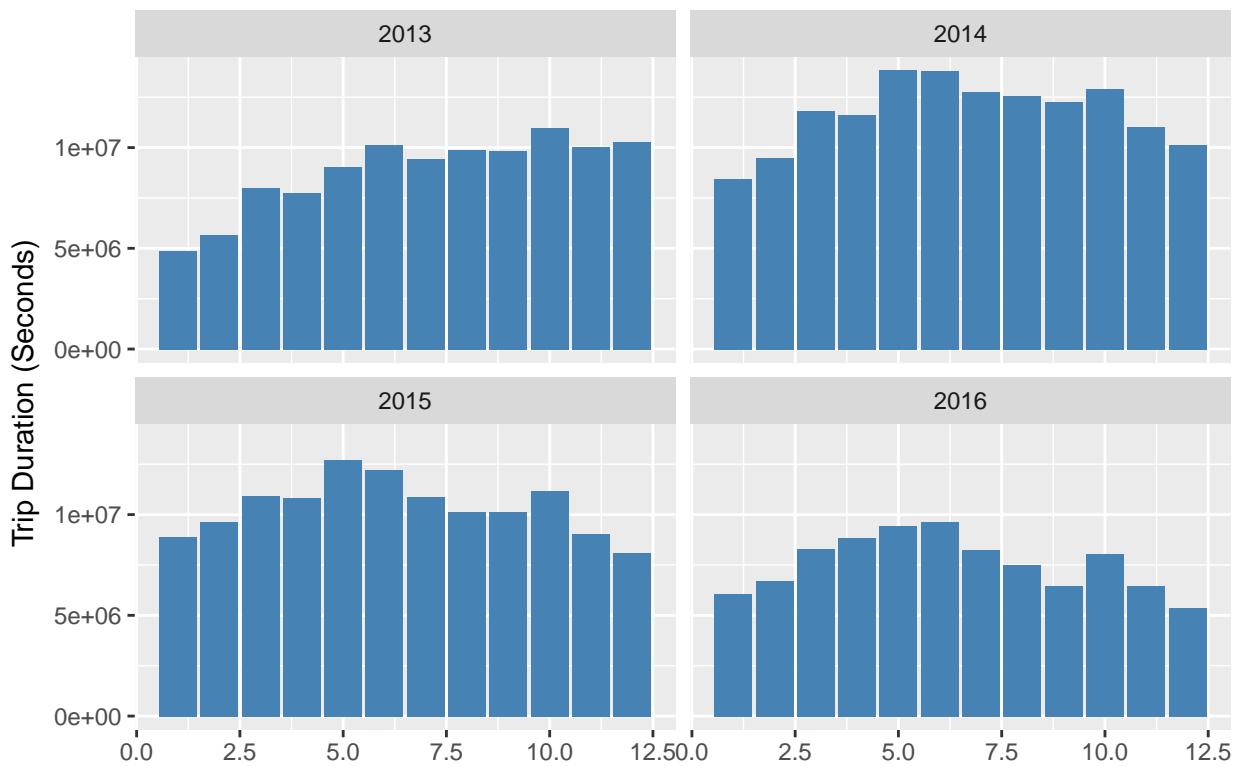
Let's begin by doing a breakdown by the month of year.

Trip Duration

The first variable we want to examine is trip duration and how it varies from month to month.

```
g1 <- taxi_df[, .(TripDuration = `Trip Seconds`, Month), by = Year] %>%
  ggplot(aes(Month, TripDuration)) +
  geom_bar(stat = 'identity', fill = 'steelblue') +
  facet_wrap(~ as.factor(Year)) +
  labs(x = '', y = 'Trip Duration (Seconds)', title = 'Trip duration by month')
g1
```

Trip duration by month



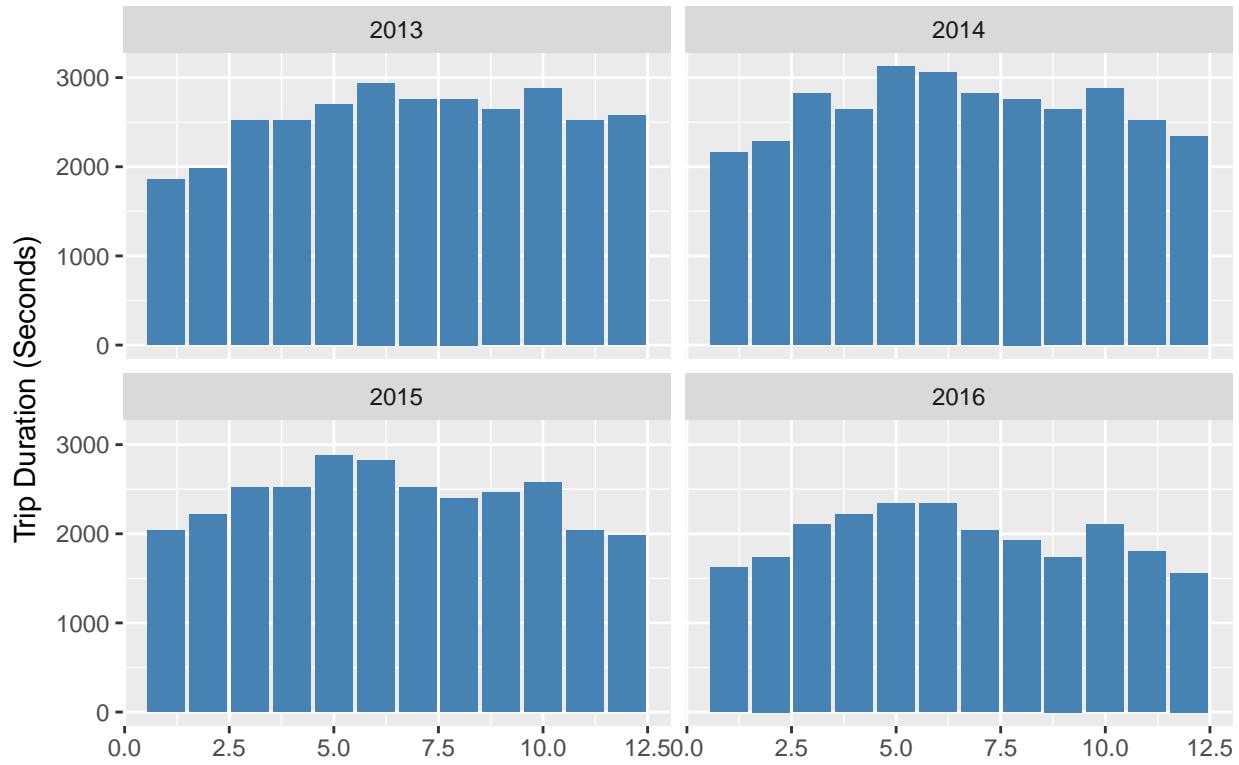
The first observation we can make is that the duration of trips increased through 2014 and then started decreasing. The general shape of the histograms have remained the same with May, June, and October having the longest trips and January having the shortest trips. This is total trip duration so let's see if that is due to a high trip count or if the general taxi ride is longer those months. We will make the same graph but this time with median taxi trip duration.

```
g2 <- taxi_df[, .(TotalTrip = sum(`Trip Seconds`)), by = list(`Taxi ID`, Month, Year)][, .(Median = median(Trip Seconds))]
```

```
ggplot(aes(Month, Median)) +
  geom_bar(stat = 'identity', fill = 'steelblue') +
  facet_wrap(~ as.factor(Year)) +
  labs(x = '', y = 'Trip Duration (Seconds)', title = 'Median Trip duration by month')
```

```
g2
```

Median Trip duration by month



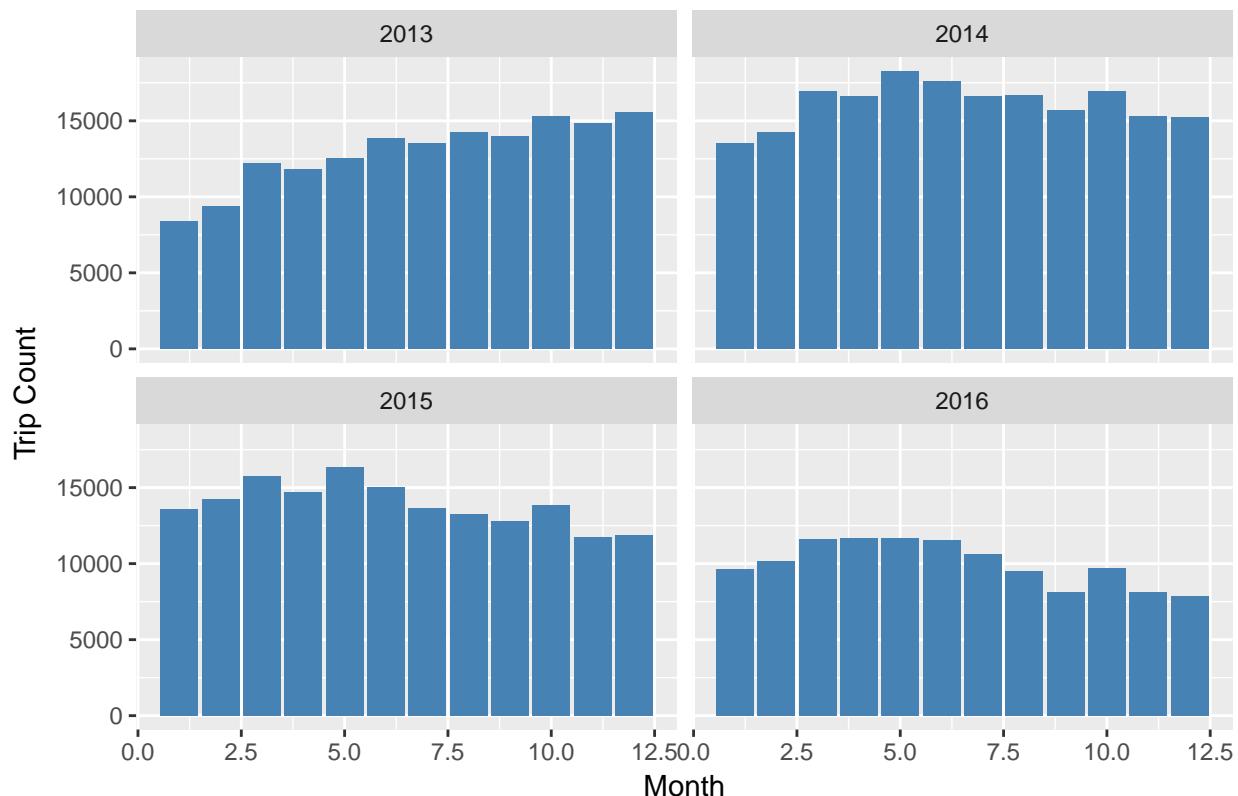
Looking at the median trip durations, we still see that the peaks are generally in May, June, and October and that the low points are in January. The difference is not as big though.

Trip Count

Now let's investigate the number of trips that have been taken each month.

```
g3 <- taxi_df[, .(Month), by = Year][, .(TripCount = .N), by = c('Year', 'Month')] %>%
  ggplot(aes(Month, TripCount)) +
  geom_bar(stat = 'identity', fill = 'steelblue') +
  facet_wrap(~ as.factor(Year)) +
  labs(x = 'Month', y = 'Trip Count', title = 'Trip count by month')
g3
```

Trip count by month



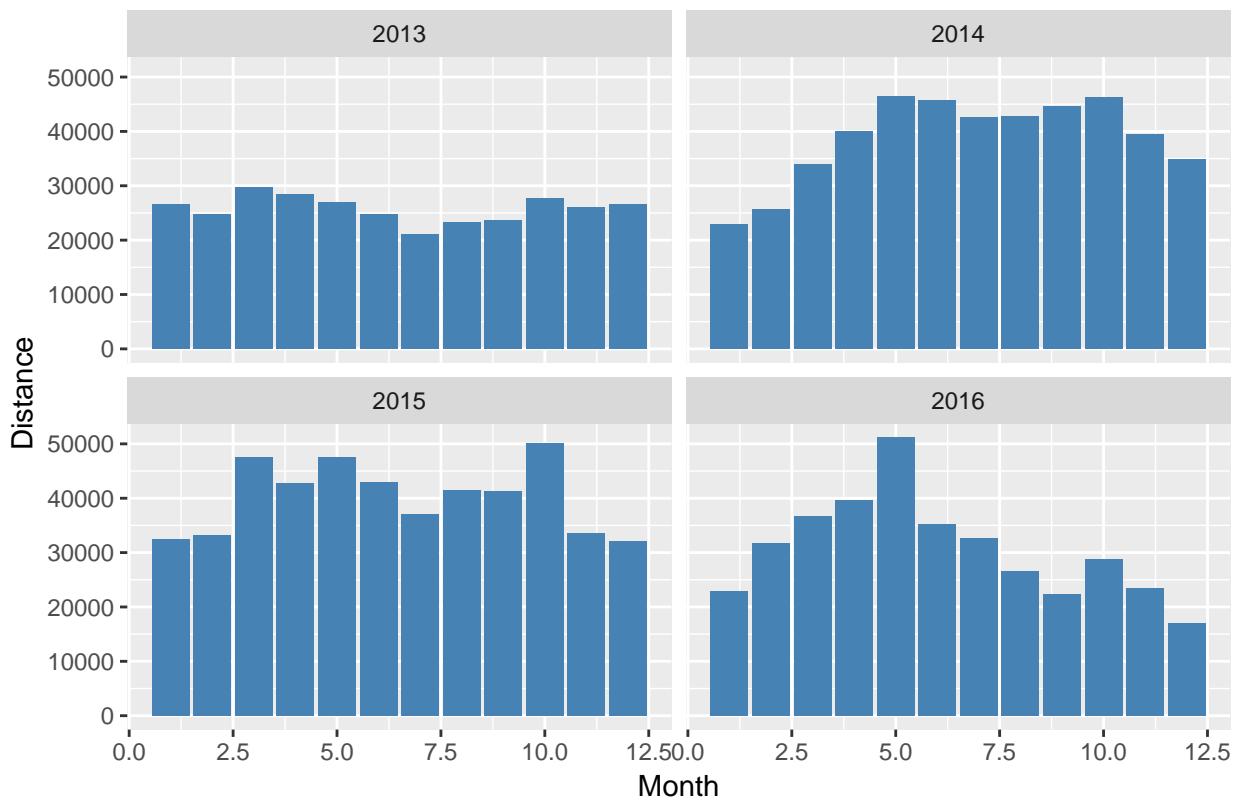
We can see that the trip count follows the same trend as trip duration, where 2014 is the highest and proceeds to decrease every year after. We can still find that May, June, and October are the peak months and January is the low.

Trip Distance

The last variable we want to look into is the trip distance for each month.

```
g4 <- taxi_df[, .(TripDistance = `Trip Miles`, Month), by = Year] %>%
  ggplot(aes(Month, TripDistance)) +
  geom_bar(stat = 'identity', fill = 'steelblue') +
  facet_wrap(~ as.factor(Year)) +
  labs(x = 'Month', y = 'Distance', title = 'Distance travelled by month')
g4
```

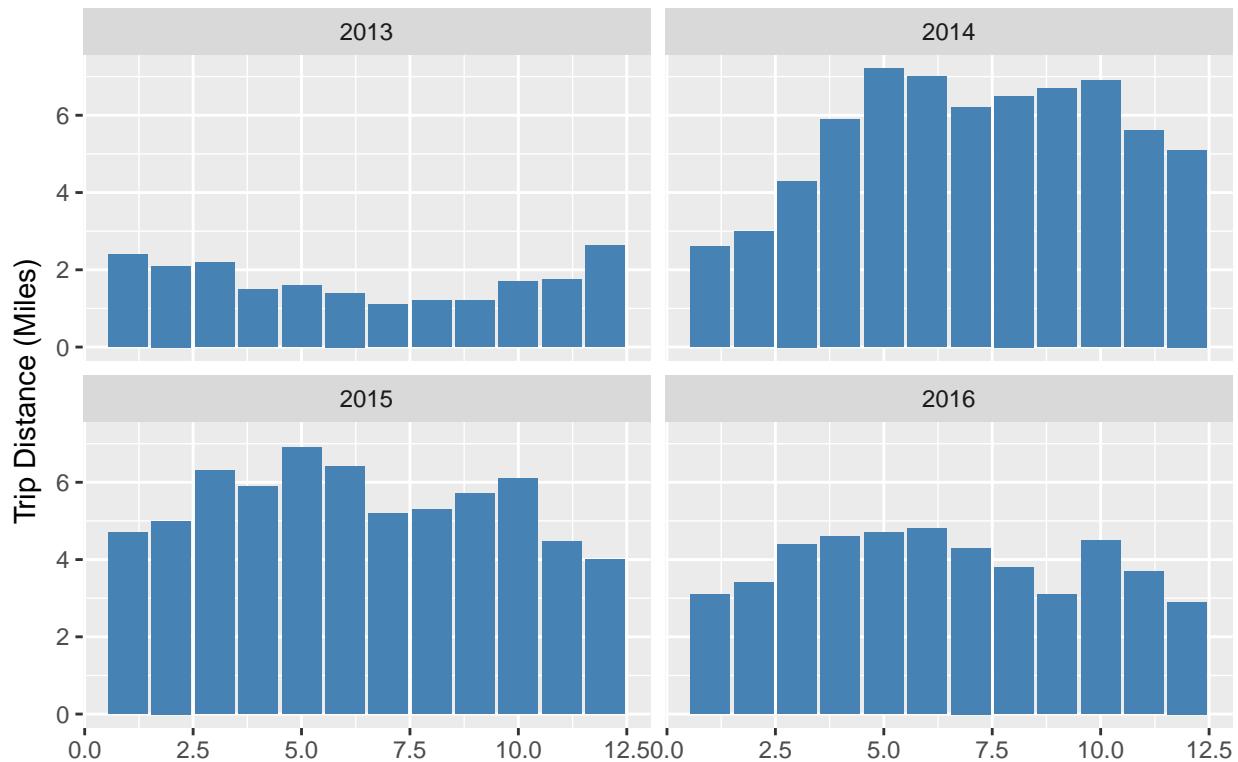
Distance travelled by month



The total trip distances increased from 2013-2014, but then decreases every year after. January appears to still be the low month, however, May, June, and October don't appear to be distinguishable peaks anymore. Now let's take a look at the median trip distance.

```
g5 <- taxi_df[, .(TotalTrip = sum(`Trip Miles`)), by = list(`Taxi ID`, Month, Year)][, .(Median = median(TotalTrip))]
ggplot(aes(Month, Median)) +
  geom_bar(stat = 'identity', fill = 'steelblue') +
  facet_wrap(~ as.factor(Year)) +
  labs(x = '', y = 'Trip Distance (Miles)', title = 'Median Trip distance by month')
g5
```

Median Trip distance by month



The median trip distance shows a large spike from 2013-2014 and then a large decrease from 2015-2016.

By Day of the week

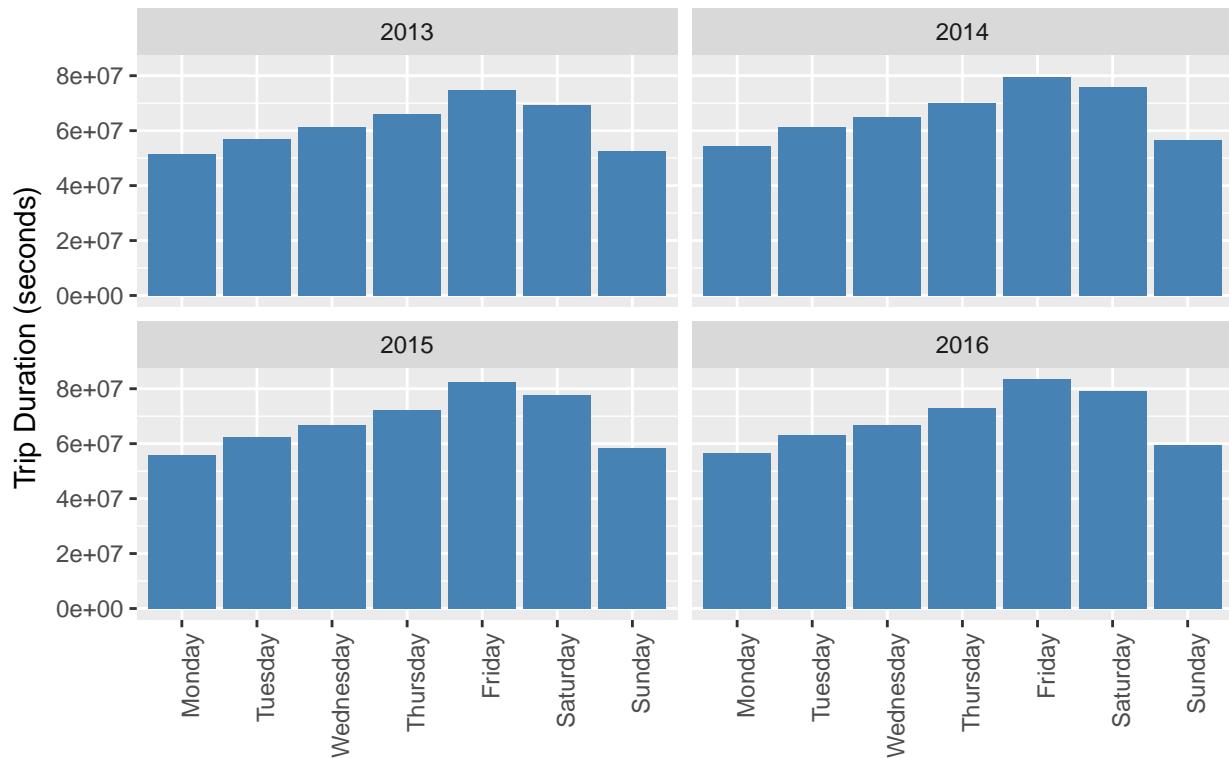
We now do a closer inspection on the same variables, but now we look at the trends by the day of the week.

Trip Duration

We will start with trip duration again.

```
g6 <- taxi_df[, .(TripDuration = `Trip Seconds`,  
                  Day = factor(weekdays(as.Date(date_time)), levels = c('Monday', 'Tuesday', 'Wednesday',  
                  ggplot(aes(Day, TripDuration)) +  
                  geom_bar(stat = 'identity', fill = 'steelblue') +  
                  facet_wrap(~ as.factor(Year)) +  
                  labs(x = '', y = 'Trip Duration (seconds)', title = 'Trip duration by day of week') +  
                  theme(axis.text.x = element_text(angle = 90, hjust = 1))  
g6
```

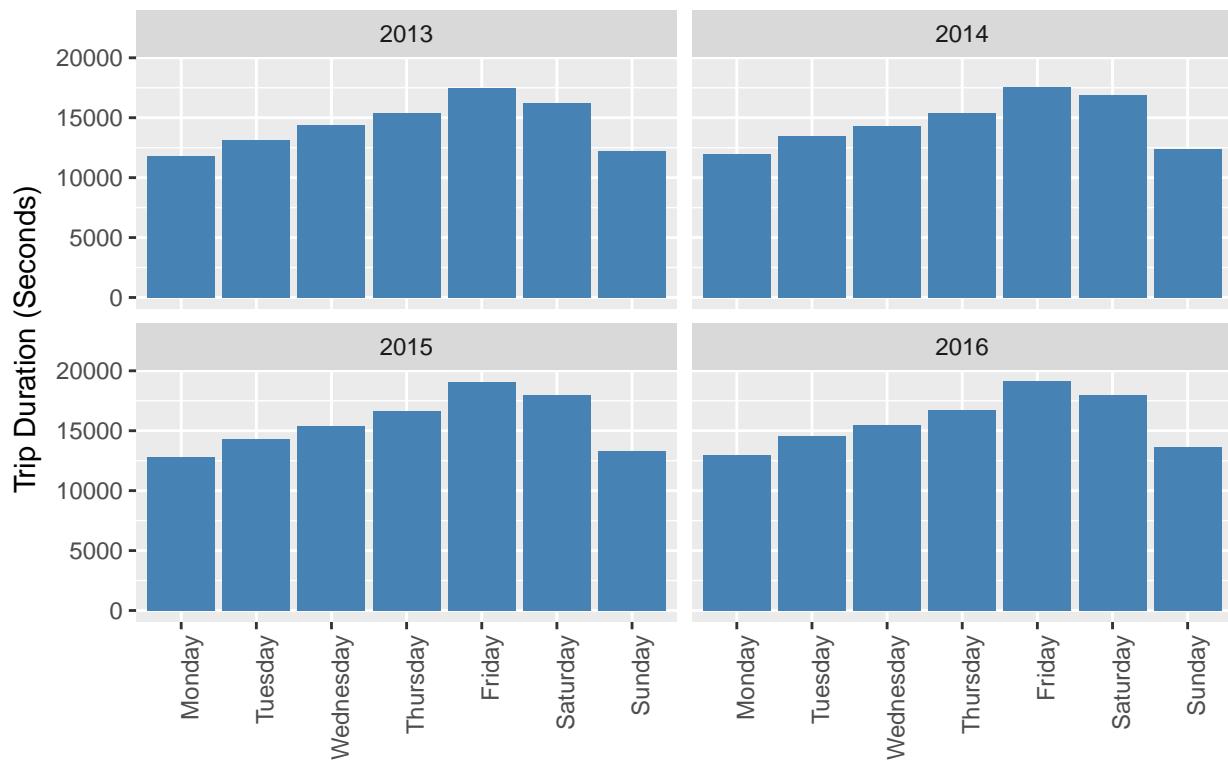
Trip duration by day of week



We see that trips duration is the most on Fridays and Saturdays for all years. Like our previous analysis with trip duration by month, we want to also look at the median trip duration to assess individual rides.

```
g7 <- taxi_df[, .(TaxiID = `Taxi ID`,
                  TripDuration = `Trip Seconds`,
                  Day = factor(weekdays(as.Date(date_time)), levels = c('Monday', 'Tuesday', 'Wednesday',
                  ggplot(aes(Day, Median)) +
                  geom_bar(stat = 'identity', fill = 'steelblue') +
                  facet_wrap(~ as.factor(Year)) +
                  labs(x = '', y = 'Trip Duration (Seconds)', title = 'Median Trip duration by day of week') +
                  theme(axis.text.x = element_text(angle = 90, hjust = 1))
g7
```

Median Trip duration by day of week

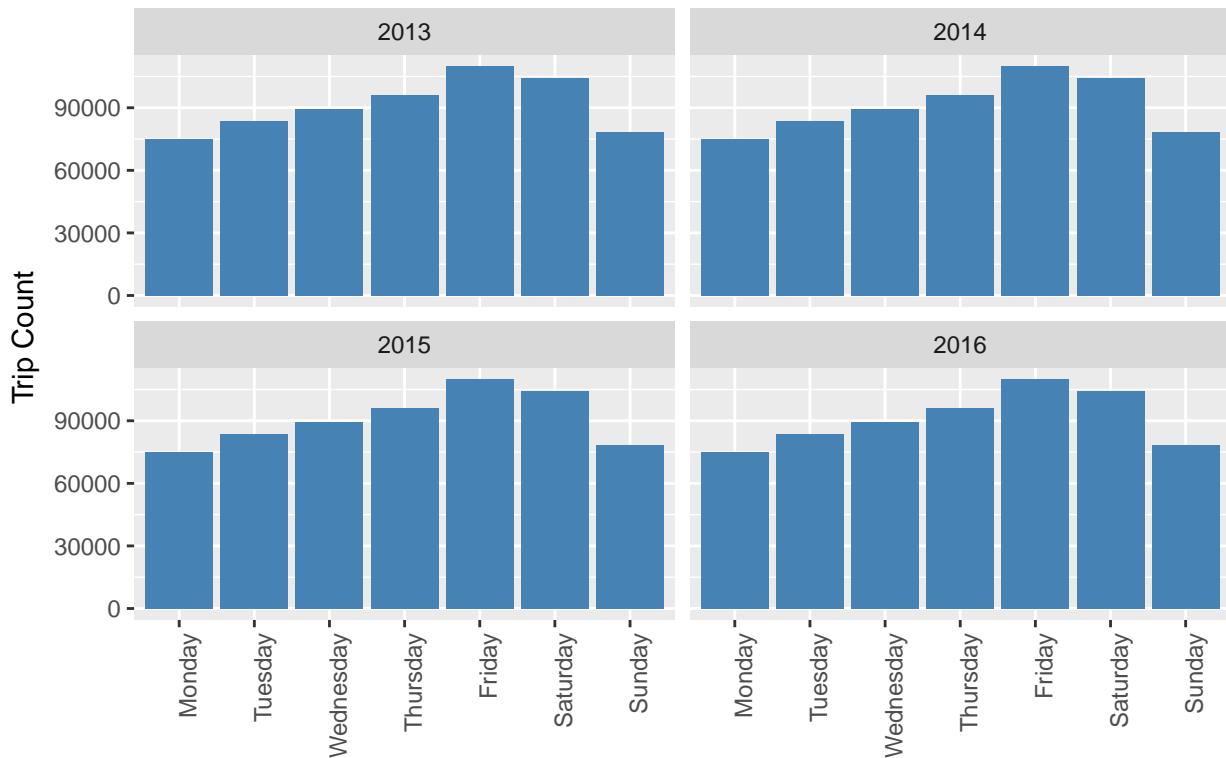


The median trip duration seems to follow the same trend as total trip duration, having the high points on Fridays and Saturdays, so we can expect individual taxi trip durations to behave in this pattern. It makes sense that Friday and Saturday see the longest trip durations as that is when people are more likely to go out and grab drinks or travel to and from the airport.

Trip Count

```
g8 <- taxi_df[, .(Day = factor(weekdays(as.Date(date_time)), levels = c('Monday', 'Tuesday', 'Wednesday',
  ggplot(aes(Day, TripCount)) +
  geom_bar(stat = 'identity', fill = 'steelblue') +
  facet_wrap(~ as.factor(Year)) +
  labs(x = '', y = 'Trip Count', title = 'Trip count by day of week') +
  theme(axis.text.x = element_text(angle = 90, hjust = 1)))
g8
```

Trip count by day of week

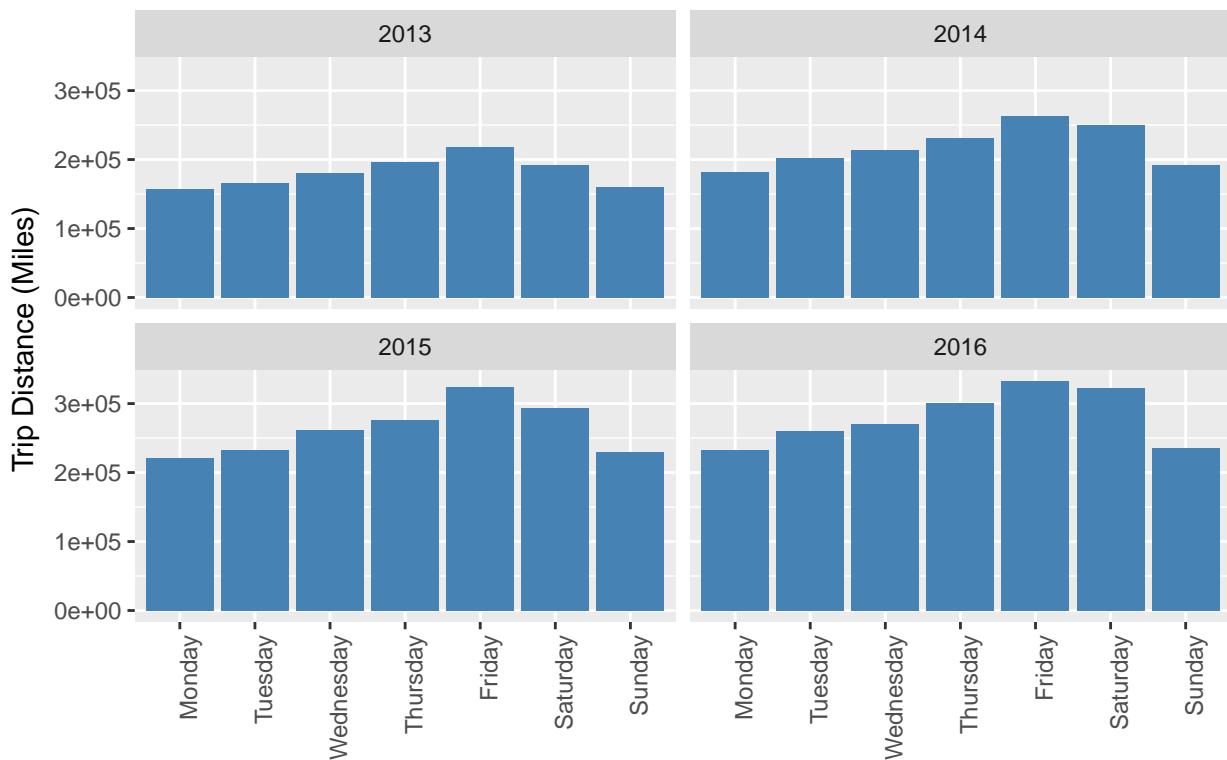


As expected, the trip count follows the same trend as the total trip duration and also the median trip duration with the peaks being on Friday and Saturdays.

Trip Distance

```
g9 <- taxi_df[, .(TripDistance = `Trip Miles`,
                  Day = factor(weekdays(as.Date(date_time)), levels = c('Monday', 'Tuesday', 'Wednesday',
                  ggplot(aes(Day, TripDistance)) +
                  geom_bar(stat = 'identity', fill = 'steelblue') +
                  facet_wrap(~ as.factor(Year)) +
                  labs(x = '', y = 'Trip Distance (Miles)', title = 'Trip distance by day of week') +
                  theme(axis.text.x = element_text(angle = 90, hjust = 1)))
g9
```

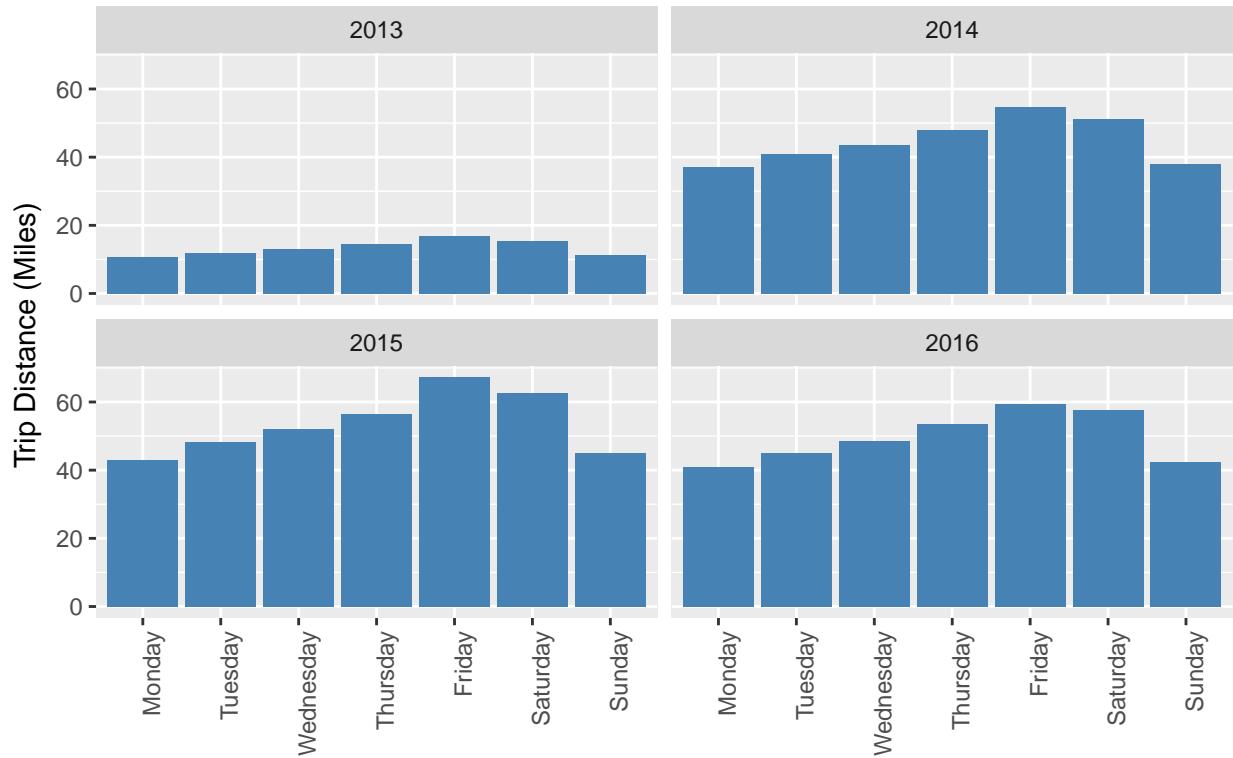
Trip distance by day of week



The trip distance peaks on Fridays and Saturdays but one interesting thing is the trip distance has seemed to increase over the years while the trip count stayed the same across all years. Let's see if the median trip distance increases also.

```
g10 <- taxi_df[, .(TaxiID = `Taxi ID`,
                    TripDistance = `Trip Miles`,
                    Day = factor(weekdays(as.Date(date_time)), levels = c('Monday', 'Tuesday', 'Wednesday',
                    'Thursday', 'Friday', 'Saturday', 'Sunday'))]
ggplot(aes(Day, Median)) +
  geom_bar(stat = 'identity', fill = 'steelblue') +
  facet_wrap(~ as.factor(Year)) +
  labs(x = '', y = 'Trip Distance (Miles)', title = 'Median Trip distance by day of week') +
  theme(axis.text.x = element_text(angle = 90, hjust = 1))
g10
```

Median Trip distance by day of week



Not much appears to change in this plot except that the 2013 median trip distance is very low.

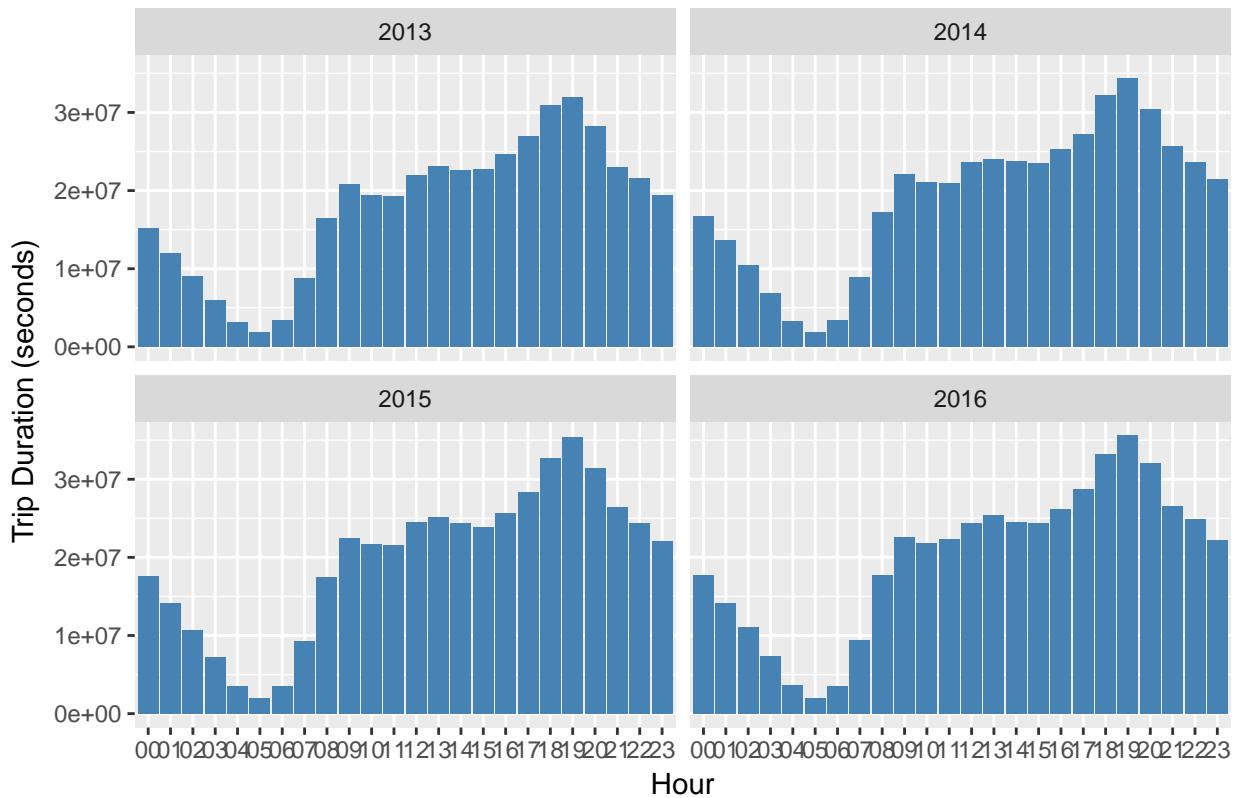
By Hour of day

Lastly we want to break it down even further and analyze trends by the hour of any day.

Trip Duration

```
g11 <- taxi_df[, .(TripDuration = `Trip Seconds`, Hour = strftime(date_time, '%H')), by = Year] %>%
  ggplot(aes(Hour, TripDuration)) +
  geom_bar(stat = 'identity', fill = 'steelblue') +
  facet_wrap(~ as.factor(Year)) +
  labs(x = 'Hour', y = 'Trip Duration (seconds)', title = 'Trip duration by hour of day')
g11
```

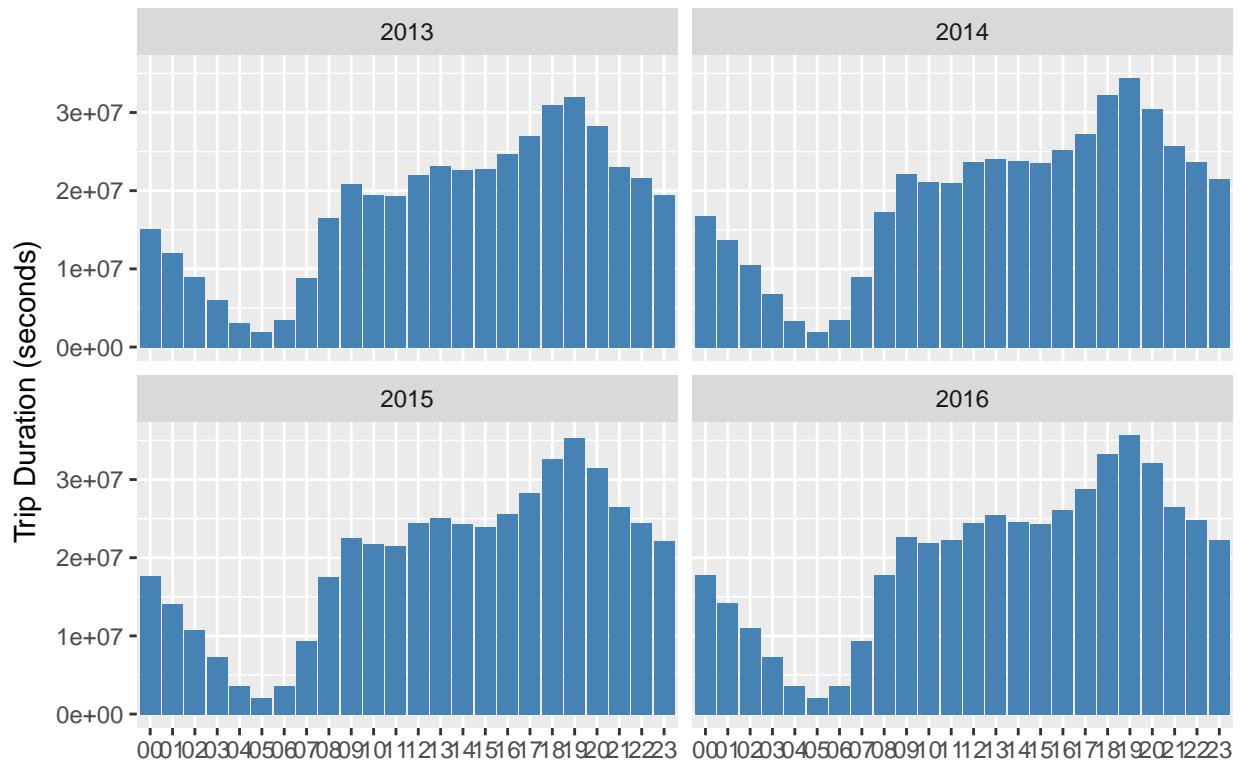
Trip duration by hour of day



6pm and 7pm appears to be the peaks for trip duration for all years and there appears to be only a slight increase in trip duration after 2013. Let's take a look at the median trip duration.

```
g12 <- taxi_df[, .(TripDuration = `Trip Seconds`,
                     Hour = strftime(date_time, '%H')), by = Year] %>%
  ggplot(aes(Hour, TripDuration)) +
  geom_bar(stat = 'identity', fill = 'steelblue') +
  facet_wrap(~ as.factor(Year)) +
  labs(x = '', y = 'Trip Duration (seconds)', title = 'Median Trip duration by hour of day')
g12
```

Median Trip duration by hour of day



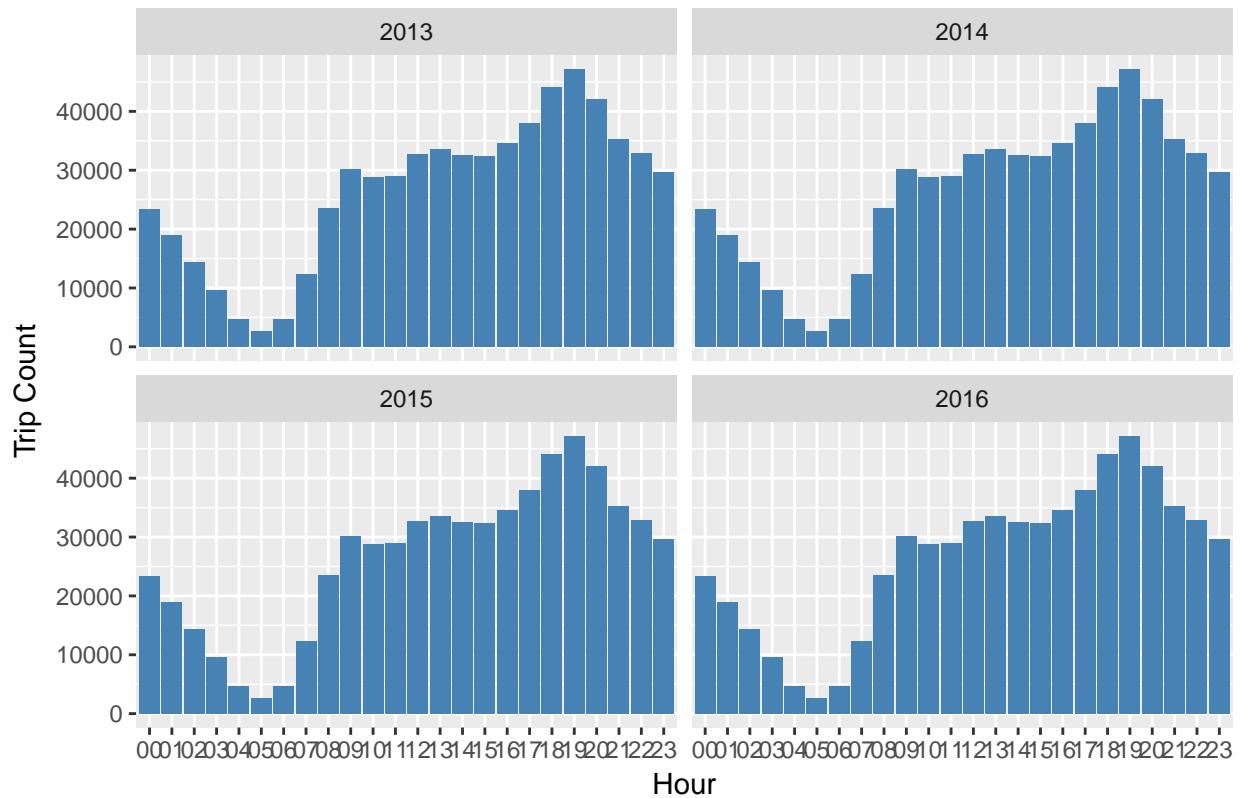
Trip Count

```
g13 <- taxi_df[, .(Hour = strftime(date_time, '%H')), by = Year][, .(TripCount = .N), by = c('Year', 'Hour')]
```

```
ggplot(aes(Hour, TripCount)) +
  geom_bar(stat = 'identity', fill = 'steelblue') +
  facet_wrap(~ as.factor(Year)) +
  labs(x = 'Hour', y = 'Trip Count', title = 'Trip count by hour of day')
```

```
g13
```

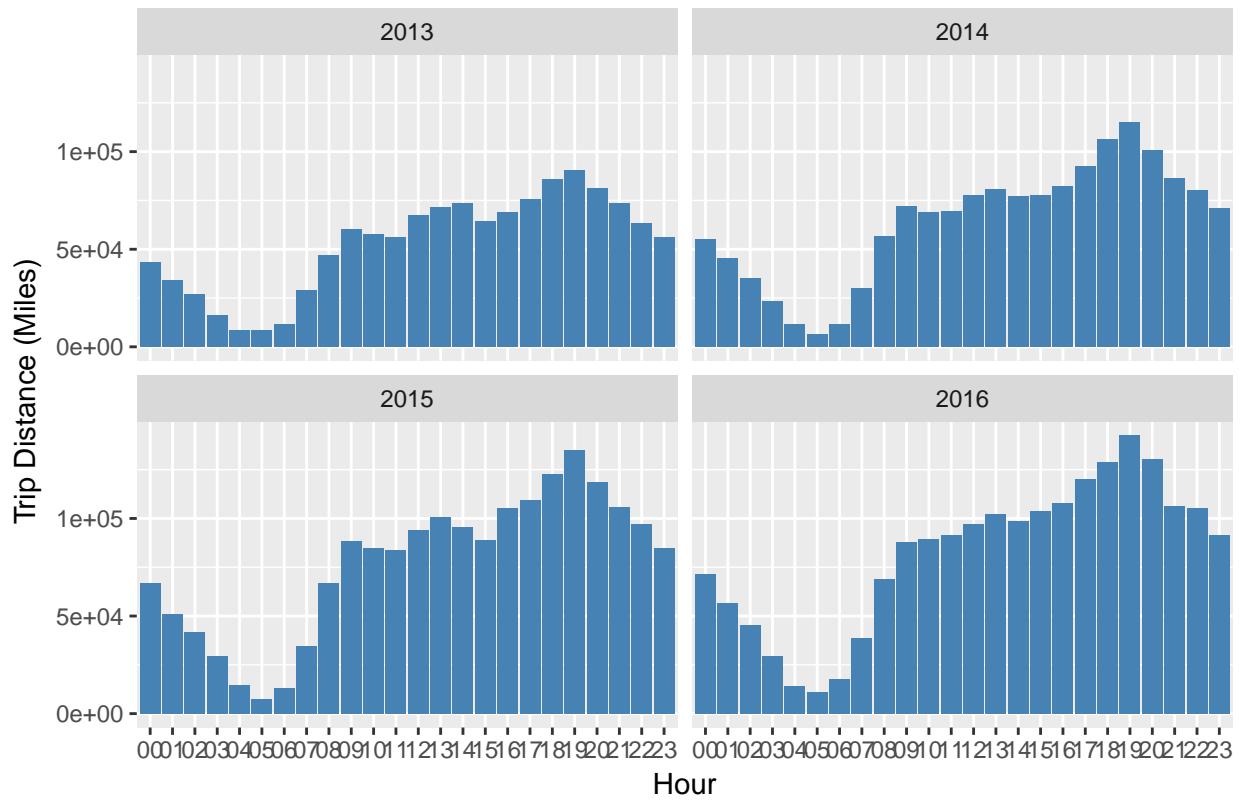
Trip count by hour of day



Trip Distance

```
g14 <- taxi_df[, .(TripDistance = `Trip Miles`, Hour = strftime(date_time, '%H')), by = Year] %>%
  ggplot(aes(Hour, TripDistance)) +
  geom_bar(stat = 'identity', fill = 'steelblue') +
  facet_wrap(~ as.factor(Year)) +
  labs(x = 'Hour', y = 'Trip Distance (Miles)', title = 'Trip distance by hour of day')
g14
```

Trip distance by hour of day



And the median trip distance.

```
g15 <- taxi_df[, .(TaxiID = `Taxi ID`,
                  TripDistance = `Trip Miles`,
                  Hour = strftime(date_time, '%H')), by = Year][, .(TotalTrip = sum(TripDistance)), by =
ggplot(aes(Hour, Median)) +
  geom_bar(stat = 'identity', fill = 'steelblue') +
  facet_wrap(~ as.factor(Year)) +
  labs(x = '', y = 'Trip Distance (Miles)', title = 'Median Trip distance by hour of day')
g15
```

Median Trip distance by hour of day

