midterm_project

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```
library(readr)
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

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

```
library(ggplot2)
library(knitr)
library(scales)
```

```
##
## Attaching package: 'scales'
```

```
## The following object is masked from 'package:readr':
##
##     col_factor
```

```
library(gridExtra)
```

```
##
## Attaching package: 'gridExtra'
```

```
## The following object is masked from 'package:dplyr':
##
##     combine
```

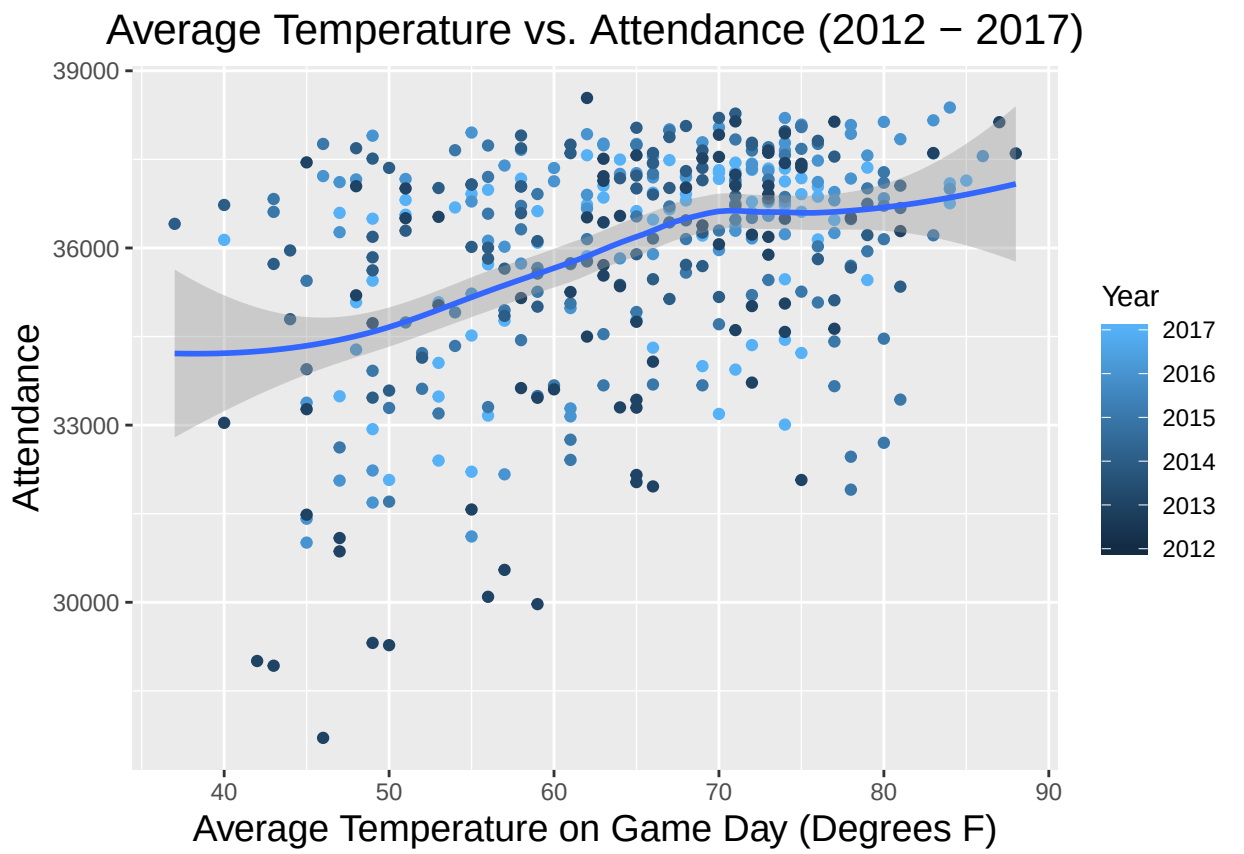
```
# We write the scraping code for the Celtics attendance, which is in MA615 Celtics Webscrape.Rmd. And i
baseball <- read.csv("baseball_weather.csv", header = T) %>% filter(X.1 != "@")
basketball <- read.csv("basketball_weather.csv", header = T)
baseball11 <- read.csv("baseball_weather.csv", header = T) %>% filter(X.1 != "@")
baseball <- select(baseball, Gm., Year, DATE, X, Tm, Opp, W.L, Win, Loss, Save, Time, D.N, Attendance, 
write.csv(baseball, file = "baseball00.csv")
```

```
ggplot(baseball, mapping = aes(x = TAVG, y = Attendance)) +
  geom_point(mapping = aes(color = Year)) +
  geom_smooth() +
  ggtitle("Average Temperature vs. Attendance (2012 - 2017)") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Average Temperature on Game Day (Degrees F)") +
  ylab("Attendance")
```

```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'
```

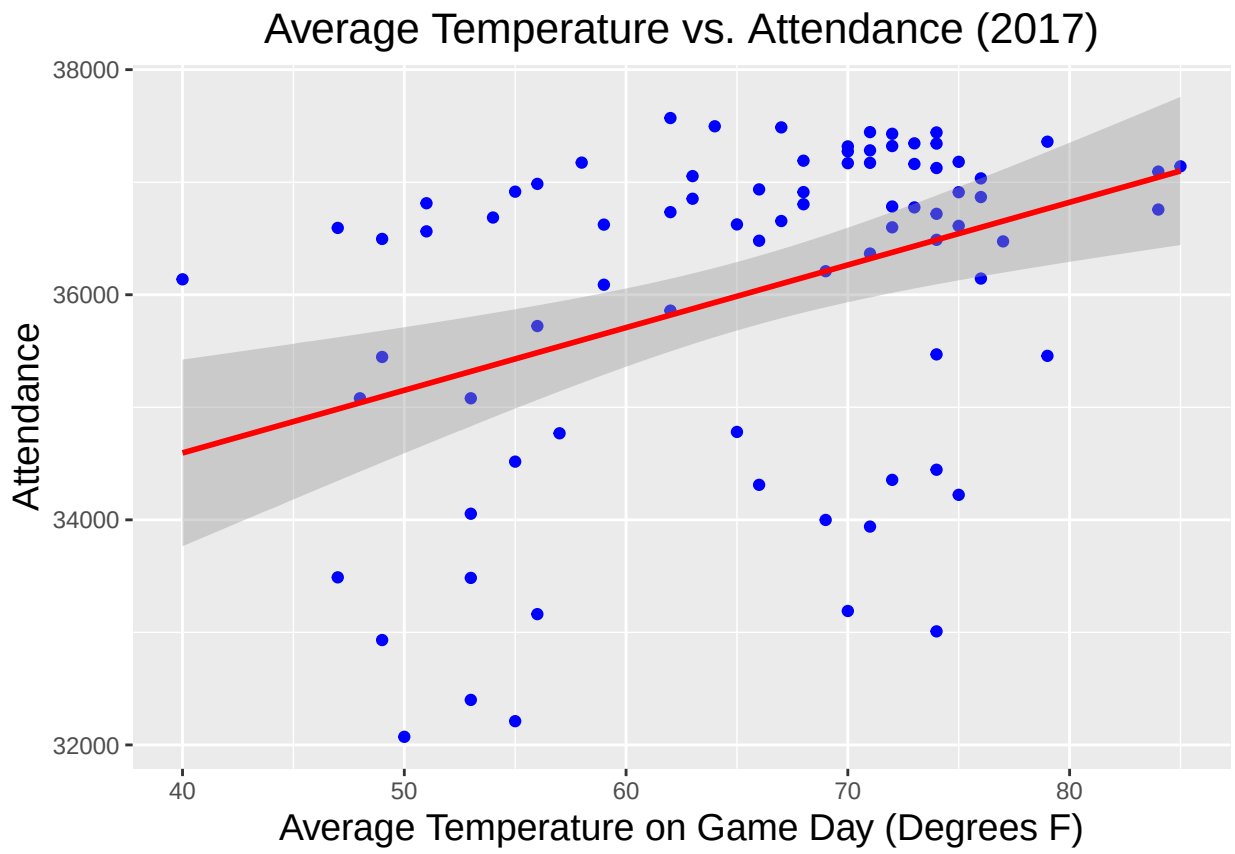
```
## Warning: Removed 81 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 81 rows containing missing values (geom_point).
```

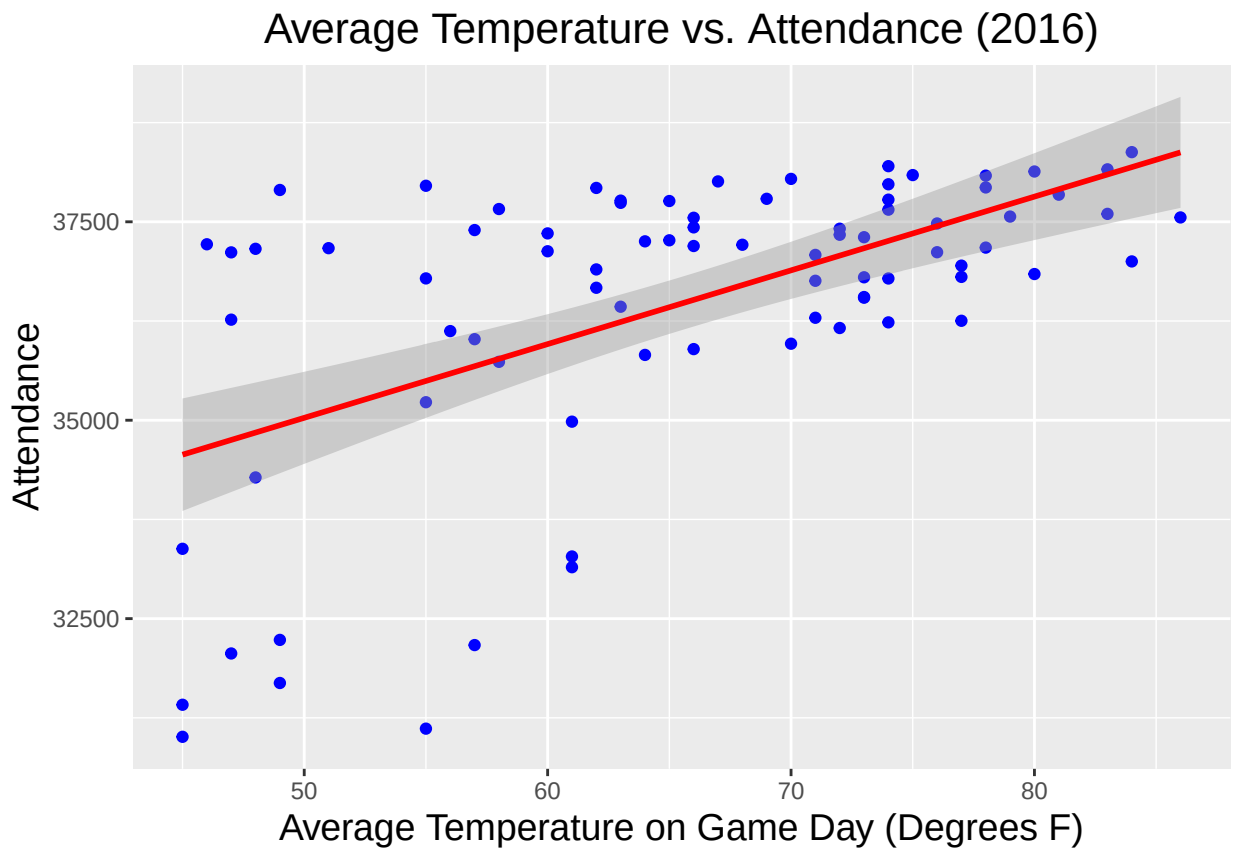


There appears to be a weak but slightly positive relationship between average temperature and attendance over the past six seasons. Most of the low attendance games occured in 2012 when the Red Sox finished in last place in the division.

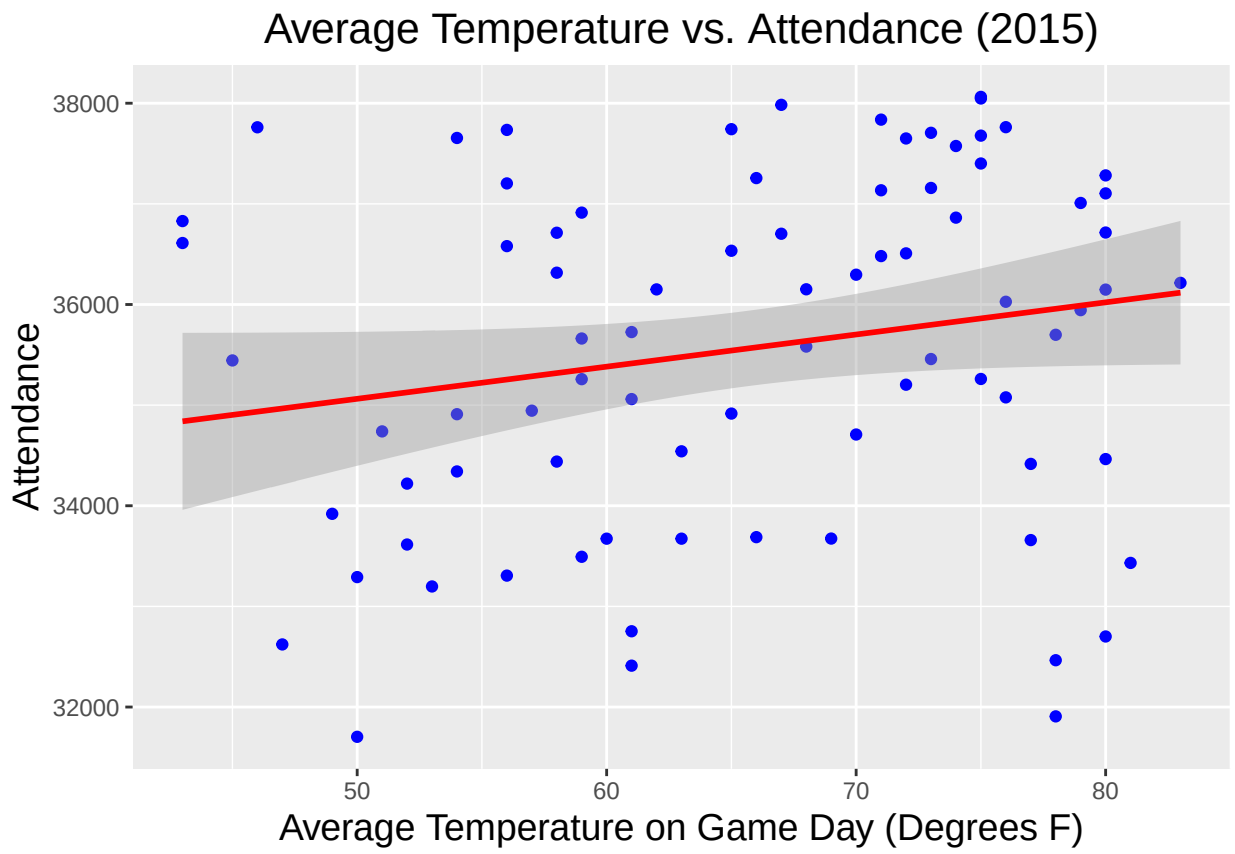
```
# 2017 Season
baseball_2017 <- baseball %>% filter(Year == 2017)
# Relationship between average temperature with attendance of season 2017
ggplot(baseball_2017, aes(TAVG, Attendance)) +
  geom_point(color = "blue") +
  geom_smooth(method = "lm", color = "red") +
  ggtitle("Average Temperature vs. Attendance (2017)") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Average Temperature on Game Day (Degrees F)") +
  ylab("Attendance")
```



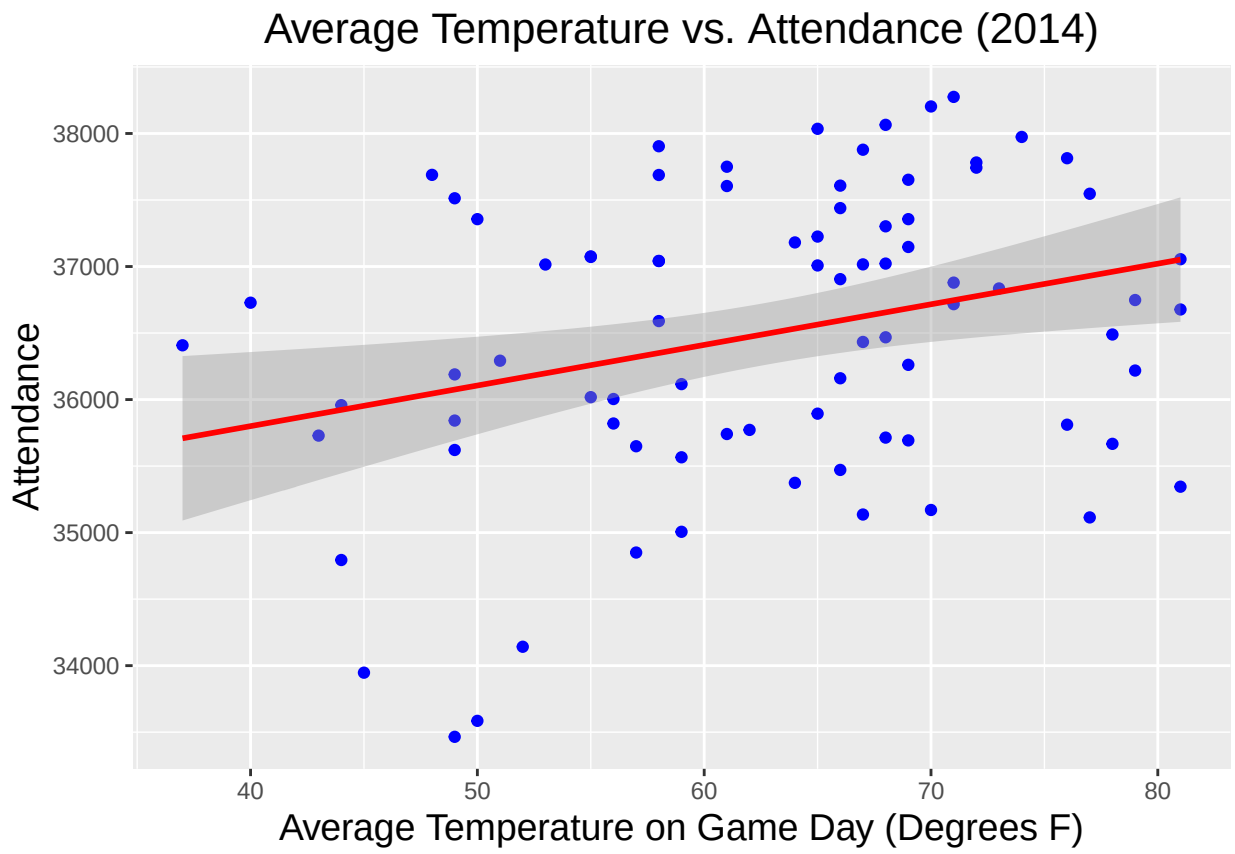

```
# 2016 Season
baseball_2016 <- baseball %>% filter(Year == 2016)
# Relationship between average temperature with attendance of season 2016
ggplot(baseball_2016, aes(TAVG, Attendance)) +
  geom_point(color = "blue") +
  geom_smooth(method = "lm", color = "red") +
  ggtitle("Average Temperature vs. Attendance (2016)") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Average Temperature on Game Day (Degrees F)") +
  ylab("Attendance")
```



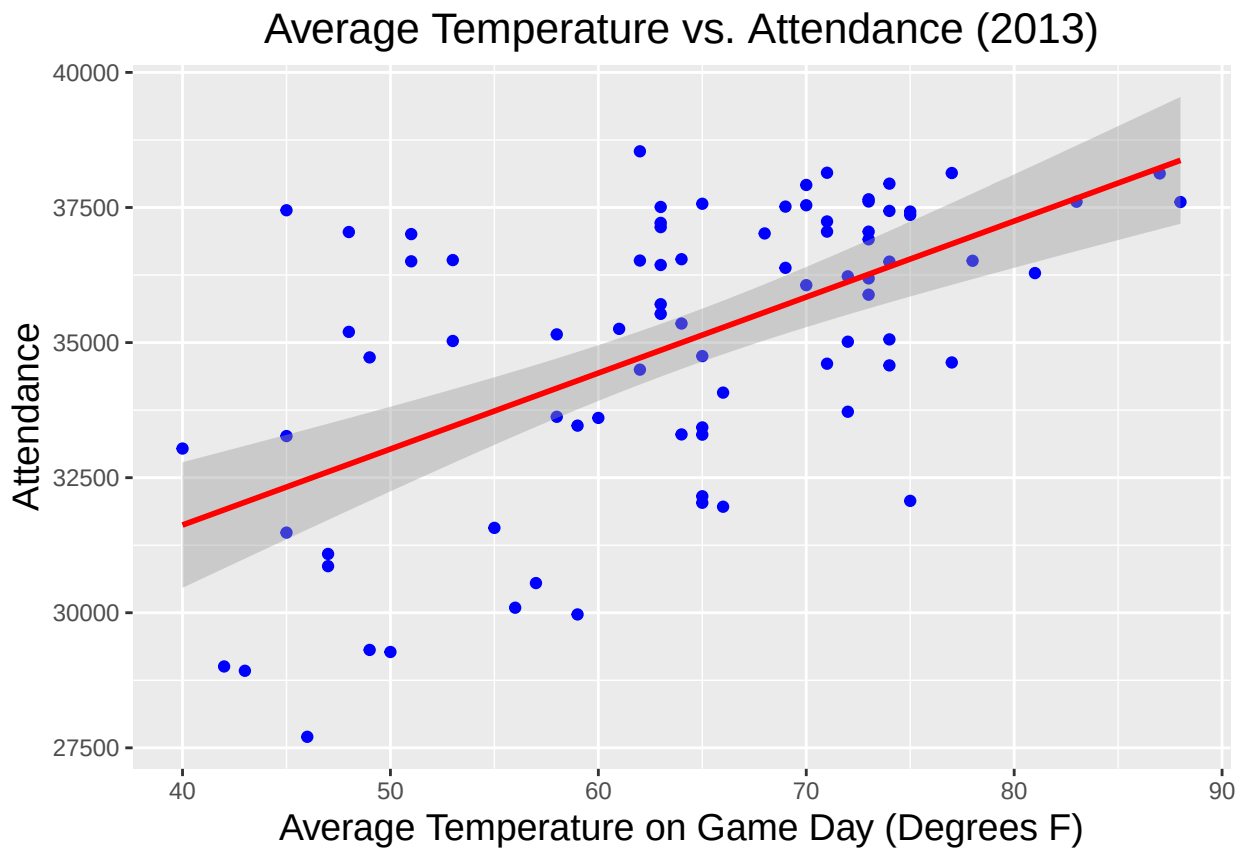

```
# 2015 Season
baseball_2015 <- baseball %>% filter(Year == 2015)
# Relationship between average temperature with attendance of season 2015
ggplot(baseball_2015, aes(TAVG, Attendance)) +
  geom_point(color = "blue") +
  geom_smooth(method = "lm", color = "red") +
  ggtitle("Average Temperature vs. Attendance (2015)") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Average Temperature on Game Day (Degrees F)") +
  ylab("Attendance")
```




```
# 2014 Season
baseball_2014 <- baseball %>% filter(Year == 2014)
# Relationship between average temperature with attendance of season 2014
ggplot(baseball_2014, aes(TAVG, Attendance)) +
  geom_point(color = "blue") +
  geom_smooth(method = "lm", color = "red") +
  ggtitle("Average Temperature vs. Attendance (2014)") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Average Temperature on Game Day (Degrees F)") +
  ylab("Attendance")
```

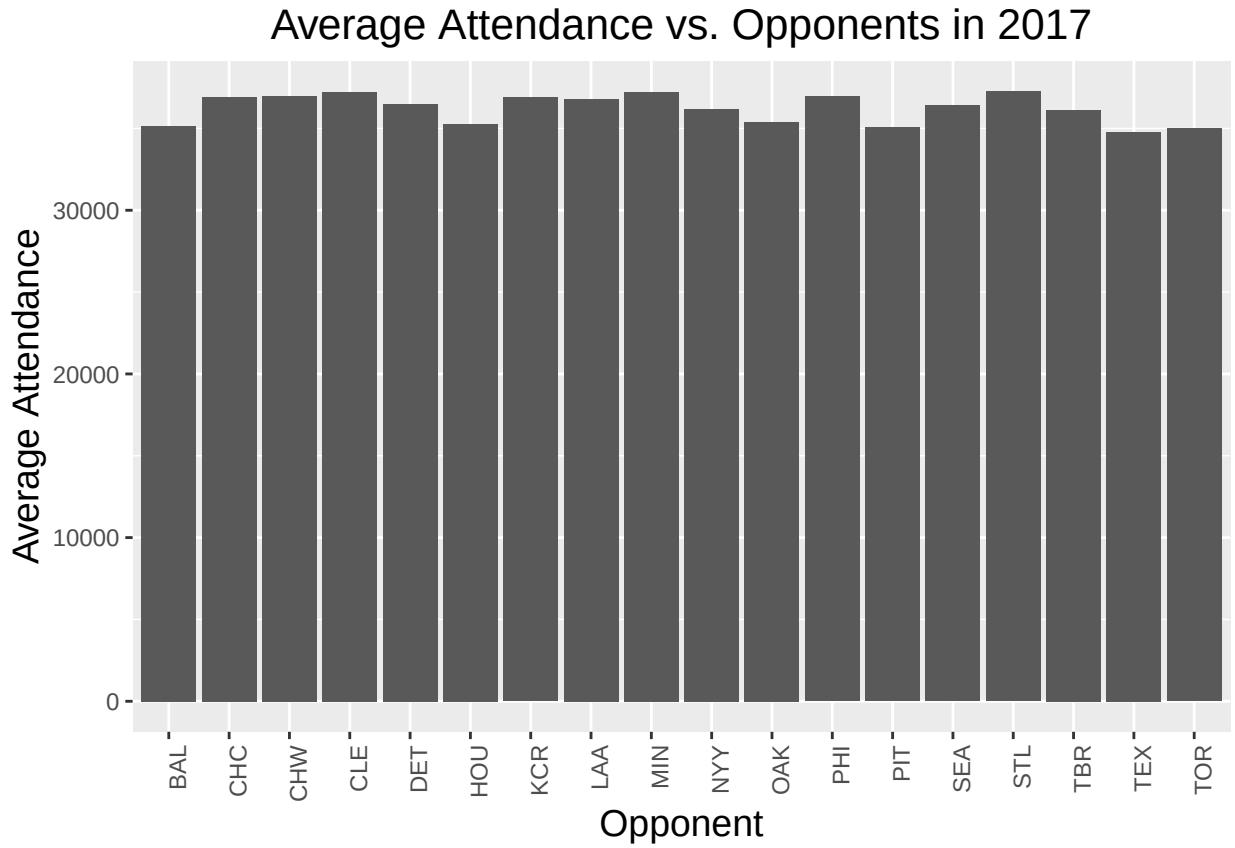



```r
# 2013 Season
baseball_2013 <- baseball %>% filter(Year == 2013)
# Relationship between average temperature with attendance of season 2013
ggplot(baseball_2013, aes(TAVG, Attendance)) +
  geom_point(color = "blue") +
  geom_smooth(method = "lm", color = "red") +
  ggtitle("Average Temperature vs. Attendance (2013)") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Average Temperature on Game Day (Degrees F)") +
  ylab("Attendance")
```



Conclusion: There appears to be a weak positive relationship between average temperature and attendance over the past six seasons. The influence of a few data points per season in which temperature is unseasonably low (40 degress or below) appear to have an outsized effect on the relationship.

```
# 2017
# Summary of attendance in seanson 2017 with different opponent.
# Group by different opponents and arrange the attendance from high to low
baseball_opp17 <- baseball_2017 %>% group_by(Opp) %>% summarise(avg_attendance = round(mean(Attendance)
baseball_opp17 <- arrange(baseball_opp17, desc(avg_attendance))

ggplot(baseball_opp17, aes(Opp, avg_attendance)) +
  geom_bar(stat = "identity") +
  ggtitle("Average Attendance vs. Opponents in 2017") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(axis.text.x = element_text(angle = 90, hjust = 1)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Opponent") +
  ylab("Average Attendance")
```

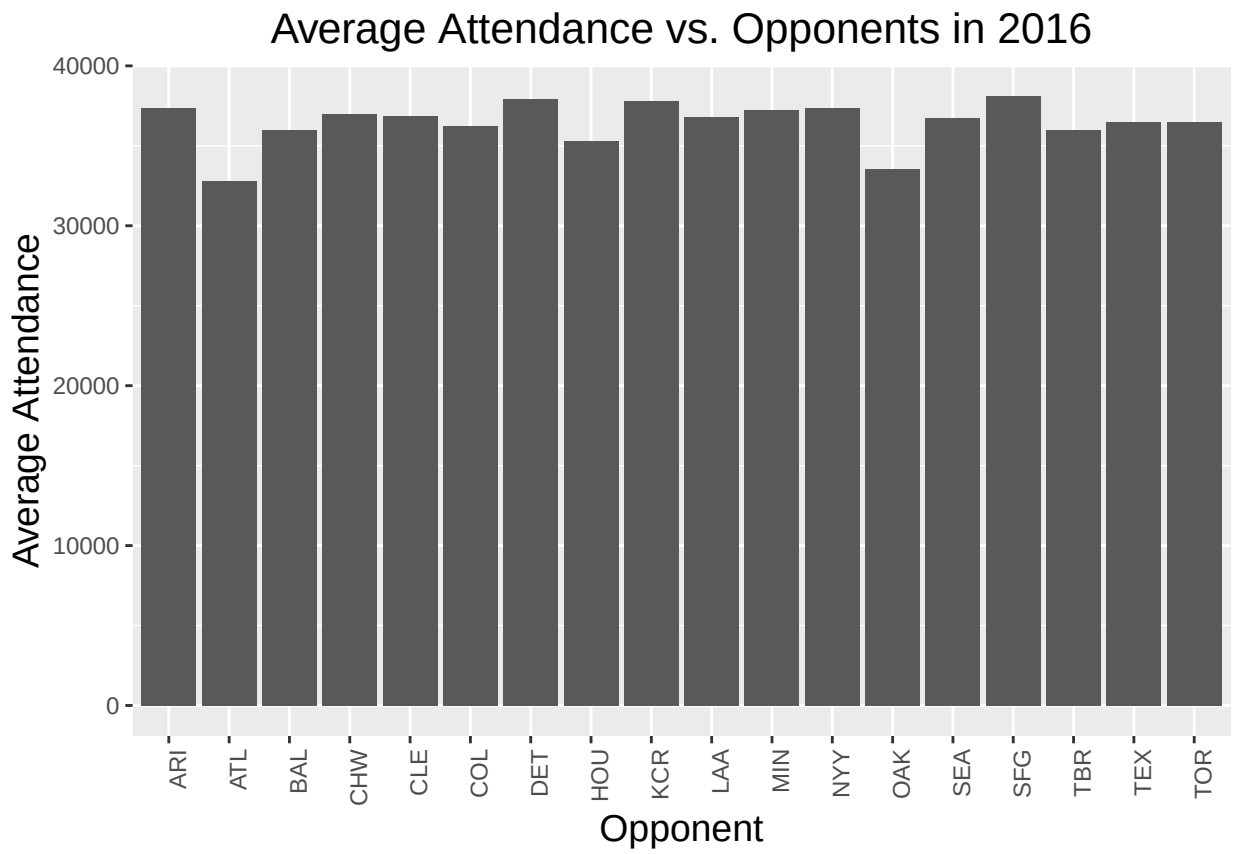



```
kable(baseball_opp17)
```

Opp	avg_attendance
STL	37263
CLE	37242
MIN	37227
CHW	36984
PHI	36949
CHC	36915
KCR	36904
LAA	36792
DET	36491
SEA	36413
NYY	36185
TBR	36142
OAK	35397
HOU	35271
BAL	35147
PIT	35044
TOR	34998
TEX	34781

```
# 2016
# Summary of attendance in seanson 2016 with different opponent.
# Group by different opponents and arrange the attendance from high to low
```

```r
baseball_opp16 <- baseball_2016 %>% group_by(Opp) %>% summarise(avg_attendance = round(mean(Attendance)
baseball_opp16 <- arrange(baseball_opp16, desc(avg_attendance))

ggplot(baseball_opp16, aes(Opp, avg_attendance)) +
  geom_bar(stat = "identity") +
  ggtitle("Average Attendance vs. Opponents in 2016") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(axis.text.x = element_text(angle = 90, hjust = 1)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Opponent") +
  ylab("Average Attendance")
```

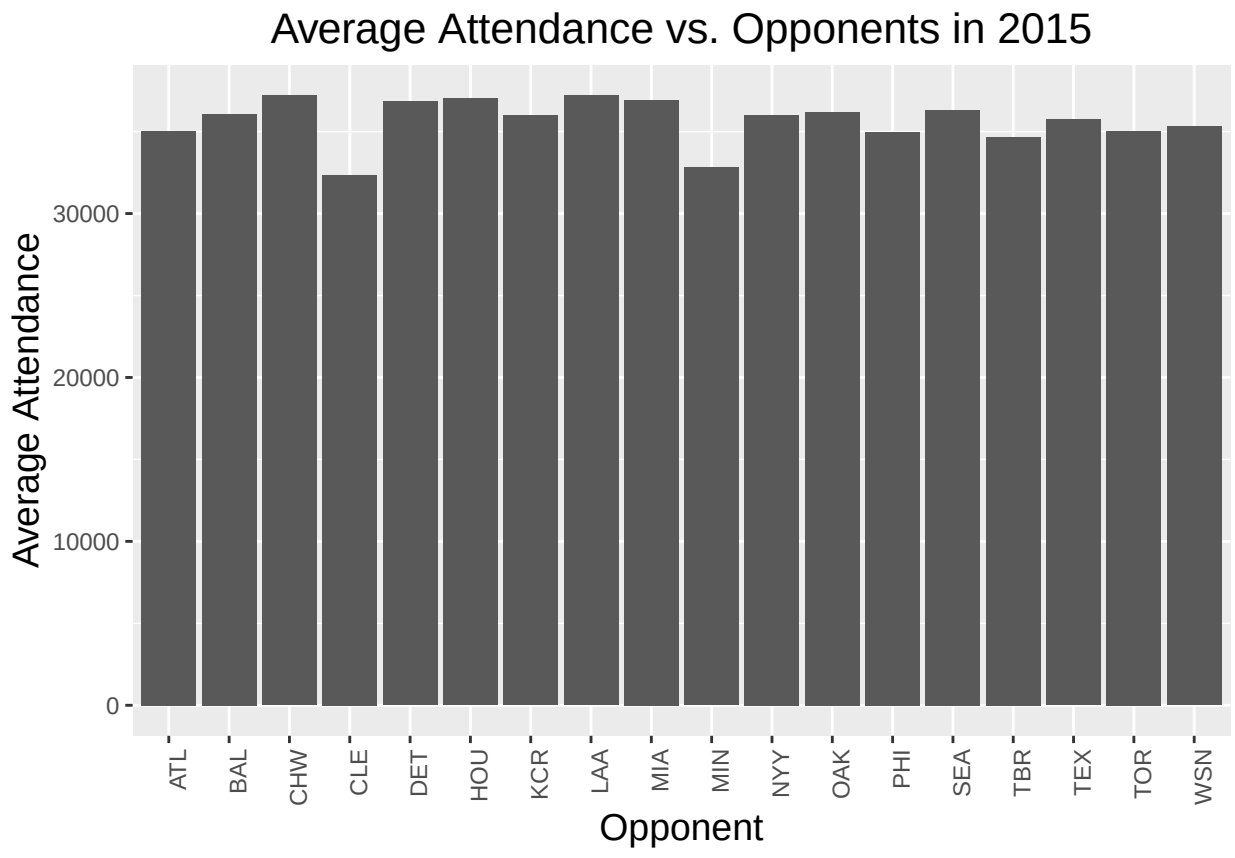



```r
kable(baseball_opp16)
```

Opp	avg_attendance
SFG	38142
DET	37900
KCR	37801
NYY	37359
ARI	37350
MIN	37243
CHW	37010
CLE	36876
LAA	36823
SEA	36767

Opp	avg_attendance
TEX	36464
TOR	36462
COL	36238
BAL	35983
TBR	35981
HOU	35324
OAK	33559
ATL	32806

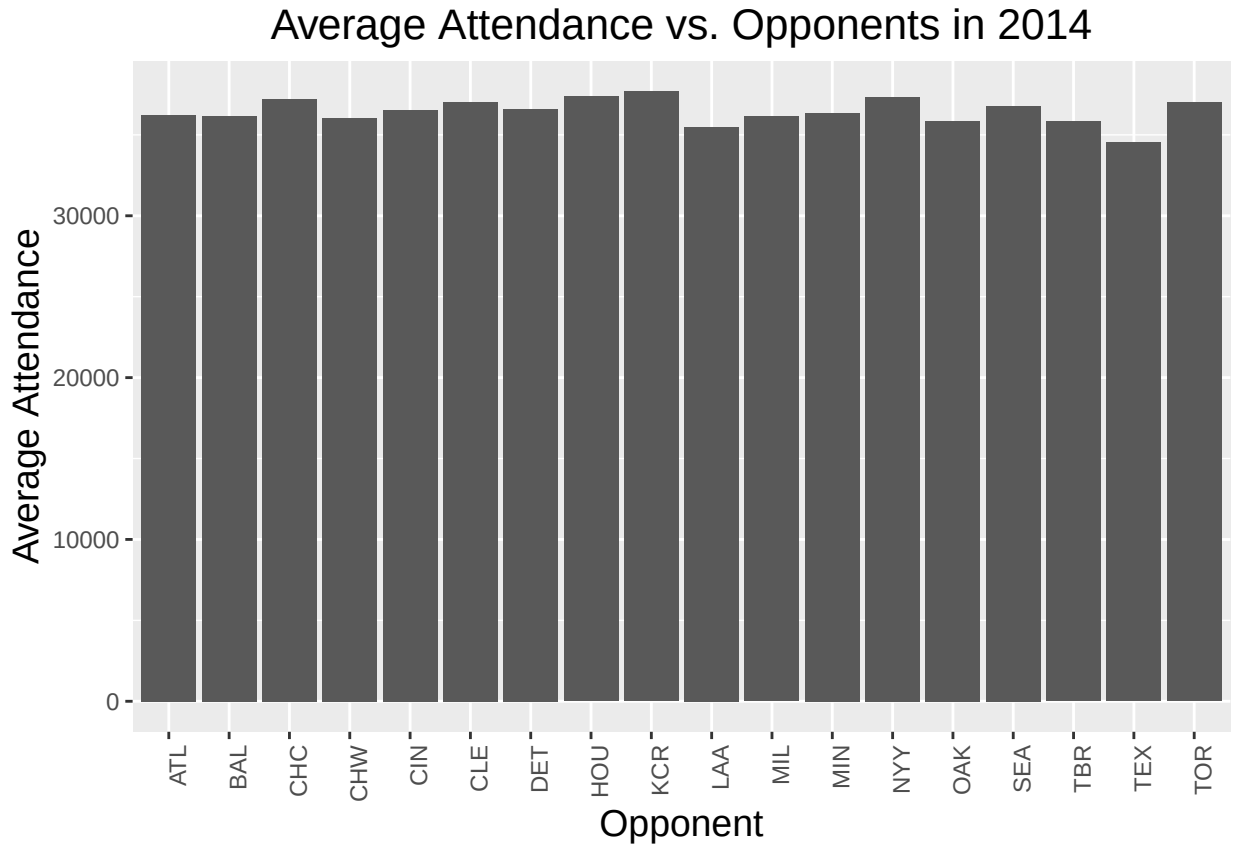
```
# 2015
# Summary of attendance in seanson 2016 with different opponent.
# Group by different opponents and arrange the attendance from high to low
baseball_opp15 <- baseball_2015 %>% group_by(Opp) %>% summarise(avg_attendance = round(mean(Attendance)
baseball_opp15 <- arrange(baseball_opp15, desc(avg_attendance))

ggplot(baseball_opp15, aes(Opp, avg_attendance)) +
  geom_bar(stat = "identity") +
  ggtitle("Average Attendance vs. Opponents in 2015") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(axis.text.x = element_text(angle = 90, hjust = 1)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Opponent") +
  ylab("Average Attendance")
```



```r
kable(baseball_opp15)
```

Opp	avg_attendance
LAA	37209
CHW	37196
HOU	37007
MIA	36936
DET	36829
SEA	36322
OAK	36179
BAL	36060
NYY	36023
KCR	35987
TEX	35750
WSN	35318
TOR	35051
ATL	35050
PHI	34972
TBR	34666
MIN	32808
CLE	32358

```r
# 2014
# Summary of attendance in seanson 2016 with different opponent.
# Group by different opponents and arrange the attendance from high to low
baseball_opp14 <- baseball_2014 %>% group_by(Opp) %>% summarise(avg_attendance = round(mean(Attendance)
baseball_opp14 <- arrange(baseball_opp14, desc(avg_attendance))

ggplot(baseball_opp14, aes(Opp, avg_attendance)) +
  geom_bar(stat = "identity") +
  ggtitle("Average Attendance vs. Opponents in 2014") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(axis.text.x = element_text(angle = 90, hjust = 1)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Opponent") +
  ylab("Average Attendance")
```

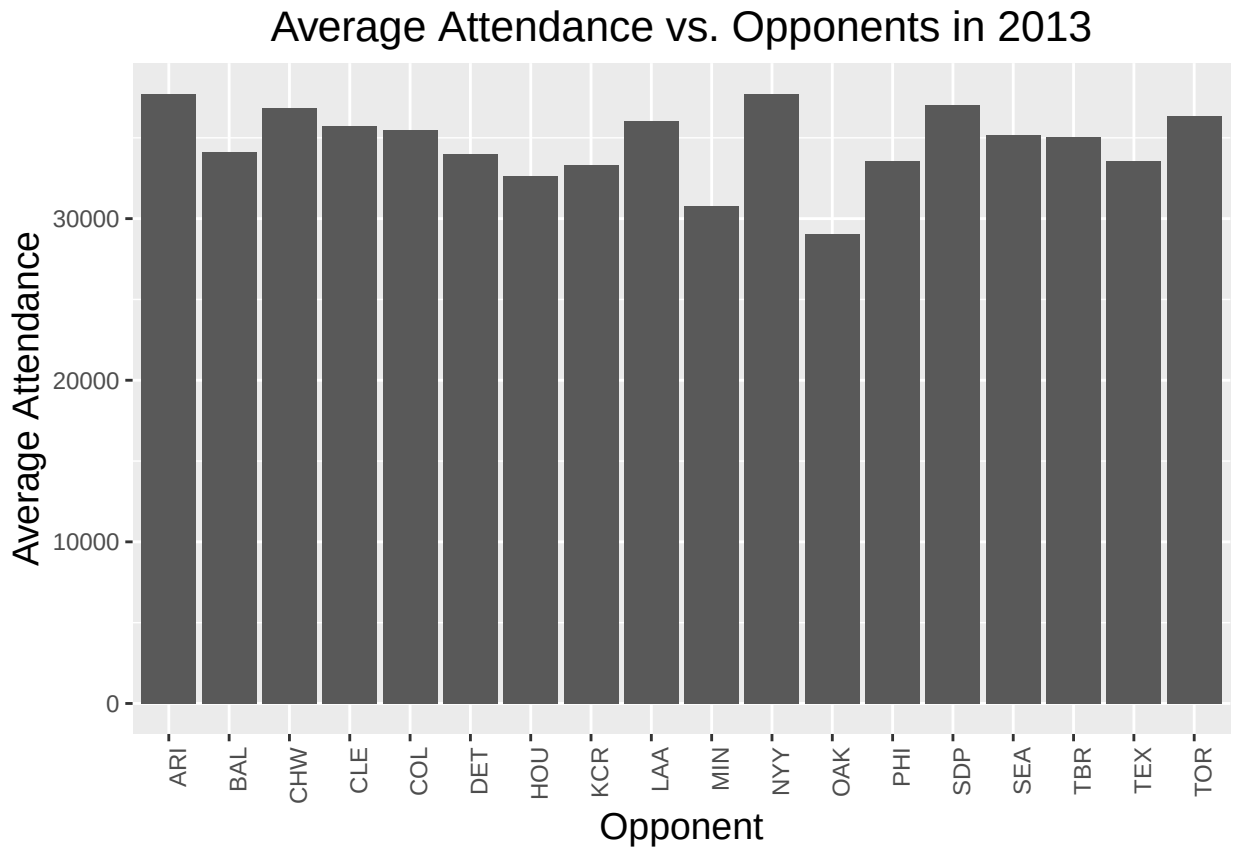



```
kable(baseball_opp14)
```

Opp	avg_attendance
KCR	37687
HOU	37362
NYY	37351
CHC	37206
CLE	37015
TOR	37011
SEA	36787
DET	36613
CIN	36538
MIN	36339
ATL	36240
BAL	36183
MIL	36138
CHW	36056
OAK	35847
TBR	35818
LAA	35484
TEX	34523

```
# 2013
# Summary of attendance in seanson 2013 with different opponent.
# Group by different opponents and arrange the attendance from high to low
```

```r
baseball_opp13 <- baseball_2013 %>% group_by(Opp) %>% summarise(avg_attendance = round(mean(Attendance)
baseball_opp13 <- arrange(baseball_opp13, desc(avg_attendance))

ggplot(baseball_opp13, aes(Opp, avg_attendance)) +
  geom_bar(stat = "identity") +
  ggtitle("Average Attendance vs. Opponents in 2013")+
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(axis.text.x = element_text(angle = 90, hjust = 1)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Opponent") +
  ylab("Average Attendance")
```

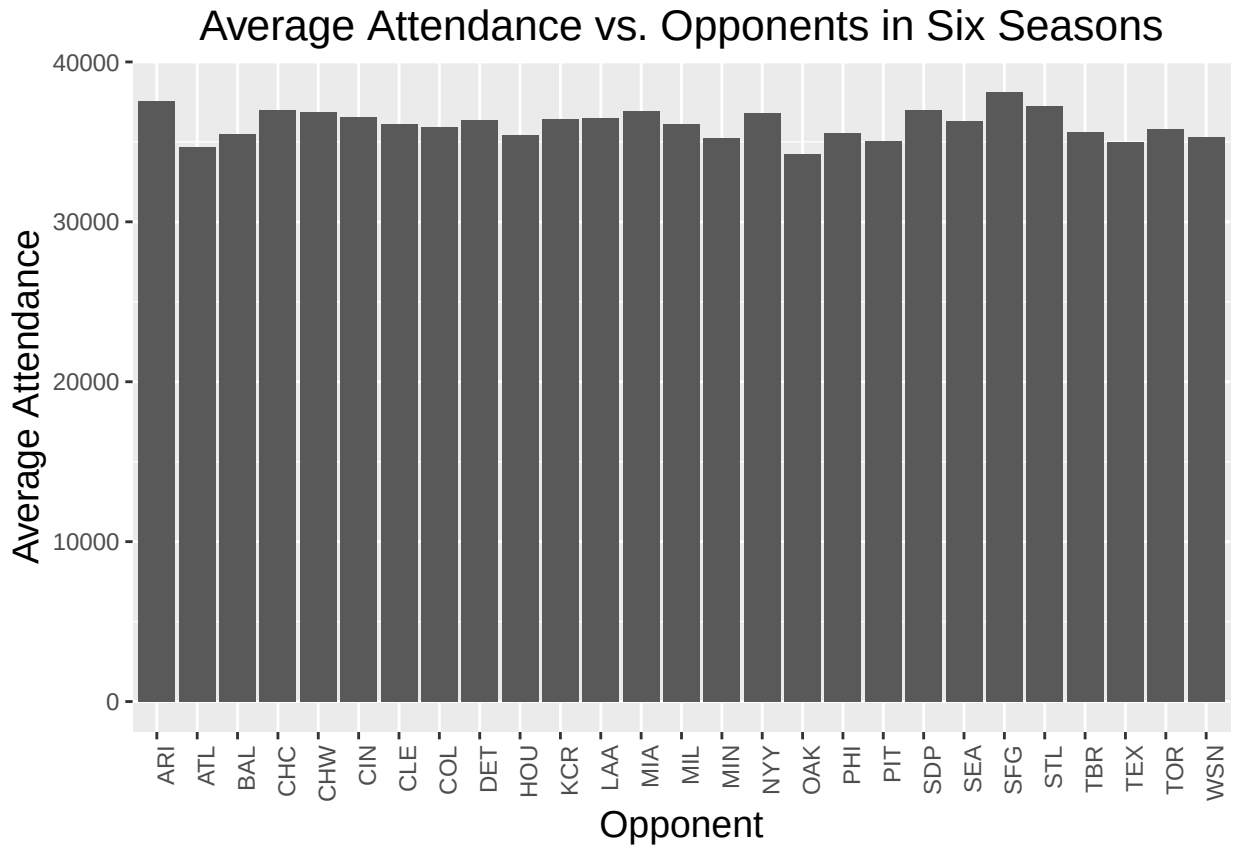



```r
kable(baseball_opp13)
```

Opp	avg_attendance
NYY	37737
ARI	37735
SDP	37005
CHW	36826
TOR	36348
LAA	36024
CLE	35720
COL	35459
SEA	35174
TBR	35036

Opp	avg_attendance
BAL	34119
DET	33993
TEX	33561
PHI	33545
KCR	33302
HOU	32664
MIN	30794
OAK	29069

```
# Summary of attendance in 6 seansons with different opponent.
# Group by different opponents and arrange the attendance from high to low
baseball_opp <- baseball %>% group_by(Opp) %>% summarise(avg_attendance = round(mean(Attendance),digits
baseball_opp <- arrange(baseball_opp, desc(avg_attendance))

ggplot(baseball_opp, aes(Opp, avg_attendance)) +
  geom_bar(stat = "identity") + ggtitle("Average Attendance vs. Opponents in Six Seasons") +
  theme(axis.text.x = element_text(angle = 90, hjust = 1)) +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Opponent") +
  ylab("Average Attendance")
```



```
kable(baseball_opp)
```

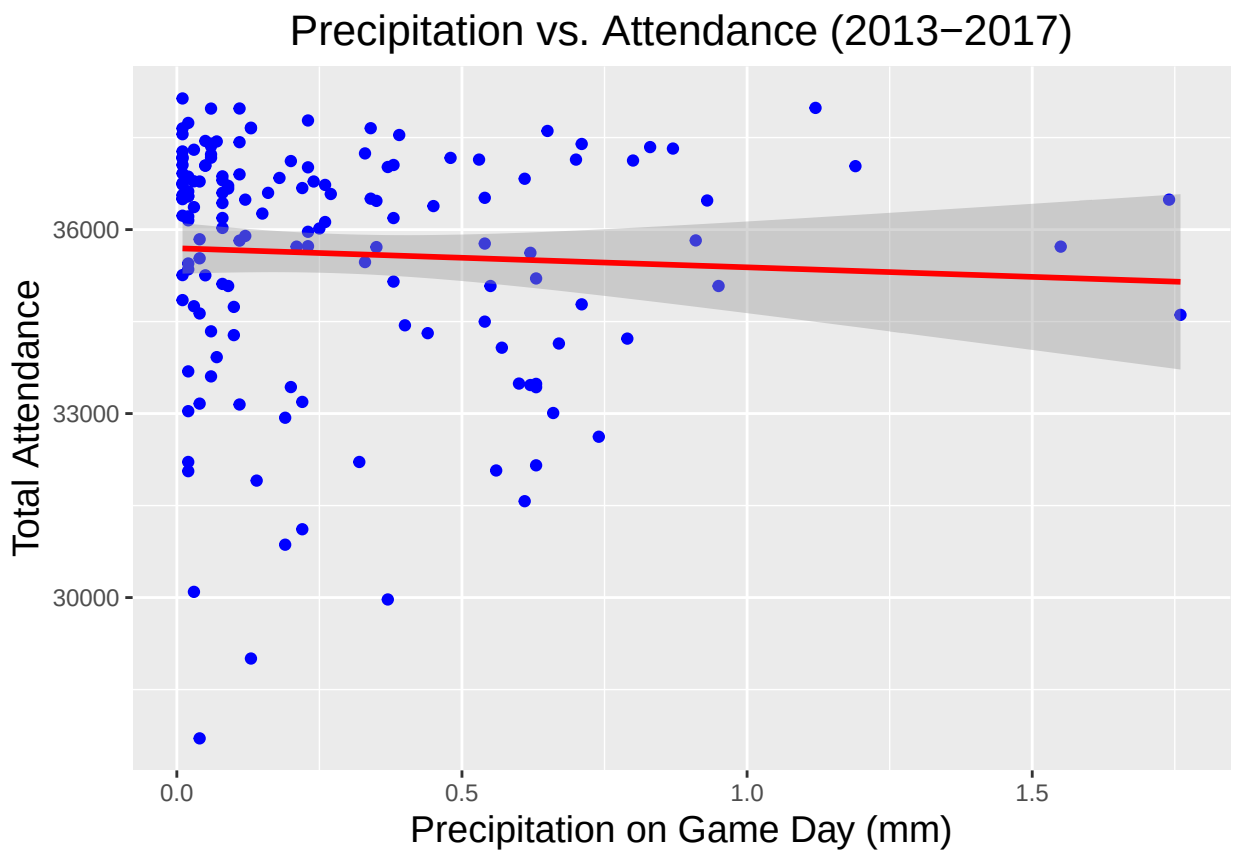
Opp	avg_attendance
SFG	38142
ARI	37542
STL	37263
CHC	37012
SDP	37005
MIA	36936
CHW	36843
NYY	36817
CIN	36538
LAA	36466
KCR	36407
DET	36386
SEA	36313
MIL	36138
CLE	36104
COL	35927
TOR	35804
TBR	35622
PHI	35534
BAL	35464
HOU	35417
WSN	35318
MIN	35227
PIT	35044
TEX	34977
ATL	34699
OAK	34241

Conclusion: Based on the bar plots, different opponents have a small effect on attendance, but when considering the average attendance, almost all of the games are in a narrow band between 34000 and 36000 which represents a crowd at or near capacity.

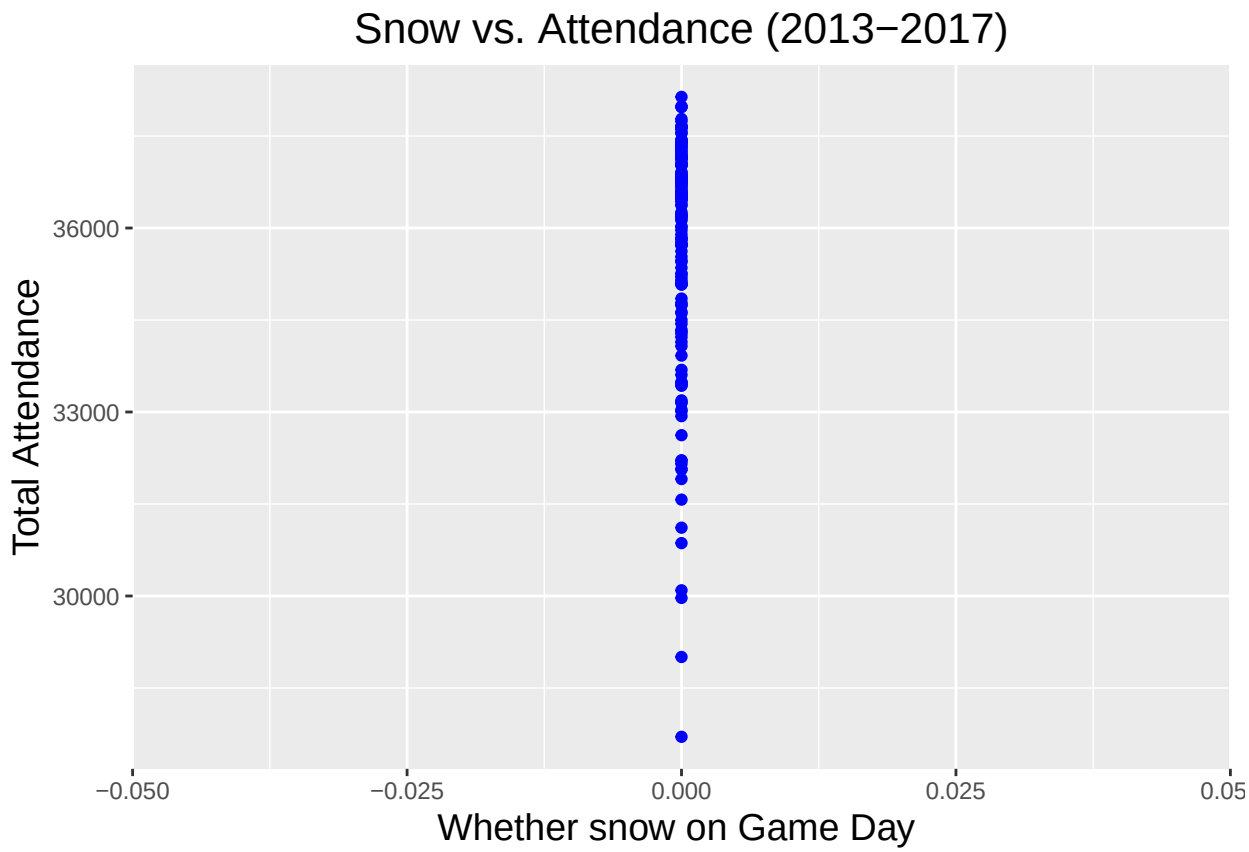
```
# How the rain/snowy/windy days will affect the attendance of Red Sox, since base game is hypaethral.
baseball_SpecialWeather<- baseball11 %>% select(Gm.,Year,DATE, Tm, Time, Attendance,SNOW,PRCP )%>% filt

# The rain influences on Red Sox attendence
plot1<-ggplot(baseball_SpecialWeather, aes(PRCP, Attendance)) +
  geom_point(color = "blue") +
  geom_smooth(method = "lm", color = "red") +
  ggtitle("Precipitation vs. Attendance (2013-2017)") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Precipitation on Game Day (mm)") +
  ylab("Total Attendance")

# The snow influences on Red Sox attendence
plot2<-ggplot(baseball_SpecialWeather, aes(SNOW, Attendance)) +
  geom_point(color = "blue") +
```

```
  geom_smooth(method = "lm", color = "red") +
  ggtitle("Snow vs. Attendance (2013-2017)") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Whether snow on Game Day ") +
  ylab("Total Attendance")
```

```
plot1
```



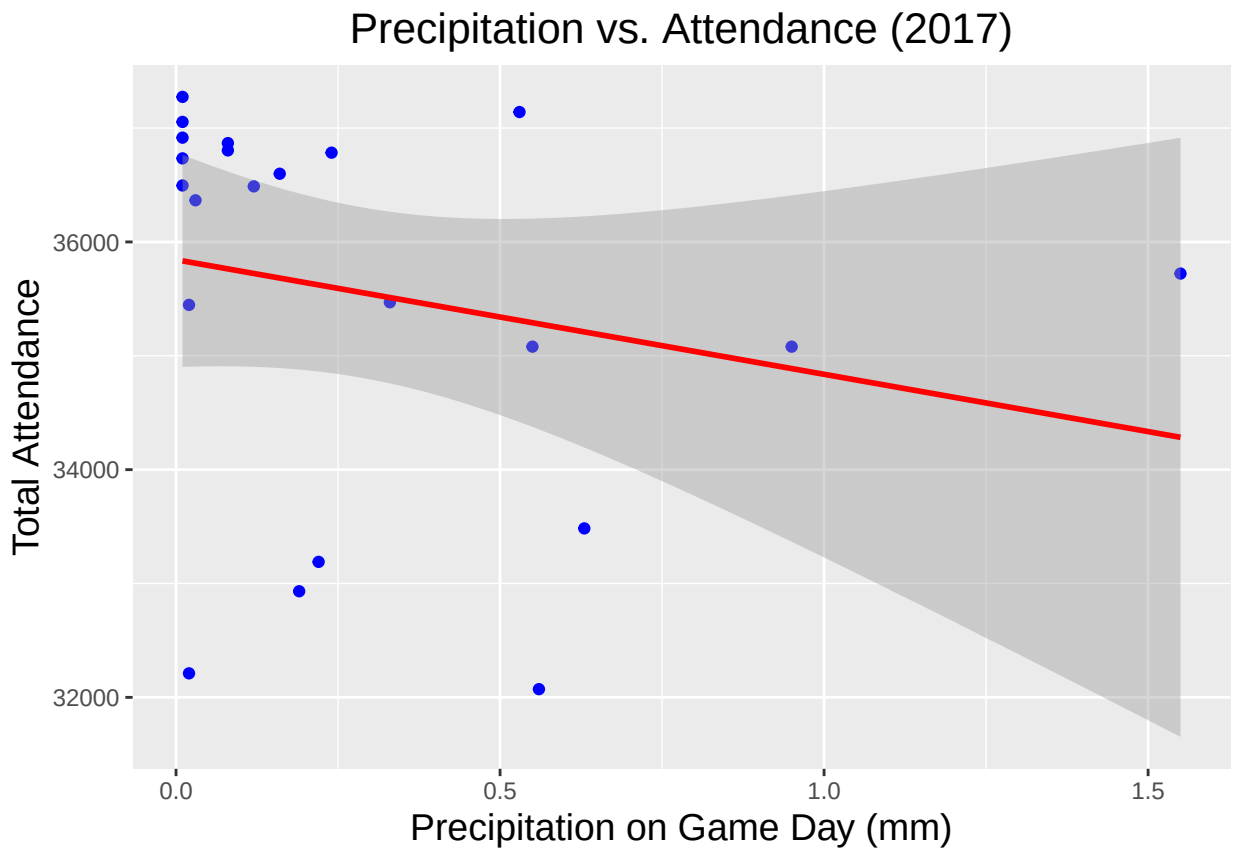

```
plot2
```



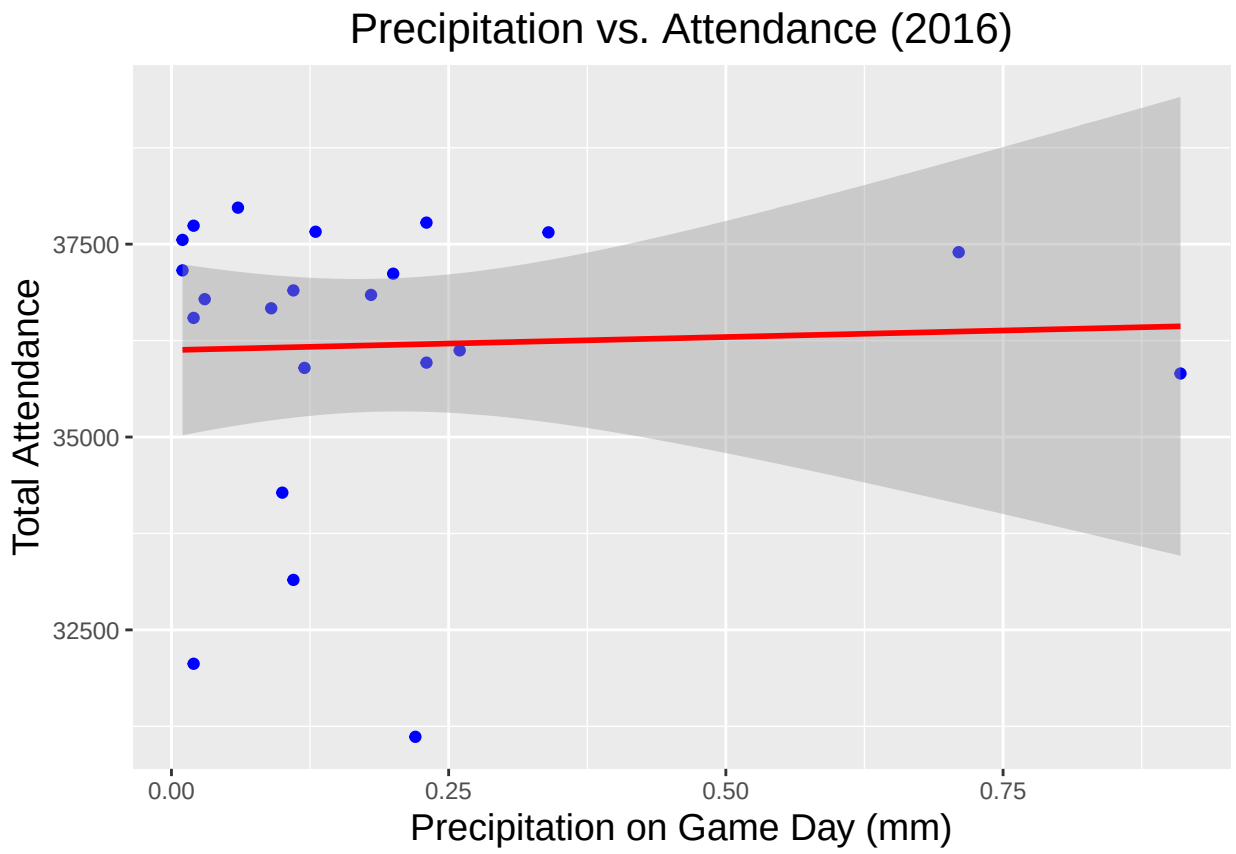
Conclusion: Rain has a very slight negative influcence on Red Sox attendence but the effects of rain are difficult to visualize because games with significant amounts of rain are typically canceled ("rained out"). But snow does not have obvious influcences on attendence because most baseball games occur between May and latest October if the Red Sox make a deep playoff run, in which case attendance would be elevated regardless of weather conditions.

```
baseball_SpecialWeather17 <- baseball_SpecialWeather %>% filter(Year == 2017)
baseball_SpecialWeather16 <- baseball_SpecialWeather %>% filter(Year == 2016)
baseball_SpecialWeather15 <- baseball_SpecialWeather %>% filter(Year == 2015)
baseball_SpecialWeather14 <- baseball_SpecialWeather %>% filter(Year == 2014)
baseball_SpecialWeather13 <- baseball_SpecialWeather %>% filter(Year == 2013)

# Rain influences on Red Sox attendence in 2017:
plot17<-ggplot(baseball_SpecialWeather17, aes(PRCP, Attendance)) +
  geom_point(color = "blue") +
  geom_smooth(method = "lm", color = "red") +
  ggtitle("Precipitation vs. Attendance (2017)") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Precipitation on Game Day (mm)") +
  ylab("Total Attendance")

# The rain influences on Red Sox attendence in 2016:
plot16<-ggplot(baseball_SpecialWeather16, aes(PRCP, Attendance)) +
  geom_point(color = "blue") +
  geom_smooth(method = "lm", color = "red") +
```

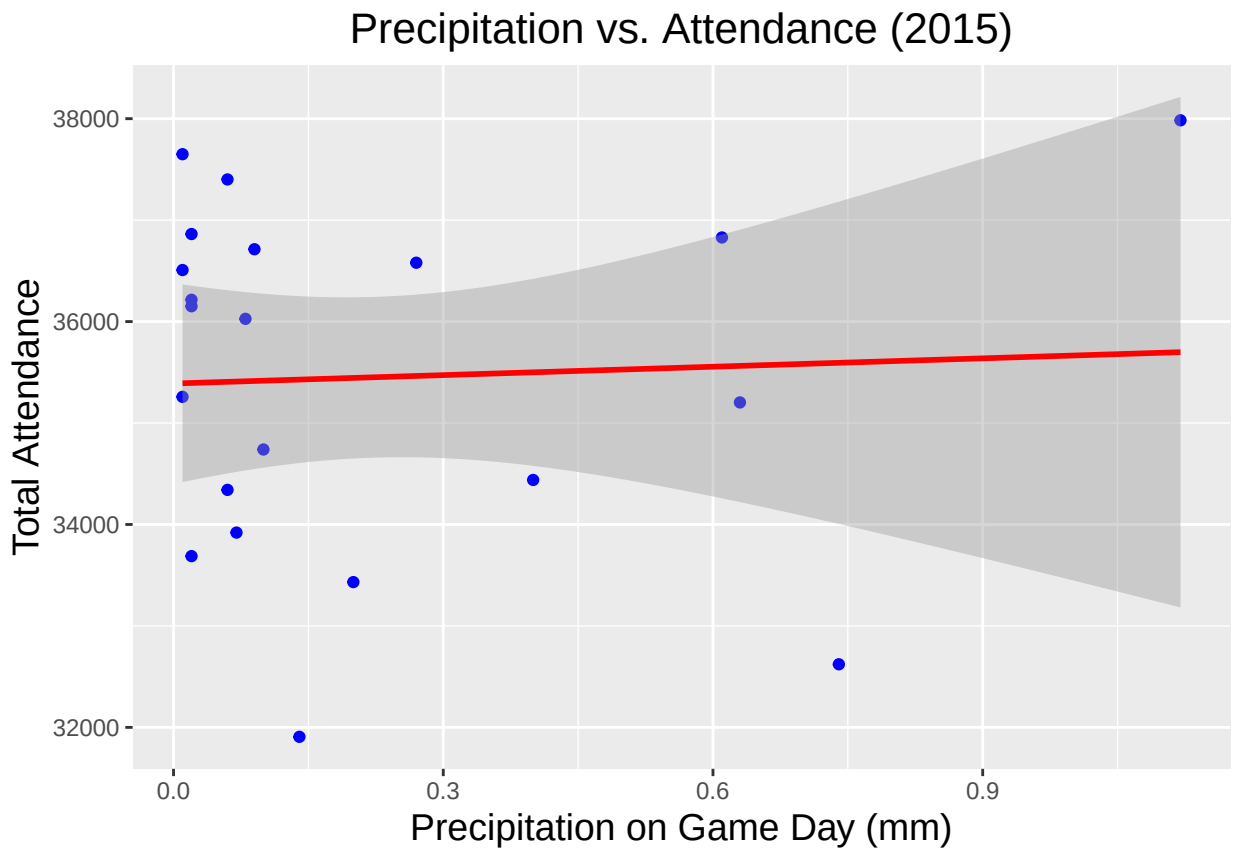
```
  ggtitle("Precipitation vs. Attendance (2016)") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Precipitation on Game Day (mm)") +
  ylab("Total Attendance")

# The rain influences on Red Sox attendence in 2015:
plot15<-ggplot(baseball_SpecialWeather15, aes(PRCP, Attendance)) +
  geom_point(color = "blue") +
  geom_smooth(method = "lm", color = "red") +
  ggtitle("Precipitation vs. Attendance (2015)") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Precipitation on Game Day (mm)") +
  ylab("Total Attendance")

# The rain influences on Red Sox attendence in 2014:
plot14<-ggplot(baseball_SpecialWeather14, aes(PRCP, Attendance)) +
  geom_point(color = "blue") +
  geom_smooth(method = "lm", color = "red") +
  ggtitle("Precipitation vs. Attendance (2014)") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Precipitation on Game Day (mm)") +
  ylab("Total Attendance")

# The rain influences on Red Sox attendence in 2013:
plot13<-ggplot(baseball_SpecialWeather13, aes(PRCP, Attendance)) +
  geom_point(color = "blue") +
  geom_smooth(method = "lm", color = "red") +
  ggtitle("Precipitation vs. Attendance (2013)") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Precipitation on Game Day (mm)") +
  ylab("Total Attendance")

plot17
```


Precipitation vs. Attendance (2017)
Total Attendance
36000
34000
32000
0.0
0.5
1.0
1.5
Precipitation on Game Day (mm)

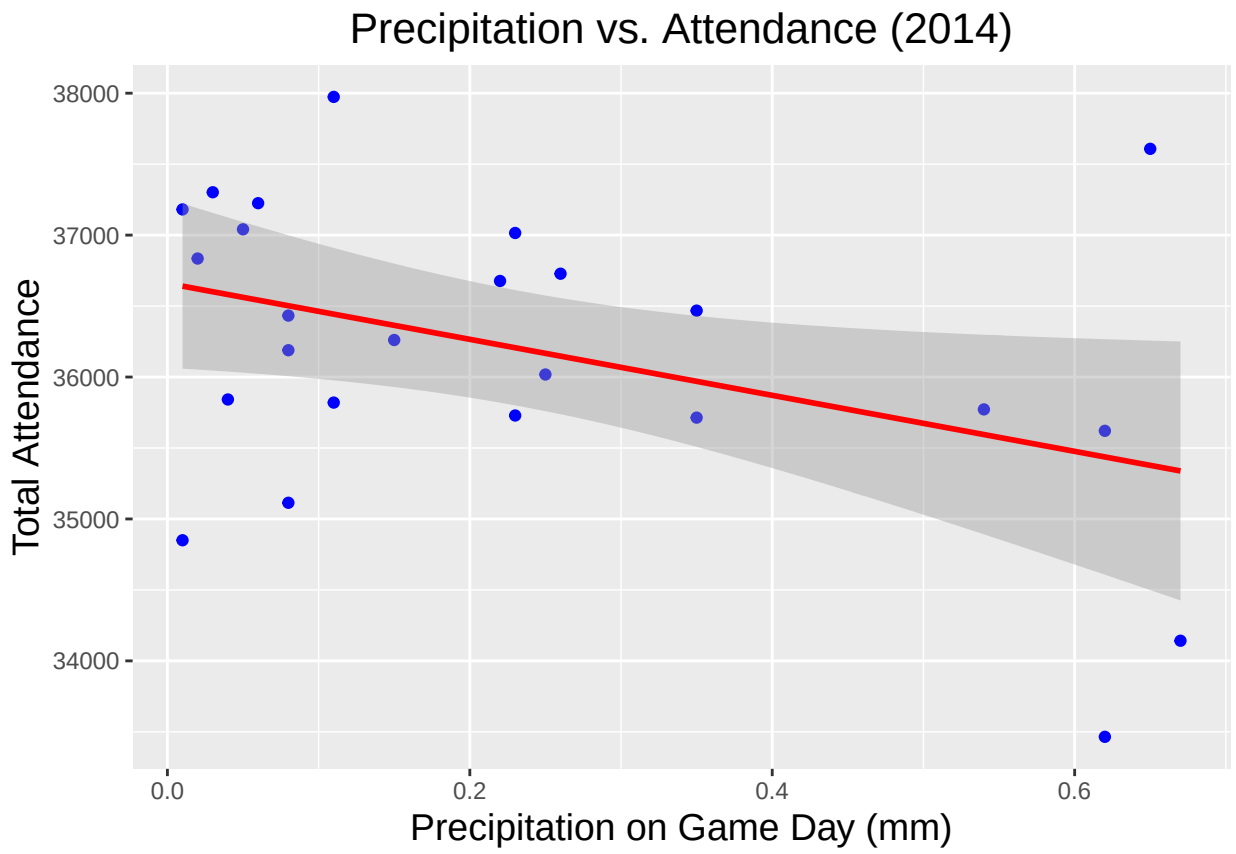
```
plot16
```


Precipitation vs. Attendance (2016)
Total Attendance
37500
35000
32500
0.00
0.25
0.50
0.75
Precipitation on Game Day (mm)

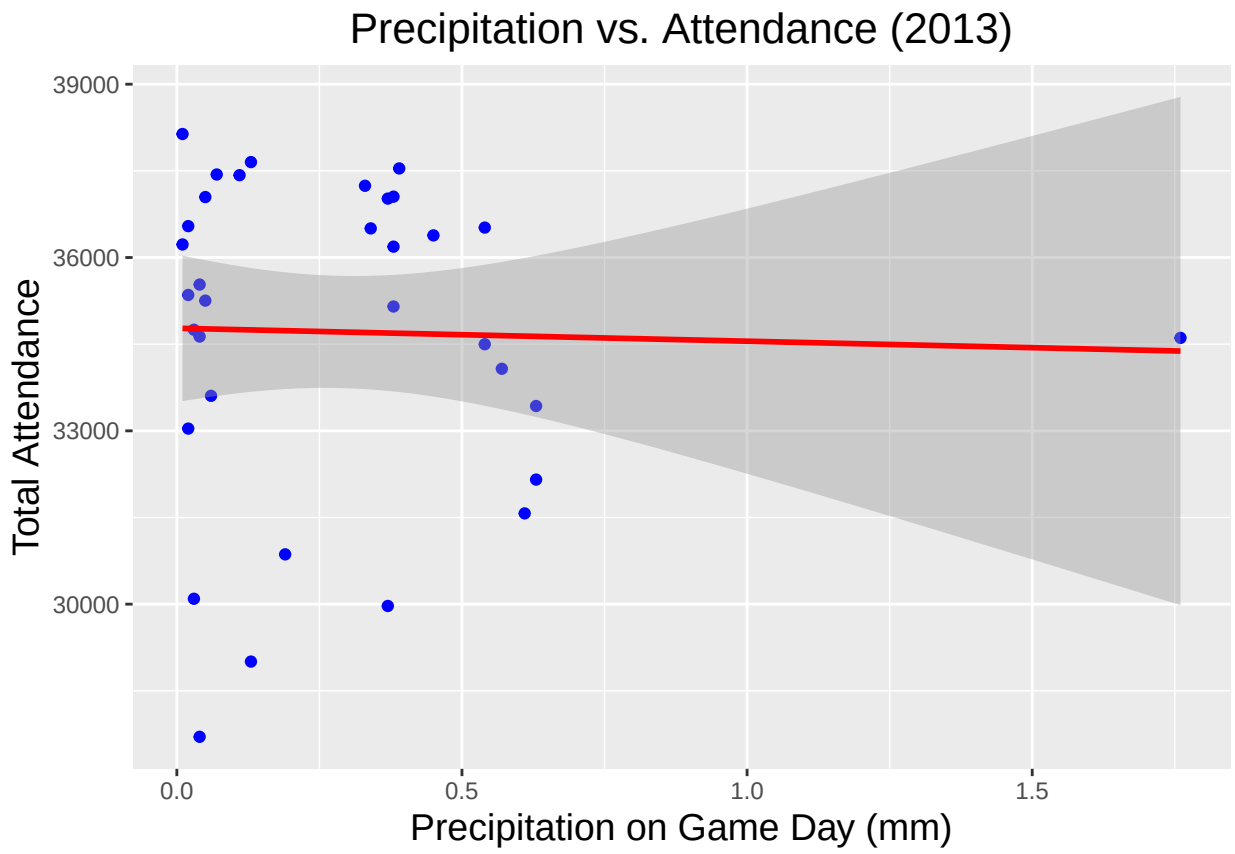
```
plot15
```


Precipitation vs. Attendance (2015)
Total Attendance
38000
36000
34000
32000
0.0
0.3
0.6
0.9
Precipitation on Game Day (mm)

```
plot14
```


Precipitation vs. Attendance (2014)
Total Attendance
38000
37000
36000
35000
34000
0.0
0.2
0.4
0.6
Precipitation on Game Day (mm)

```
plot13
```

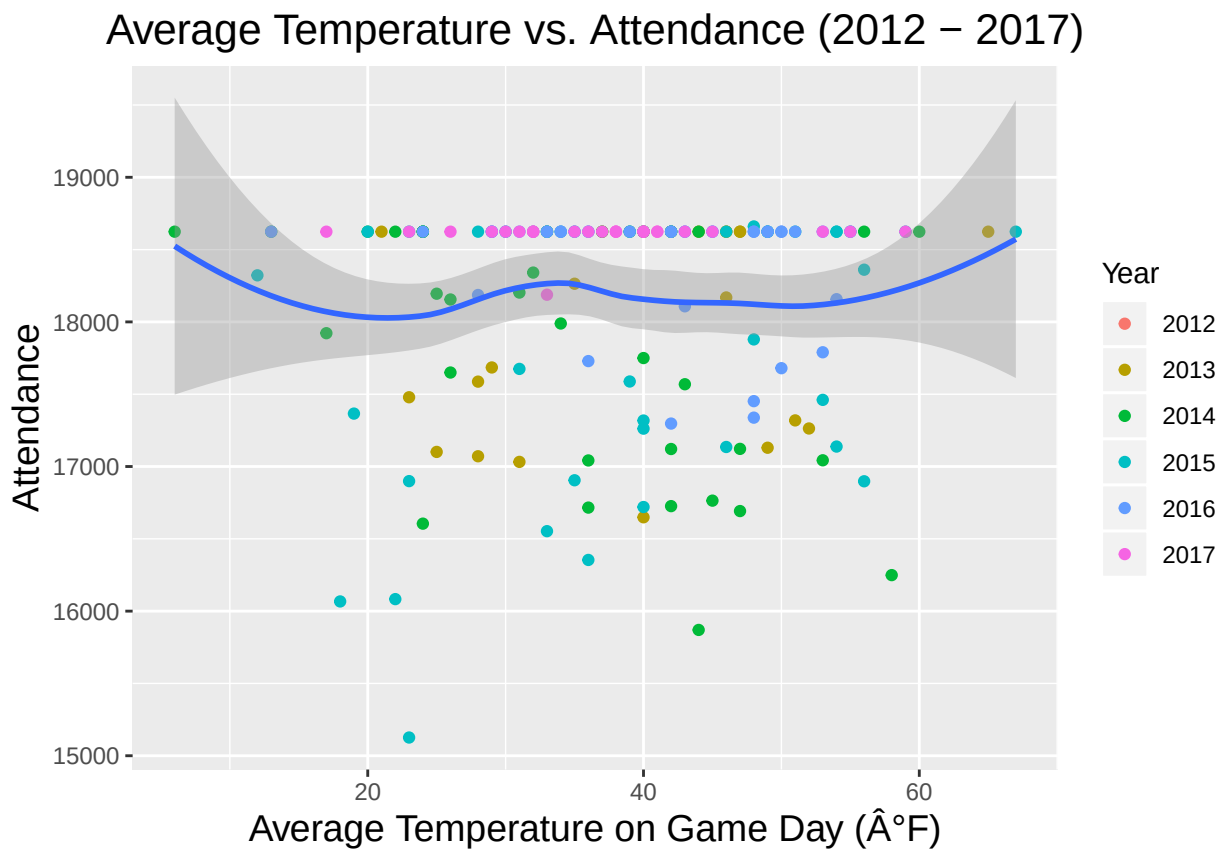


Basketball

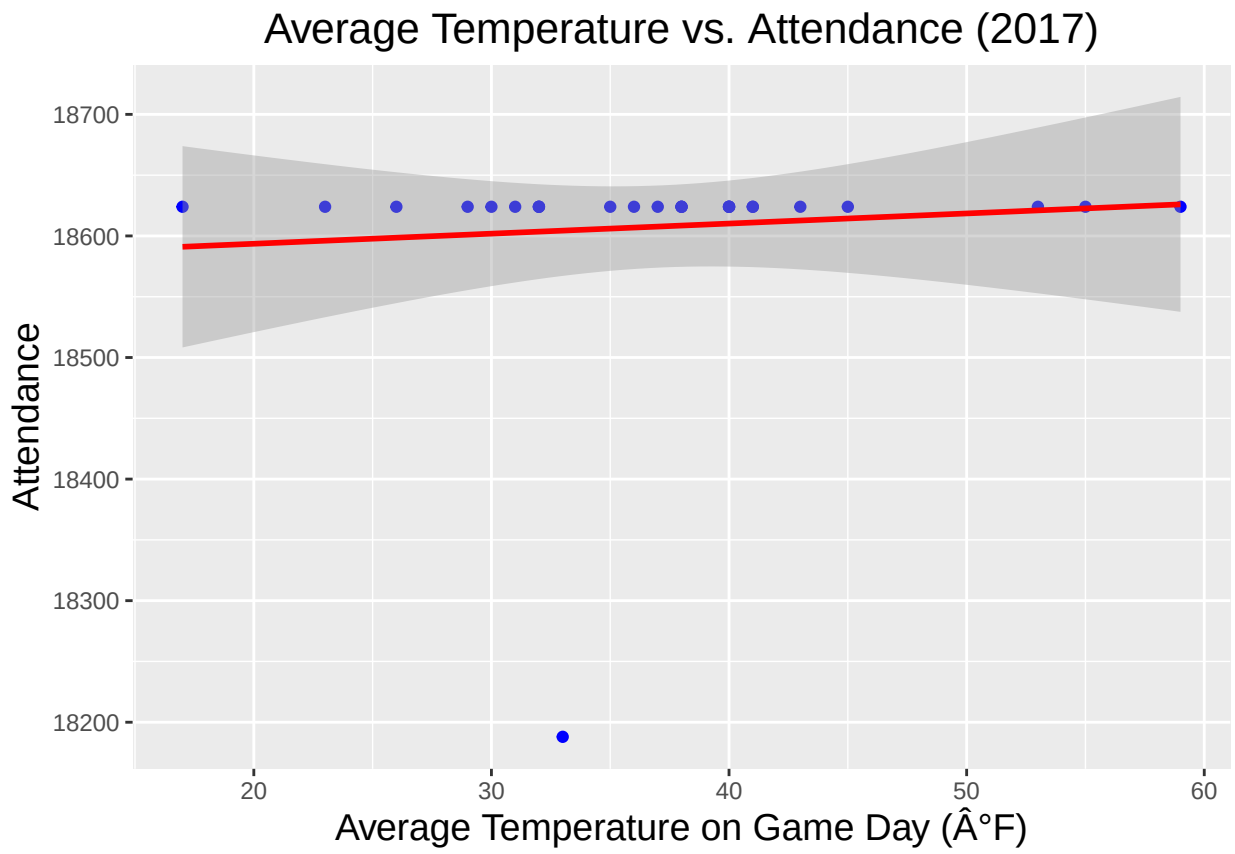
```
bball12 <- read.csv("attend2012.csv")
bball13 <- read.csv("attend2013.csv")
bball14 <- read.csv("attend2014.csv")
bball15 <- read.csv("attend2015.csv")
bball16 <- read.csv("attend2016.csv")

bball <- rbind(bball12, bball13, bball14, bball15, bball16)
bball$Year <- factor(bball$Year)
colnames(bball)[3] <- "Opp"
bball$Opp <- factor(bball$Opp)
write.csv(bball, file = "bball.csv")
#View(bball)
```

```
ggplot(bball, mapping = aes(x = TAVG, y = Attendance)) +
  geom_point(mapping = aes(color = Year)) +
  geom_smooth() +
  ggtitle("Average Temperature vs. Attendance (2012 - 2017)") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Average Temperature on Game Day (Â°F)") +
  ylab("Attendance")
```

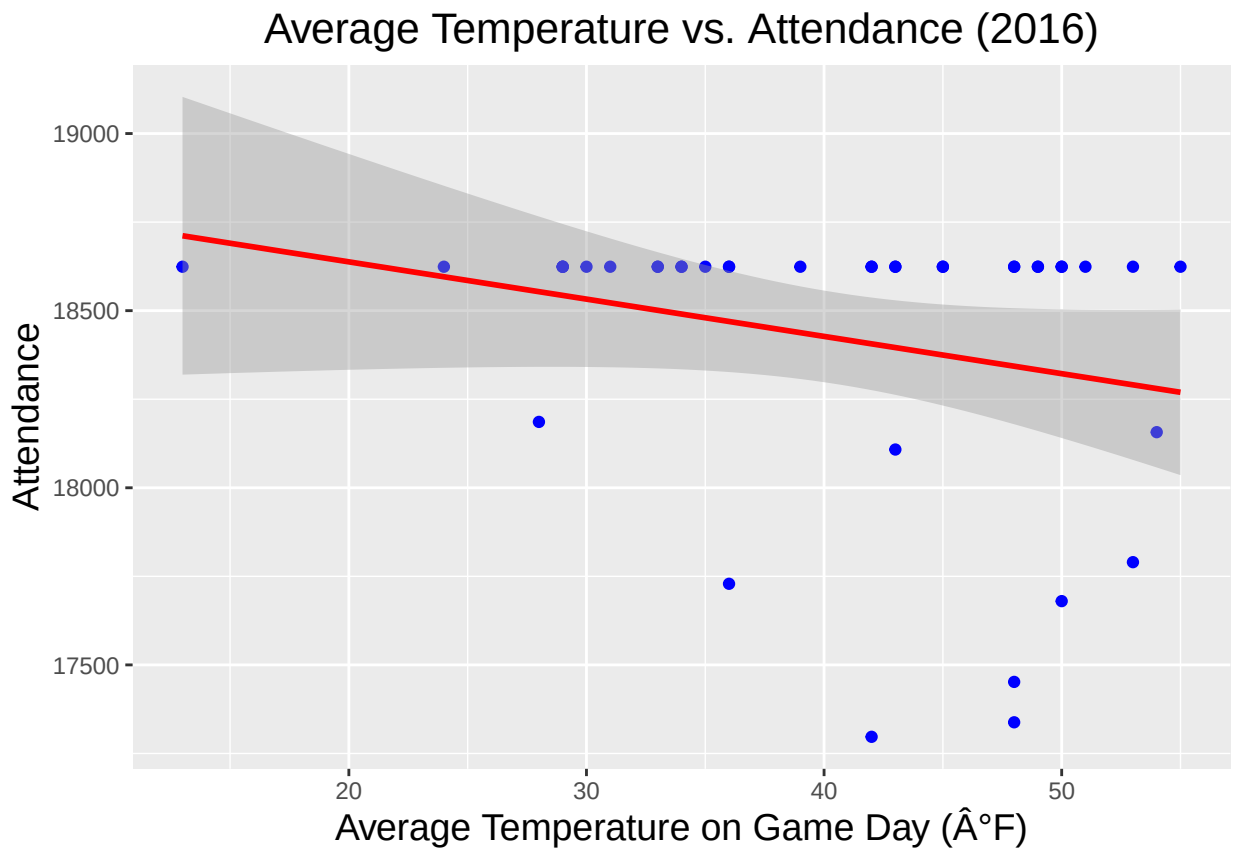
```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'
## Warning: Removed 36 rows containing non-finite values (stat_smooth).
## Warning: Removed 36 rows containing missing values (geom_point).
```



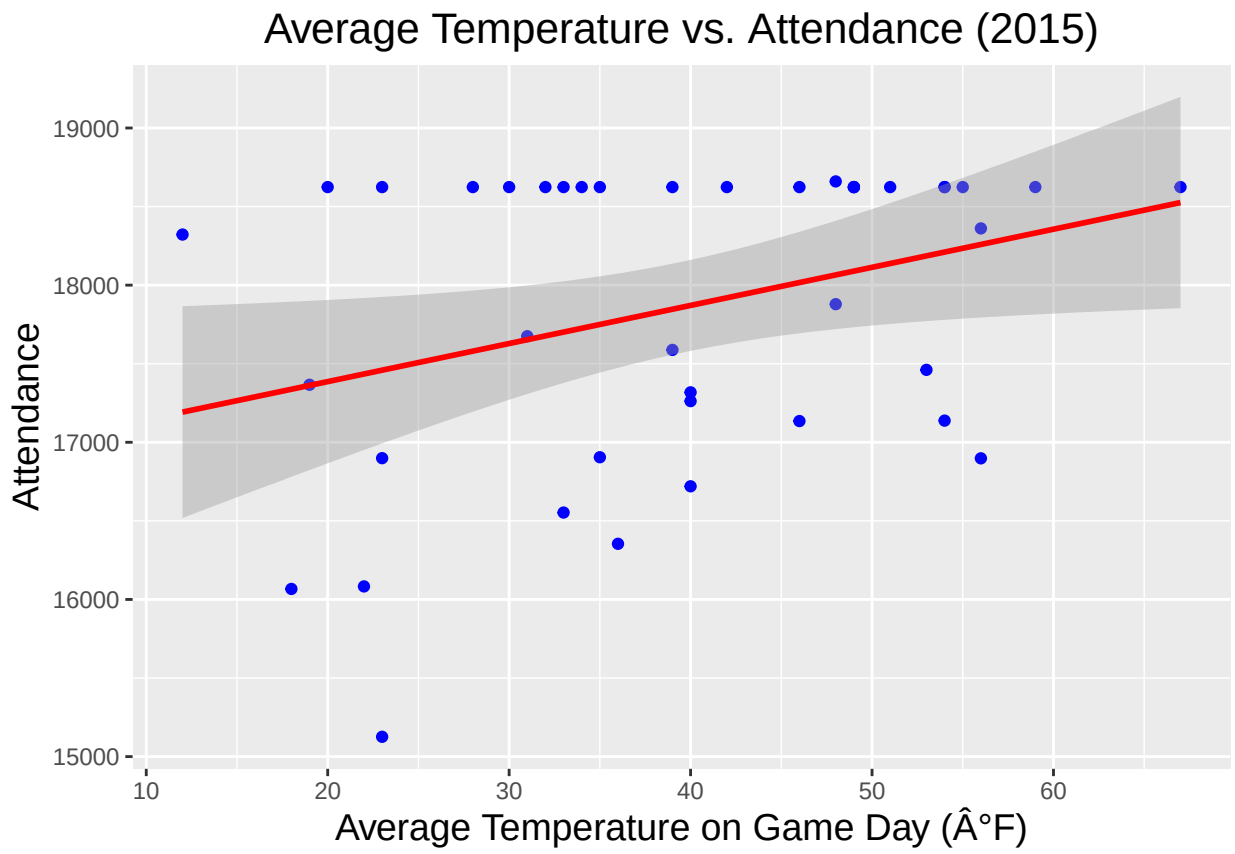

```
# 2017 Season
bball_2017 <- bball %>% filter(Year == 2017)
# Relationship between average temperature with attendance of season 2017
ggplot(bball_2017, aes(TAVG, Attendance)) +
  geom_point(color = "blue") +
  geom_smooth(method = "lm", color = "red") +
  ggtitle("Average Temperature vs. Attendance (2017)") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Average Temperature on Game Day (Â°F)") +
  ylab("Attendance")
```



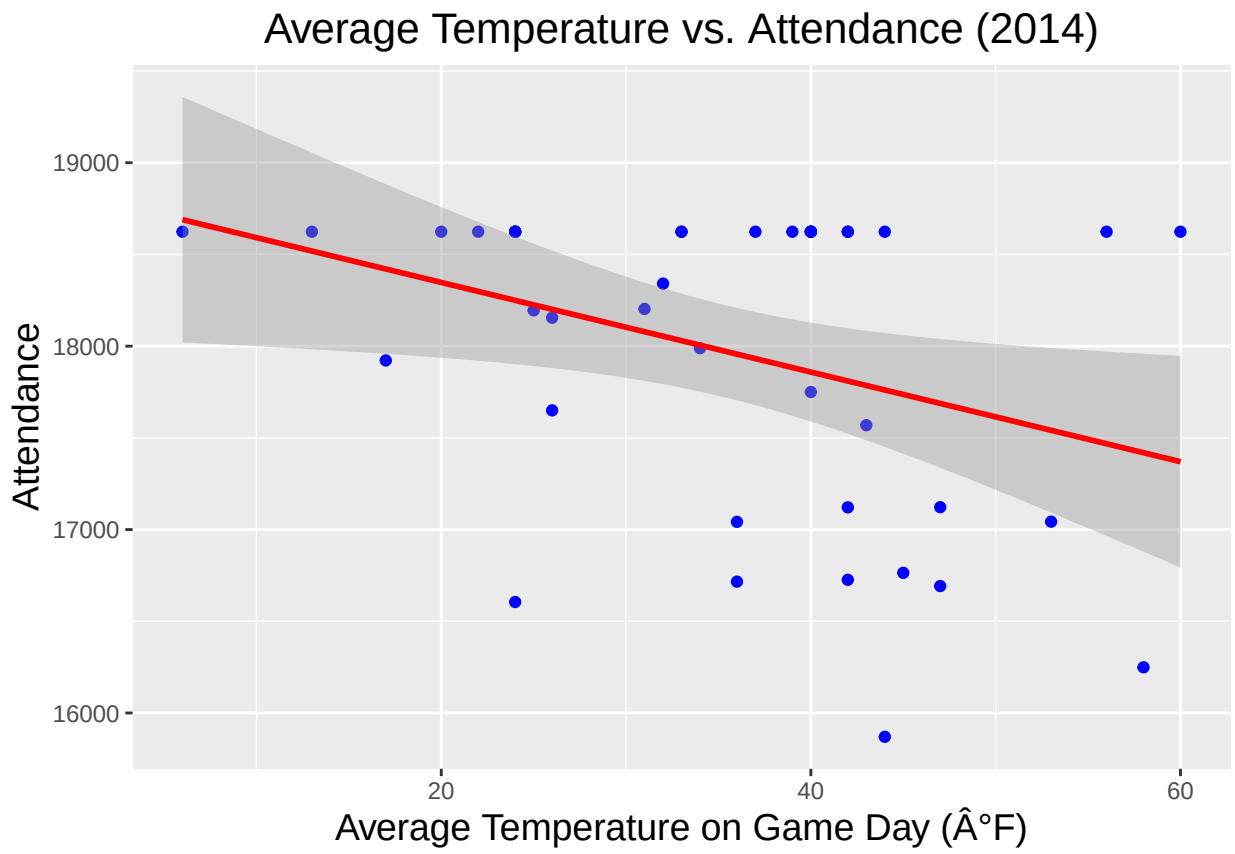

```
# 2016 Season
bball_2016 <- bball %>% filter(Year == 2016)
# Relationship between average temperature with attendance of season 2016
ggplot(bball_2016, aes(TAVG, Attendance)) +
  geom_point(color = "blue") +
  geom_smooth(method = "lm", color = "red") +
  ggtitle("Average Temperature vs. Attendance (2016)") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Average Temperature on Game Day (Â°F)") +
  ylab("Attendance")
```



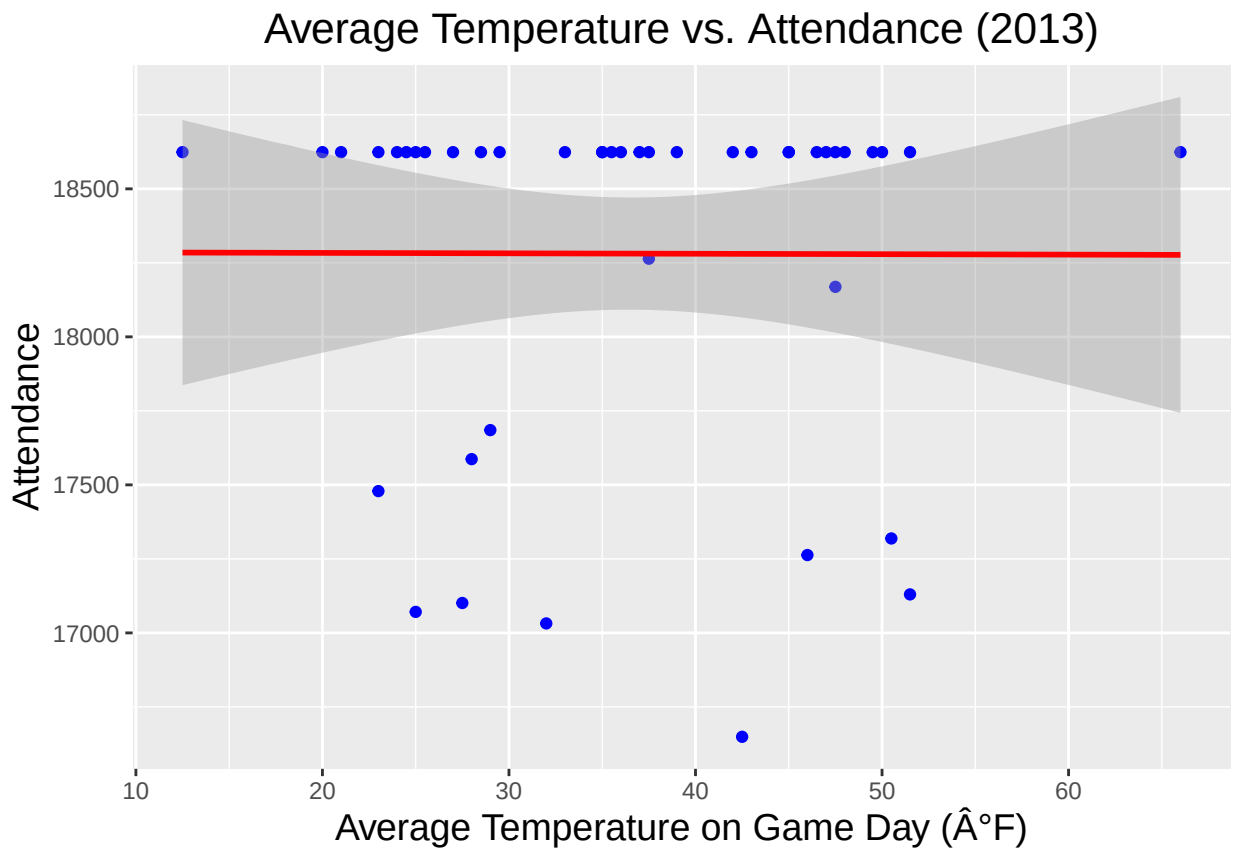

```
# 2015 Season
bball_2015 <- bball %>% filter(Year == 2015)
# Relationship between average temperature with attendance of season 2015
ggplot(bball_2015, aes(TAVG, Attendance)) +
  geom_point(color = "blue") +
  geom_smooth(method = "lm", color = "red") +
  ggtitle("Average Temperature vs. Attendance (2015)") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Average Temperature on Game Day (Â°F)") +
  ylab("Attendance")
```




```
# 2014 Season
bball_2014 <- bball %>% filter(Year == 2014)
# Relationship between average temperature with attendance of season 2014
ggplot(bball_2014, aes(TAVG, Attendance)) +
  geom_point(color = "blue") +
  geom_smooth(method = "lm", color = "red") +
  ggtitle("Average Temperature vs. Attendance (2014)") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Average Temperature on Game Day (Â°F)") +
  ylab("Attendance")
```

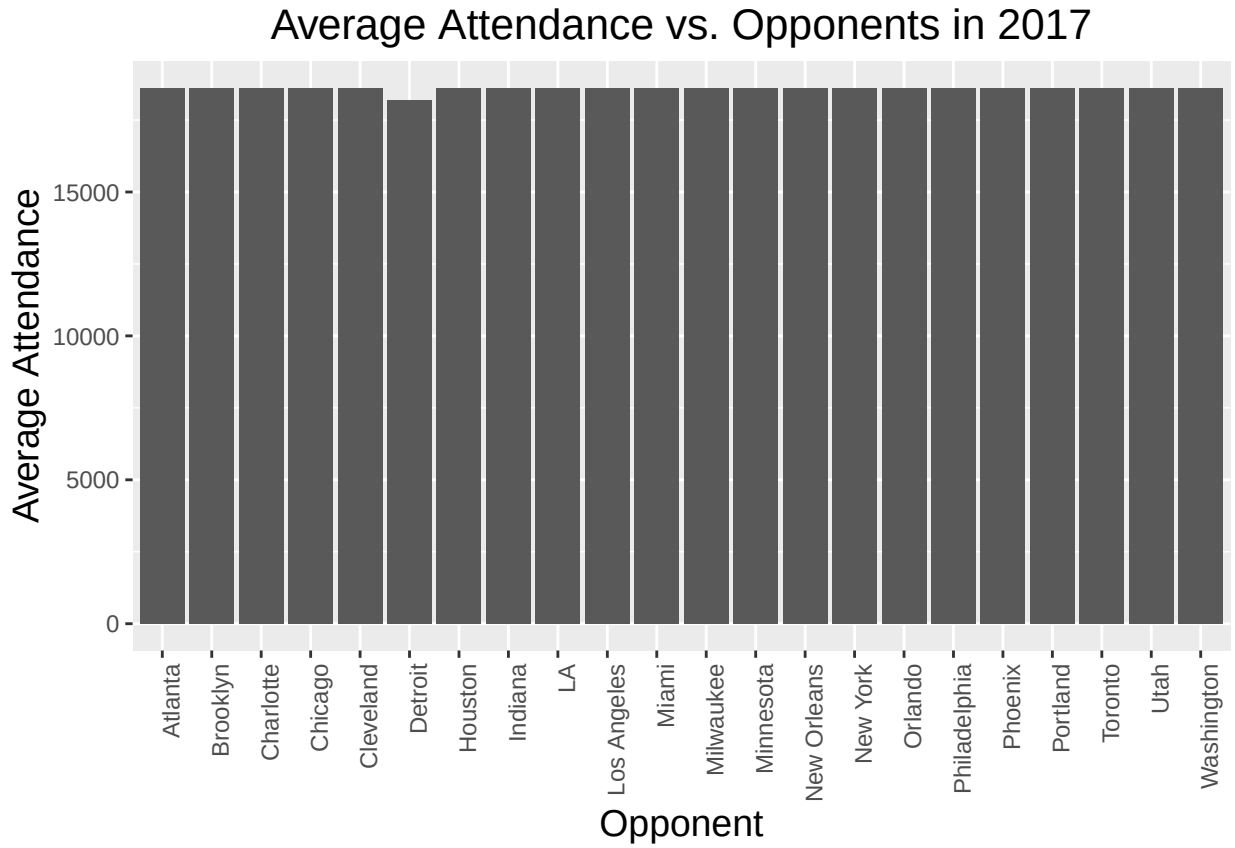



```
# 2013 Season
bball_2013 <- bball %>% filter(Year == 2013)
# Relationship between average temperature with attendance of season 2013

bball_2013$TAVG <- (bball_2013$TMAX + bball_2013$TMIN)/2
ggplot(bball_2013, aes(TAVG, Attendance)) +
  geom_point(color = "blue") +
  geom_smooth(method = "lm", color = "red") +
  ggtitle("Average Temperature vs. Attendance (2013)") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Average Temperature on Game Day (Â°F)") +
  ylab("Attendance")
```



Conclusion: There is no evident relationship between the average temperature and the Celtics attendace of these six seasons game. Taken in context, the last two teams with serious star power (2013 and 2017) have had almost exclusively sold out games with the same attendance.

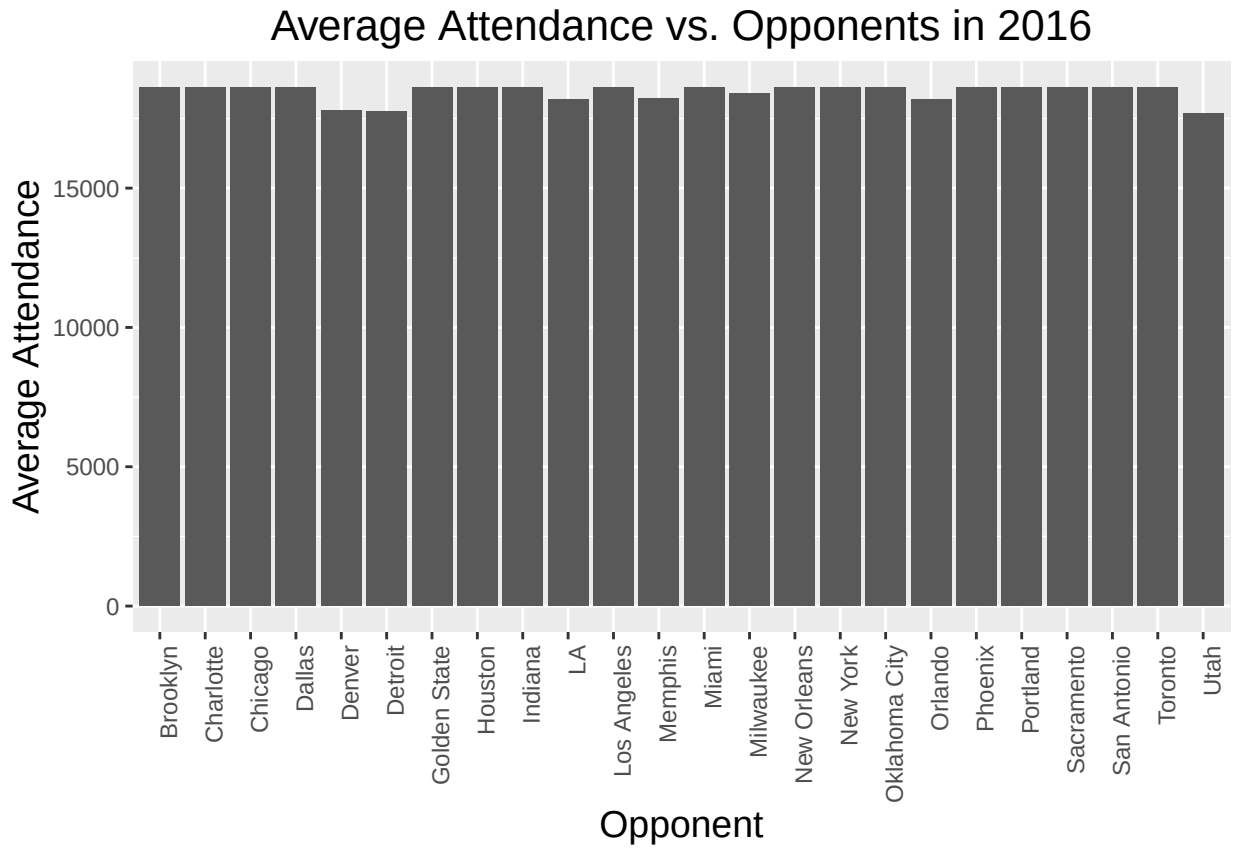
```
# 2017
# Summary of attendance in seanson 2017 with different opponent.
# Group by different opponents and arrange the attendance from high to low
bball_opp17 <- bball_2017 %>% group_by(Opp) %>% summarise(avg_attendance = round(mean(Attendance),,digi
bball_opp17 <- arrange(bball_opp17, desc(avg_attendance))

ggplot(bball_opp17, aes(Opp, avg_attendance)) +
  geom_bar(stat = "identity") +
  ggtitle("Average Attendance vs. Opponents in 2017") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(axis.text.x = element_text(angle = 90, hjust = 1)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Opponent") +
  ylab("Average Attendance")
```




```
knitr::kable(bball_opp17)
```

Opp	avg_attendance
Atlanta	18624
Brooklyn	18624
Charlotte	18624
Chicago	18624
Cleveland	18624
Houston	18624
Indiana	18624
LA	18624
Los Angeles	18624
Miami	18624
Milwaukee	18624
Minnesota	18624
New Orleans	18624
New York	18624
Orlando	18624
Philadelphia	18624
Phoenix	18624
Portland	18624
Toronto	18624
Utah	18624
Washington	18624
Detroit	18188

```r
# 2016
# Summary of attendance in seanson 2016 with different opponent.
# Group by different opponents and arrange the attendance from high to low
bball_opp16 <- bball_2016 %>% group_by(Opp) %>% summarise(avg_attendance = round(mean(Attendance),digits
bball_opp16 <- arrange(bball_opp16, desc(avg_attendance))

ggplot(bball_opp16, aes(Opp, avg_attendance)) +
  geom_bar(stat = "identity") +
  ggtitle("Average Attendance vs. Opponents in 2016") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(axis.text.x = element_text(angle = 90, hjust = 1)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Opponent") +
  ylab("Average Attendance")
```

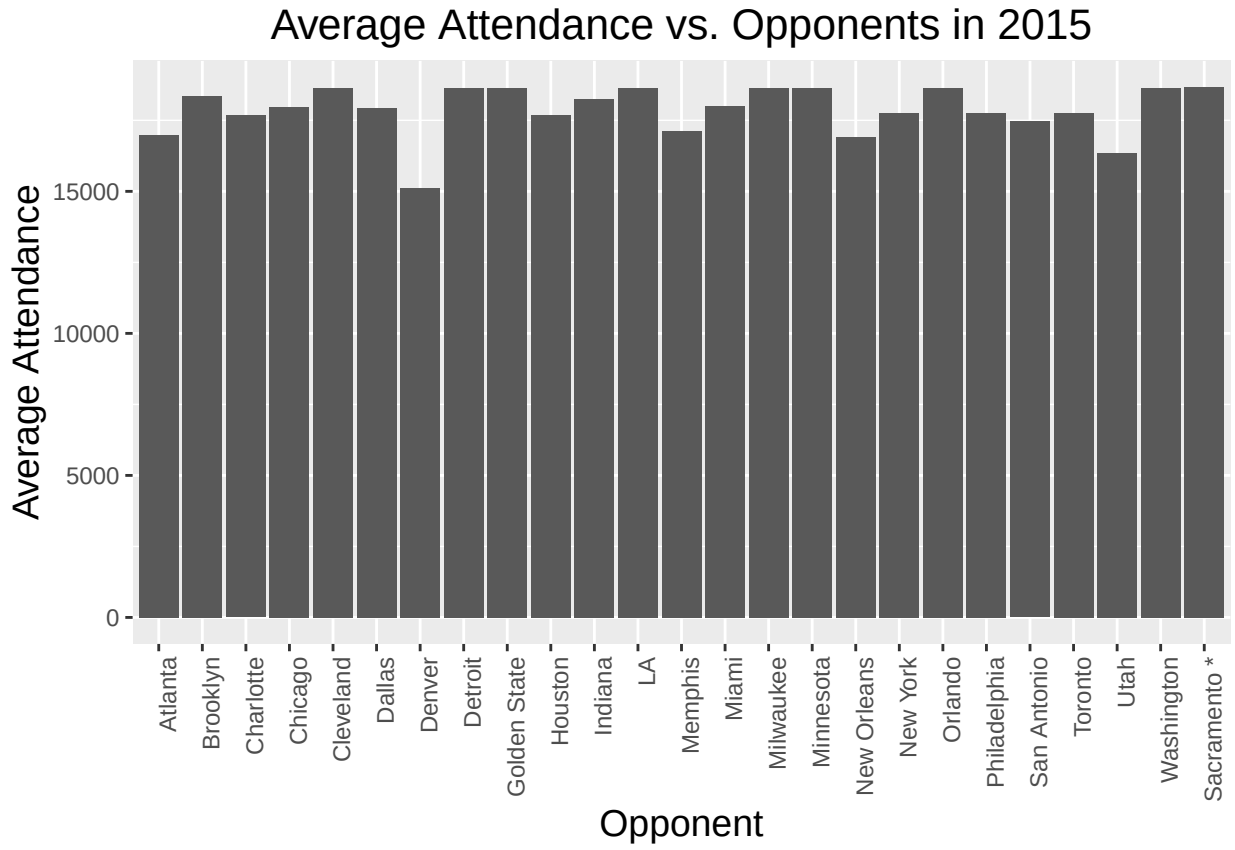



```r
knitr::kable(bball_opp16)
```

Opp	avg_attendance
Brooklyn	18624
Charlotte	18624
Chicago	18624
Dallas	18624
Golden State	18624
Houston	18624
Indiana	18624

Opp	avg_attendance
Los Angeles	18624
Miami	18624
New Orleans	18624
New York	18624
Oklahoma City	18624
Phoenix	18624
Portland	18624
Sacramento	18624
San Antonio	18624
Toronto	18624
Milwaukee	18390
Memphis	18207
LA	18186
Orlando	18176
Denver	17780
Detroit	17753
Utah	17680

```
# 2015
# Summary of attendance in seanson 2016 with different opponent.
# Group by different opponents and arrange the attendance from high to low
bball_opp15 <- bball_2015 %>% group_by(Opp) %>% summarise(avg_attendance = round(mean(Attendance),digits
bball_opp15 <- arrange(bball_opp15, desc(avg_attendance))

ggplot(bball_opp15, aes(Opp, avg_attendance)) +
  geom_bar(stat = "identity") +
  ggtitle("Average Attendance vs. Opponents in 2015") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(axis.text.x = element_text(angle = 90, hjust = 1)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Opponent") +
  ylab("Average Attendance")
```

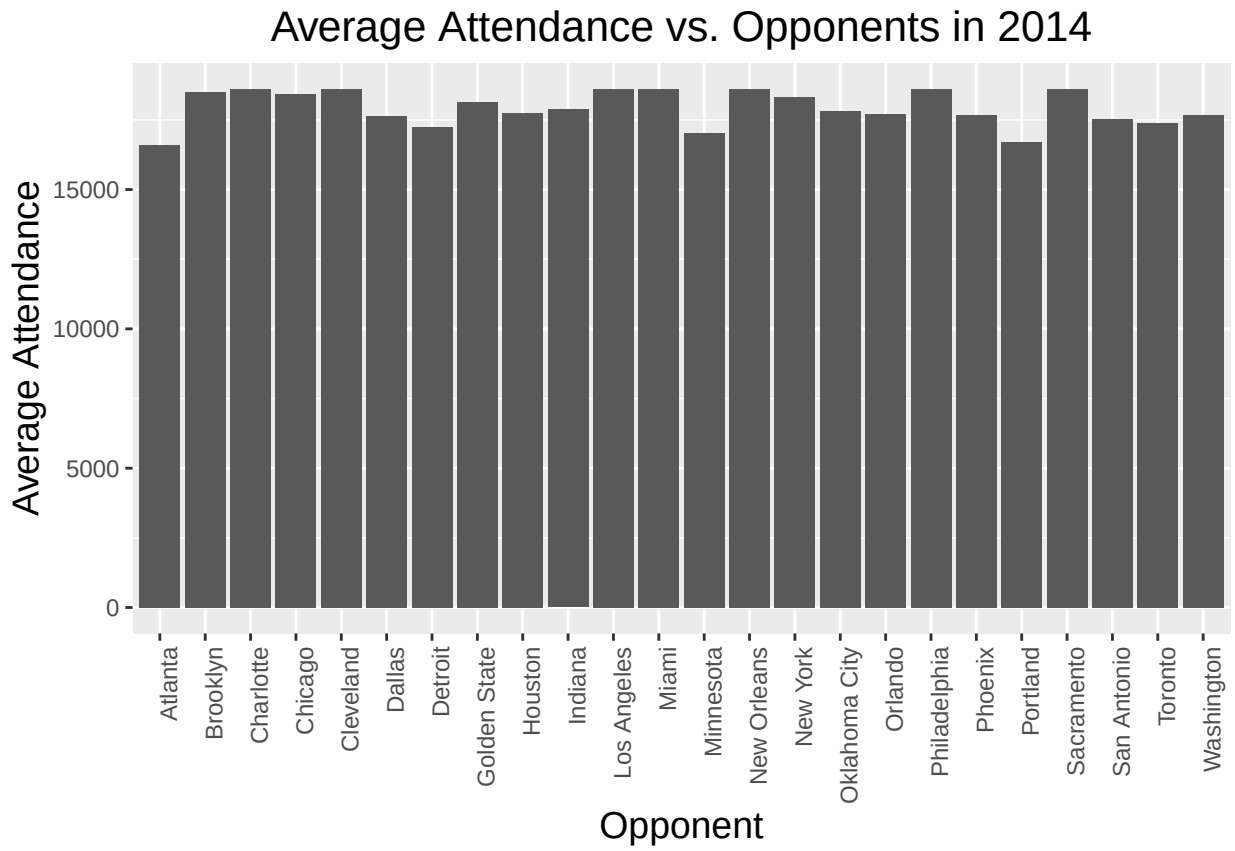



```
knitr::kable(bball_opp15)
```

Opp	avg_attendance
Sacramento *	18660
Cleveland	18624
Detroit	18624
Golden State	18624
LA	18624
Milwaukee	18624
Minnesota	18624
Orlando	18624
Washington	18624
Brooklyn	18361
Indiana	18252
Miami	17995
Chicago	17971
Dallas	17943
Philadelphia	17772
New York	17762
Toronto	17761
Houston	17675
Charlotte	17672
San Antonio	17461
Memphis	17135
Atlanta	16978
New Orleans	16905

Opp	avg_attendance
Utah	16354
Denver	15126

```
# 2014
# Summary of attendance in seanson 2016 with different opponent.
# Group by different opponents and arrange the attendance from high to low
bball_opp14 <- bball_2014 %>% group_by(Opp) %>% summarise(avg_attendance = round(mean(Attendance),,digi
bball_opp14 <- arrange(bball_opp14, desc(avg_attendance))

ggplot(bball_opp14, aes(Opp, avg_attendance)) +
  geom_bar(stat = "identity") +
  ggtitle("Average Attendance vs. Opponents in 2014") +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(axis.text.x = element_text(angle = 90, hjust = 1)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Opponent") +
  ylab("Average Attendance")
```

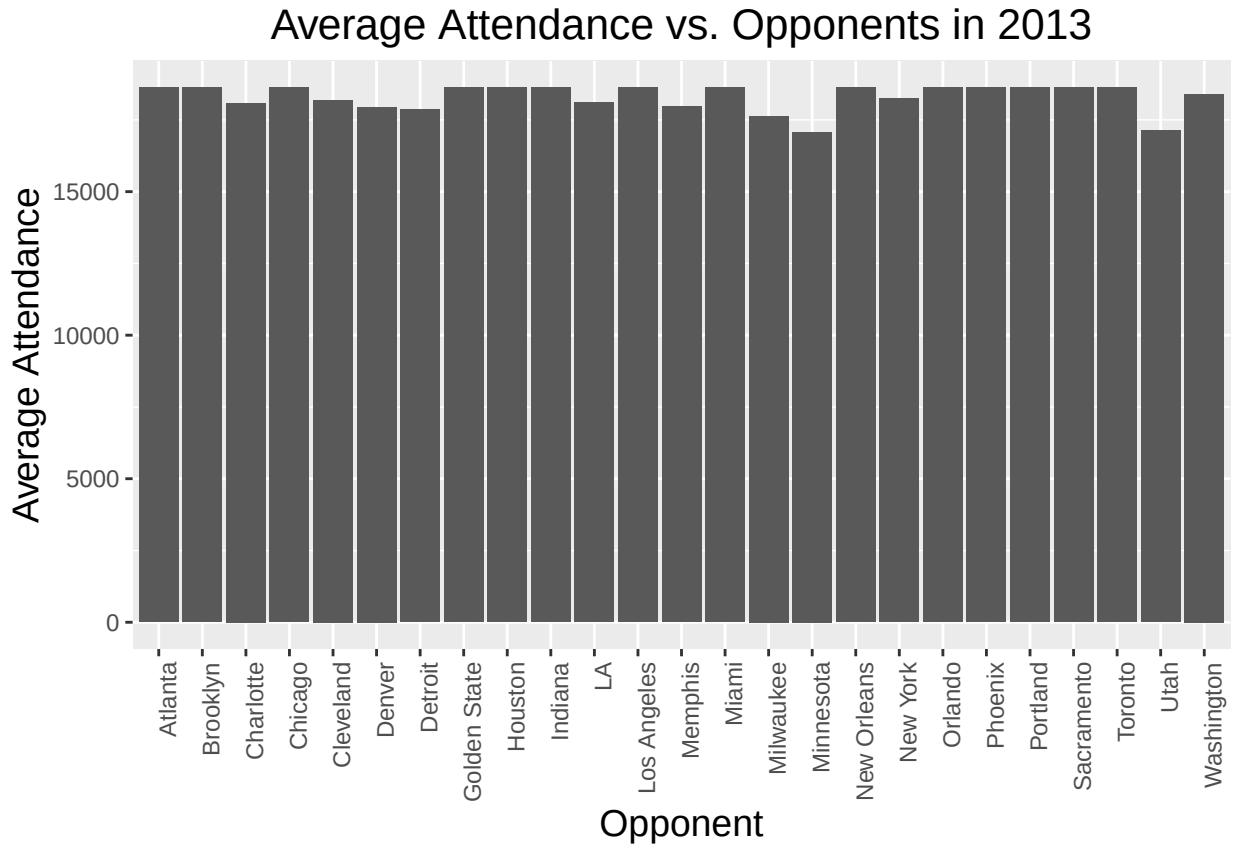



```
knitr::kable(bball_opp14)
```

Opp	avg_attendance
Charlotte	18624
Cleveland	18624

Opp	avg_attendance
Los Angeles	18624
Miami	18624
New Orleans	18624
Philadelphia	18624
Sacramento	18624
Brooklyn	18517
Chicago	18414
New York	18306
Golden State	18155
Indiana	17873
Oklahoma City	17834
Houston	17750
Orlando	17694
Phoenix	17675
Washington	17670
Dallas	17650
San Antonio	17522
Toronto	17386
Detroit	17247
Minnesota	17042
Portland	16692
Atlanta	16605

```
# 2013
# Summary of attendance in seanson 2013 with different opponent.
# Group by different opponents and arrange the attendance from high to low
bball_opp13 <- bball_2013 %>% group_by(Opp) %>% summarise(avg_attendance = round(mean(Attendance),digits
bball_opp13 <- arrange(bball_opp13, desc(avg_attendance))

ggplot(bball_opp13, aes(Opp, avg_attendance)) +
  geom_bar(stat = "identity") +
  ggtitle("Average Attendance vs. Opponents in 2013")+
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(axis.text.x = element_text(angle = 90, hjust = 1)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Opponent") +
  ylab("Average Attendance")
```

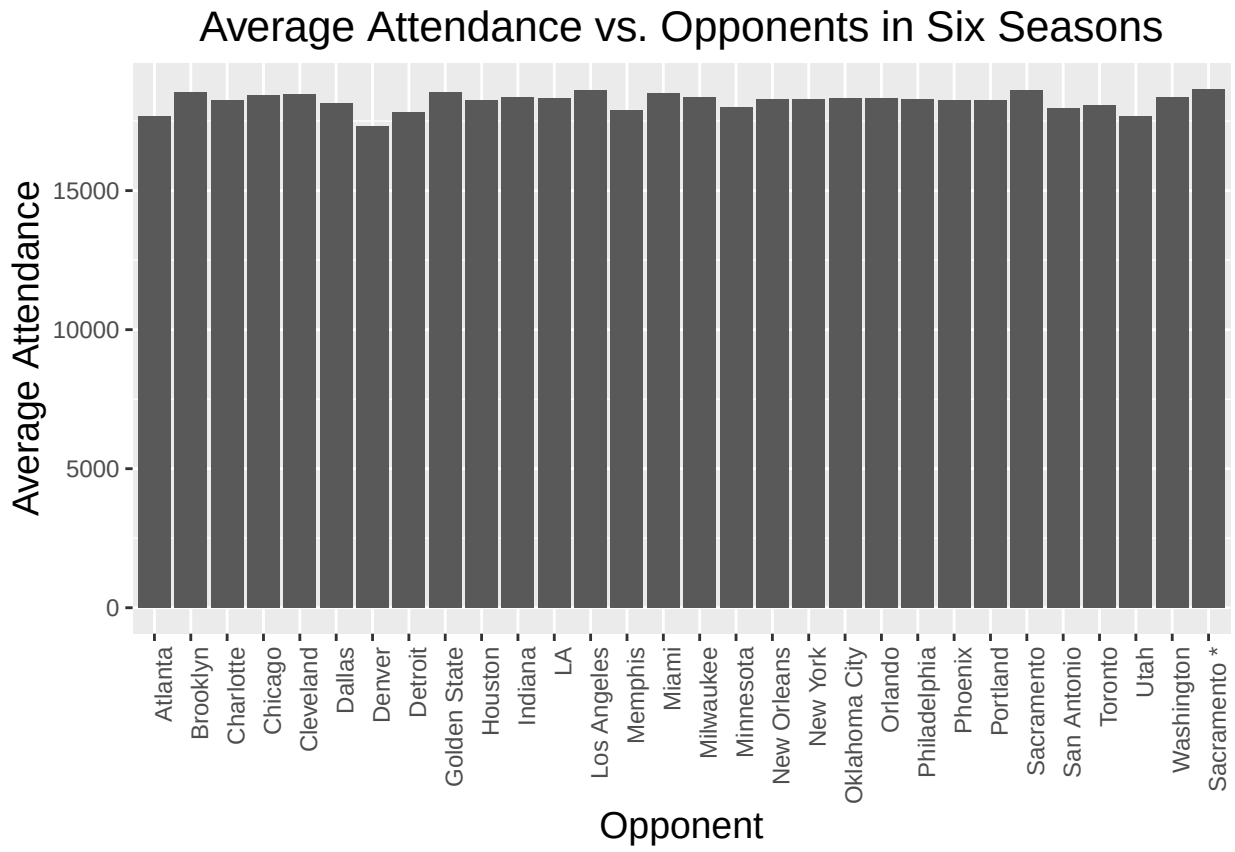



```
knitr::kable(bball_opp13)
```

Opp	avg_attendance
Atlanta	18624
Brooklyn	18624
Chicago	18624
Golden State	18624
Houston	18624
Indiana	18624
Los Angeles	18624
Miami	18624
New Orleans	18624
Orlando	18624
Phoenix	18624
Portland	18624
Sacramento	18624
Toronto	18624
Washington	18396
New York	18242
Cleveland	18191
LA	18106
Charlotte	18093
Memphis	17972
Denver	17944
Detroit	17862
Milwaukee	17636

Opp	avg_attendance
Utah	17130
Minnesota	17071

```
# Summary of attendance in 6 seansons with different opponent.
# Group by different opponents and arrange the attendance from high to low
bball_opp <- bball %>% group_by(Opp) %>% summarise(avg_attendance = round(mean(Attendance),digits = 0))
bball_opp <- arrange(bball_opp, desc(avg_attendance))

ggplot(bball_opp, aes(Opp, avg_attendance)) +
  geom_bar(stat = "identity") + ggtitle("Average Attendance vs. Opponents in Six Seasons") +
  theme(axis.text.x = element_text(angle = 90, hjust = 1)) +
  theme(axis.title.x = element_text(size = 14)) +
  theme(axis.title.y = element_text(size = 14)) +
  theme(plot.title = element_text(hjust = 0.5, size = 16)) +
  xlab("Opponent") +
  ylab("Average Attendance")
```



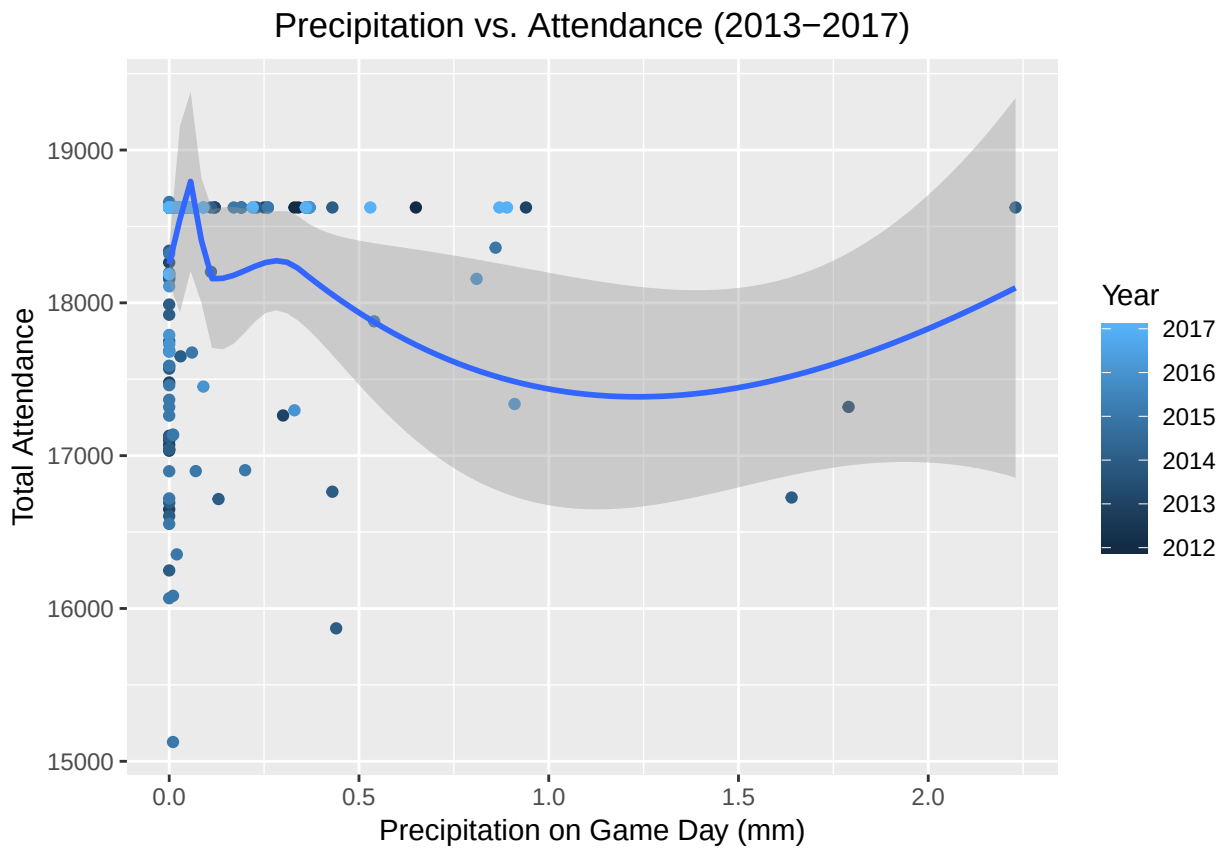

```
knitr::kable(bball_opp)
```

Opp
Sacramento *
Los Angeles
Sacramento
Brooklyn

Opp
Golden State
Miami
Cleveland
Chicago
Washington
Milwaukee
Indiana
LA
Orlando
Oklahoma City
Philadelphia
New Orleans
New York
Houston
Phoenix
Portland
Charlotte
Dallas
Toronto
Minnesota
San Antonio
Memphis
Detroit
Utah
Atlanta
Denver
Conclusion: Oppo nents have a very slight but insignificant influence on Celtics attendance. Some of the weakest opponer

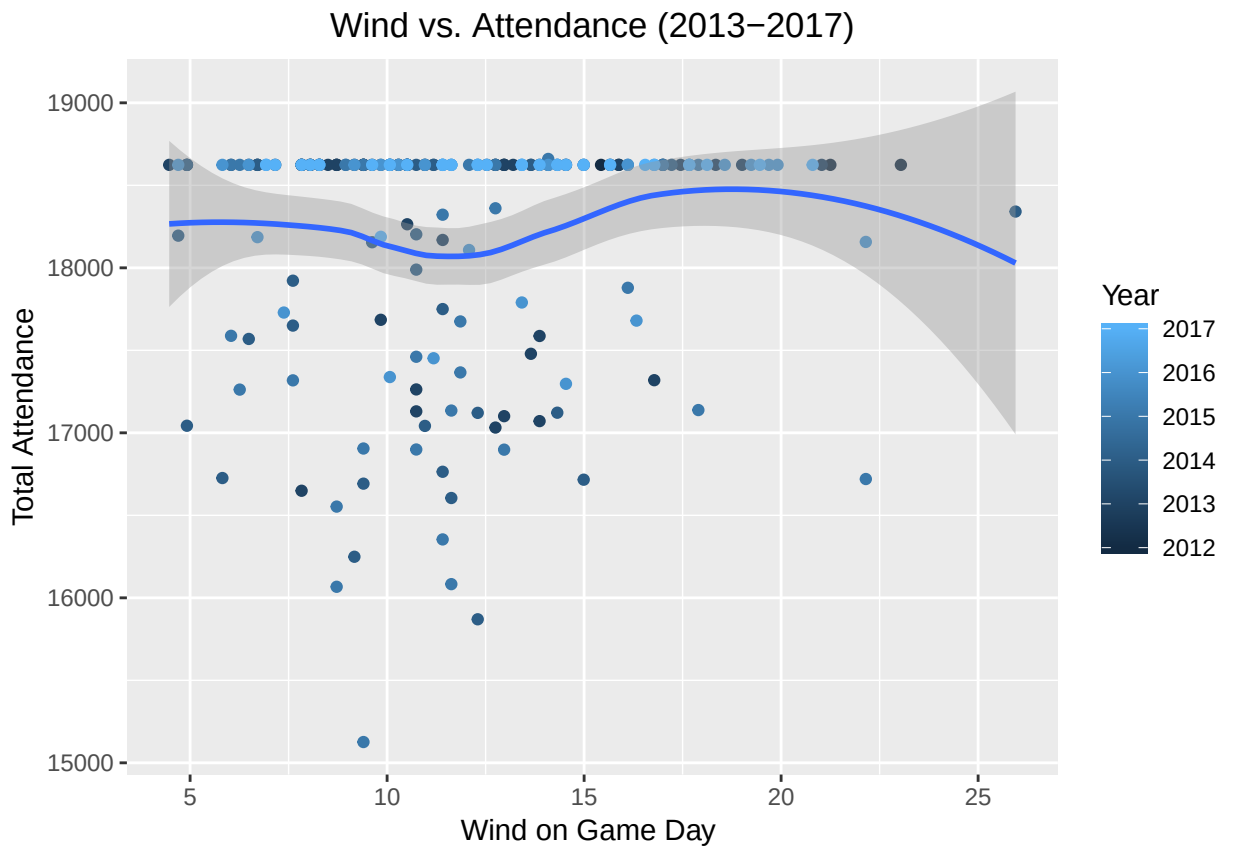
```
basketball_WeatherAll<-read.csv("bball.csv")
basketball_SpecialWeather<- basketball_WeatherAll %>% select(Year,Date, Attendance,AWND,PRCP )

# The snow influences on Celtics attendence
plot1<-ggplot(basketball_SpecialWeather, aes(PRCP, Attendance)) +
  geom_point(mapping=aes(color = Year)) +
  geom_smooth() +
  ggtitle("Precipitation vs. Attendance (2013-2017)") +
  theme(plot.title = element_text(hjust = 0.5)) +
  xlab("Precipitation on Game Day (mm)") +
  ylab("Total Attendance")
# The wind influences on Celtics attendence
plot2<-ggplot(basketball_SpecialWeather, aes(AWND,Attendance)) +
  geom_point(mapping=aes(color = Year)) +
  geom_smooth() +
  ggtitle("Wind vs. Attendance (2013-2017)") +
  theme(plot.title = element_text(hjust = 0.5)) +
  xlab("Wind on Game Day ") +
  ylab("Total Attendance")
plot1
```

```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'
```




```
plot2
```

```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'
```



Conclusion: Rainy and windy weathers don't have an obvious relationship on attendance. Drawing a smooth line through the trend we see a slightly negative relationship but this is based on the outsized influences of just a few points. Because NBA games are indoors, this fits intuitively with our understanding of how weather might afffect attendance.