Border Patrol Apprehensions: 2010 vs 2017

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Since Donald Trump became President, apprehensions at the US-Mexico border have been very low compared to previous years. This is because people have stopped illegally crossing the Southern border, which may be due to the President's "rhetoric and aggressive push" to enforce immigration laws. "Would-be" immigrants may be waiting and watching instead of crossing the border.

In this project, we compare the number of border patrol apprehensions in the years 2010 and 2017, as well as monthly summaries to see if there has been a significant decrease in apprehensions. We compare different months in each sector: Big Bend, Del Rio, El Centro, El Paso, Laredo, Rio Grande Valley, San Diego, Tucson, and Yuma.

Ahead we call in the two data tables, which now include totals for each sector and month.

```
# read bp tables for each year
A2010 <- read.csv("bp appre 2010.csv", header = TRUE, stringsAsFactors = FALSE)
A2017 <- read.csv("bp appre 2017.csv", header = TRUE, stringsAsFactors = FALSE)



# get name of each sector
rownames(A2010) <- A2010[,1]
A2010[,1]
```

```
## [1] "Big Bend"          "Del Rio"           "El Centro"
## [4] "El Paso"           "Laredo"            "Rio Grande Valley"
## [7] "San Diego"         "Tucson"            "Yuma"
```

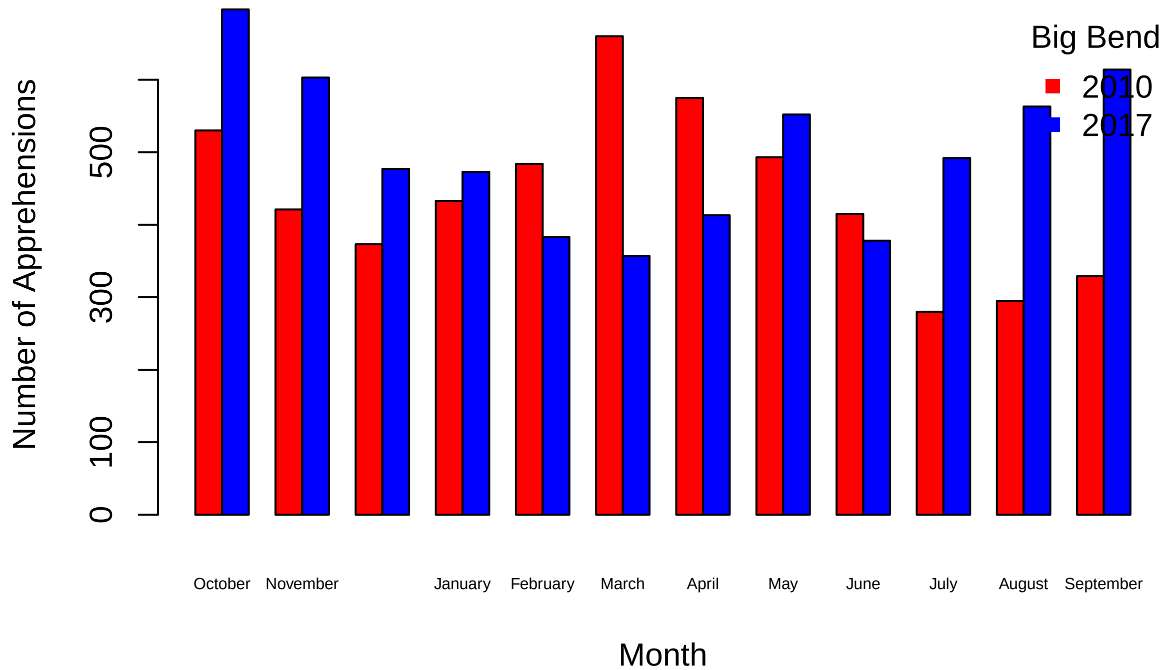
```
rownames(A2017) <- A2017[,1]



# function to get totals of each sector, month, and data as a whole
getTotals <- function(data) {
  data <-  subset(data, select= -c(Sector))
  rownames(data)

  data <- rbind(data, colSums(data))

  rownames(data)

  -length(rownames(data))

  rownames(data) <- c(rownames(data)[-length(rownames(data))], "Total")

  data <- cbind(data,rowSums(data))

  colnames(data) <- c(colnames(data)[-length(colnames(data))], "Total")
  return(data)

}
```

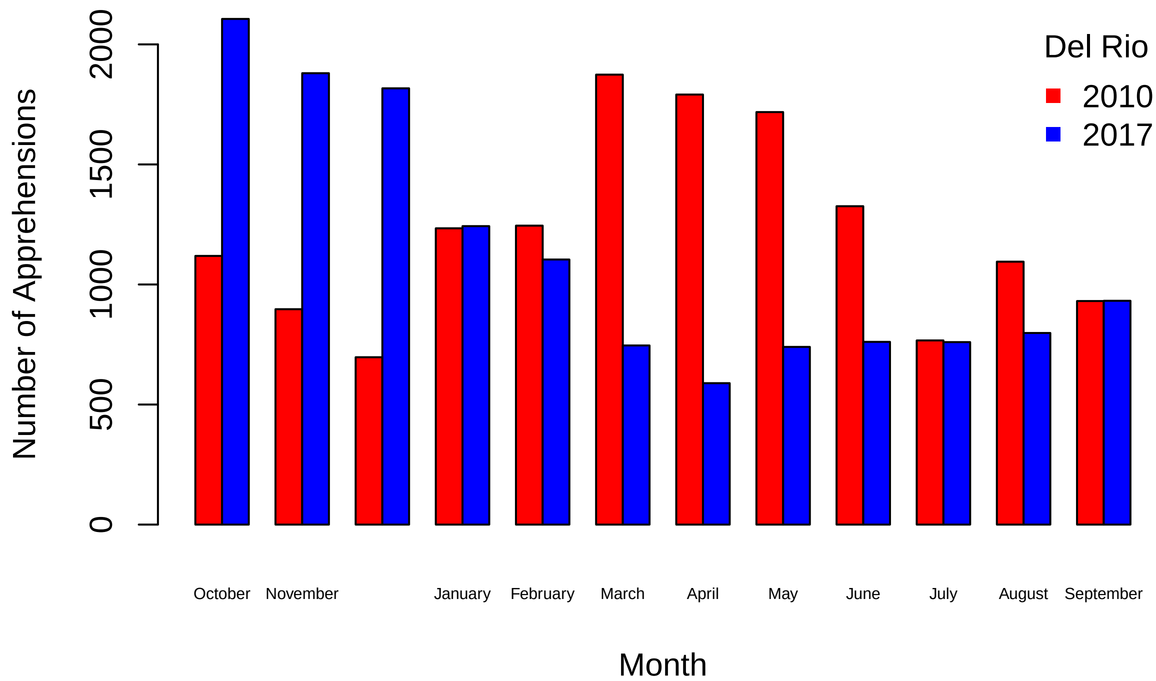
```r
# Append totals for data
A2010 <- getTotals(A2010)
A2017 <- getTotals(A2017)
```

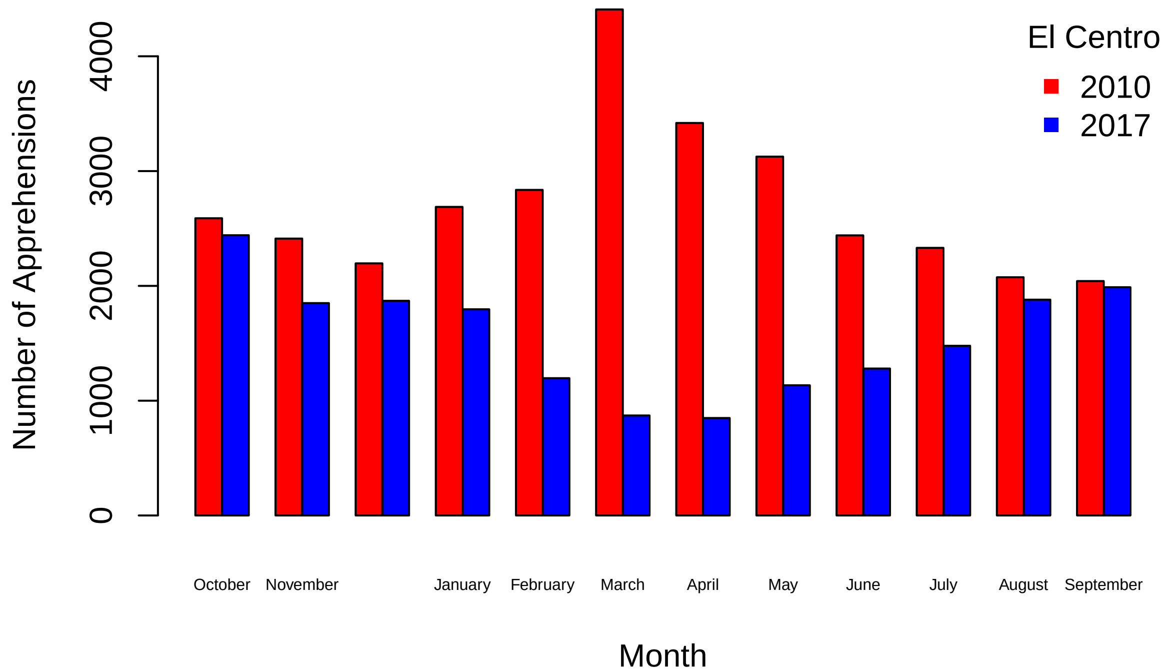
Visualization of the Data

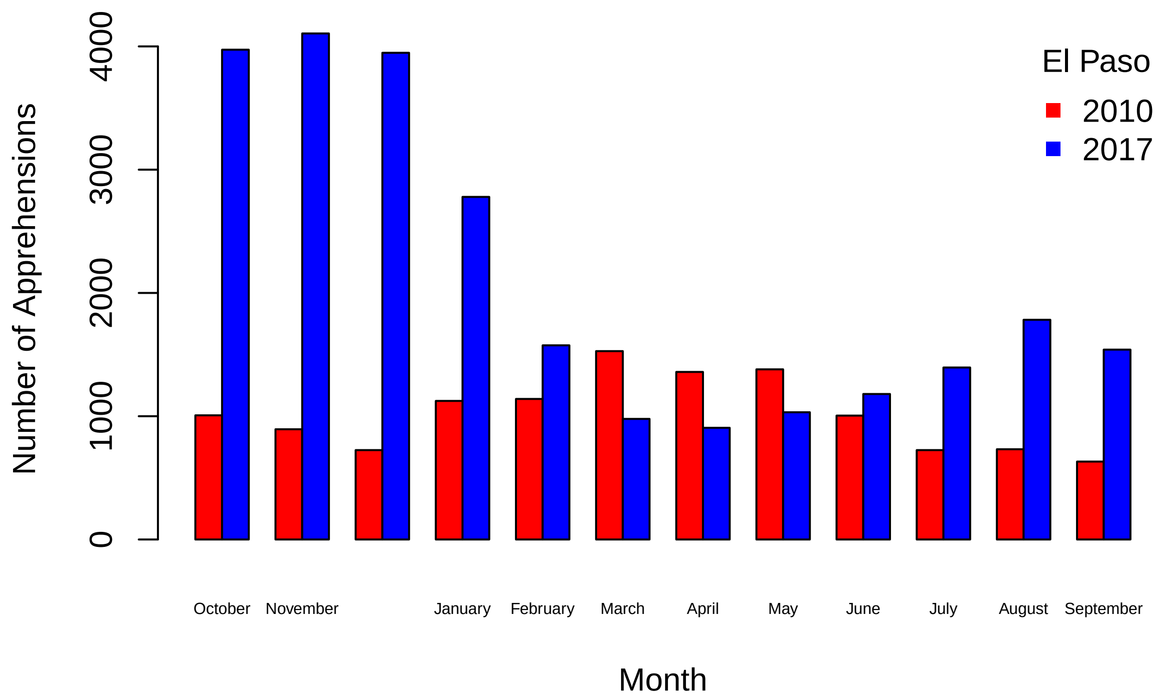
We compare the number of apprehensions in 2010 and 2017 by months and sector in a side by side barplot. Below are 9 barplots that represent each sector.

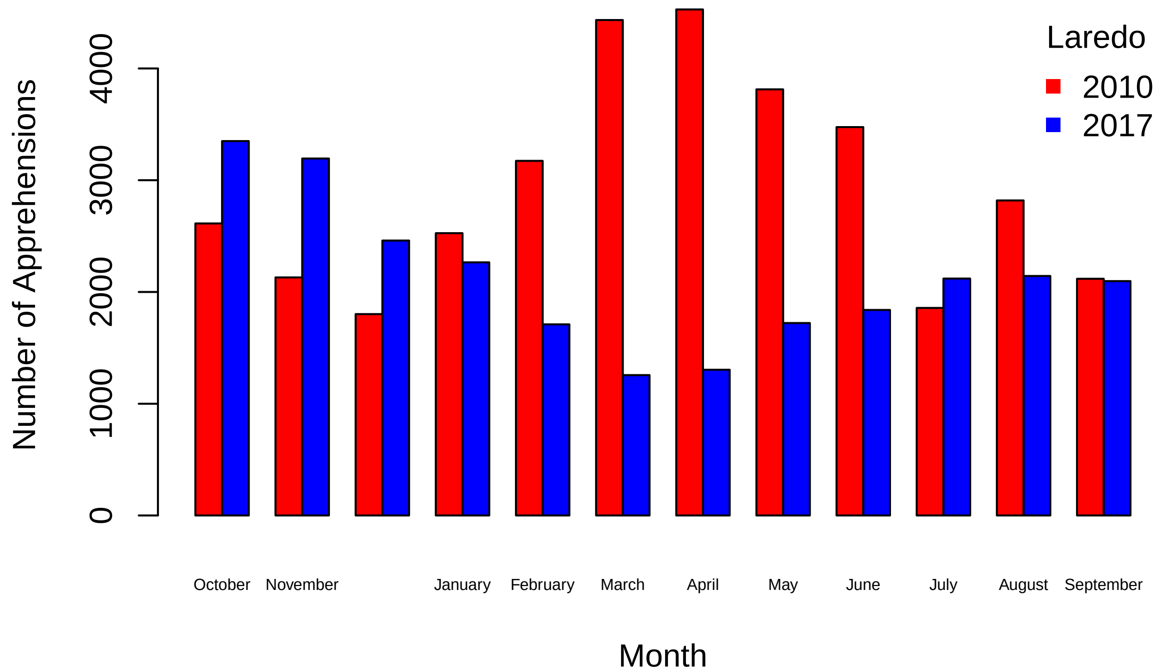
```r
# a function to create side-by-side barplots comparing the 2010 and 2017 statistics by
# month and sector
compare <- function(){

  for (x in 1:9) {

    title <- rownames(A2010)[x]

    both <- rbind(A2010[x,1:12], A2017[x,1:12])

    row.names(both) <- c("2010", "2017")

    barplot(as.matrix(both), beside = TRUE, col = c("red", "blue"), bty="n",xlab = 'Month',
            ylab = 'Number of Apprehensions', cex.names = 0.5 )

    legend("topright", c("2010","2017"), pch=15,  col=c("red","blue"),  bty="n",
           title = title)

  }
}
compare()
```

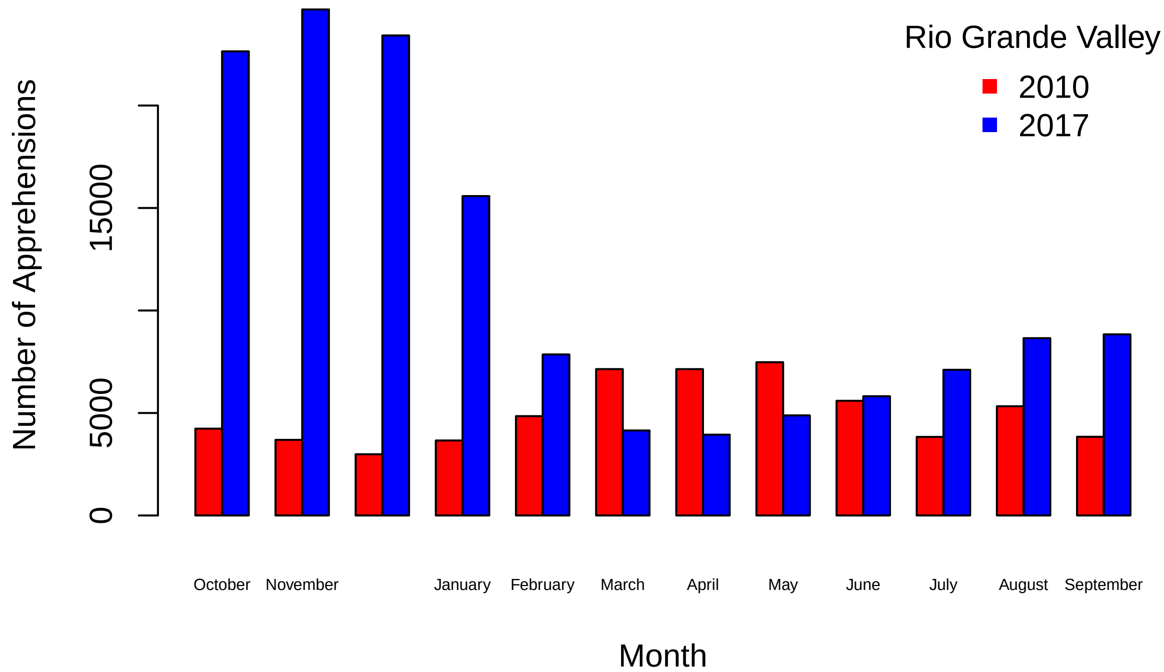

Big Bend
2010
2017
Number of Apprehensions
0
100
300
500
October
November
January
February
March
April
May
June
July
August
September
Month

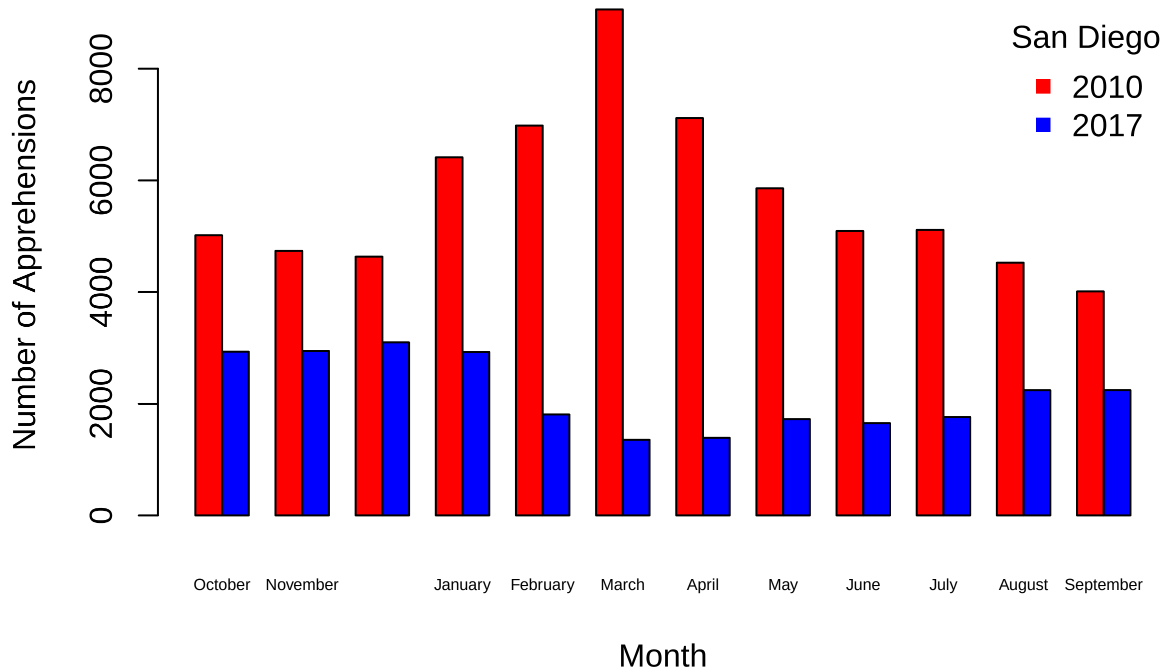

Del Rio
2010
2017
Number of Apprehensions
0
500
1000
1500
2000
October
November
January
February
March
April
May
June
July
August
September
Month

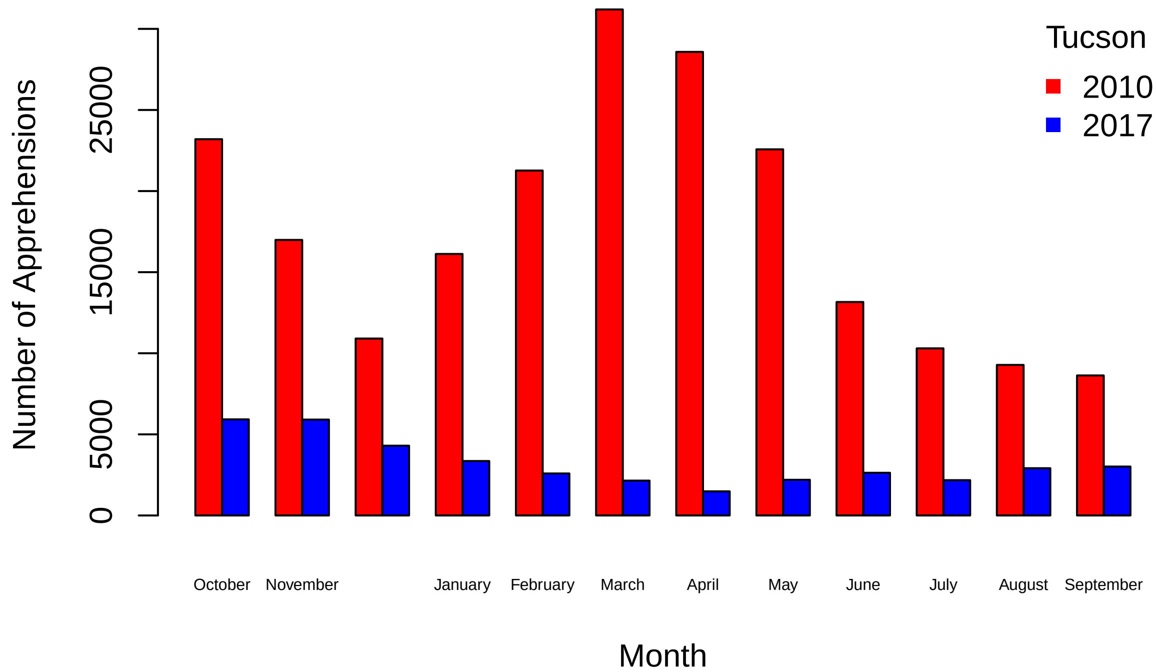

El Centro
2010
2017
Number of Apprehensions
0
1000
2000
3000
4000
October
November
January
February
March
April
May
June
July
August
September
Month

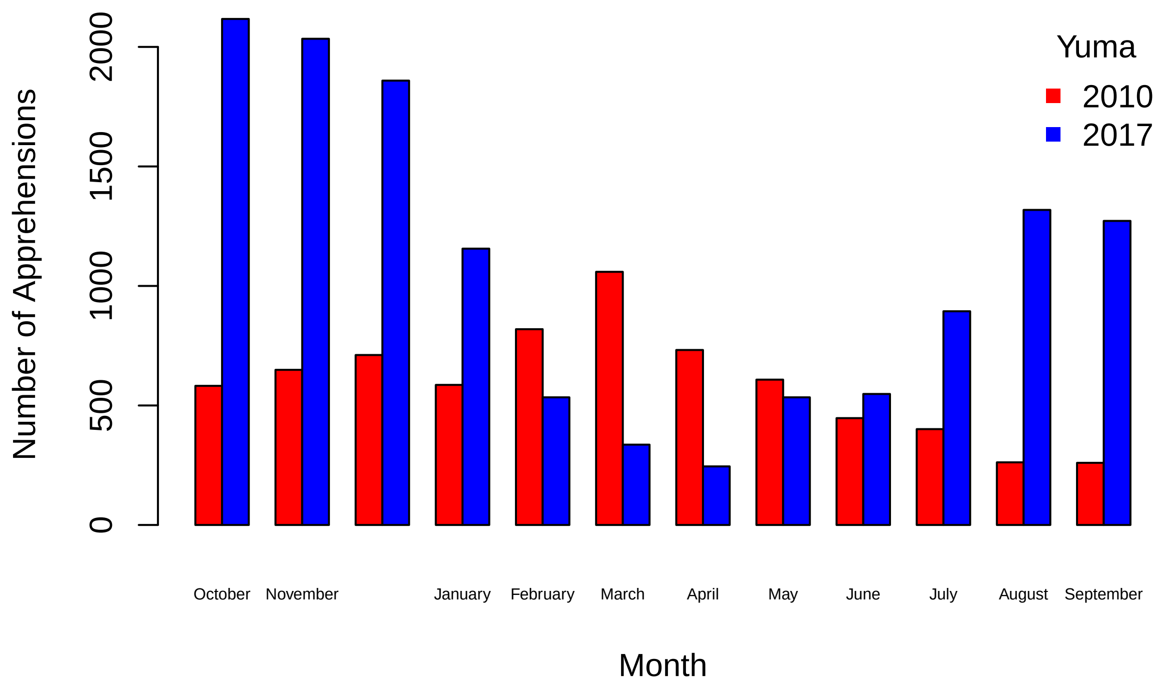

Number of Apprehensions
0
1000
2000
3000
4000
El Paso
2010
2017
October
November
January
February
March
April
May
June
July
August
September
Month


Laredo
2010
2017
Number of Apprehensions
0
1000
2000
3000
4000
October
November
January
February
March
April
May
June
July
August
September
Month


Rio Grande Valley
2010
2017
Number of Apprehensions
0
5000
15000
October
November
January
February
March
April
May
June
July
August
September
Month


San Diego
2010
2017
Number of Apprehensions
0
2000
4000
6000
8000
October
November
January
February
March
April
May
June
July
August
September
Month


Tucson
2010
2017
Number of Apprehensions
0
5000
15000
25000
October
November
January
February
March
April
May
June
July
August
September
Month



In general, there seemed to be a much higher number of apprehensions in 2010 between the months of February and May, and a higher number of apprehensions in 2017 between September and December. Tucson and San Diego had the most change when looking at the barplots. There was a large decrease in number of apprehensions from 2010 to 2017.

Statistical Testing

Most Apprehensions by Sector

We first compared the sector with the most apprehensions in 2010 and 2017. In 2010, Tucson had the most apprehensions, and in 2017, Rio Grande Valley had the most apprehensions. With this data, we took a t-test to see if there was a significant difference in these maximums. The null hypothesis is that the means between these apprehensions are equal to 0, and the alternative hypothesis is that they are not equal to 0.

```r
# T Test for most apprehensions by sector
customTest <- function(earlyData, newData) {
  #Assumes getTotals function has been run on data
  #Data for old data input
  maximumOld <- max(earlyData[1:9,13])
  maxRowIndexOld <- which.max(earlyData[1:9,13])
  earlyDataMean <- rowMeans(earlyData[maxRowIndexOld,1:12])


  #Data for new data input
  maximumNew <- max(newData[1:9,13])
  maxRowIndexNew <- which.max(newData[1:9,13])
  newDataMean <- rowMeans(newData[maxRowIndexNew,1:12])


  t.test(earlyData[maxRowIndexOld,1:12], newData[maxRowIndexNew,1:12])

}
customTest(A2010,A2017)
```

```
##
##  Welch Two Sample t-test
##
## data:  earlyData[maxRowIndexOld, 1:12] and newData[maxRowIndexNew, 1:12]
## t = 1.9547, df = 21.973, p-value = 0.06346
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##   -379.5935 12819.5935
## sample estimates:
## mean of x mean of y
##   17683.5   11463.5
```

Although the mean of Tucson in 2010 was 17684 apprehensions, and the mean of Rio Grande Valley in 2017 was 11464, there seems that there would be a difference in the mean. Surprisingly, the t-test gave a t-score of 2, and a p-value of 0.06. Using an alpha of 0.05, we fail to reject the null hypothesis since the p-value is greater than alpha. This p-value is still low, but not low enough. This means that the difference in the means of apprehensions in 2010 and 2017 are not significantly different. This is also seen in the confidence interval, which is (-380, 12820), and includes 0, meaning there is not a significant difference.

Most Apprehensions in 3 Month Period

Then, we compared the 3 month periods with the most apprehensions in 2010 and 2017. In 2010, March, April, and May had the most apprehensions, and in 2017, October, November, and December had the most apprehensions. Again, with this data, we took a t-test to see if there was a significant difference in these maximums.

```
#Get top three months
topMonths <- function(data){
  copy <- data
  copy <- sort(copy[10,1:12], decreasing = TRUE)[1:3]
  copy
}

# T test for top three months in apprehensions
compareThreeMonthPeriod <- function(earlyData, newData) {
  earlyDataThree <- topMonths(earlyData)
  newDataThree <- topMonths(newData)
  # get indices of these months
  earlyColName1 <- grep(colnames(earlyDataThree[1]), colnames(earlyData))
  earlyColName2 <- grep(colnames(earlyDataThree[2]), colnames(earlyData))
  earlyColName3 <- grep(colnames(earlyDataThree[3]), colnames(earlyData))
  earlyIndex <- min(earlyColName1,earlyColName2,earlyColName3)

  newColName1 <- grep(colnames(newDataThree[1]), colnames(newData))
  newColName2 <- grep(colnames(newDataThree[2]), colnames(newData))
  newColName3 <- grep(colnames(newDataThree[3]), colnames(newData))
  newIndex <- min(newColName1,newColName2,newColName3)


  earlyMean <- mean(c(earlyData[1:9,earlyIndex],earlyData[1:9,earlyIndex+1],
                      earlyData[1:9,earlyIndex+2]))
  newMean <- mean(c(newData[1:9,newIndex],newData[1:9,newIndex+1],newData[1:9,newIndex+2]))



  t.test(c(earlyData[1:9,earlyIndex],earlyData[1:9,earlyIndex+1],
         earlyData[1:9,earlyIndex+2]),c(newData[1:9,newIndex],newData[1:9,newIndex+1],
                                        newData[1:9,newIndex+2]))


}

compareThreeMonthPeriod(A2010,A2017)
```

```
##
##  Welch Two Sample t-test
##
## data:  c(earlyData[1:9, earlyIndex], earlyData[1:9, earlyIndex + 1],  and c(newData[1:9, newIndex], n
## t = 0.48741, df = 50.321, p-value = 0.6281
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -3119.921  5119.699
## sample estimates:
## mean of x mean of y
```

```
## 6060.852 5060.963
```

Although the mean for 2010 was 6061, and the mean for 2017 was 5061, which is a decrease in apprehensions, the t-test said that this difference was insignificant. The t score was 0.5 and the p-value was 0.6, which is way above the alpha of 0.05. Since the p-value was above alpha, we fail to reject the null hypothesis, so the true difference in means is equal to 0, which means there is no significant difference in the means comparing most apprehensions in 3 month periods. The confidence interval says the same since it is (-3120,5120), which includes 0, meaning the differences in means are insignificant.

Most Apprehensions Overall

Because we believed there still may be a significant difference, we took a t-test of each data as a whole in 2010 and 2017, to see if there may be a difference there. The total number of apprehensions in 2010 was 447731, and in 2017 was 303916. This looks like a huge difference, since it nearly decreased by 15000.

```r
# T test for whole data
t.test(A2010, A2017)
```

```
##
##  Welch Two Sample t-test
##
## data:  A2010 and A2017
## t = 0.93944, df = 226.33, p-value = 0.3485
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -4856.601 13706.755
## sample estimates:
## mean of x mean of y
## 13776.338  9351.262
```

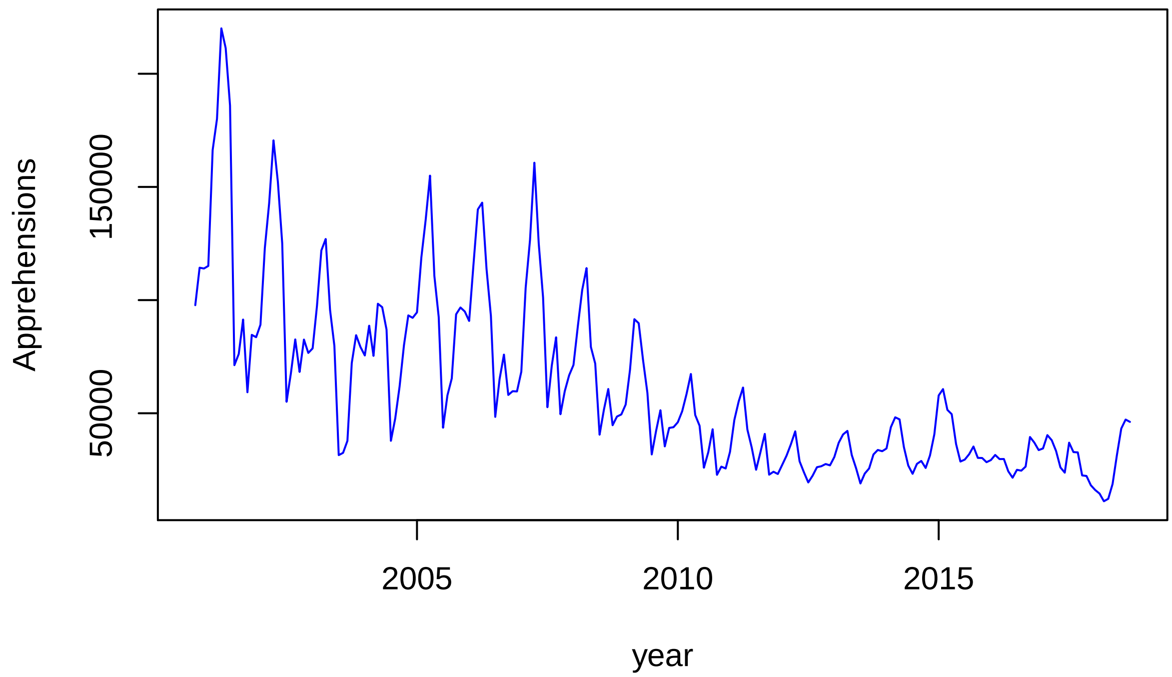
Surprisingly, although there seemed to be a big change, there was not a significant difference in the means of apprehensions. The t test gave a t score of 0.9 and the p-value was 0.3, which is above the alpha of 0.05, meaning we fail to reject the null hypothesis. So, there is no true difference between the means in 2010 and 2017. The confidence interval says the same, being (-4857,13707), which includes 0, saying that there is no true difference between the means.

Time Series Chart

```
# time series chart for monthly summaries
ts <- readClipboard(raw = FALSE)

ts1 <- read.table("clipboard", sep = "\t")
ts1
```

```
##       V1    V2    V3     V4     V5     V6     V7     V8     V9    V10
## 1  46184 47211 43251  31576  18754  12195  11127  14519  16087  18187
## 2  32724 32838 37014  23758  26072  33316  38089  40337  34450  33723
## 3  26450 24641 25019  21514  24376  29791  29750  31576  29303  28388
## 4  35312 31896 29528  28668  36403  49596  51502  60683  57862  40708
## 5  28929 27636 23243  26921  35042  47293  48212  43856  34436  33230
## 6  25612 23368 18983  25714  31579  42218  40628  36966  30669  26978
## 7  26165 22405 19429  23926  28786  42014  36251  31236  27166  23170
## 8  40890 32815 25034  34784  42790  61361  55237  47045  32955  25609
## 9  42938 32780 25947  44502  49211  67342  58493  50884  46044  43843
## 10 51339 42209 31802  59028  73483  89770  91566  69233  53854  49472
## 11 60713 51594 40527  71934  79268 114137 104465  88504  71338  66782
## 12 83557 70975 52673 101195 125046 160696 126538 105450  68366  59641
## 13 75913 65135 48406  93020 113775 143048 140062 115823  90786  94954
## 14 65391 57894 43614  92521 110669 154981 135468 118726  94590  92165
## 15 61792 47731 37824  86925  96869  98399  75359  88690  75530  79284
## 16 37812 32506 31501  79793  95724 126992 121921  97424  78655  76661
## 17 82632 67709 55081 125090 152229 170580 142813 122927  89131  83602
## 18 91410 76196 71252 185979 211328 220063 180050 166296 115093 113956
##       V11   V12
## 1   22288 22537
## 2   37048 39501
## 3   30239 30286
## 4   31388 25825
## 5   33797 31802
## 6   27567 26591
## 7   24166 22863
## 8   26415 22796
## 9   43522 35359
## 10  48541 44708
## 11  59795 49581
## 12  59751 58084
## 13  96733 93741
## 14  93246 80017
## 15  84486 72176
## 16  82557 68263
## 17  84648 59276
## 18 114312 97744
```

```
ts2 <- rev(as.vector(t(ts1)))

ts3 <- ts(ts2, start = c(2000,10), frequency=12)

ts.plot(ts3, gpars=list(xlab="year", ylab="Apprehensions", lty=c(1:3)), col = 'blue')
```



The time series chart shows a decrease in apprehensions throughout the years from 2000 to 2017. There seems to be a large decrease, although our statistical tests say otherwise for 2010 and 2017.

Overall

In conclusion, there seems to be a decrease in apprehensions throughout the years, probably due to the fact that less “would-be” immigrants are crossing the border since the president has been changing immigration laws. The t-tests, though, don’t show a significant difference between mean of apprehensions in 2010 and 2017. But the flaw in this may be that we are only comparing the maximum number of apprehensions by sectors or months in each year, disregarding what month and sector they are actually in. If there was a comparison between each sector and each month, there may be a bigger significant difference.