R Notebook

The following is your first chunk to start with. Remember, you can add chunks using the menu above (Insert -> R) or using the keyboard shortcut Ctrl+Alt+I. A good practice is to use different code chunks to answer different questions. You can delete this comment if you like.

Other useful keyboard shortcuts include Alt- for the assignment operator, and Ctrl+Shift+M for the pipe operator. You can delete these reminders if you don't want them in your report.

```
setwd("C:/") #Don't forget to set your working directory before you start!

library("tidyverse")

## -- Attaching packages --------------------------------------- tidyverse
1.3.0 --

## v ggplot2 3.2.1     v purrr   0.3.3
## v tibble  2.1.3     v dplyr   0.8.3
## v tidyr   1.0.0     v stringr 1.4.0
## v readr   1.3.1     v forcats 0.4.0

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

library("tidymodels")

## Registered S3 method overwritten by 'xts':
##   method     from
##   as.zoo.xts zoo

## -- Attaching packages -------------------------------------- tidymodels
0.0.3 --

## v broom     0.5.3     v recipes   0.1.9
## v dials     0.0.4     v rsample   0.0.5
## v infer     0.5.1     v yardstick 0.0.4
## v parsnip   0.0.5

## -- Conflicts -----------------------------------------
tidymodels_conflicts() --
## x scales::discard()   masks purrr::discard()
## x dplyr::filter()     masks stats::filter()
## x recipes::fixed()    masks stringr::fixed()
## x dplyr::lag()        masks stats::lag()
## x dials::margin()     masks ggplot2::margin()
## x yardstick::spec()   masks readr::spec()
## x recipes::step()     masks stats::step()
## x recipes::yj_trans() masks scales::yj_trans()
```

```r
library("plotly")
```

```
##
## Attaching package: 'plotly'

## The following object is masked from 'package:ggplot2':
##
##     last_plot

## The following object is masked from 'package:stats':
##
##     filter

## The following object is masked from 'package:graphics':
##
##     layout
```

```r
library("skimr")
library("lubridate")
```

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

## The following object is masked from 'package:base':
##
##     date
```

```r
dfw <- read_csv("walmartSales.csv")
```

```
## Parsed with column specification:
## cols(
##   Store = col_double(),
##   Date = col_date(format = ""),
##   IsHoliday = col_logical(),
##   Temperature = col_double(),
##   Fuel_Price = col_double(),
##   CPI = col_double(),
##   Unemployment = col_double(),
##   Size = col_double(),
##   Weekly_Sales = col_double()
## )
```

```r
head(dfw)
```

```
## # A tibble: 6 x 9
##   Store Date       IsHoliday Temperature Fuel_Price   CPI Unemployment
Size
##   <dbl> <date>     <lgl>           <dbl>      <dbl> <dbl>        <dbl>
```

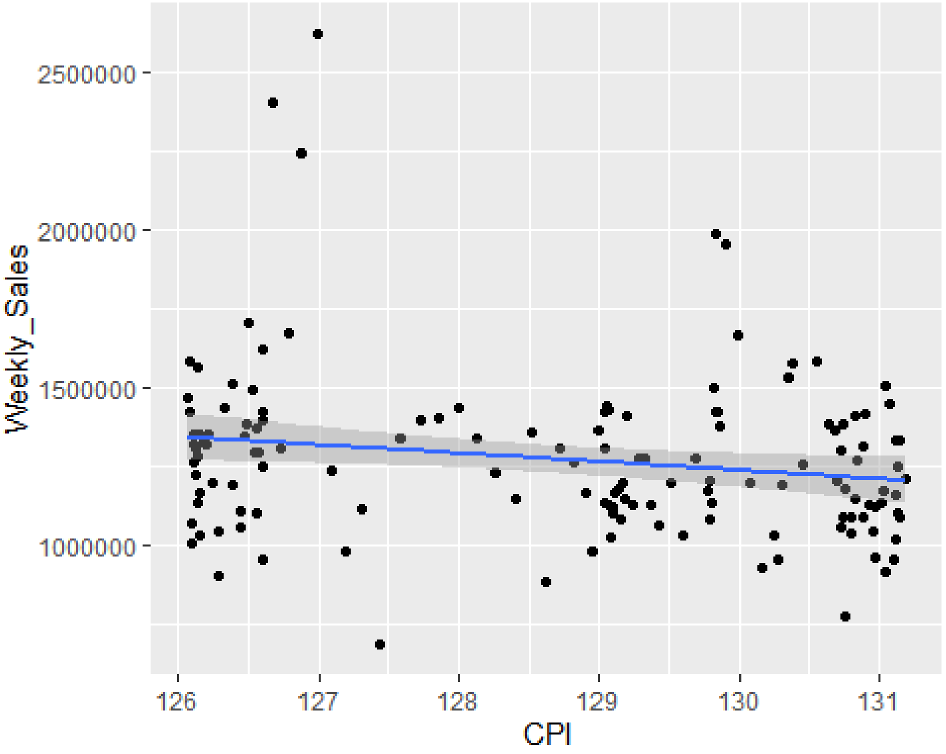
```
<dbl>
## 1    26 2011-08-26 FALSE            61.1       3.80  136.         7.77
152513
## 2    34 2011-03-25 FALSE            53.1       3.48  129.        10.4
158114
## 3    21 2010-12-03 FALSE            50.4       2.71  211.         8.16
140167
## 4     8 2010-09-17 FALSE            75.3       2.58  215.         6.32
155078
## 5    19 2012-05-18 FALSE            58.8       4.03  138.         8.15
203819
## 6    13 2012-03-16 FALSE            52.5       3.53  131.         6.10
219622
## # ... with 1 more variable: Weekly_Sales <dbl>
```

QUESTION 1

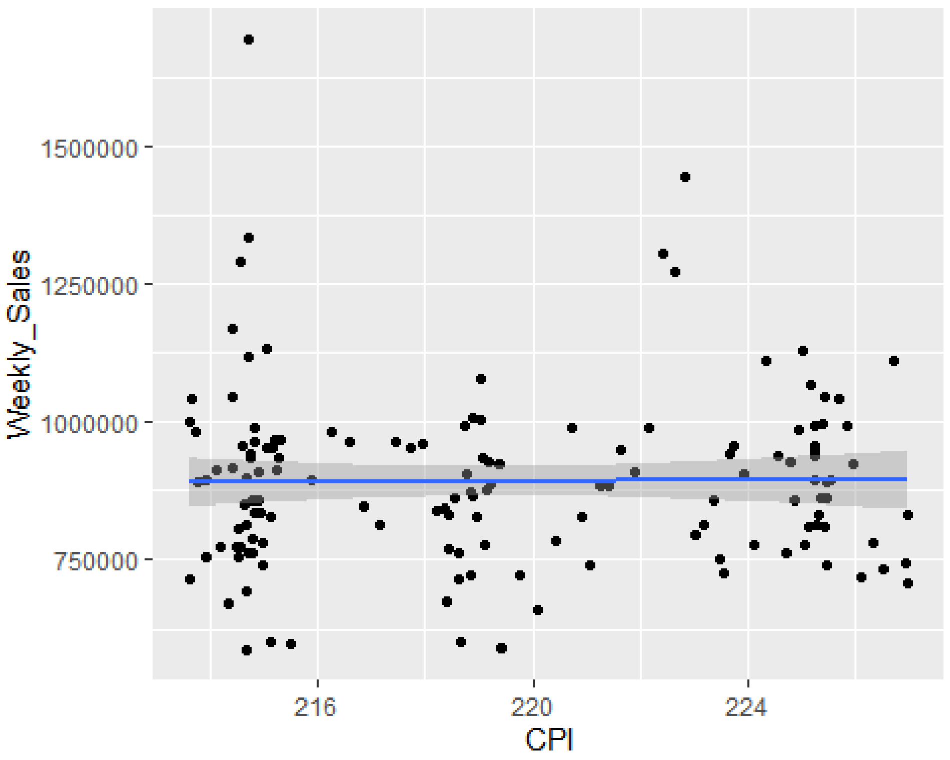
```
fitCPI <- lm(formula = Weekly_Sales ~ CPI, data=dfw)
fitCPI

##
## Call:
## lm(formula = Weekly_Sales ~ CPI, data = dfw)
##
## Coefficients:
## (Intercept)          CPI
##    827280.5       -732.7

summary(fitCPI)

##
## Call:
## lm(formula = Weekly_Sales ~ CPI, data = dfw)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -662386 -318443  -73868  258442 2095880
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 827280.5    21778.4  37.986  < 2e-16 ***
## CPI           -732.7      123.7  -5.923 3.33e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 390600 on 6433 degrees of freedom
## Multiple R-squared:  0.005423,   Adjusted R-squared:  0.005269
## F-statistic: 35.08 on 1 and 6433 DF,  p-value: 3.332e-09
```

QUESTION 2

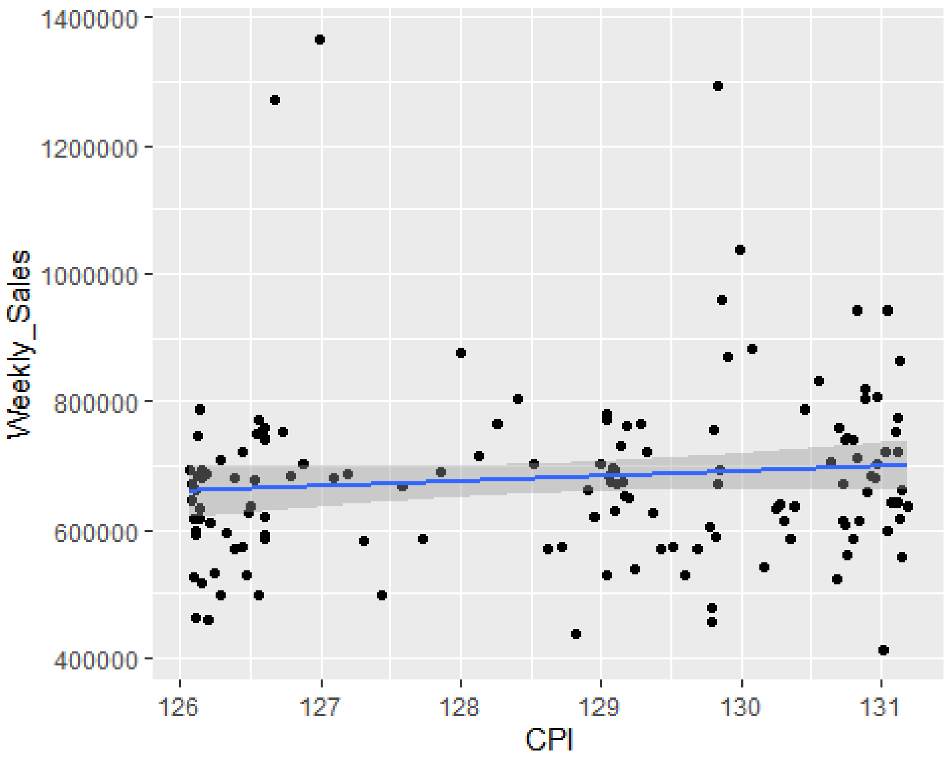
```
dfw %>%
  filter(Store==10) %>%
  ggplot(aes(x=CPI, y=Weekly_Sales))+
  geom_point() +
  geom_smooth(method='lm')
```



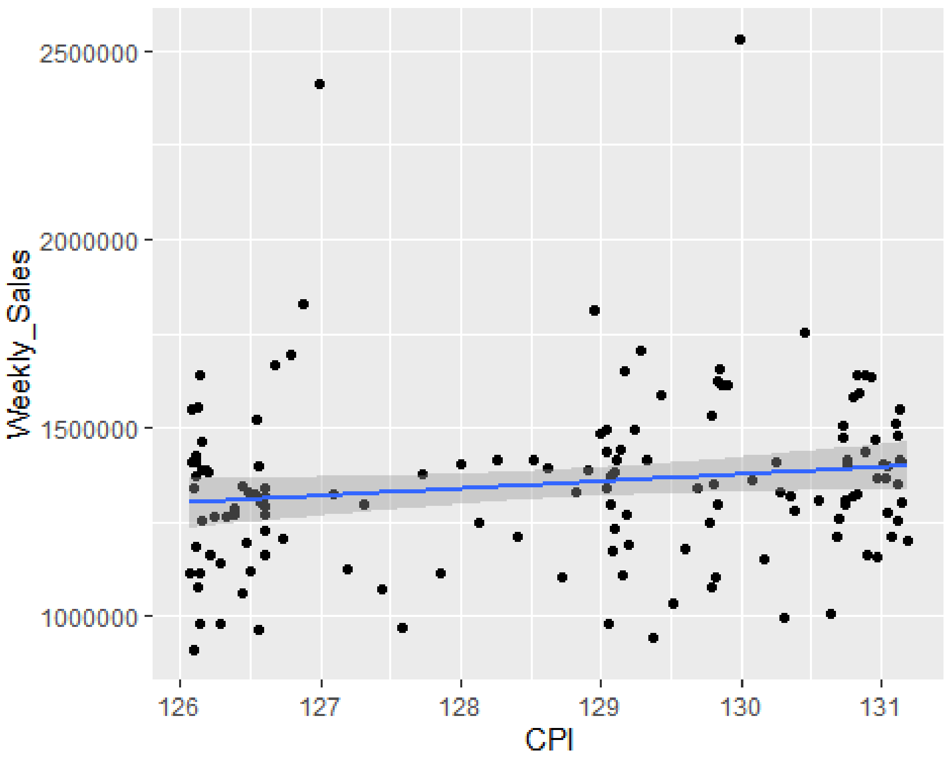
```
dfw %>%
  filter(Store==11) %>%
  ggplot(aes(x=CPI, y=Weekly_Sales))+
  geom_point() +
  geom_smooth(method='lm')
```



```r
dfw %>%
  filter(Store==12) %>%
  ggplot(aes(x=CPI, y=Weekly_Sales))+
  geom_point() +
  geom_smooth(method='lm')
```

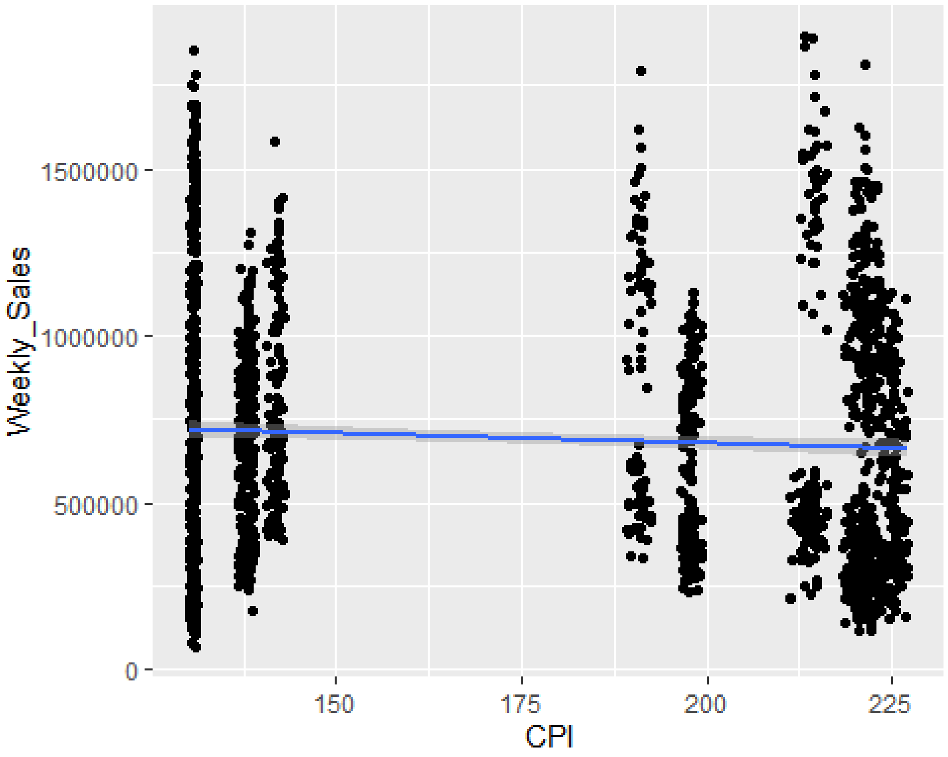


```
dfw %>%
  filter(Store==13) %>%
  ggplot(aes(x=CPI, y=Weekly_Sales))+
  geom_point() +
  geom_smooth(method='lm')
```



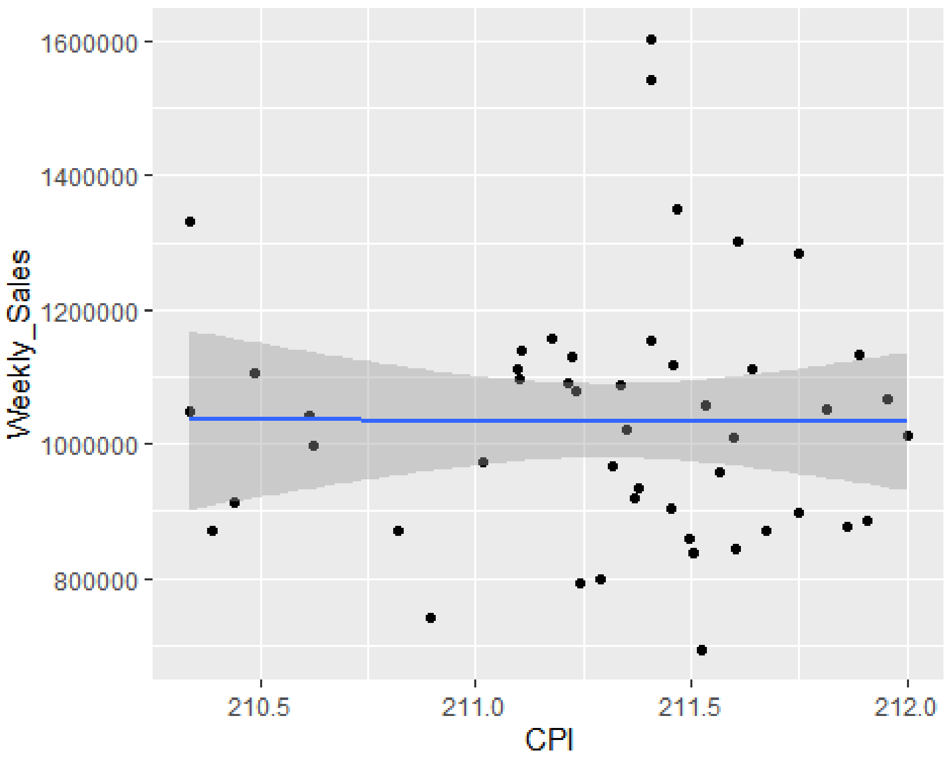
QUESTION 3

```
library("lubridate")

pltQ3 <- dfw %>%
    filter(year(Date)==2012) %>%
    ggplot(aes(x=CPI, y=Weekly_Sales))+
    geom_point()+
    geom_smooth(method=lm)

pltQ3
```



Question 4

```
dfw %>%
  filter(Store==1,year(Date)==2010) %>%
  ggplot(aes(x=CPI, y=Weekly_Sales))+
  geom_point() +
  geom_smooth(method='lm')
```



Question 5

```
fitCPISize <- lm(formula = Weekly_Sales ~ CPI + Size, data=dfw)
summary(fitCPISize)

##
## Call:
## lm(formula = Weekly_Sales ~ CPI + Size, data = dfw)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -563750 -167145  -29612  112172 1912650
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)  1.828e+05  1.497e+04  12.216   <2e-16 ***
## CPI         -6.570e+02  7.692e+01  -8.542   <2e-16 ***
## Size         4.847e+00  4.796e-02 101.048   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 242800 on 6432 degrees of freedom
## Multiple R-squared:  0.6156, Adjusted R-squared:  0.6155
## F-statistic:  5151 on 2 and 6432 DF,  p-value: < 2.2e-16

anova(fitCPI, fitCPISize)
```

```
## Analysis of Variance Table
##
## Model 1: Weekly_Sales ~ CPI
## Model 2: Weekly_Sales ~ CPI + Size
##   Res.Df        RSS Df  Sum of Sq     F    Pr(>F)
## 1   6433 9.8128e+14
## 2   6432 3.7924e+14  1 6.0204e+14 10211 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Question 7

```
fitFull <- lm(formula = Weekly_Sales ~ IsHoliday + Temperature + Fuel_Price +
CPI + Unemployment + Size, data=dfw)
summary(fitFull)
```

```
##
## Call:
## lm(formula = Weekly_Sales ~ IsHoliday + Temperature + Fuel_Price +
##     CPI + Unemployment + Size, data = dfw)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -557148 -165608  -24125  112851 1918479
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)     3.133e+05  3.546e+04   8.834  < 2e-16 ***
## IsHolidayTRUE   6.012e+04  1.196e+04   5.026 5.14e-07 ***
## Temperature     1.002e+03  1.739e+02   5.761 8.72e-09 ***
## Fuel_Price     -1.333e+04  6.822e+03  -1.954   0.0507 .
## CPI            -9.461e+02  8.445e+01 -11.203  < 2e-16 ***
## Unemployment   -1.252e+04  1.725e+03  -7.258 4.40e-13 ***
## Size            4.840e+00  4.802e-02 100.786  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 241200 on 6428 degrees of freedom
## Multiple R-squared:  0.621,  Adjusted R-squared:  0.6206
## F-statistic:  1755 on 6 and 6428 DF,  p-value: < 2.2e-16
```

```
anova(fitCPISize, fitFull)
```

```
## Analysis of Variance Table
##
## Model 1: Weekly_Sales ~ CPI + Size
## Model 2: Weekly_Sales ~ IsHoliday + Temperature + Fuel_Price + CPI +
Unemployment +
##     Size
##   Res.Df        RSS Df  Sum of Sq      F    Pr(>F)
## 1   6432 3.7924e+14
## 2   6428 3.7394e+14  4 5.3028e+12 22.789 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

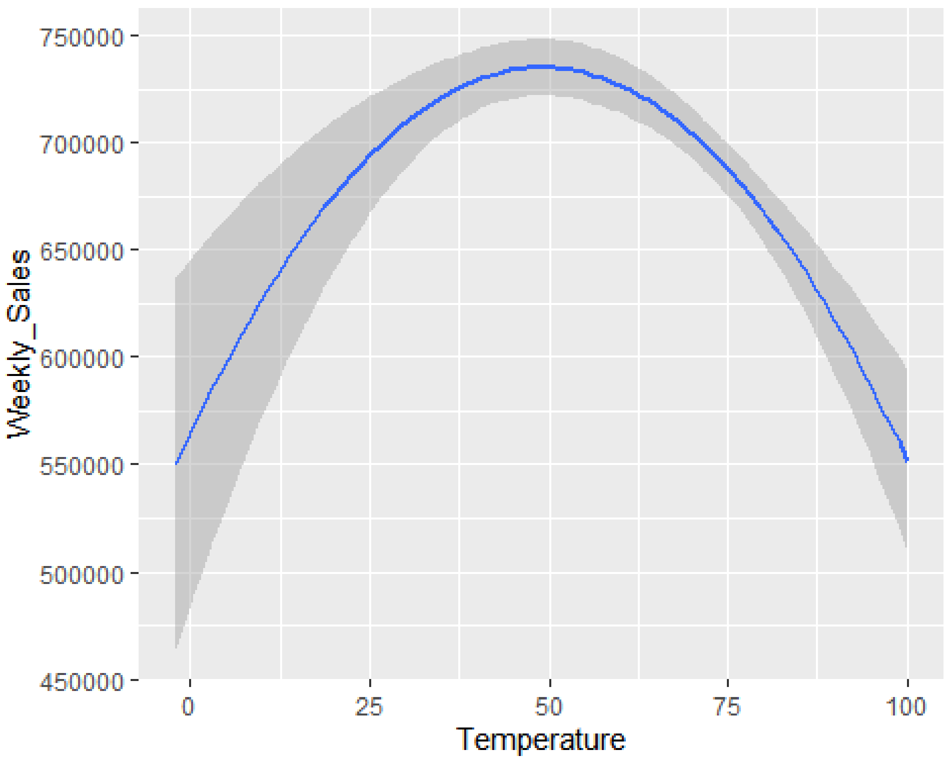
Question 8

```
fitFullTemp <- lm(formula = Weekly_Sales ~ IsHoliday + Temperature +
Fuel_Price + CPI + Unemployment + Size + I(Temperature^2), data=dfw)
summary(fitFullTemp)
```

```
##
## Call:
## lm(formula = Weekly_Sales ~ IsHoliday + Temperature + Fuel_Price +
##     CPI + Unemployment + Size + I(Temperature^2), data = dfw)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -561455 -165260  -24674  112058 1911166
##
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)       2.610e+05  4.111e+04   6.350 2.30e-10 ***
## IsHolidayTRUE     6.230e+04  1.199e+04   5.197 2.09e-07 ***
## Temperature       3.294e+03  9.301e+02   3.542   0.0004 ***
## Fuel_Price       -1.471e+04  6.841e+03  -2.151   0.0315 *
## CPI              -9.547e+02  8.449e+01 -11.300  < 2e-16 ***
## Unemployment     -1.253e+04  1.724e+03  -7.268 4.09e-13 ***
## Size              4.831e+00  4.811e-02 100.420  < 2e-16 ***
## I(Temperature^2) -1.982e+01  7.901e+00  -2.509   0.0121 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 241100 on 6427 degrees of freedom
## Multiple R-squared:  0.6214, Adjusted R-squared:  0.621
## F-statistic:  1507 on 7 and 6427 DF,  p-value: < 2.2e-16
```

Visualization:

```
dfw %>%
  ggplot(aes(x=Temperature, y=Weekly_Sales))+
  geom_smooth(method='lm', formula=y~x+I(x^2))
```



Question 9

part 9a

```
set.seed(333)
dfwTrain <- dfw %>% sample_frac(0.8)
```

part 9b

```
dfwTest <- dplyr::setdiff(dfw, dfwTrain)
```

part 9c

```
fitOrg <- lm(formula = Weekly_Sales ~ IsHoliday + Temperature + Fuel_Price +
CPI + Unemployment + Size + I(Temperature^2), data=dfwTrain)
summary(fitOrg)

##
## Call:
## lm(formula = Weekly_Sales ~ IsHoliday + Temperature + Fuel_Price +
##     CPI + Unemployment + Size + I(Temperature^2), data = dfwTrain)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -564201 -166879  -25149  111412 1909304
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)       2.635e+05  4.630e+04   5.691 1.34e-08 ***
## IsHolidayTRUE     6.569e+04  1.365e+04   4.811 1.55e-06 ***
## Temperature       3.636e+03  1.039e+03   3.498 0.000473 ***
## Fuel_Price       -1.748e+04  7.694e+03  -2.272 0.023130 *
## CPI              -9.883e+02  9.491e+01 -10.413  < 2e-16 ***
## Unemployment     -1.281e+04  1.939e+03  -6.603 4.43e-11 ***
## Size              4.851e+00  5.408e-02  89.686  < 2e-16 ***
## I(Temperature^2) -2.192e+01  8.832e+00  -2.481 0.013119 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 242200 on 5140 degrees of freedom
## Multiple R-squared:  0.6212, Adjusted R-squared:  0.6207
## F-statistic:  1204 on 7 and 5140 DF,  p-value: < 2.2e-16
```

```
tidy(fitOrg)
```

```
## # A tibble: 8 x 5
##   term              estimate  std.error statistic  p.value
##   <chr>                <dbl>      <dbl>     <dbl>    <dbl>
## 1 (Intercept)      263485.   46302.          5.69 1.34e- 8
## 2 IsHolidayTRUE     65688.   13655.          4.81 1.55e- 6
## 3 Temperature        3636.    1039.          3.50 4.73e- 4
## 4 Fuel_Price       -17481.    7694.         -2.27 2.31e- 2
## 5 CPI                -988.      94.9       -10.4  3.86e-25
## 6 Unemployment     -12805.    1939.         -6.60 4.43e-11
## 7 Size                  4.85     0.0541     89.7  0.
## 8 I(Temperature^2)    -21.9      8.83       -2.48 1.31e- 2
```

part 9d

```
resultsOrg <- dfwTest %>%
  mutate(predictedSales = predict(fitOrg,dfwTest))

resultsOrg
```

```
## # A tibble: 1,287 x 10
##    Store Date       IsHoliday Temperature Fuel_Price   CPI Unemployment
Size
##    <dbl> <date>     <lgl>           <dbl>      <dbl> <dbl>        <dbl>
<dbl>
##  1    34 2011-03-25 FALSE            53.1       3.48  129.         10.4
158114
##  2     8 2010-09-17 FALSE            75.3       2.58  215.          6.32
155078
##  3    13 2012-03-16 FALSE            52.5       3.53  131.          6.10
219622
##  4    45 2011-02-18 FALSE            40.7       3.24  184.          8.55
118221
##  5    38 2011-08-26 FALSE            94.6       3.74  129.         13.5
39690
```

```
##  6     1 2010-04-16 FALSE            66.3       2.81  210.         7.81
151315
##  7    22 2010-10-01 FALSE            69.3       2.72  137.         8.57
119557
##  8    40 2010-04-02 FALSE            41.4       2.83  132.         5.44
155083
##  9    36 2010-11-26 TRUE             67.7       2.72  211.         8.48
39910
## 10    22 2010-08-20 FALSE            73.2       2.80  137.         8.43
119557
## # ... with 1,277 more rows, and 2 more variables: Weekly_Sales <dbl>,
## #   predictedSales <dbl>
```

part 9e

```
perform_result <- metric_set(rmse, mae)
perform_result(resultsOrg, truth=Weekly_Sales, estimate=predictedSales)
```

```
## # A tibble: 2 x 3
##   .metric .estimator .estimate
##   <chr>   <chr>          <dbl>
## 1 rmse    standard     236687.
## 2 mae     standard     177863.
```

part 9f

```
fitOrgDate <- lm(formula = Weekly_Sales ~ IsHoliday + Temperature +
Fuel_Price + CPI + Unemployment + Size + Date + I(Temperature^2),
data=dfwTrain)
summary(fitOrgDate)
```

```
##
## Call:
## lm(formula = Weekly_Sales ~ IsHoliday + Temperature + Fuel_Price +
##     CPI + Unemployment + Size + Date + I(Temperature^2), data = dfwTrain)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -562281 -167059  -25354  111694 1909518
##
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)       1.194e+05  2.803e+05   0.426 0.670102
## IsHolidayTRUE     6.505e+04  1.371e+04   4.745 2.14e-06 ***
## Temperature       3.660e+03  1.041e+03   3.517 0.000439 ***
## Fuel_Price       -2.278e+04  1.275e+04  -1.786 0.074114 .
## CPI              -1.001e+03  9.792e+01 -10.221  < 2e-16 ***
## Unemployment     -1.252e+04  2.017e+03  -6.207 5.83e-10 ***
## Size              4.851e+00  5.410e-02  89.669  < 2e-16 ***
## Date              1.065e+01  2.043e+01   0.521 0.602246
## I(Temperature^2) -2.217e+01  8.845e+00  -2.506 0.012247 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 242200 on 5139 degrees of freedom
## Multiple R-squared:  0.6212, Adjusted R-squared:  0.6206
## F-statistic:  1053 on 8 and 5139 DF,  p-value: < 2.2e-16
```

```
resultsOrgDate <-dfwTest %>%
  mutate(predictedSales = predict(fitOrgDate, dfwTest))

resultsOrgDate
```

```
## # A tibble: 1,287 x 10
##    Store Date       IsHoliday Temperature Fuel_Price   CPI Unemployment
Size
##    <dbl> <date>     <lgl>           <dbl>      <dbl> <dbl>        <dbl>
<dbl>
##  1    34 2011-03-25 FALSE            53.1       3.48  129.        10.4
158114
##  2     8 2010-09-17 FALSE            75.3       2.58  215.         6.32
155078
##  3    13 2012-03-16 FALSE            52.5       3.53  131.         6.10
219622
##  4    45 2011-02-18 FALSE            40.7       3.24  184.         8.55
118221
##  5    38 2011-08-26 FALSE            94.6       3.74  129.        13.5
39690
##  6     1 2010-04-16 FALSE            66.3       2.81  210.         7.81
151315
##  7    22 2010-10-01 FALSE            69.3       2.72  137.         8.57
119557
##  8    40 2010-04-02 FALSE            41.4       2.83  132.         5.44
155083
##  9    36 2010-11-26 TRUE             67.7       2.72  211.         8.48
39910
## 10    22 2010-08-20 FALSE            73.2       2.80  137.         8.43
119557
## # ... with 1,277 more rows, and 2 more variables: Weekly_Sales <dbl>,
## #   predictedSales <dbl>
```

```
perform_result(resultsOrgDate, truth=Weekly_Sales, estimate=predictedSales)
```

```
## # A tibble: 2 x 3
##   .metric .estimator .estimate
##   <chr>   <chr>          <dbl>
## 1 rmse    standard     236595.
## 2 mae     standard     177765.
```

part 9g

```
fitOrgNoUn <- lm(formula = Weekly_Sales ~ IsHoliday + Temperature +
Fuel_Price + CPI  + Size + I(Temperature^2), data=dfwTrain)
summary(fitOrgNoUn)
```

```
##
## Call:
## lm(formula = Weekly_Sales ~ IsHoliday + Temperature + Fuel_Price +
##     CPI + Size + I(Temperature^2), data = dfwTrain)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -571464 -169026  -27962  112635 1905709
##
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)       1.125e+05  4.043e+04   2.783  0.00541 **
## IsHolidayTRUE     6.362e+04  1.371e+04   4.641 3.55e-06 ***
## Temperature       3.419e+03  1.043e+03   3.278  0.00105 **
## Fuel_Price       -1.087e+04  7.660e+03  -1.419  0.15605
## CPI              -7.762e+02  8.968e+01  -8.655  < 2e-16 ***
## Size              4.878e+00  5.414e-02  90.097  < 2e-16 ***
## I(Temperature^2) -2.197e+01  8.868e+00  -2.478  0.01325 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 243200 on 5141 degrees of freedom
## Multiple R-squared:  0.618,  Adjusted R-squared:  0.6175
## F-statistic:  1386 on 6 and 5141 DF,  p-value: < 2.2e-16
```

```
resultsOrgNoUn <-dfwTest %>%
  mutate(predictedSales = predict(fitOrgNoUn, dfwTest))
resultsOrgNoUn
```

```
## # A tibble: 1,287 x 10
##    Store Date       IsHoliday Temperature Fuel_Price   CPI Unemployment
Size
##    <dbl> <date>     <lgl>           <dbl>      <dbl> <dbl>        <dbl>
<dbl>
##  1    34 2011-03-25 FALSE            53.1       3.48  129.         10.4
158114
##  2     8 2010-09-17 FALSE            75.3       2.58  215.          6.32
155078
##  3    13 2012-03-16 FALSE            52.5       3.53  131.          6.10
219622
##  4    45 2011-02-18 FALSE            40.7       3.24  184.          8.55
118221
##  5    38 2011-08-26 FALSE            94.6       3.74  129.         13.5
39690
##  6     1 2010-04-16 FALSE            66.3       2.81  210.          7.81
151315
```

```
##  7    22 2010-10-01 FALSE            69.3       2.72  137.          8.57
119557
##  8    40 2010-04-02 FALSE            41.4       2.83  132.          5.44
155083
##  9    36 2010-11-26 TRUE             67.7       2.72  211.          8.48
39910
## 10    22 2010-08-20 FALSE            73.2       2.80  137.          8.43
119557
## # ... with 1,277 more rows, and 2 more variables: Weekly_Sales <dbl>,
## #   predictedSales <dbl>
```

```
perform_result(resultsOrgNoUn, truth=Weekly_Sales, estimate=predictedSales)
```

```
## # A tibble: 2 x 3
##   .metric .estimator .estimate
##   <chr>   <chr>          <dbl>
## 1 rmse    standard     237532.
## 2 mae     standard     178680.
```

Question 10

```
set.seed(333)

dfwTrainln <- dfw %>%
 sample_frac(0.8)

dfwTestln <- dplyr::setdiff(dfw, dfwTrainln)
fitLog <- lm(log1p(Weekly_Sales)~. + I(Temperature^2) - Date  - Store,
data=dfwTrainln)
  summary(fitLog)
```

```
## 
## Call:
## lm(formula = log1p(Weekly_Sales) ~ . + I(Temperature^2) - Date - 
##     Store, data = dfwTrainln)
## 
## Residuals:
##      Min       1Q   Median       3Q      Max 
## -1.47563 -0.22777 -0.01893  0.22414  1.46688 
## 
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)    
## (Intercept)       1.233e+01  6.370e-02 193.558  < 2e-16 ***
## IsHolidayTRUE     7.941e-02  1.879e-02   4.227 2.41e-05 ***
## Temperature       5.660e-03  1.430e-03   3.958 7.67e-05 ***
## Fuel_Price       -1.908e-03  1.059e-02  -0.180 0.856955    
## CPI              -1.197e-03  1.306e-04  -9.164  < 2e-16 ***
## Unemployment     -6.863e-03  2.668e-03  -2.572 0.010132 *  
## Size              8.146e-06  7.441e-08 109.472  < 2e-16 ***
## I(Temperature^2) -4.592e-05  1.215e-05  -3.779 0.000159 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3332 on 5140 degrees of freedom
## Multiple R-squared:  0.7082, Adjusted R-squared:  0.7078
## F-statistic:  1783 on 7 and 5140 DF,  p-value: < 2.2e-16
```

```
resultsln <-dfwTestln %>%
  mutate(predictedSales = predict(fitLog, dfwTestln))
resultsln
```

```
## # A tibble: 1,287 x 10
##    Store Date       IsHoliday Temperature Fuel_Price   CPI Unemployment
Size
##    <dbl> <date>     <lgl>           <dbl>      <dbl> <dbl>        <dbl>
<dbl>
##  1    34 2011-03-25 FALSE            53.1       3.48  129.         10.4
158114
##  2     8 2010-09-17 FALSE            75.3       2.58  215.          6.32
155078
##  3    13 2012-03-16 FALSE            52.5       3.53  131.          6.10
219622
##  4    45 2011-02-18 FALSE            40.7       3.24  184.          8.55
118221
##  5    38 2011-08-26 FALSE            94.6       3.74  129.         13.5
39690
##  6     1 2010-04-16 FALSE            66.3       2.81  210.          7.81
151315
##  7    22 2010-10-01 FALSE            69.3       2.72  137.          8.57
119557
##  8    40 2010-04-02 FALSE            41.4       2.83  132.          5.44
155083
##  9    36 2010-11-26 TRUE             67.7       2.72  211.          8.48
39910
## 10    22 2010-08-20 FALSE            73.2       2.80  137.          8.43
119557
## # ... with 1,277 more rows, and 2 more variables: Weekly_Sales <dbl>,
## #   predictedSales <dbl>
```

```
perform_result(resultsln, truth=Weekly_Sales, estimate=exp(predictedSales))
```

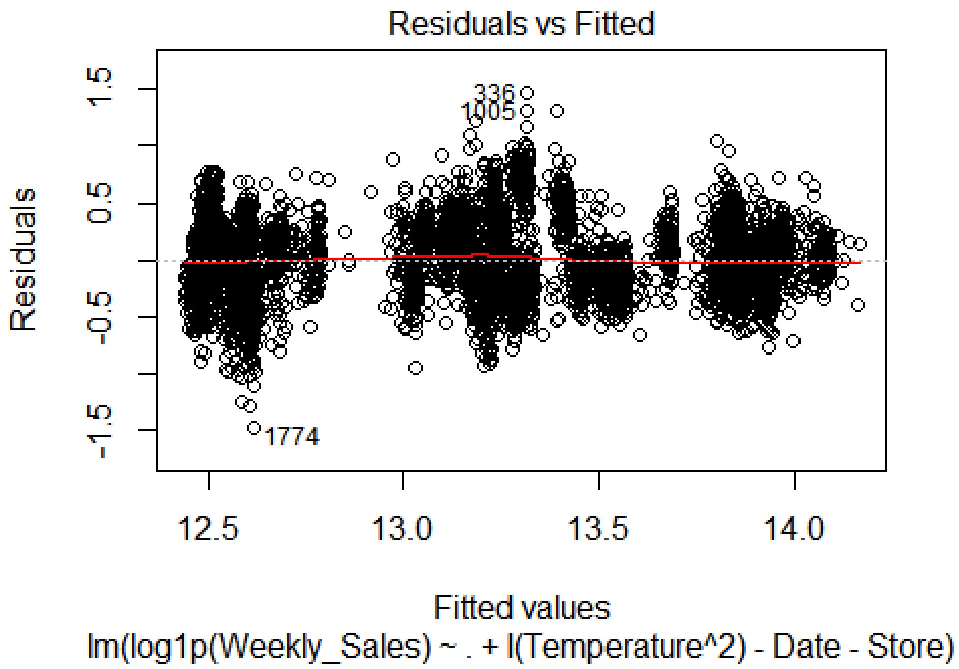
```
## # A tibble: 2 x 3
##   .metric .estimator .estimate
##   <chr>   <chr>          <dbl>
## 1 rmse    standard     237825.
## 2 mae     standard     171555.
```

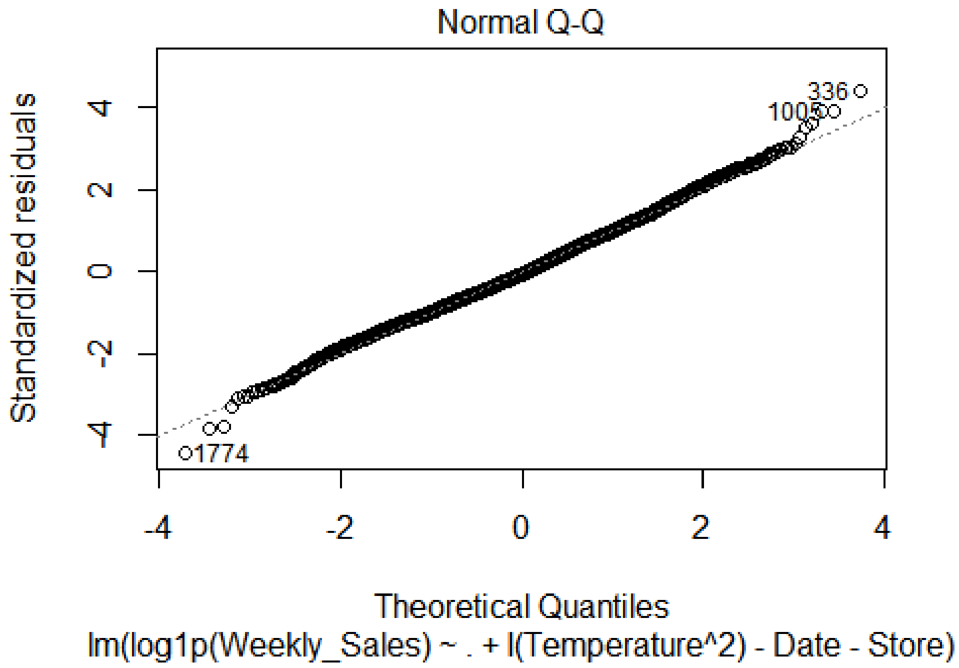
```
anova(fitLog, fitOrg)
```

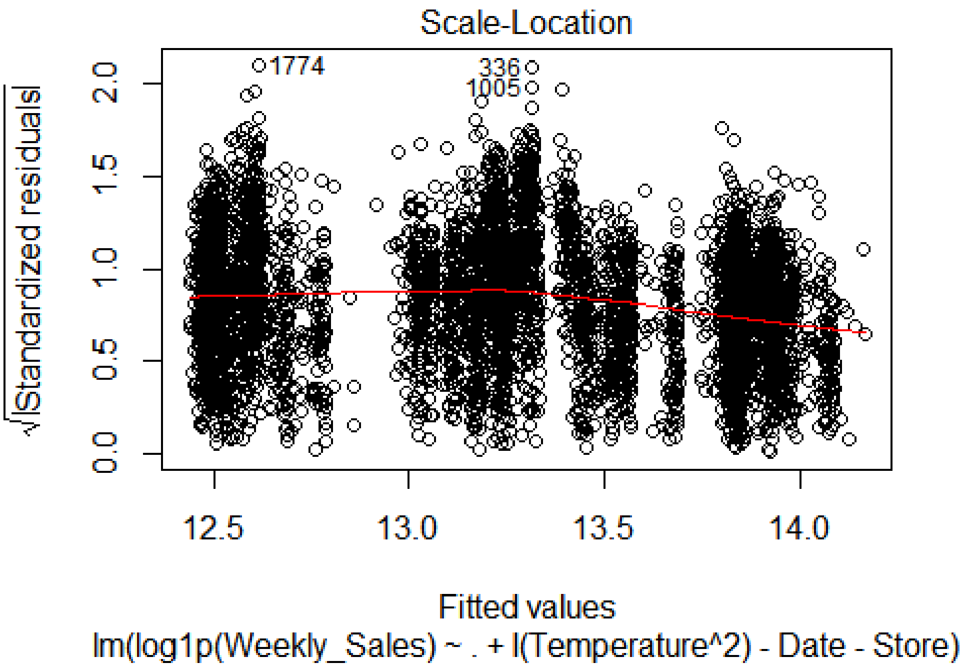
```
## Warning in anova.lmlist(object, ...): models with response
'"Weekly_Sales"'
## removed because response differs from model 1
## Analysis of Variance Table
##
## Response: log1p(Weekly_Sales)
##                    Df  Sum Sq Mean Sq   F value    Pr(>F)    
## IsHoliday           1    2.04    2.04    18.335 1.887e-05 ***
## Temperature         1   15.69   15.69   141.358 < 2.2e-16 ***
## Fuel_Price          1    2.90    2.90    26.110 3.342e-07 ***
## CPI                 1    6.09    6.09    54.829 1.528e-13 ***
## Unemployment        1   13.83   13.83   124.570 < 2.2e-16 ***
## Size                1 1343.23 1343.23 12098.034 < 2.2e-16 ***
## I(Temperature^2)    1    1.59    1.59    14.281 0.0001592 ***
## Residuals        5140  570.69    0.11                        
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

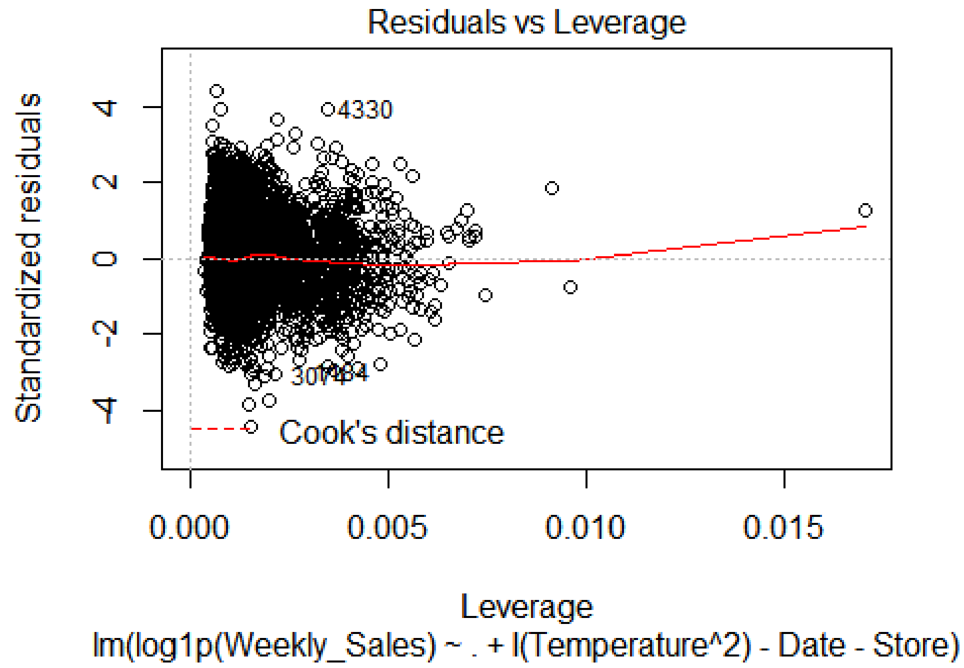
Diagnostic:

```
plot(fitLog)
```

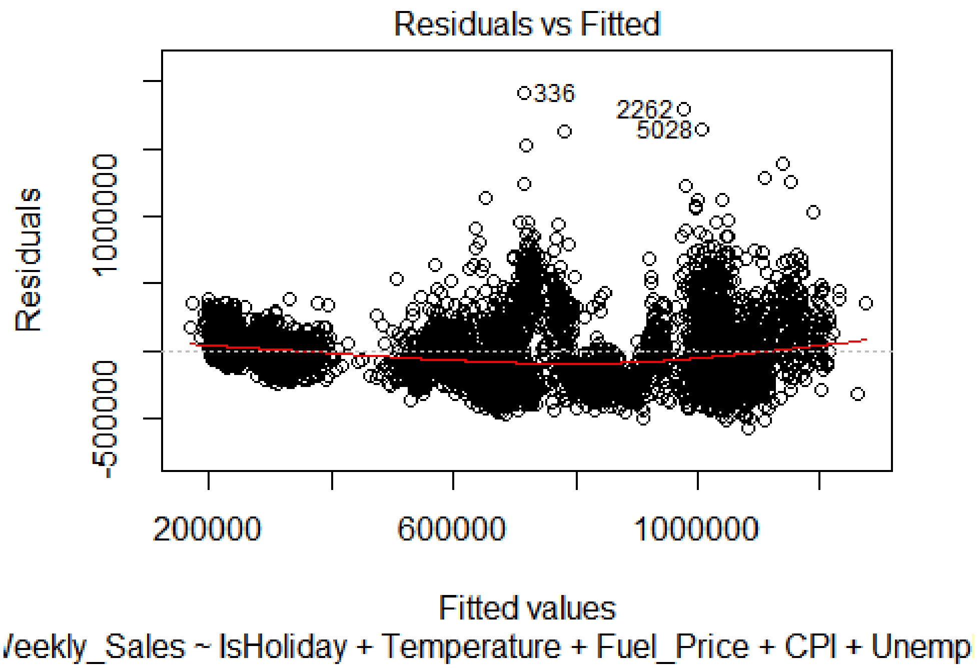

Residuals vs Fitted
Residuals
1.5
0.5
-0.5
-1.5
336
1005
1774
12.5
13.0
13.5
14.0
Fitted values
lm(log1p(Weekly_Sales) ~ . + I(Temperature^2) - Date - Store)

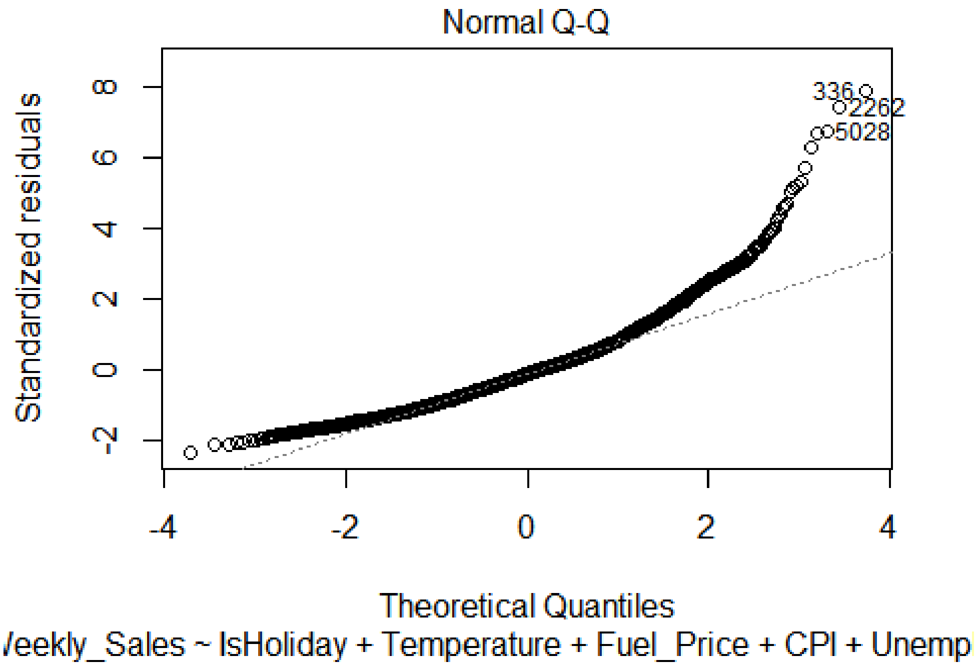

Normal Q-Q
Standardized residuals
4
2
0
-2
-4
336
1005
1774
-4
-2
0
2
4
Theoretical Quantiles
lm(log1p(Weekly_Sales) ~ . + I(Temperature^2) - Date - Store)

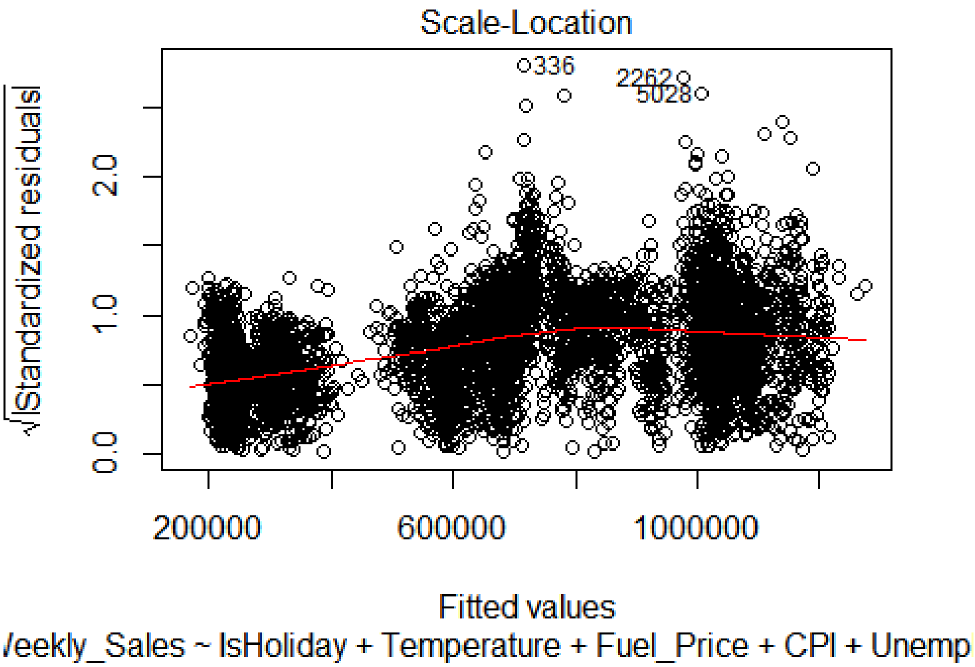

Scale-Location
√|Standardized residuals|
0.0
0.5
1.0
1.5
2.0
1774
336
1005
12.5
13.0
13.5
14.0
Fitted values
lm(log1p(Weekly_Sales) ~ . + I(Temperature^2) - Date - Store)

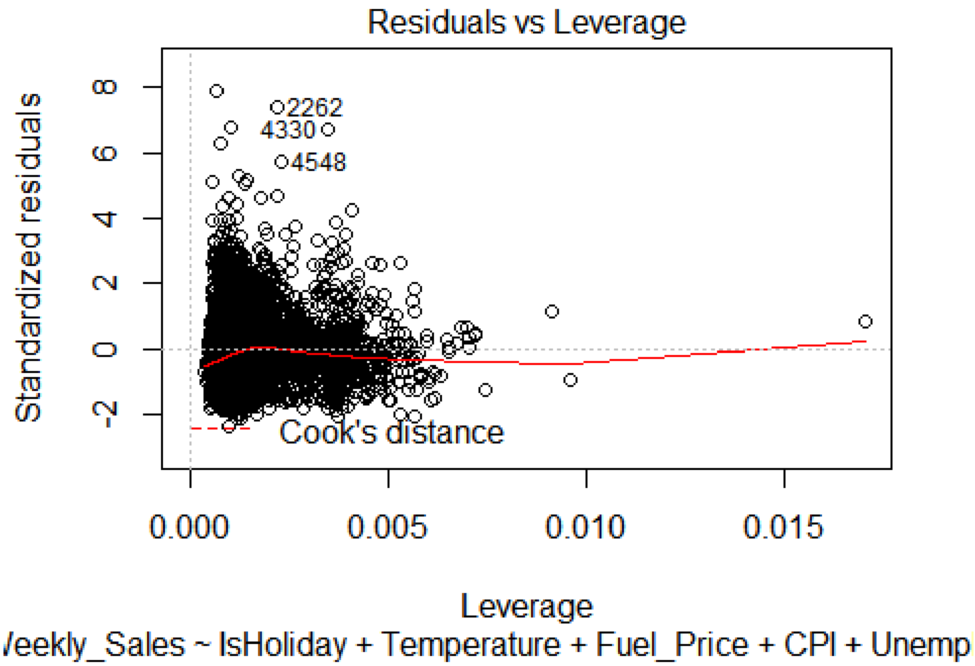

Residuals vs Leverage
Standardized residuals
-4
-2
0
2
4
4330
30784
Cook's distance
0.000
0.005
0.010
0.015
Leverage
lm(log1p(Weekly_Sales) ~ . + I(Temperature^2) - Date - Store)

```
plot(fitOrg)
```

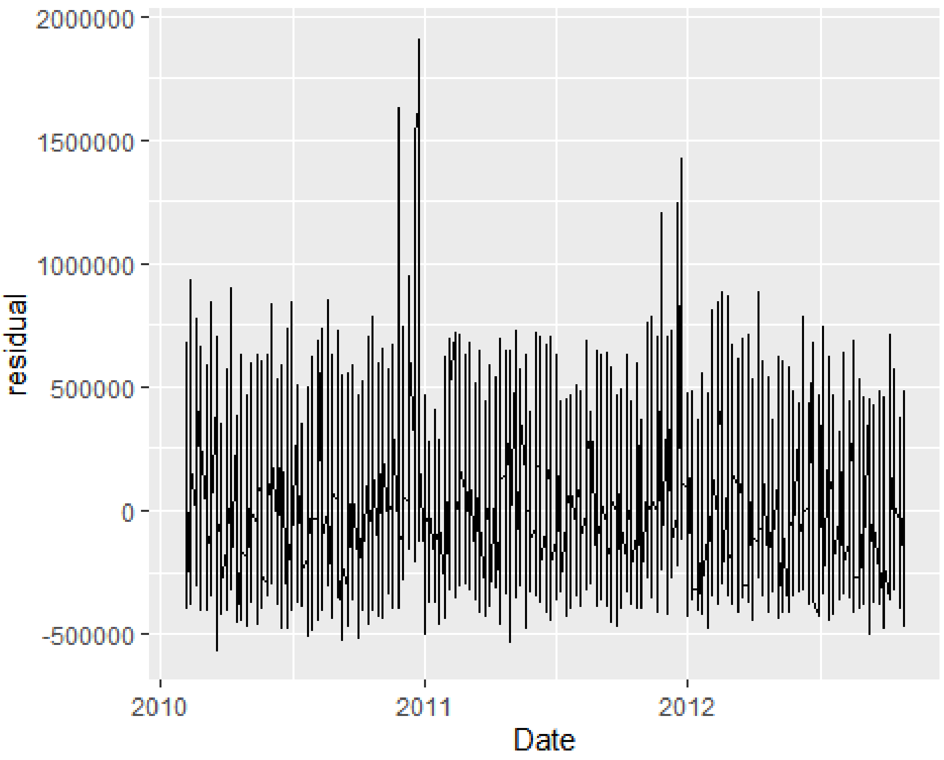

Residuals vs Fitted
Residuals
-500000
1000000
200000
600000
1000000
Fitted values
/eekly_Sales ~ IsHoliday + Temperature + Fuel_Price + CPI + Unemp
336
2262
5028


Normal Q-Q
Standardized residuals
-2
0
2
4
6
8
-4
-2
0
2
4
Theoretical Quantiles
/eekly_Sales ~ IsHoliday + Temperature + Fuel_Price + CPI + Unemp
336
2262
5028

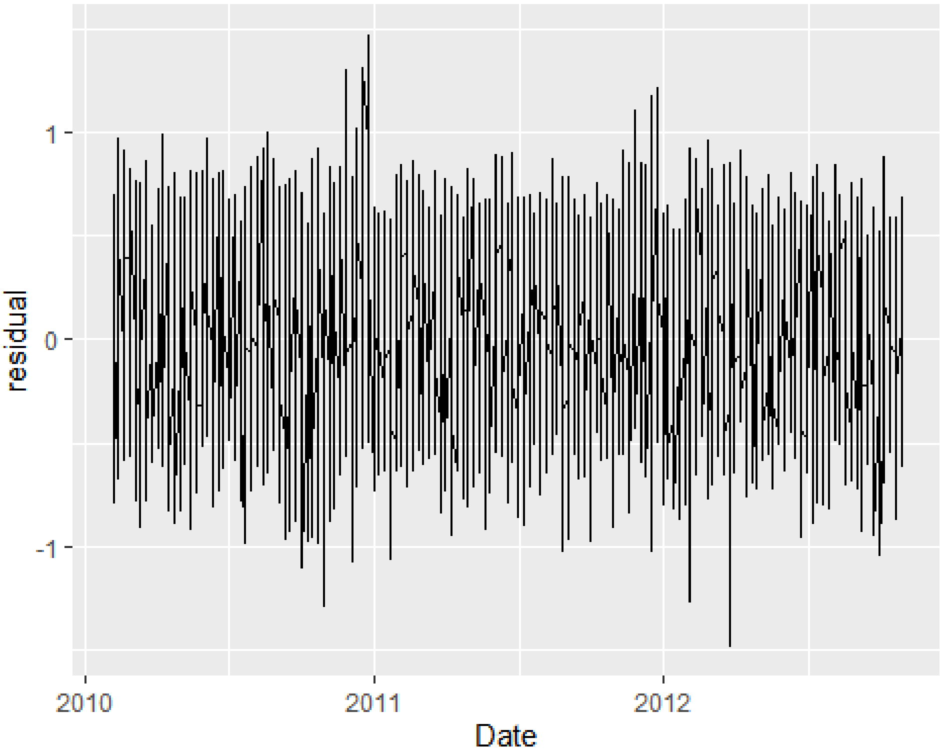




```
dfw %>%
modelr::add_residuals(fitOrg, var="residual") %>%
ggplot(aes(Date, residual))+geom_line()
```



```
dfw %>%
modelr::add_residuals(fitLog, var="residual") %>%
ggplot(aes(Date, residual))+geom_line()
```



```
library(car)

## Loading required package: carData

## Registered S3 methods overwritten by 'car':
##   method                          from
##   influence.merMod                lme4
##   cooks.distance.influence.merMod lme4
##   dfbeta.influence.merMod         lme4
##   dfbetas.influence.merMod        lme4

##
## Attaching package: 'car'

## The following object is masked from 'package:dplyr':
##
##     recode

## The following object is masked from 'package:purrr':
##
##     some

car::vif(fitOrg)

##        IsHoliday      Temperature        Fuel_Price               CPI
##         1.034109        32.240751          1.100752          1.221980
##     Unemployment             Size I(Temperature^2)
##         1.151461         1.022226         31.836056

car::vif(fitLog)

##        IsHoliday      Temperature        Fuel_Price               CPI
##         1.034109        32.240751          1.100752          1.221980
##     Unemployment             Size I(Temperature^2)
##         1.151461         1.022226         31.836056
```

BONUS QUESTION

```
dfw2 <- dfw %>%
  mutate(salesPerSquareFoot = Weekly_Sales/Size)
dfw2

## # A tibble: 6,435 x 10
##    Store Date       IsHoliday Temperature Fuel_Price   CPI Unemployment
Size
##    <dbl> <date>     <lgl>           <dbl>      <dbl> <dbl>        <dbl>
<dbl>
##  1    26 2011-08-26 FALSE            61.1       3.80  136.         7.77
152513
##  2    34 2011-03-25 FALSE            53.1       3.48  129.        10.4
158114
##  3    21 2010-12-03 FALSE            50.4       2.71  211.         8.16
```

```
140167
##  4     8 2010-09-17 FALSE            75.3       2.58  215.         6.32
155078
##  5    19 2012-05-18 FALSE            58.8       4.03  138.         8.15
203819
##  6    13 2012-03-16 FALSE            52.5       3.53  131.         6.10
219622
##  7    19 2010-08-06 FALSE            74.2       2.94  133.         8.10
203819
##  8     2 2010-12-24 FALSE            50.0       2.89  211.         8.16
202307
##  9    32 2010-10-08 FALSE            61.8       2.74  191.         9.14
203007
## 10    45 2012-03-02 FALSE            41.6       3.82  190.         8.42
118221
## # ... with 6,425 more rows, and 2 more variables: Weekly_Sales <dbl>,
## #   salesPerSquareFoot <dbl>
```

```
set.seed(333)

dfwTrain2 <- dfw2 %>%
  sample_frac(0.8)
dfwTest2 <- dplyr::setdiff(dfw2, dfwTrain2)
fitSalesSqFoot <- lm(salesPerSquareFoot~. + I(Temperature^2) - Store - Date -
Weekly_Sales, data=dfwTrain2)
  summary(fitSalesSqFoot)
```

```
## 
## Call:
## lm(formula = salesPerSquareFoot ~ . + I(Temperature^2) - Store - 
##     Date - Weekly_Sales, data = dfwTrain2)
## 
## Residuals:
##     Min      1Q  Median      3Q     Max 
## -4.8163 -1.3917 -0.3038  1.1058 14.9128 
## 
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)    
## (Intercept)       6.459e+00  3.833e-01  16.851  < 2e-16 ***
## IsHolidayTRUE     6.137e-01  1.130e-01   5.429 5.91e-08 ***
## Temperature       3.949e-02  8.604e-03   4.589 4.55e-06 ***
## Fuel_Price       -1.117e-01  6.369e-02  -1.754 0.079512 .  
## CPI              -2.566e-03  7.856e-04  -3.267 0.001096 ** 
## Unemployment     -1.792e-02  1.605e-02  -1.116 0.264403    
## Size             -9.593e-06  4.477e-07 -21.429  < 2e-16 ***
## I(Temperature^2) -2.493e-04  7.311e-05  -3.410 0.000655 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 2.005 on 5140 degrees of freedom
## Multiple R-squared:  0.09829,    Adjusted R-squared:  0.09707
## F-statistic: 80.04 on 7 and 5140 DF,  p-value: < 2.2e-16
```

```
results2 <-dfwTest2 %>%
  mutate(predictSalesPerSqFoot = predict(fitSalesSqFoot, dfwTest2))
results2
```

```
## # A tibble: 1,287 x 11
##    Store Date       IsHoliday Temperature Fuel_Price   CPI Unemployment
Size
##    <dbl> <date>     <lgl>           <dbl>      <dbl> <dbl>        <dbl>
<dbl>
##   1    34 2011-03-25 FALSE            53.1       3.48  129.        10.4 
158114
##   2     8 2010-09-17 FALSE            75.3       2.58  215.         6.32
155078
##   3    13 2012-03-16 FALSE            52.5       3.53  131.         6.10
219622
##   4    45 2011-02-18 FALSE            40.7       3.24  184.         8.55
118221
##   5    38 2011-08-26 FALSE            94.6       3.74  129.        13.5 
39690
##   6     1 2010-04-16 FALSE            66.3       2.81  210.         7.81
151315
##   7    22 2010-10-01 FALSE            69.3       2.72  137.         8.57
119557
##   8    40 2010-04-02 FALSE            41.4       2.83  132.         5.44
155083
##   9    36 2010-11-26 TRUE             67.7       2.72  211.         8.48
39910
## 10    22 2010-08-20 FALSE            73.2       2.80  137.         8.43
119557
## # ... with 1,277 more rows, and 3 more variables: Weekly_Sales <dbl>,
## #   salesPerSquareFoot <dbl>, predictSalesPerSqFoot <dbl>
```

```
perform_result(results2, truth=salesPerSquareFoot,
estimate=predictSalesPerSqFoot)
```

```
## # A tibble: 2 x 3
##   .metric .estimator .estimate
##   <chr>   <chr>          <dbl>
## 1 rmse    standard        1.90
## 2 mae     standard        1.49
```

#Without Size variable

```
fitSalesSqFoot2 <- lm(salesPerSquareFoot~. + I(Temperature^2) - Store - Date
- Weekly_Sales - Size, data=dfwTrain2)
  summary(fitSalesSqFoot2)
```

```
##
## Call:
## lm(formula = salesPerSquareFoot ~ . + I(Temperature^2) - Store -
##     Date - Weekly_Sales - Size, data = dfwTrain2)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.1697 -1.5086 -0.4037  1.0960 14.9822
##
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)    
## (Intercept)       5.126e+00  3.947e-01  12.987  < 2e-16 ***
## IsHolidayTRUE     6.222e-01  1.180e-01   5.274 1.39e-07 ***
## Temperature       3.012e-02  8.968e-03   3.359 0.000788 ***
## Fuel_Price       -1.258e-01  6.647e-02  -1.893 0.058411 .  
## CPI              -2.254e-03  8.198e-04  -2.750 0.005979 ** 
## Unemployment      8.738e-03  1.670e-02   0.523 0.600877    
## I(Temperature^2) -1.417e-04  7.612e-05  -1.861 0.062772 .  
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.092 on 5141 degrees of freedom
## Multiple R-squared:  0.01774,    Adjusted R-squared:  0.01659 
## F-statistic: 15.48 on 6 and 5141 DF,  p-value: < 2.2e-16
```

```
resultsWOSize <-dfwTest2 %>%
  mutate(predictSalesPerSqFoot2 = predict(fitSalesSqFoot2, dfwTest2))

resultsWOSize
```

```
## # A tibble: 1,287 x 11
##    Store Date       IsHoliday Temperature Fuel_Price   CPI Unemployment
Size
##    <dbl> <date>     <lgl>           <dbl>      <dbl> <dbl>        <dbl>
<dbl>
##  1    34 2011-03-25 FALSE            53.1       3.48  129.        10.4 
158114
##  2     8 2010-09-17 FALSE            75.3       2.58  215.         6.32
155078
##  3    13 2012-03-16 FALSE            52.5       3.53  131.         6.10
219622
##  4    45 2011-02-18 FALSE            40.7       3.24  184.         8.55
118221
##  5    38 2011-08-26 FALSE            94.6       3.74  129.        13.5 
39690
##  6     1 2010-04-16 FALSE            66.3       2.81  210.         7.81
151315
##  7    22 2010-10-01 FALSE            69.3       2.72  137.         8.57
119557
##  8    40 2010-04-02 FALSE            41.4       2.83  132.         5.44
```

```
155083
##  9    36 2010-11-26 TRUE             67.7       2.72  211.         8.48
39910
## 10    22 2010-08-20 FALSE            73.2       2.80  137.         8.43
119557
## # ... with 1,277 more rows, and 3 more variables: Weekly_Sales <dbl>,
## #   salesPerSquareFoot <dbl>, predictSalesPerSqFoot2 <dbl>
```

```
perform_result(resultsWOSize, truth=salesPerSquareFoot,
estimate=predictSalesPerSqFoot2)
```

```
## # A tibble: 2 x 3
##   .metric .estimator .estimate
##   <chr>   <chr>          <dbl>
## 1 rmse    standard        2.01
## 2 mae     standard        1.59
```