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.

```r
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()
```

```r
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()
```

```
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
```

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

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

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

```
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
```

```
dfw <-
  read_csv("walmartSales.csv") %>%
  rename_all(tolower)
```

```
## 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()
## )
```

Question 1:

```
summary(dfw)
```

```
##      store          date              isholiday       temperature
##  Min.   : 1   Min.   :2010-02-05   Mode :logical   Min.   : -2.06
##  1st Qu.:12   1st Qu.:2010-10-08   FALSE:5985      1st Qu.: 47.46
##  Median :23   Median :2011-06-17   TRUE :450       Median : 62.67
##  Mean   :23   Mean   :2011-06-17                   Mean   : 60.66
##  3rd Qu.:34   3rd Qu.:2012-02-24                   3rd Qu.: 74.94
##  Max.   :45   Max.   :2012-10-26                   Max.   :100.14
##    fuel_price         cpi         unemployment         size
##  Min.   :2.472   Min.   :126.1   Min.   : 3.879   Min.   : 34875
##  1st Qu.:2.933   1st Qu.:131.7   1st Qu.: 6.891   1st Qu.: 70713
##  Median :3.445   Median :182.6   Median : 7.874   Median :126512
##  Mean   :3.359   Mean   :171.6   Mean   : 7.999   Mean   :130288
##  3rd Qu.:3.735   3rd Qu.:212.7   3rd Qu.: 8.622   3rd Qu.:202307
##  Max.   :4.468   Max.   :227.2   Max.   :14.313   Max.   :219622
##   weekly_sales
##  Min.   :  68982
##  1st Qu.: 375614
##  Median : 639652
##  Mean   : 701560
##  3rd Qu.: 958807
##  Max.   :2773216
```

```
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
```

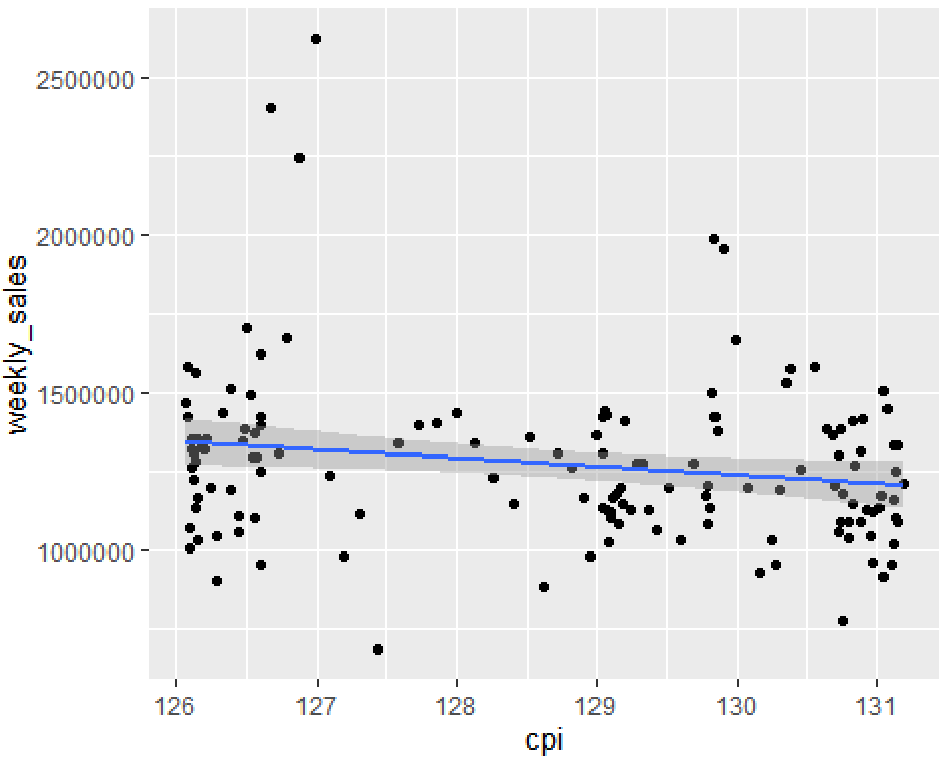
```
152513
## 2    34 2011-03-25 FALSE            53.1       3.48  129.        10.4
158114
## 3    21 2010-12-03 FALSE            50.4       2.71  211.         8.16
140167
## 4     8 2010-09-17 FALSE            75.3       2.58  215.         6.32
155078
## 5    19 2012-05-18 FALSE            58.8       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>
```

```
fitcpi<- lm(formula=weekly_sales~cpi,data=dfw)
summary(fitcpi)
```

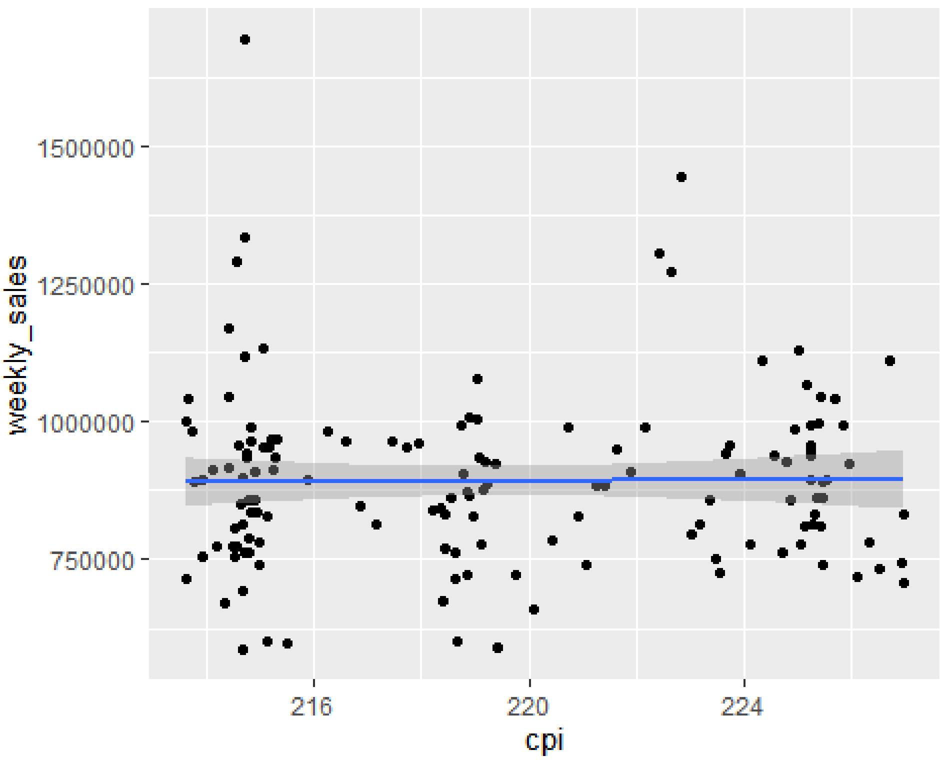
```
##
## Call:
## lm(formula = weekly_sales ~ cpi, data = dfw)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -662386 -318443  -73868  258442 2095880
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 827280.5    21778.4  37.986  < 2e-16 ***
## cpi           -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:

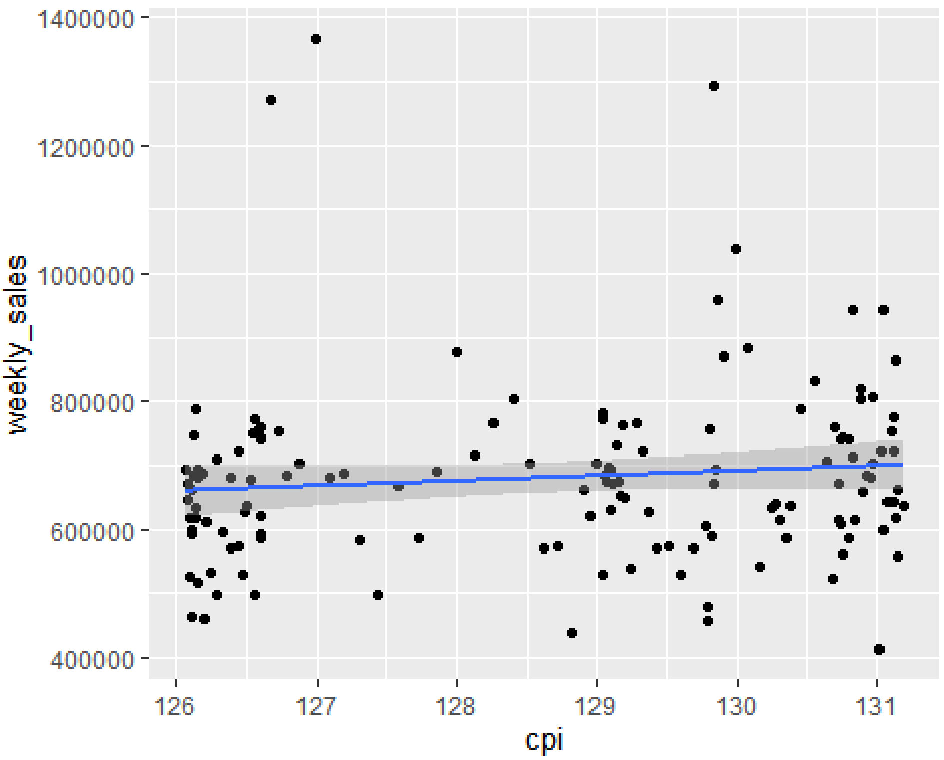
```
#for Store10
plot1<-dfw %>%
  filter(store==10) %>%
  ggplot(mapping=
aes(x=cpi,y=weekly_sales))+geom_point()+geom_smooth(method=lm)
plot1
```



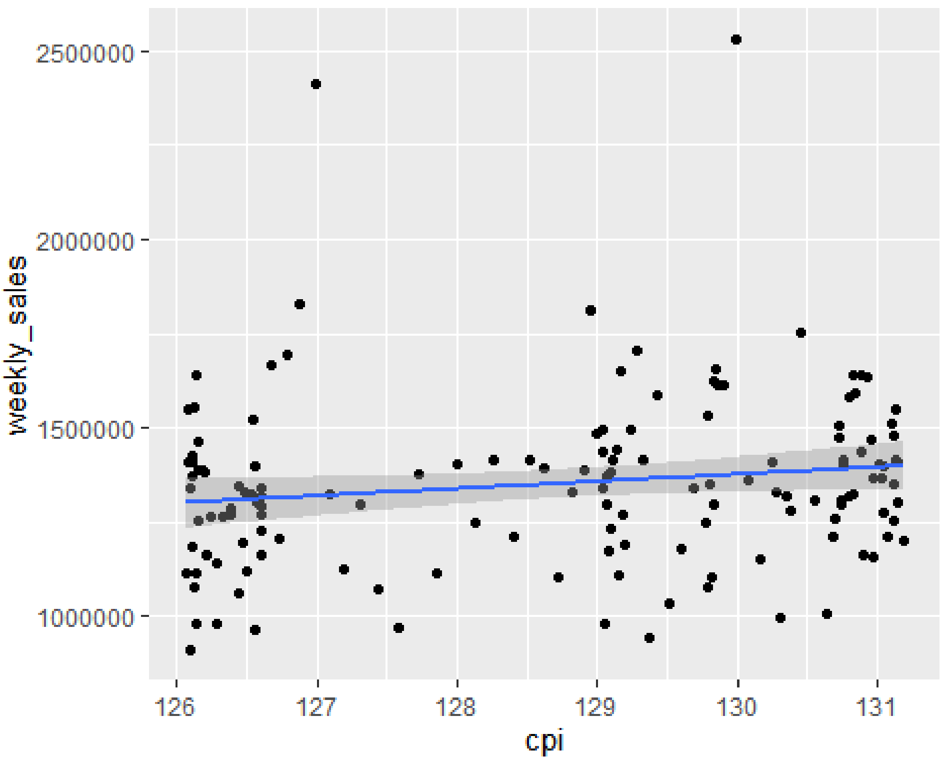
```
#for Store11
plot2<-dfw %>%
  filter(store==11) %>%
  ggplot(mapping=
aes(x=cpi,y=weekly_sales))+geom_point()+geom_smooth(method=lm)
plot2
```



```
#for Store12
plot3<-dfw %>%
  filter(store==12) %>%
  ggplot(mapping=
aes(x=cpi,y=weekly_sales))+geom_point()+geom_smooth(method=lm)
plot3
```

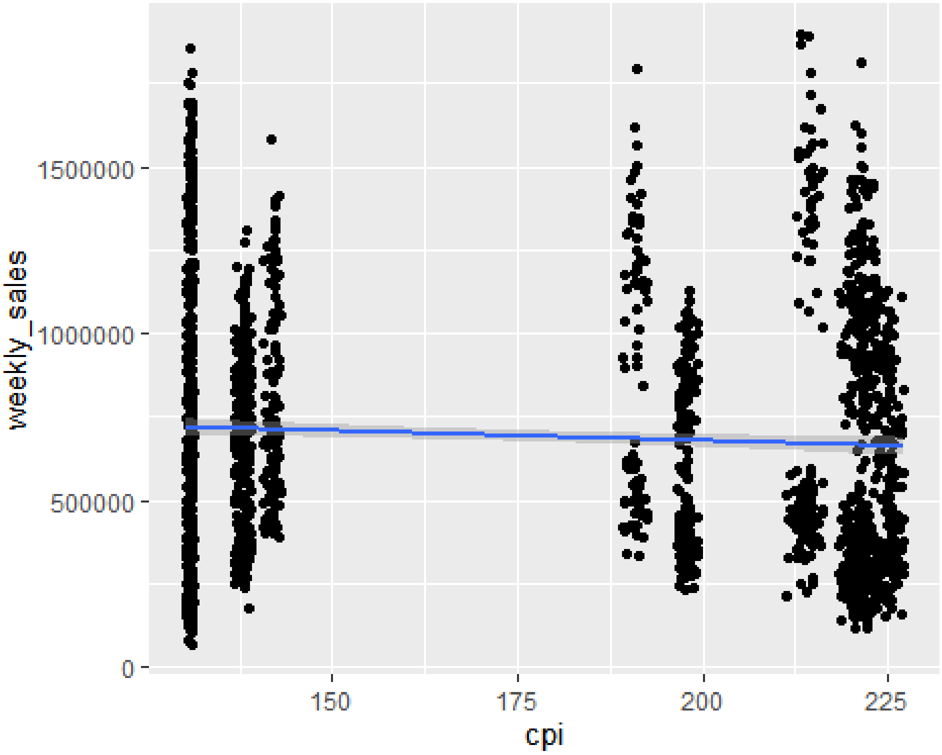


```
#for Store13
plot4<-dfw %>%
  filter(store==13) %>%
  ggplot(mapping=
aes(x=cpi,y=weekly_sales))+geom_point()+geom_smooth(method=lm)
plot4
```



Question 3:

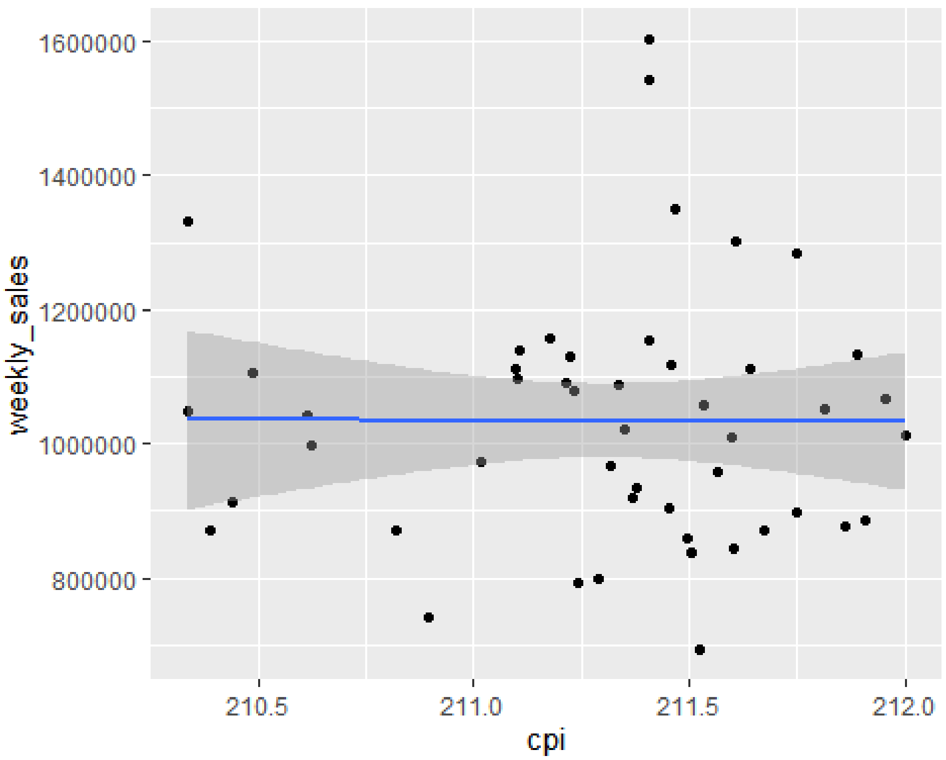
```
#for year 2012
plotYear <- dfw %>%
  filter(year(date)==2012) %>%
  ggplot(mapping=
aes(x=cpi,y=weekly_sales))+geom_point()+geom_smooth(method=lm)
plotYear
```



```
ggplotly(plotYear)
```

Question 4:

```
plotYearStr <- dfw %>%
  filter(store==1 , year(date)==2010) %>%
  ggplot(mapping=
aes(x=cpi,y=weekly_sales))+geom_point()+geom_smooth(method=lm)
plotYearStr
```



```
ggplotly(plotYearStr)
```

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
```

```
fitFull <-lm(formula=weekly_sales~cpi + size,data=dfw)
summary(fitFull)

## 
## 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
```

Question 7:

```
fitFull1 <-lm(formula=weekly_sales ~ .-store - date,data=dfw)
summary(fitFull1)

## 
## Call:
## lm(formula = weekly_sales ~ . - store - date, 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(fitFull1)

## Analysis of Variance Table
##
## Response: weekly_sales
##                Df     Sum Sq    Mean Sq    F value    Pr(>F)    
## isholiday       1 1.0494e+12 1.0494e+12    18.0389 2.195e-05 ***
## temperature     1 2.6425e+12 2.6425e+12    45.4251 1.724e-11 ***
## fuel_price      1 5.3604e+11 5.3604e+11     9.2146  0.002411 ** 
## cpi             1 3.7878e+12 3.7878e+12    65.1117 8.378e-16 ***
## unemployment    1 1.3762e+13 1.3762e+13   236.5719 < 2.2e-16 ***
## size            1 5.9091e+14 5.9091e+14 10157.7625 < 2.2e-16 ***
## Residuals    6428 3.7394e+14 5.8173e+10                         
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Question 8:A

```
fitFullTemp <-lm(formula=weekly_sales ~ .-store - date +
I(temperature^2),data=dfw)
summary(fitFullTemp)

##
## Call:
## lm(formula = weekly_sales ~ . - store - date + 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

anova(fitFullTemp)
```

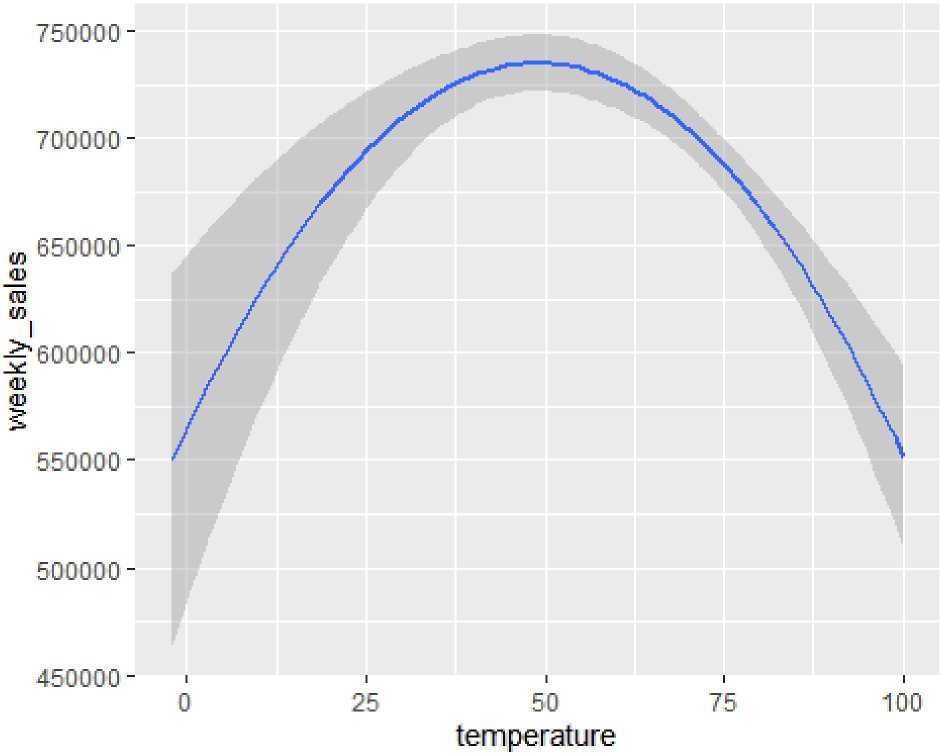
```
## Analysis of Variance Table
##
## Response: weekly_sales
##                     Df     Sum Sq    Mean Sq    F value    Pr(>F)
## isholiday            1 1.0494e+12 1.0494e+12    18.0537 2.178e-05 ***
## temperature          1 2.6425e+12 2.6425e+12    45.4626 1.691e-11 ***
## fuel_price           1 5.3604e+11 5.3604e+11     9.2222  0.002401 **
## cpi                  1 3.7878e+12 3.7878e+12    65.1653 8.156e-16 ***
## unemployment         1 1.3762e+13 1.3762e+13   236.7667 < 2.2e-16 ***
## size                 1 5.9091e+14 5.9091e+14 10166.1287 < 2.2e-16 ***
## I(temperature^2)     1 3.6586e+11 3.6586e+11     6.2943  0.012137 *
## Residuals         6427 3.7357e+14 5.8126e+10
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Question 8:B

```
plotTemp <- dfw %>%

  ggplot(aes(x= temperature,y=weekly_sales))+geom_smooth(method=lm, formula =
y~x+I(x^2))

plotTemp
```



Question 9:A

```
set.seed(333)
```

Question 9:B

```
dfwTrain <- dfw %>% sample_frac(0.8)
dfwTest <- dplyr::setdiff(dfw, dfwTrain)
```

Question 9:C

```
fitOrg <- lm (weekly_sales~. + I(temperature^2) - store - date,
data=dfwTrain)
summary(fitOrg)

##
## Call:
## lm(formula = weekly_sales ~ . + I(temperature^2) - store - date,
##     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
```

Question 9:C

```
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
```

Question 9:D

```
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>
```

Question 9:E

```
performance <- metric_set(rmse, mae)
performance(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.
```

Question 9:F

```
fitOrgDate <- lm (weekly_sales~. + I(temperature^2) - store, data=dfwTrain)
summary(fitOrgDate)

##
## Call:
```

```
## lm(formula = weekly_sales ~ . + I(temperature^2) - store, 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    
## date              1.065e+01  2.043e+01   0.521 0.602246    
## 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 ***
## 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>
```

```
performance(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.
```

Question 9:G

```
fitOrgNoUn <- lm (weekly_sales~. + I(temperature^2) - date - store -
unemployment, data=dfwTrain)
summary(fitOrgNoUn)
```

```
##
## Call:
## lm(formula = weekly_sales ~ . + I(temperature^2) - date - store -
##     unemployment, 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>
```

```
performance(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)
dfwTrainLog <- dfw %>%
sample_frac(0.8)
dfwTestLog <- dplyr::setdiff(dfw, dfwTrainLog)
fitLog <- lm(log1p(weekly_sales)~. + I(temperature^2) - date - store,
data=dfwTrainLog)
summary(fitLog)
```

```
##
## Call:
## lm(formula = log1p(weekly_sales) ~ . + I(temperature^2) - date -
##     store, data = dfwTrainLog)
##
## 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
```

```
resultsLog <-dfwTestLog %>%
mutate(predictedSales = predict(fitLog, dfwTestLog))
resultsLog
```

```
## # 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>
```

```
performance(resultsLog, truth=weekly_sales, estimate=exp(predictedSales))
```

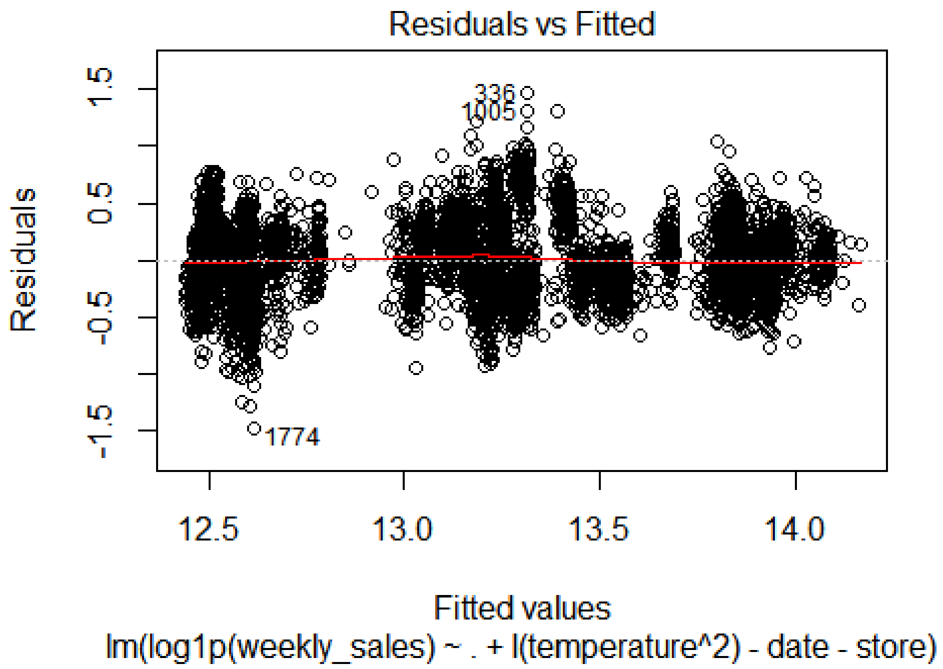
```
## # A tibble: 2 x 3
##   .metric .estimator .estimate
##   <chr>   <chr>          <dbl>
## 1 rmse    standard     237825.
## 2 mae     standard     171555.
```

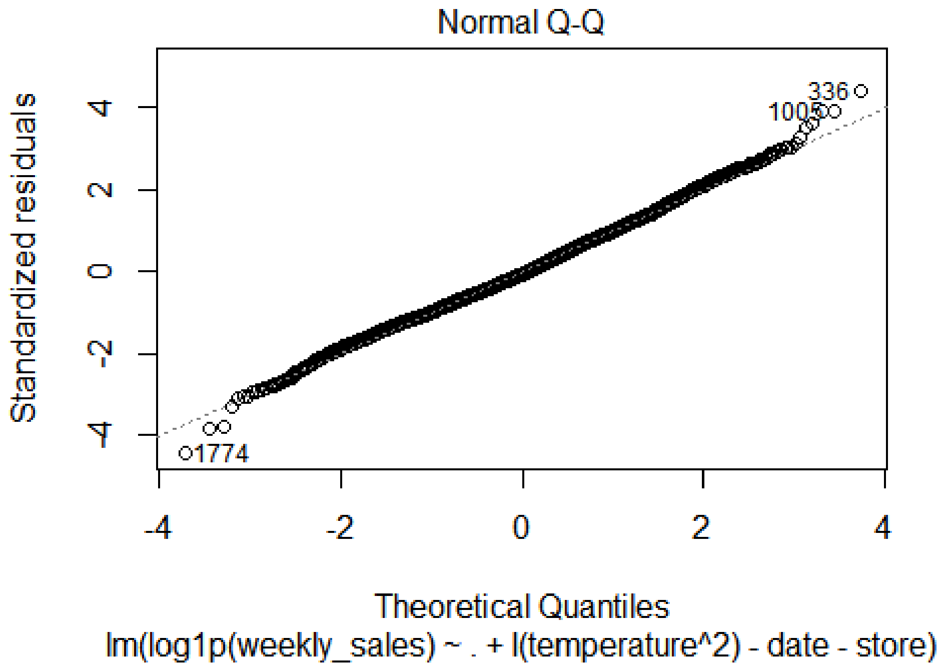
```
anova(fitLog, fitOrg)
```

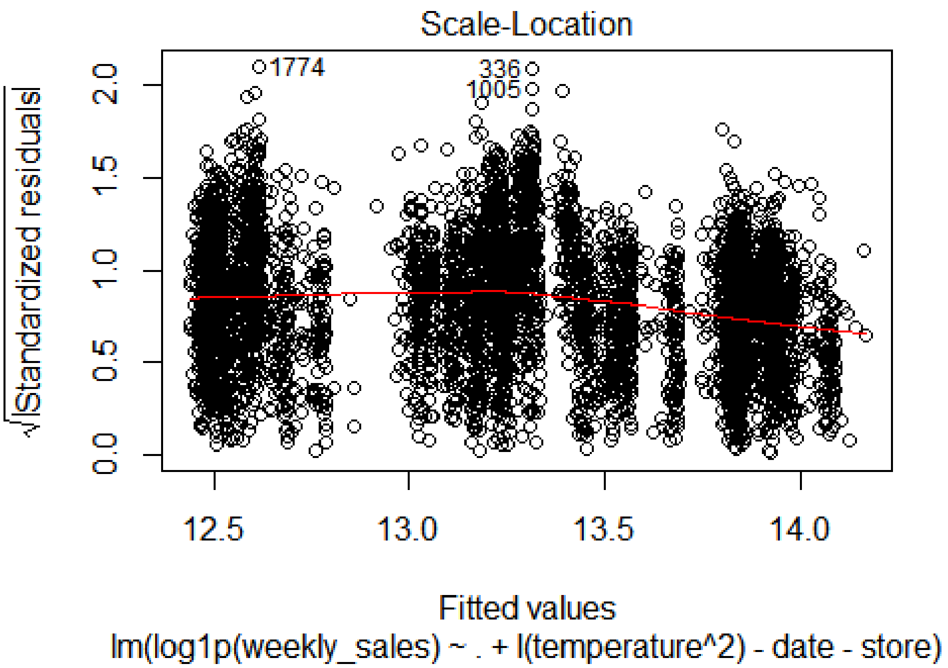
```
## Warning in anova.lmlist(object, ...): models with response
'"weekly_sales"'
## removed because response differs from model 1
```

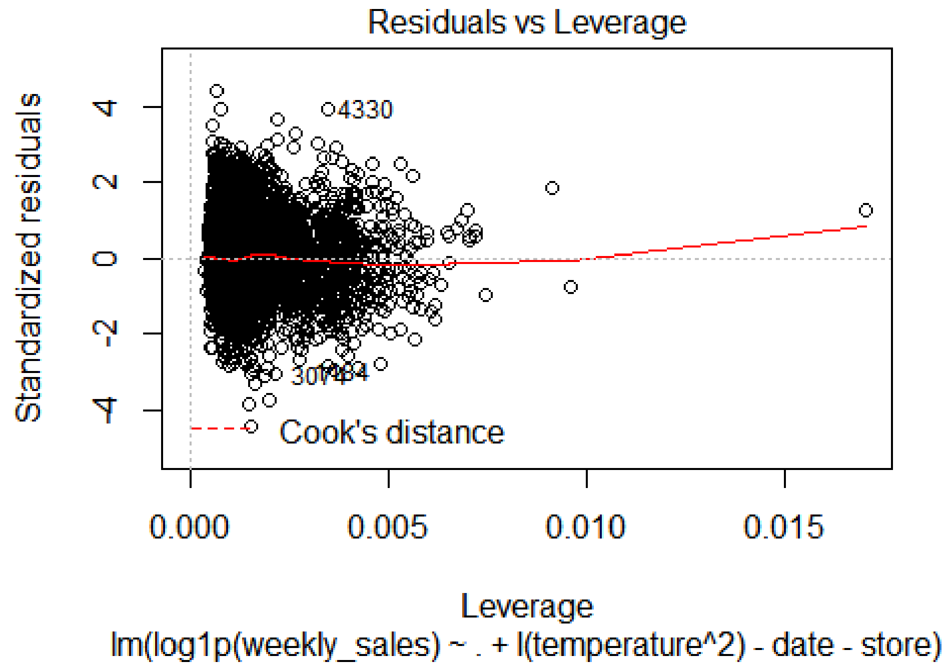
```
## Analysis of Variance Table
##
## Response: log1p(weekly_sales)
##                      Df  Sum Sq Mean Sq   F value    Pr(>F)
## isholiday             1    2.04    2.04    18.335 1.887e-05 ***
## temperature           1   15.69   15.69   141.358 < 2.2e-16 ***
## fuel_price            1    2.90    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
```

```
plot(fitLog)
```

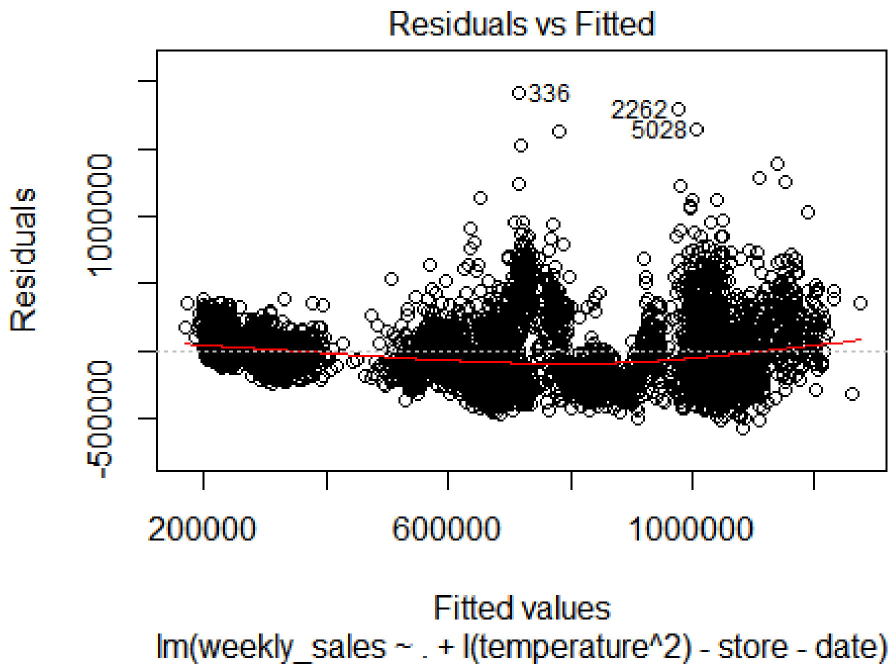

Residuals vs Fitted
Residuals
1.5
0.5
-0.5
-1.5
336
1005
1774
12.5
13.0
13.5
14.0
Fitted values
lm(log1p(weekly_sales) ~ . + I(temperature^2) - date - store)

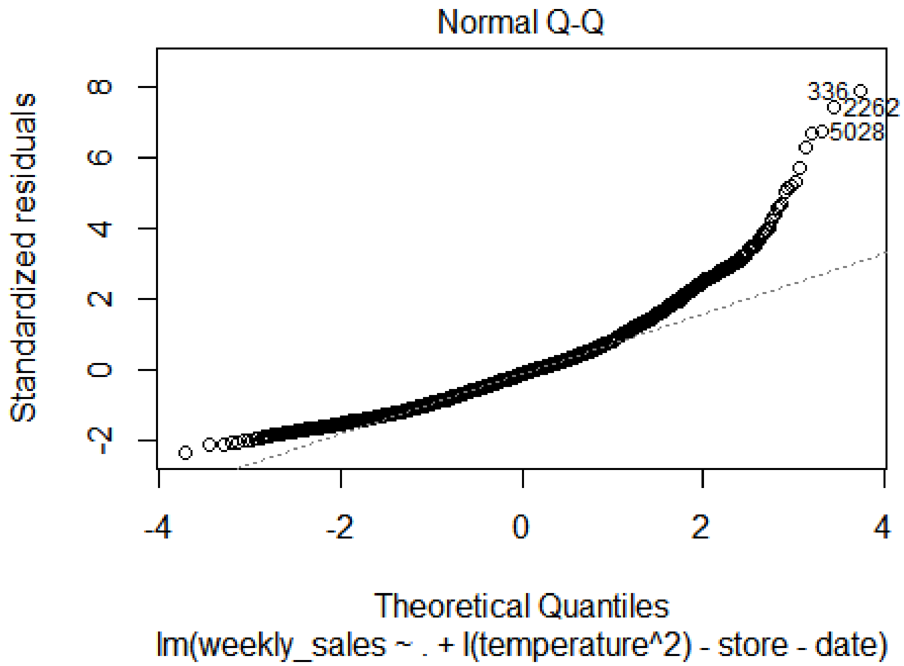

Normal Q-Q
Standardized residuals
4
2
0
-2
-4
336
1005
1774
-4
-2
0
2
4
Theoretical Quantiles
lm(log1p(weekly_sales) ~ . + I(temperature^2) - date - store)

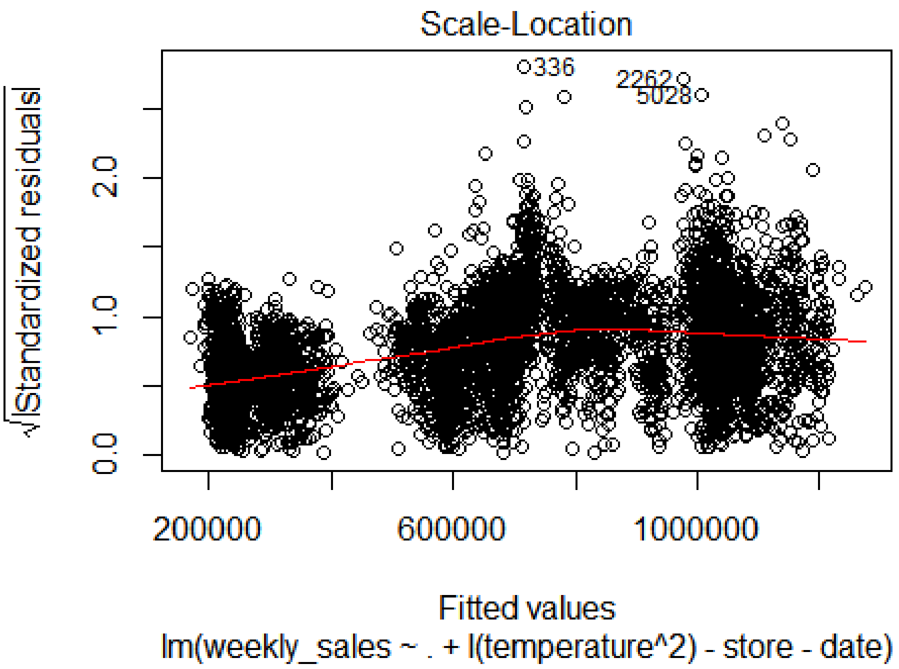

Scale-Location
√|Standardized residuals|
0.0
0.5
1.0
1.5
2.0
12.5
13.0
13.5
14.0
1774
336
1005
Fitted values
lm(log1p(weekly_sales) ~ . + I(temperature^2) - date - store)

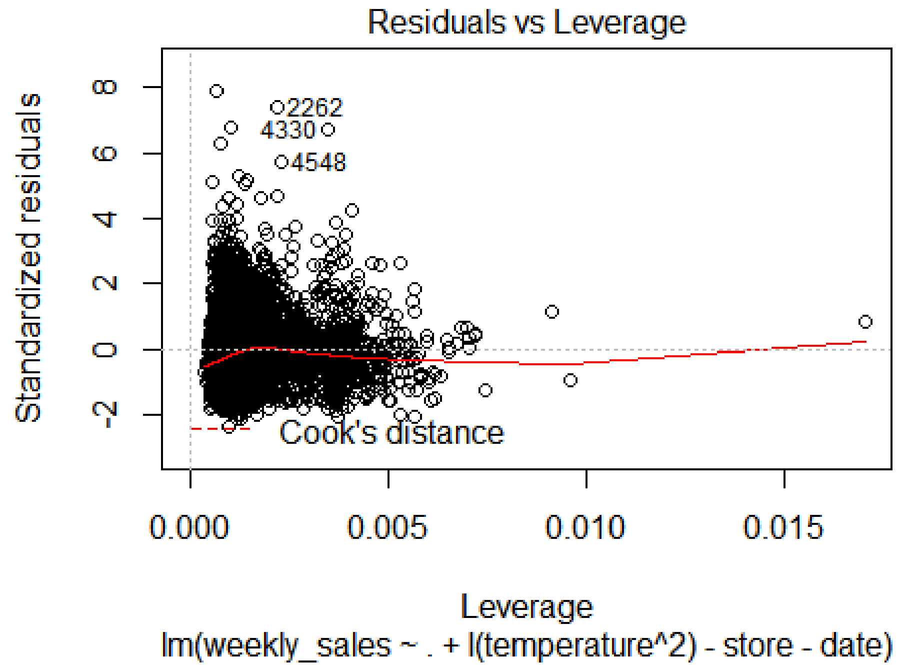

Residuals vs Leverage
Standardized residuals
-4
-2
0
2
4
0.000
0.005
0.010
0.015
4330
3074
Cook's distance
Leverage
lm(log1p(weekly_sales) ~ . + I(temperature^2) - date - store)

```
plot(fitOrg)
```

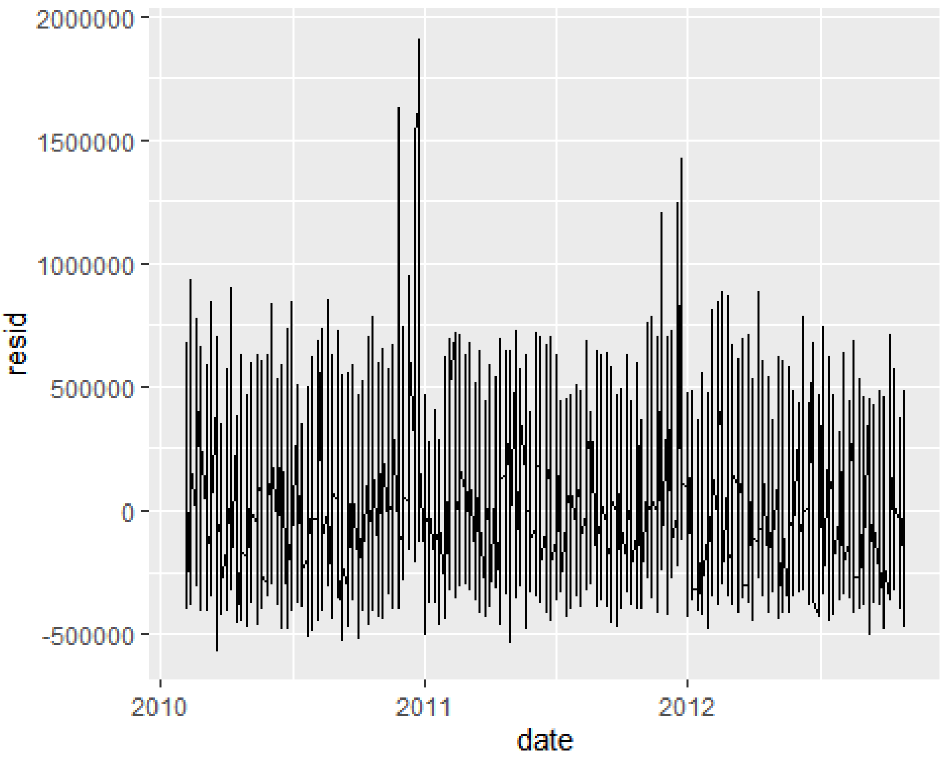

Residuals vs Fitted
Residuals
-500000
1000000
200000
600000
1000000
336
2262
5028
Fitted values
lm(weekly_sales ~ . + I(temperature^2) - store - date)


Normal Q-Q
Standardized residuals
8
6
4
2
0
-2
-4
-2
0
2
4
336
2262
5028
Theoretical Quantiles
lm(weekly_sales ~ . + I(temperature^2) - store - date)

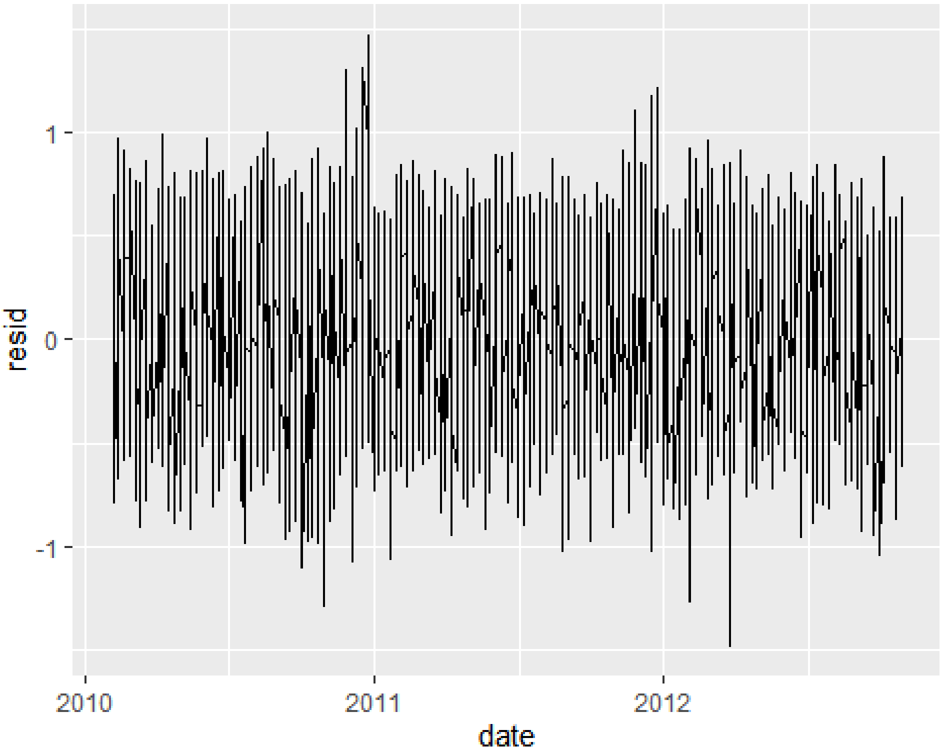




```r
dfw %>%
modelr::add_residuals(fitOrg, var="resid") %>%
ggplot(aes(date, resid))+geom_line()
```



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



BoNUS Question

```
bonusDfw <- dfw %>%
mutate(salesPerSqFoot = weekly_sales/size)
bonusDfw

## # 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>,
## #   salesPerSqFoot <dbl>

set.seed(333)
dfwTrainBonus <- bonusDfw %>%
sample_frac(0.8)
dfwTestBonus <- dplyr::setdiff(bonusDfw, dfwTrainBonus)
fitSalesSqFoot <- lm(salesPerSqFoot~. + I(temperature^2) - store - date -
weekly_sales, data=dfwTrainBonus)
summary(fitSalesSqFoot)

##
## Call:
## lm(formula = salesPerSqFoot ~ . + I(temperature^2) - store -
##     date - weekly_sales, data = dfwTrainBonus)
##
## 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
```

```
resultsBonus <-dfwTestBonus %>%
mutate(predictedSalesPerSqFoot = predict(fitSalesSqFoot, dfwTestBonus))
resultsBonus
```

```
## # 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>,
## #   salesPerSqFoot <dbl>, predictedSalesPerSqFoot <dbl>
```