STAT625_Project

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```
rm(list = ls())
walmart <- read.csv("~/Documents/Stat 625/Project/Walmart.csv")
head(walmart)
```

```
##   Store       Date Weekly_Sales Holiday_Flag Temperature Fuel_Price      CPI
## 1     1 05-02-2010      1643691            0       42.31      2.572 211.0964
## 2     1 12-02-2010      1641957            1       38.51      2.548 211.2422
## 3     1 19-02-2010      1611968            0       39.93      2.514 211.2891
## 4     1 26-02-2010      1409728            0       46.63      2.561 211.3196
## 5     1 05-03-2010      1554807            0       46.50      2.625 211.3501
## 6     1 12-03-2010      1439542            0       57.79      2.667 211.3806
##   Unemployment
## 1        8.106
## 2        8.106
## 3        8.106
## 4        8.106
## 5        8.106
## 6        8.106
```

Data Preprocessing

Since dates are strings, they must be converted to parsed and converted to days. Use days since the first day rather than the actual date to make computation easier.

```
# Convert the dates from character strings into days since the first date
asDate_result <- as.Date(walmart$Date, "%d-%m-%Y")
first_date <- min(asDate_result)
days_elapsed <- asDate_result-first_date
walmart["Days_since"] <- days_elapsed
head(walmart)
```

```
##   Store       Date Weekly_Sales Holiday_Flag Temperature Fuel_Price      CPI
## 1     1 05-02-2010      1643691            0       42.31      2.572 211.0964
## 2     1 12-02-2010      1641957            1       38.51      2.548 211.2422
## 3     1 19-02-2010      1611968            0       39.93      2.514 211.2891
## 4     1 26-02-2010      1409728            0       46.63      2.561 211.3196
## 5     1 05-03-2010      1554807            0       46.50      2.625 211.3501
## 6     1 12-03-2010      1439542            0       57.79      2.667 211.3806
##   Unemployment Days_since
## 1        8.106     0 days
```

```
## 2        8.106     7 days
## 3        8.106    14 days
## 4        8.106    21 days
## 5        8.106    28 days
## 6        8.106    35 days
```

Using forward selection:

```
model1 <- lm(log(Weekly_Sales) ~ 1, data = walmart)
step(model1, scope = ~ Days_since + Unemployment + CPI + Fuel_Price + Temperature + Holiday_Flag, direc
```

```
## Start:  AIC=-6826.73
## log(Weekly_Sales) ~ 1
##
##                Df Sum of Sq    RSS     AIC
## + Temperature   1   19.0609 2207.7 -6880.1
## + Unemployment  1   14.1863 2212.6 -6865.9
## + CPI           1   13.3680 2213.4 -6863.5
## + Holiday_Flag  1    1.5958 2225.2 -6829.3
## + Fuel_Price    1    0.7846 2226.0 -6827.0
## <none>                      2226.8 -6826.7
## + Days_since    1    0.2017 2226.6 -6825.3
##
## Step:  AIC=-6880.05
## log(Weekly_Sales) ~ Temperature
##
##                Df Sum of Sq    RSS     AIC
## + Unemployment  1   11.1688 2196.6 -6910.7
## + CPI           1    8.5859 2199.2 -6903.1
## + Fuel_Price    1    2.3561 2205.4 -6884.9
## + Days_since    1    1.1999 2206.5 -6881.5
## <none>                      2207.7 -6880.1
## + Holiday_Flag  1    0.3520 2207.4 -6879.1
##
## Step:  AIC=-6910.69
## log(Weekly_Sales) ~ Temperature + Unemployment
##
##                Df Sum of Sq    RSS     AIC
## + CPI           1   18.1099 2178.5 -6962.0
## + Fuel_Price    1    1.8745 2194.7 -6914.2
## <none>                      2196.6 -6910.7
## + Holiday_Flag  1    0.4681 2196.1 -6910.1
## + Days_since    1    0.0443 2196.5 -6908.8
##
## Step:  AIC=-6961.96
## log(Weekly_Sales) ~ Temperature + Unemployment + CPI
##
##                Df Sum of Sq    RSS     AIC
## + Holiday_Flag  1   0.70853 2177.8 -6962.1
## <none>                      2178.5 -6962.0
## + Fuel_Price    1   0.15786 2178.3 -6960.4
```

```
## + Days_since    1   0.00245 2178.5 -6960.0
##
## Step:  AIC=-6962.06
## log(Weekly_Sales) ~ Temperature + Unemployment + CPI + Holiday_Flag
##
##              Df Sum of Sq    RSS     AIC
## <none>                    2177.8 -6962.1
## + Fuel_Price  1  0.192584 2177.6 -6960.6
## + Days_since  1  0.001139 2177.8 -6960.1

##
## Call:
## lm(formula = log(Weekly_Sales) ~ Temperature + Unemployment +
##     CPI + Holiday_Flag, data = walmart)
##
## Coefficients:
##  (Intercept)   Temperature  Unemployment           CPI  Holiday_Flag
##    14.328394     -0.001977     -0.032376     -0.001460      0.041693
```

Using backward elimination:

```
model2 <- lm(log(Weekly_Sales) ~ Days_since + Unemployment + CPI + Fuel_Price + Temperature + Holiday_F
step(model2, scope = ~ 1, direction="backward")
```

```
## Start:  AIC=-6959.44
## log(Weekly_Sales) ~ Days_since + Unemployment + CPI + Fuel_Price +
##     Temperature + Holiday_Flag
##
##                Df Sum of Sq    RSS     AIC
## - Days_since    1    0.2754 2177.6 -6960.6
## - Fuel_Price    1    0.4668 2177.8 -6960.1
## <none>                      2177.3 -6959.4
## - Holiday_Flag  1    0.8247 2178.1 -6959.0
## - Temperature   1    7.8738 2185.2 -6938.2
## - CPI           1   14.6860 2192.0 -6918.2
## - Unemployment  1   19.8667 2197.2 -6903.0
##
## Step:  AIC=-6960.62
## log(Weekly_Sales) ~ Unemployment + CPI + Fuel_Price + Temperature +
##     Holiday_Flag
##
##                Df Sum of Sq    RSS     AIC
## - Fuel_Price    1    0.1926 2177.8 -6962.1
## <none>                      2177.6 -6960.6
## - Holiday_Flag  1    0.7433 2178.3 -6960.4
## - Temperature   1    8.0395 2185.6 -6938.9
## - CPI           1   16.5560 2194.1 -6913.9
## - Unemployment  1   20.1433 2197.7 -6903.4
##
## Step:  AIC=-6962.06
## log(Weekly_Sales) ~ Unemployment + CPI + Temperature + Holiday_Flag
```

```
##
##                Df Sum of Sq    RSS     AIC
## <none>                      2177.8 -6962.1
## - Holiday_Flag  1    0.7085 2178.5 -6962.0
## - Temperature   1    7.8570 2185.6 -6940.9
## - CPI           1   18.3503 2196.1 -6910.1
## - Unemployment  1   20.9529 2198.7 -6902.4
```

```
##
## Call:
## lm(formula = log(Weekly_Sales) ~ Unemployment + CPI + Temperature +
##     Holiday_Flag, data = walmart)
##
## Coefficients:
##  (Intercept)  Unemployment           CPI   Temperature  Holiday_Flag
##    14.328394     -0.032376     -0.001460     -0.001977      0.041693
```

To choose between the models obtained through forward selection and backward elimination. The model with the lower AIC is generally preferred because it indicates a better balance between goodness of fit and model complexity.

1. Forward Selection Model:
   AIC = -6962.1

2. Backward Elimination Model:
   AIC = -6962.1

Both models have the same AIC value (-6962.1). Both models have the same predictors: Unemployment, CPI, Temperature, and Holiday_Flag.

Interaction terms

```
library(car)
```

```
## Loading required package: carData
```

```
model3 <- lm(log(Weekly_Sales) ~ (Days_since + Unemployment + CPI + Fuel_Price + Temperature + Holiday_
Anova(model3, type="II")
```

```
## Anova Table (Type II tests)
##
## Response: log(Weekly_Sales)
##                                                          Sum Sq   Df
## Days_since                                                 3.90    9
## Unemployment                                              30.26   11
## CPI                                                       43.08    9
## Fuel_Price                                                18.77   10
## Temperature                                               12.02   11
## Holiday_Flag                                               2.62   15
```

```
## Days_since:Unemployment                                          2.18    2
## Days_since:CPI                                                   0.48    2
## Days_since:Fuel_Price                                            0.17    2
## Days_since:Temperature                                           1.32    2
## Days_since:Holiday_Flag                                          0.30    4
## Unemployment:CPI                                                26.06    2
## Unemployment:Fuel_Price                                          4.38    2
## Unemployment:Temperature                                         0.87    4
## Unemployment:Holiday_Flag                                        0.32    6
## CPI:Fuel_Price                                                   8.07    2
## CPI:Temperature                                                  1.66    2
## CPI:Holiday_Flag                                                 0.21    4
## Fuel_Price:Temperature                                           7.24    2
## Fuel_Price:Holiday_Flag                                          0.67    5
## Temperature:Holiday_Flag                                         0.59    5
## Days_since:Unemployment:CPI                                      0.01    1
## Days_since:Unemployment:Fuel_Price                               3.74    1
## Days_since:Unemployment:Temperature                              0.37    1
## Days_since:Unemployment:Holiday_Flag                             0.05    1
## Days_since:CPI:Fuel_Price                                        1.34    1
## Days_since:CPI:Temperature                                       0.92    1
## Days_since:CPI:Holiday_Flag                                      0.31    1
## Days_since:Fuel_Price:Temperature                                0.10    1
## Days_since:Fuel_Price:Holiday_Flag                               0.03    1
## Days_since:Temperature:Holiday_Flag                              0.15    1
## Unemployment:CPI:Fuel_Price                                      0.08    1
## Unemployment:CPI:Temperature                                     0.20    1
## Unemployment:CPI:Holiday_Flag                                    0.01    1
## Unemployment:Fuel_Price:Temperature                              1.23    1
## Unemployment:Fuel_Price:Holiday_Flag                             0.12    1
## Unemployment:Temperature:Holiday_Flag                            0.11    2
## CPI:Fuel_Price:Temperature                                       1.39    1
## CPI:Fuel_Price:Holiday_Flag                                      0.28    1
## CPI:Temperature:Holiday_Flag                                     0.05    1
## Fuel_Price:Temperature:Holiday_Flag                              0.54    1
## Days_since:Unemployment:CPI:Fuel_Price                           0.90    1
## Days_since:Unemployment:CPI:Temperature                          0.09    1
## Days_since:Unemployment:CPI:Holiday_Flag                         0.00    1
## Days_since:Unemployment:Fuel_Price:Temperature                   1.47    1
## Days_since:Unemployment:Fuel_Price:Holiday_Flag                  0.03    1
## Days_since:Unemployment:Temperature:Holiday_Flag                 0.10    1
## Days_since:CPI:Fuel_Price:Temperature                            2.37    1
## Days_since:CPI:Fuel_Price:Holiday_Flag                           0.01    1
## Days_since:CPI:Temperature:Holiday_Flag                          0.02    1
## Days_since:Fuel_Price:Temperature:Holiday_Flag                   0.16    1
## Unemployment:CPI:Fuel_Price:Temperature                          0.23    1
## Unemployment:CPI:Fuel_Price:Holiday_Flag                         0.00    1
## Unemployment:CPI:Temperature:Holiday_Flag                        0.00    1
## Unemployment:Fuel_Price:Temperature:Holiday_Flag                 0.09    1
## CPI:Fuel_Price:Temperature:Holiday_Flag                          0.01    1
## Days_since:Unemployment:CPI:Fuel_Price:Temperature               0.25    1
## Days_since:Unemployment:CPI:Fuel_Price:Holiday_Flag              0.05    1
## Days_since:Unemployment:CPI:Temperature:Holiday_Flag             0.05    1
## Days_since:Unemployment:Fuel_Price:Temperature:Holiday_Flag      0.02    1
```

```
## Days_since:CPI:Fuel_Price:Temperature:Holiday_Flag                 0.08    1
## Unemployment:CPI:Fuel_Price:Temperature:Holiday_Flag               0.00    1
## Days_since:Unemployment:CPI:Fuel_Price:Temperature:Holiday_Flag     0.01    1
## Residuals                                                       2122.19 6371
##                                                                 F value
## Days_since                                                       1.3003
## Unemployment                                                     8.2581
## CPI                                                             14.3697
## Fuel_Price                                                       5.6353
## Temperature                                                      3.2796
## Holiday_Flag                                                     0.5248
## Days_since:Unemployment                                          3.2697
## Days_since:CPI                                                   0.7152
## Days_since:Fuel_Price                                            0.2539
## Days_since:Temperature                                           1.9800
## Days_since:Holiday_Flag                                          0.2261
## Unemployment:CPI                                                39.1133
## Unemployment:Fuel_Price                                          6.5702
## Unemployment:Temperature                                         0.6526
## Unemployment:Holiday_Flag                                        0.1622
## CPI:Fuel_Price                                                  12.1204
## CPI:Temperature                                                  2.4911
## CPI:Holiday_Flag                                                 0.1579
## Fuel_Price:Temperature                                          10.8712
## Fuel_Price:Holiday_Flag                                          0.4034
## Temperature:Holiday_Flag                                         0.3542
## Days_since:Unemployment:CPI                                      0.0316
## Days_since:Unemployment:Fuel_Price                              11.2239
## Days_since:Unemployment:Temperature                              1.1219
## Days_since:Unemployment:Holiday_Flag                             0.1358
## Days_since:CPI:Fuel_Price                                        4.0365
## Days_since:CPI:Temperature                                       2.7521
## Days_since:CPI:Holiday_Flag                                      0.9203
## Days_since:Fuel_Price:Temperature                                0.3097
## Days_since:Fuel_Price:Holiday_Flag                               0.1005
## Days_since:Temperature:Holiday_Flag                              0.4438
## Unemployment:CPI:Fuel_Price                                      0.2328
## Unemployment:CPI:Temperature                                     0.6031
## Unemployment:CPI:Holiday_Flag                                    0.0224
## Unemployment:Fuel_Price:Temperature                              3.7016
## Unemployment:Fuel_Price:Holiday_Flag                             0.3559
## Unemployment:Temperature:Holiday_Flag                            0.1607
## CPI:Fuel_Price:Temperature                                       4.1646
## CPI:Fuel_Price:Holiday_Flag                                      0.8347
## CPI:Temperature:Holiday_Flag                                     0.1417
## Fuel_Price:Temperature:Holiday_Flag                              1.6138
## Days_since:Unemployment:CPI:Fuel_Price                           2.7010
## Days_since:Unemployment:CPI:Temperature                          0.2706
## Days_since:Unemployment:CPI:Holiday_Flag                         0.0014
## Days_since:Unemployment:Fuel_Price:Temperature                   4.4225
## Days_since:Unemployment:Fuel_Price:Holiday_Flag                  0.0974
## Days_since:Unemployment:Temperature:Holiday_Flag                 0.3009
## Days_since:CPI:Fuel_Price:Temperature                            7.1088
## Days_since:CPI:Fuel_Price:Holiday_Flag                           0.0220
```

```
## Days_since:CPI:Temperature:Holiday_Flag                            0.0669
## Days_since:Fuel_Price:Temperature:Holiday_Flag                     0.4844
## Unemployment:CPI:Fuel_Price:Temperature                            0.6833
## Unemployment:CPI:Fuel_Price:Holiday_Flag                           0.0145
## Unemployment:CPI:Temperature:Holiday_Flag                          0.0110
## Unemployment:Fuel_Price:Temperature:Holiday_Flag                   0.2806
## CPI:Fuel_Price:Temperature:Holiday_Flag                            0.0294
## Days_since:Unemployment:CPI:Fuel_Price:Temperature                  0.7521
## Days_since:Unemployment:CPI:Fuel_Price:Holiday_Flag                0.1642
## Days_since:Unemployment:CPI:Temperature:Holiday_Flag               0.1519
## Days_since:Unemployment:Fuel_Price:Temperature:Holiday_Flag        0.0516
## Days_since:CPI:Fuel_Price:Temperature:Holiday_Flag                 0.2391
## Unemployment:CPI:Fuel_Price:Temperature:Holiday_Flag               0.0099
## Days_since:Unemployment:CPI:Fuel_Price:Temperature:Holiday_Flag    0.0310
## Residuals
##                                                                      Pr(>F)
## Days_since                                                        0.2308627
## Unemployment                                                      1.482e-14 ***
## CPI                                                               < 2.2e-16 ***
## Fuel_Price                                                        1.932e-08 ***
## Temperature                                                       0.0001693 ***
## Holiday_Flag                                                      0.9287133
## Days_since:Unemployment                                           0.0380818 *
## Days_since:CPI                                                    0.4891253
## Days_since:Fuel_Price                                             0.7757679
## Days_since:Temperature                                            0.1381555
## Days_since:Holiday_Flag                                           0.9238991
## Unemployment:CPI                                                  < 2.2e-16 ***
## Unemployment:Fuel_Price                                           0.0014110 **
## Unemployment:Temperature                                          0.6250095
## Unemployment:Holiday_Flag                                         0.9865891
## CPI:Fuel_Price                                                    5.574e-06 ***
## CPI:Temperature                                                   0.0829017 .
## CPI:Holiday_Flag                                                  0.9594870
## Fuel_Price:Temperature                                            1.935e-05 ***
## Fuel_Price:Holiday_Flag                                           0.8467783
## Temperature:Holiday_Flag                                          0.8797993
## Days_since:Unemployment:CPI                                       0.8588521
## Days_since:Unemployment:Fuel_Price                                0.0008122 ***
## Days_since:Unemployment:Temperature                               0.2895431
## Days_since:Unemployment:Holiday_Flag                              0.7125513
## Days_since:CPI:Fuel_Price                                         0.0445671 *
## Days_since:CPI:Temperature                                        0.0971787 .
## Days_since:CPI:Holiday_Flag                                       0.3374392
## Days_since:Fuel_Price:Temperature                                 0.5778937
## Days_since:Fuel_Price:Holiday_Flag                                0.7512603
## Days_since:Temperature:Holiday_Flag                               0.5052992
## Unemployment:CPI:Fuel_Price                                       0.6294767
## Unemployment:CPI:Temperature                                      0.4374295
## Unemployment:CPI:Holiday_Flag                                     0.8809059
## Unemployment:Fuel_Price:Temperature                               0.0544047 .
## Unemployment:Fuel_Price:Holiday_Flag                              0.5508101
## Unemployment:Temperature:Holiday_Flag                             0.8515529
## CPI:Fuel_Price:Temperature                                        0.0413176 *
```

```
## CPI:Fuel_Price:Holiday_Flag                                        0.3609591
## CPI:Temperature:Holiday_Flag                                       0.7066115
## Fuel_Price:Temperature:Holiday_Flag                                0.2040048
## Days_since:Unemployment:CPI:Fuel_Price                             0.1003360
## Days_since:Unemployment:CPI:Temperature                            0.6029152
## Days_since:Unemployment:CPI:Holiday_Flag                           0.9705241
## Days_since:Unemployment:Fuel_Price:Temperature                     0.0355067 *
## Days_since:Unemployment:Fuel_Price:Holiday_Flag                    0.7550297
## Days_since:Unemployment:Temperature:Holiday_Flag                   0.5833629
## Days_since:CPI:Fuel_Price:Temperature                              0.0076902 **
## Days_since:CPI:Fuel_Price:Holiday_Flag                             0.8821555
## Days_since:CPI:Temperature:Holiday_Flag                            0.7958980
## Days_since:Fuel_Price:Temperature:Holiday_Flag                     0.4864681
## Unemployment:CPI:Fuel_Price:Temperature                            0.4084838
## Unemployment:CPI:Fuel_Price:Holiday_Flag                           0.9041542
## Unemployment:CPI:Temperature:Holiday_Flag                          0.9164204
## Unemployment:Fuel_Price:Temperature:Holiday_Flag                   0.5963451
## CPI:Fuel_Price:Temperature:Holiday_Flag                            0.8639733
## Days_since:Unemployment:CPI:Fuel_Price:Temperature                  0.3858527
## Days_since:Unemployment:CPI:Fuel_Price:Holiday_Flag                 0.6853478
## Days_since:Unemployment:CPI:Temperature:Holiday_Flag                0.6967026
## Days_since:Unemployment:Fuel_Price:Temperature:Holiday_Flag         0.8203822
## Days_since:CPI:Fuel_Price:Temperature:Holiday_Flag                  0.6248770
## Unemployment:CPI:Fuel_Price:Temperature:Holiday_Flag               0.9207832
## Days_since:Unemployment:CPI:Fuel_Price:Temperature:Holiday_Flag     0.8602379
## Residuals
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The Analysis of Deviance Table (Type II tests) showcases the statistical significance of each factor and their interactions. The main effects (Unemployment, CPI, Fuel_Price and Temperature) exhibit highly significant p-values, indicating their individual impact on the response. The interaction term (Unemployment:Fuel_Price), (CPI:Fuel_Price), and (Fuel_Price:Holiday_Flag) are also highly significant. They have (***).

(Interaction term) Using forward selection:

```
model4 <- lm(log(Weekly_Sales) ~ 1, data = walmart)
interaction_scope <- ~ Days_since + Unemployment + CPI + Fuel_Price + Temperature + Holiday_Flag +
                       Unemployment:Fuel_Price + CPI:Fuel_Price + Fuel_Price:Holiday_Flag
model5 <- step(model4, scope = interaction_scope, direction = "forward")
```

```
## Start:  AIC=-6826.73
## log(Weekly_Sales) ~ 1
##
##                Df Sum of Sq    RSS     AIC
## + Temperature   1   19.0609 2207.7 -6880.1
## + Unemployment  1   14.1863 2212.6 -6865.9
## + CPI           1   13.3680 2213.4 -6863.5
## + Holiday_Flag  1    1.5958 2225.2 -6829.3
## + Fuel_Price    1    0.7846 2226.0 -6827.0
```

```
## <none>                       2226.8 -6826.7
## + Days_since    1    0.2017 2226.6 -6825.3
##
## Step:  AIC=-6880.05
## log(Weekly_Sales) ~ Temperature
##
##                Df Sum of Sq    RSS     AIC
## + Unemployment  1   11.1688 2196.6 -6910.7
## + CPI           1    8.5859 2199.2 -6903.1
## + Fuel_Price    1    2.3561 2205.4 -6884.9
## + Days_since    1    1.1999 2206.5 -6881.5
## <none>                       2207.7 -6880.1
## + Holiday_Flag  1    0.3520 2207.4 -6879.1
##
## Step:  AIC=-6910.69
## log(Weekly_Sales) ~ Temperature + Unemployment
##
##                Df Sum of Sq    RSS     AIC
## + CPI           1   18.1099 2178.5 -6962.0
## + Fuel_Price    1    1.8745 2194.7 -6914.2
## <none>                       2196.6 -6910.7
## + Holiday_Flag  1    0.4681 2196.1 -6910.1
## + Days_since    1    0.0443 2196.5 -6908.8
##
## Step:  AIC=-6961.96
## log(Weekly_Sales) ~ Temperature + Unemployment + CPI
##
##                Df Sum of Sq    RSS     AIC
## + Holiday_Flag  1   0.70853 2177.8 -6962.1
## <none>                       2178.5 -6962.0
## + Fuel_Price    1   0.15786 2178.3 -6960.4
## + Days_since    1   0.00245 2178.5 -6960.0
##
## Step:  AIC=-6962.06
## log(Weekly_Sales) ~ Temperature + Unemployment + CPI + Holiday_Flag
##
##              Df Sum of Sq    RSS     AIC
## <none>                     2177.8 -6962.1
## + Fuel_Price  1  0.192584 2177.6 -6960.6
## + Days_since  1  0.001139 2177.8 -6960.1
```

(Interaction term) Using backward elimination:

```
model6 <- lm(log(Weekly_Sales) ~ Days_since + Unemployment + CPI + Fuel_Price + Temperature + Holiday_F
                                 Unemployment:Fuel_Price + CPI:Fuel_Price + Fuel_Price:Holiday_Flag,
                                 data = walmart)
step(model6, scope = ~ 1, direction="backward")
```

```
## Start:  AIC=-6965.04
## log(Weekly_Sales) ~ Days_since + Unemployment + CPI + Fuel_Price +
##     Temperature + Holiday_Flag + Unemployment:Fuel_Price + CPI:Fuel_Price +
```

```
##     Fuel_Price:Holiday_Flag
##
##                           Df Sum of Sq    RSS     AIC
## - Unemployment:Fuel_Price  1    0.0081 2173.4 -6967.0
## - Fuel_Price:Holiday_Flag  1    0.2874 2173.7 -6966.2
## - Days_since               1    0.3338 2173.7 -6966.1
## <none>                                  2173.4 -6965.0
## - CPI:Fuel_Price           1    3.3797 2176.7 -6957.0
## - Temperature              1    7.5568 2180.9 -6944.7
##
## Step:  AIC=-6967.02
## log(Weekly_Sales) ~ Days_since + Unemployment + CPI + Fuel_Price +
##     Temperature + Holiday_Flag + CPI:Fuel_Price + Fuel_Price:Holiday_Flag
##
##                           Df Sum of Sq    RSS     AIC
## - Fuel_Price:Holiday_Flag  1    0.2874 2173.7 -6968.2
## - Days_since               1    0.3338 2173.7 -6968.0
## <none>                                  2173.4 -6967.0
## - CPI:Fuel_Price           1    3.5740 2176.9 -6958.4
## - Temperature              1    7.5837 2180.9 -6946.6
## - Unemployment             1   19.4035 2192.8 -6911.8
##
## Step:  AIC=-6968.17
## log(Weekly_Sales) ~ Days_since + Unemployment + CPI + Fuel_Price +
##     Temperature + Holiday_Flag + CPI:Fuel_Price
##
##                  Df Sum of Sq    RSS     AIC
## - Days_since      1    0.3065 2174.0 -6969.3
## <none>                        2173.7 -6968.2
## - Holiday_Flag    1    0.8783 2174.5 -6967.6
## - CPI:Fuel_Price  1    3.6279 2177.3 -6959.4
## - Temperature     1    7.4276 2181.1 -6948.2
## - Unemployment    1   19.4202 2193.1 -6912.9
##
## Step:  AIC=-6969.26
## log(Weekly_Sales) ~ Unemployment + CPI + Fuel_Price + Temperature +
##     Holiday_Flag + CPI:Fuel_Price
##
##                  Df Sum of Sq    RSS     AIC
## <none>                        2174.0 -6969.3
## - Holiday_Flag    1    0.7893 2174.8 -6968.9
## - CPI:Fuel_Price  1    3.5968 2177.6 -6960.6
## - Temperature     1    7.5981 2181.6 -6948.8
## - Unemployment    1   19.5981 2193.6 -6913.5


##
## Call:
## lm(formula = log(Weekly_Sales) ~ Unemployment + CPI + Fuel_Price +
##     Temperature + Holiday_Flag + CPI:Fuel_Price, data = walmart)
##
## Coefficients:
##    (Intercept)    Unemployment             CPI      Fuel_Price     Temperature
##      15.062255       -0.031569       -0.006064       -0.221178       -0.001982
##   Holiday_Flag  CPI:Fuel_Price
```

```
##       0.044062        0.001383
```

Both models share common predictors: Unemployment, CPI, Temperature, and Holiday_Flag. The forward selection model does not include Fuel_Price, while the backward elimination model includes Fuel_Price and an interaction term (CPI:Fuel_Price).

1. Forward Selection Model:
   AIC = -6962.06
   log(Weekly_Sales) ~ Temperature + Unemployment + CPI + Holiday_Flag

2. Backward Elimination Model:
   AIC = -6969.26
   log(Weekly_Sales) ~ Unemployment + CPI + Fuel_Price + Temperature + Holiday_Flag + CPI:Fuel_Price

Backward Elimination Model has lower AIC. So the final model is:
log(Weekly_Sales) ~ Unemployment + CPI + Fuel_Price + Temperature + Holiday_Flag + CPI:Fuel_Price