Sharpe Financial Research Group - Quantitative Finance - Portfolio Optimization

Code

Hide

```
library(readr)
library(stats)
library(car)
```

```
Loading required package: carData
```

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```
library(biglm)
```

```
Loading required package: DBI
```

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```
# Summary of the model
summary(standardized_model)
```

```
Call:
lm(formula = Excess_Return ~ ., data = X)

Residuals:
       Min         1Q     Median         3Q        Max
-7.764e-05  0.000e+00  0.000e+00  0.000e+00  1.330e-07

Coefficients: (2 not defined because of singularities)
                 Estimate Std. Error    t value Pr(>|t|)
(Intercept)     1.145e-10  2.263e-11  5.057e+00 4.25e-07 ***
Close           6.161e-16  4.191e-14  1.500e-02 0.988271
RSI            -2.713e-12  4.063e-13 -6.679e+00 2.41e-11 ***
Volatility      6.237e-15  4.727e-13  1.300e-02 0.989472
EPS             1.213e-14  4.253e-14  2.850e-01 0.775510
Dividends       7.076e-12  2.622e-12  2.699e+00 0.006958 **
Trading_Volume  2.906e-20  2.896e-19  1.000e-01 0.920049
Liquidity       3.128e-21  2.208e-20  1.420e-01 0.887359
SMA_50          2.228e-14  5.182e-14  4.300e-01 0.667177
MACD            6.619e-14  3.033e-13  2.180e-01 0.827223
MACD_Signal    -3.411e-14  3.400e-13 -1.000e-01 0.920083
MACD_Hist              NA         NA         NA       NA
ATR             1.446e-13  4.031e-14  3.587e+00 0.000335 ***
STOCH_K         7.455e-29  6.175e-27  1.200e-02 0.990368
STOCH_D        -1.275e-28  6.697e-27 -1.900e-02 0.984811
BB_Upper       -1.370e-14  2.312e-14 -5.930e-01 0.553467
BB_Middle       4.104e-15  8.490e-14  4.800e-02 0.961448
BB_Lower               NA         NA         NA       NA
OBV            -4.244e-23  2.111e-21 -2.000e-02 0.983963
`Mkt-RF`        6.369e-11  4.386e-10  1.450e-01 0.884553
SMB             4.093e-10  8.186e-10  5.000e-01 0.617067
HML             2.762e-10  6.899e-10  4.000e-01 0.688940
RF             -1.000e+00  4.600e-08 -2.174e+07  < 2e-16 ***
Stock_Return    1.000e+00  1.112e-16  8.993e+15  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.976e-08 on 15437990 degrees of freedom
Multiple R-squared:      1, Adjusted R-squared:      1
F-statistic: 3.851e+30 on 21 and 15437990 DF,  p-value: < 2.2e-16
```

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```
# Check collinear variables
alias(standardized_model)
```

```
Model :
Excess_Return ~ Close + RSI + Volatility + EPS + Dividends +
    Trading_Volume + Liquidity + SMA_50 + MACD + MACD_Signal +
    MACD_Hist + ATR + STOCH_K + STOCH_D + BB_Upper + BB_Middle +
    BB_Lower + OBV + `Mkt-RF` + SMB + HML + RF + Stock_Return

Complete :
          (Intercept) Close RSI Volatility EPS Dividends Trading_Volume Liquidity SMA
_50 MACD
MACD_Hist  0           0     0   0          0   0         0              0         0
1
BB_Lower   0           0     0   0          0   0         0              0         0
0
          MACD_Signal ATR STOCH_K STOCH_D BB_Upper BB_Middle OBV `Mkt-RF` SMB HML RF
MACD_Hist -1           0   0       0       0        0         0   0        0   0   0
BB_Lower   0           0   0       0      -1        2         0   0        0   0   0
          Stock_Return
MACD_Hist  0
BB_Lower   0
```

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```
# Check for multicollinearity again
alias(standardized_model)
```

```
Model :
Excess_Return ~ Close + RSI + Volatility + EPS + Dividends +
    Trading_Volume + Liquidity + SMA_50 + MACD_Hist + ATR + STOCH_K +
    STOCH_D + BB_Lower + OBV + `Mkt-RF` + SMB + HML + RF + Stock_Return
```

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```
# Display VIF values
print(vif_values)
```

```
         Close            RSI     Volatility            EPS      Dividends Trading_Vo
lume
    543.309255       1.021164       1.000006       1.018664       1.032986       1.44
1154
     Liquidity         SMA_50      MACD_Hist            ATR        STOCH_K        STO
CH_D
      1.604534     144.654059       2.023157       7.070324       5.113683       5.11
3682
      BB_Lower            OBV       `Mkt-RF`            SMB            HML
RF
    510.746757       2.021197       1.019035       1.011053       1.006101       1.00
8514
  Stock_Return
      1.000034
```

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```
# Display VIF values
print(vif_values)
```

```
           RSI     Volatility            EPS      Dividends Trading_Volume      Liqui
dity
      1.021109       1.000006       1.018663       1.032972       1.441154       1.60
4530
     MACD_Hist            ATR        STOCH_K        STOCH_D            OBV       `Mkt
-RF`
      1.000331       1.000375       5.113683       5.113682       2.021196       1.01
9034
           SMB            HML             RF   Stock_Return
      1.011053       1.006100       1.008509       1.000027
```

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```
# Perform OLS regression, 'Excess_Return ~ .' means 'Excess_Return' as the dependent
variable and all other columns as independent variables
standardized_model <- lm(Excess_Return ~ ., data = X)
# Perform OLS regression, 'Excess_Return ~ .' means 'Excess_Return' as the dependent
variable and all other columns as independent variables
standardized_model <- lm(Excess_Return ~ ., data = X)
# Summary of the model
summary(standardized_model)
```

```
Call:
lm(formula = Excess_Return ~ ., data = X)

Residuals:
       Min         1Q     Median         3Q        Max
-9.313e-05  0.000e+00  0.000e+00  0.000e+00  2.250e-07

Coefficients:
                 Estimate Std. Error    t value Pr(>|t|)
(Intercept)    -2.358e-11  2.715e-11 -8.690e-01   0.3851
RSI            -1.171e-12  4.873e-13 -2.404e+00   0.0162 *
Volatility      1.570e-14  5.670e-13  2.800e-02   0.9779
EPS             3.999e-15  5.102e-14  7.800e-02   0.9375
Dividends       1.675e-12  3.145e-12  5.330e-01   0.5943
Trading_Volume  5.768e-20  3.473e-19  1.660e-01   0.8681
Liquidity       2.184e-20  2.649e-20  8.240e-01   0.4097
MACD_Hist       7.380e-14  9.362e-14  7.880e-01   0.4305
ATR             1.500e-13  1.666e-14  9.006e+00   <2e-16 ***
STOCH_K        -4.266e-29  3.276e-27 -1.300e-02   0.9896
OBV            -6.439e-22  2.533e-21 -2.540e-01   0.7993
`Mkt-RF`        1.711e-10  5.261e-10  3.250e-01   0.7451
SMB             9.408e-10  9.820e-10  9.580e-01   0.3380
HML             6.266e-10  8.276e-10  7.570e-01   0.4489
RF             -1.000e+00  5.517e-08 -1.812e+07   <2e-16 ***
Stock_Return    1.000e+00  1.334e-16  7.497e+15   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.37e-08 on 15437996 degrees of freedom
Multiple R-squared:      1, Adjusted R-squared:      1
F-statistic: 3.747e+30 on 15 and 15437996 DF,  p-value: < 2.2e-16
```

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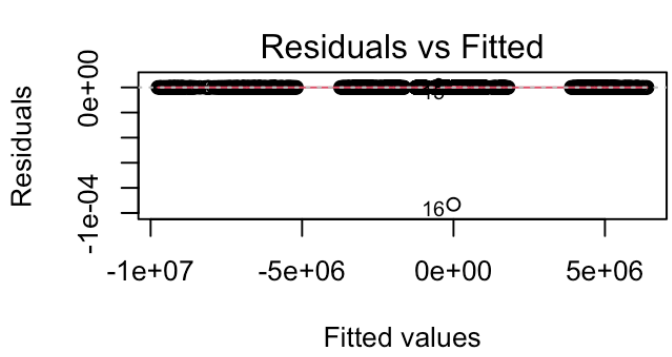
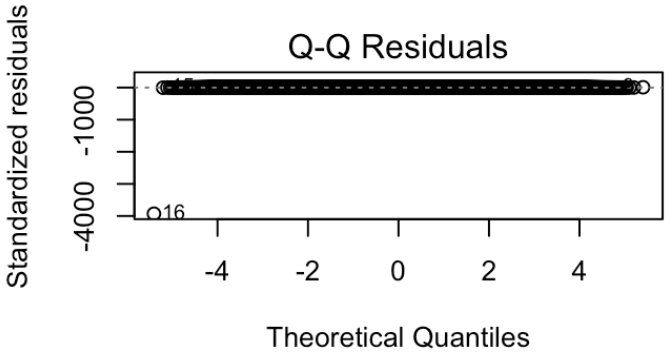
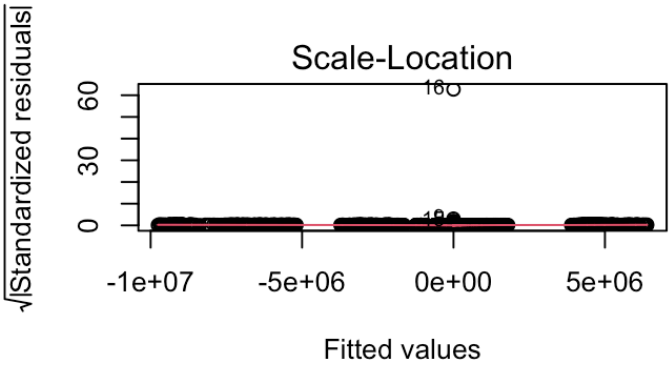
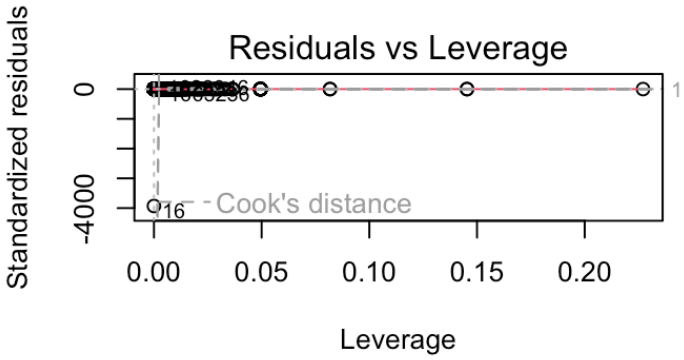
```
# Plot diagnostic plots for the model
par(mfrow = c(2, 2))  # Set up a 2x2 plotting area
plot(standardized_model)
```









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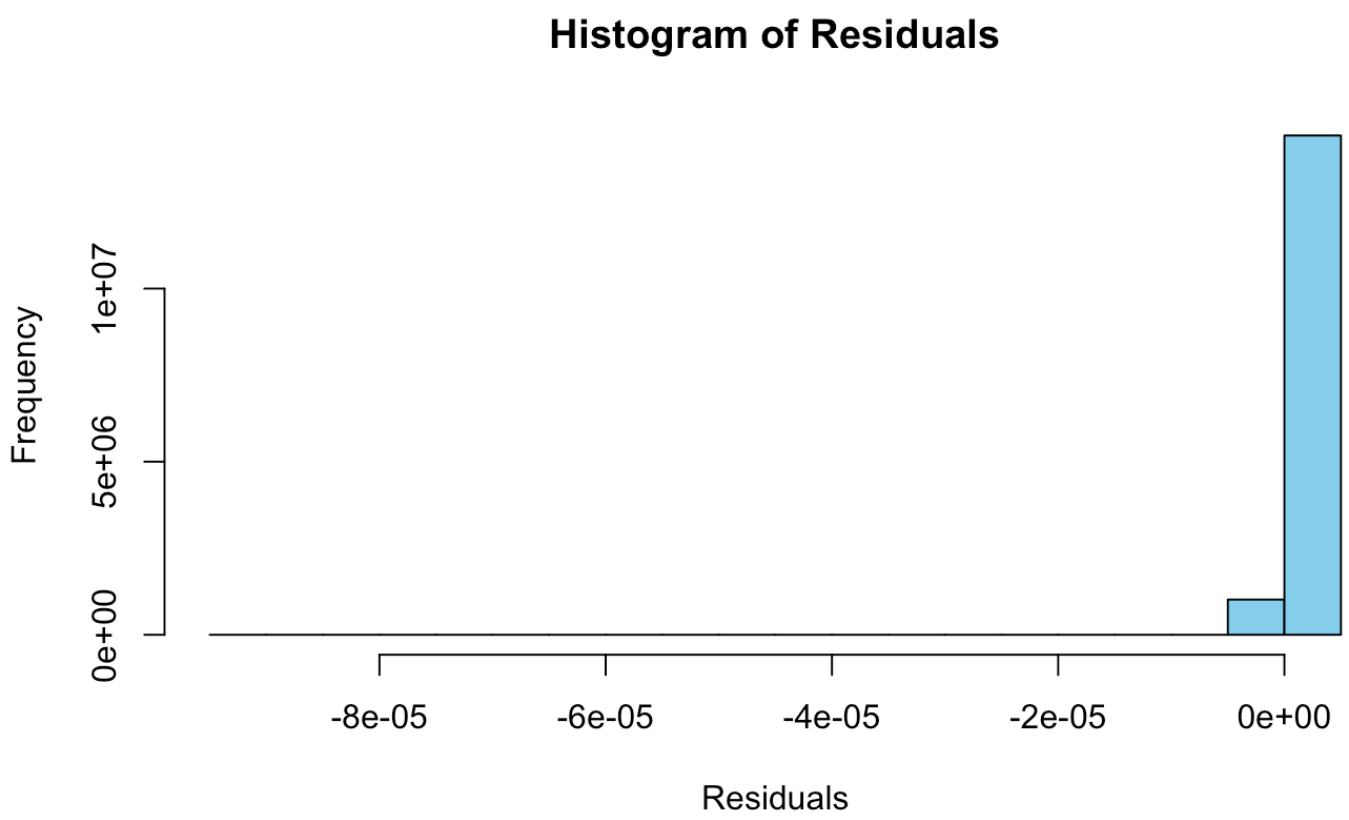
```
# Histogram of residuals
hist(residuals(standardized_model), main = "Histogram of Residuals", xlab = "Residual
s", col = "skyblue", breaks = 20)
```



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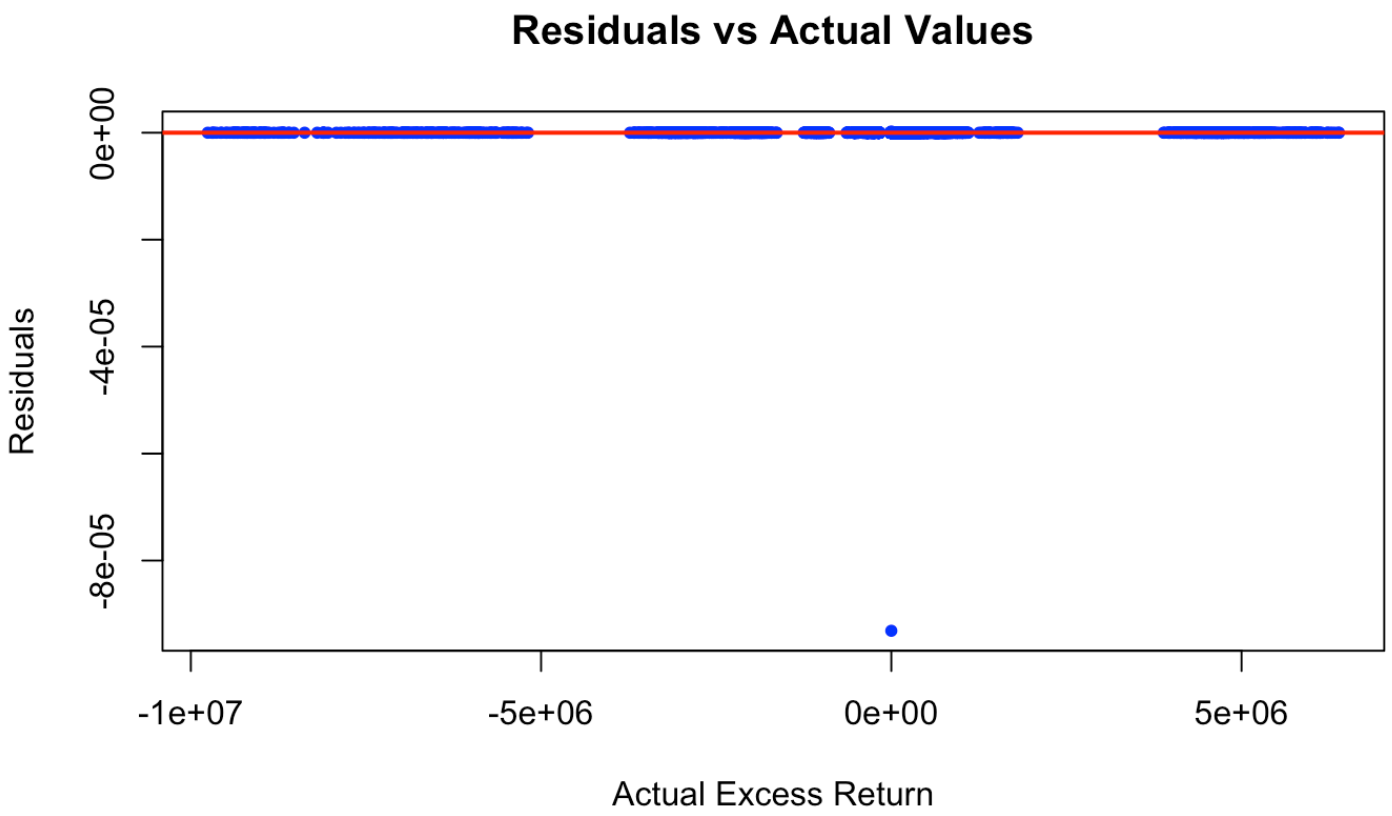
```
# Residuals vs Actual Values
plot(X$Excess_Return, residuals(standardized_model),
     main = "Residuals vs Actual Values",
     xlab = "Actual Excess Return",
     ylab = "Residuals",
     col = "blue", pch = 20)
abline(h = 0, col = "red", lwd = 2)
```



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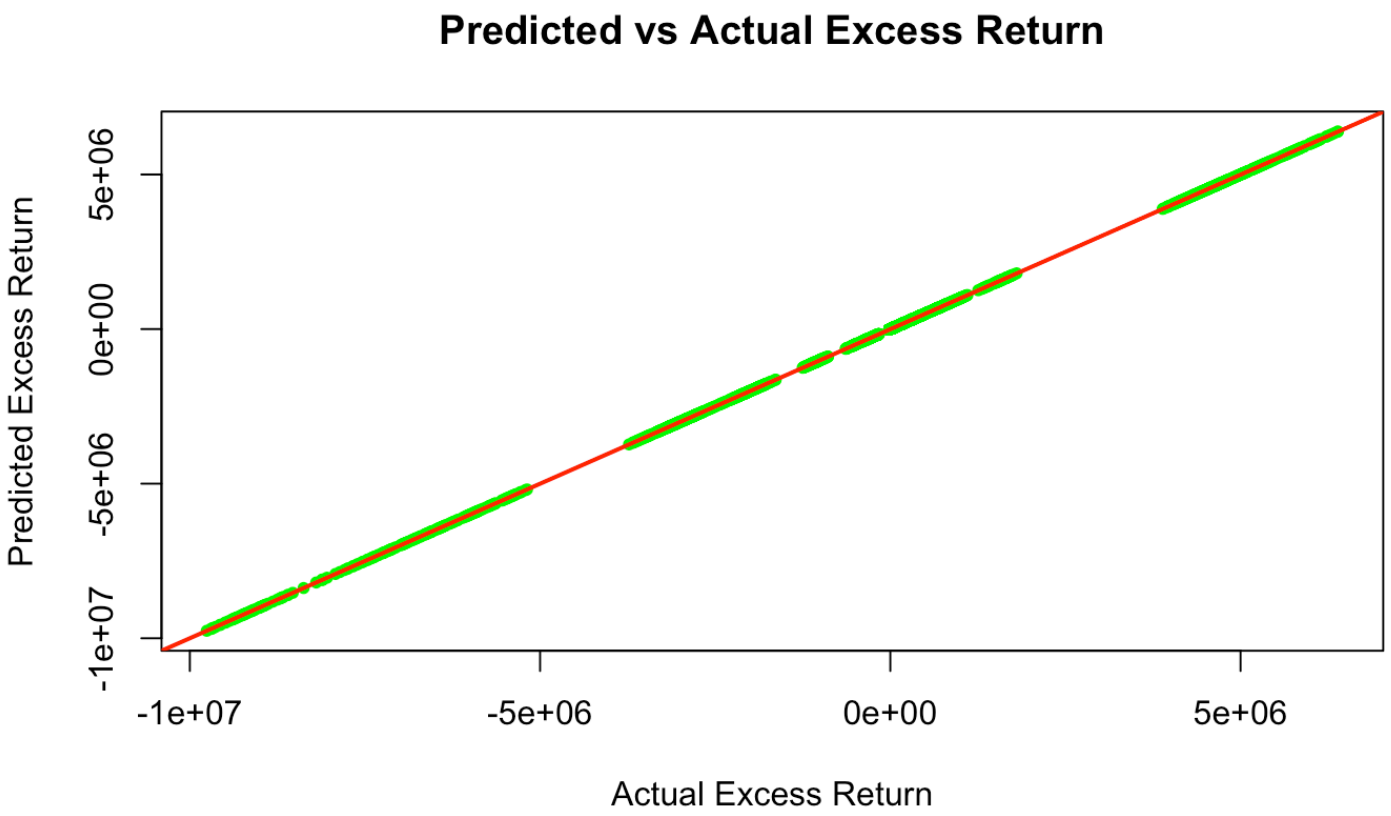
```
# Predicted vs Actual Plot
predicted_values <- predict(standardized_model, newdata = X)
plot(X$Excess_Return, predicted_values,
     main = "Predicted vs Actual Excess Return",
     xlab = "Actual Excess Return",
     ylab = "Predicted Excess Return",
     col = "green", pch = 20)
abline(a = 0, b = 1, col = "red", lwd = 2)  # Ideal line of equality
```



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```
summary(standardized_model)$r.squared  # R-squared
```

```
[1] 1
```

Hide

```
summary(standardized_model)$adj.r.squared  # Adjusted R-squared
```

```
[1] 1
```

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```
# Mean Squared Error (MSE)
mse <- mean(residuals(standardized_model)^2)
print(paste("Mean Squared Error:", mse))
```

```
[1] "Mean Squared Error: 5.61794133211019e-16"
```

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```
# Root Mean Squared Error (RMSE)
rmse <- sqrt(mse)
print(paste("Root Mean Squared Error:", rmse))
```

```
[1] "Root Mean Squared Error: 2.3702196801373e-08"
```

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```
vif_values <- vif(standardized_model)
print(vif_values)
```

```
          RSI     Volatility            EPS      Dividends Trading_Volume      Liqui
dity
     1.021108       1.000006       1.018663       1.032972       1.441154       1.60
4530
    MACD_Hist            ATR        STOCH_K            OBV       `Mkt-RF`
SMB
     1.000331       1.000375       1.000000       2.021196       1.019034       1.01
1053
          HML             RF   Stock_Return
     1.006100       1.008509       1.000027
```

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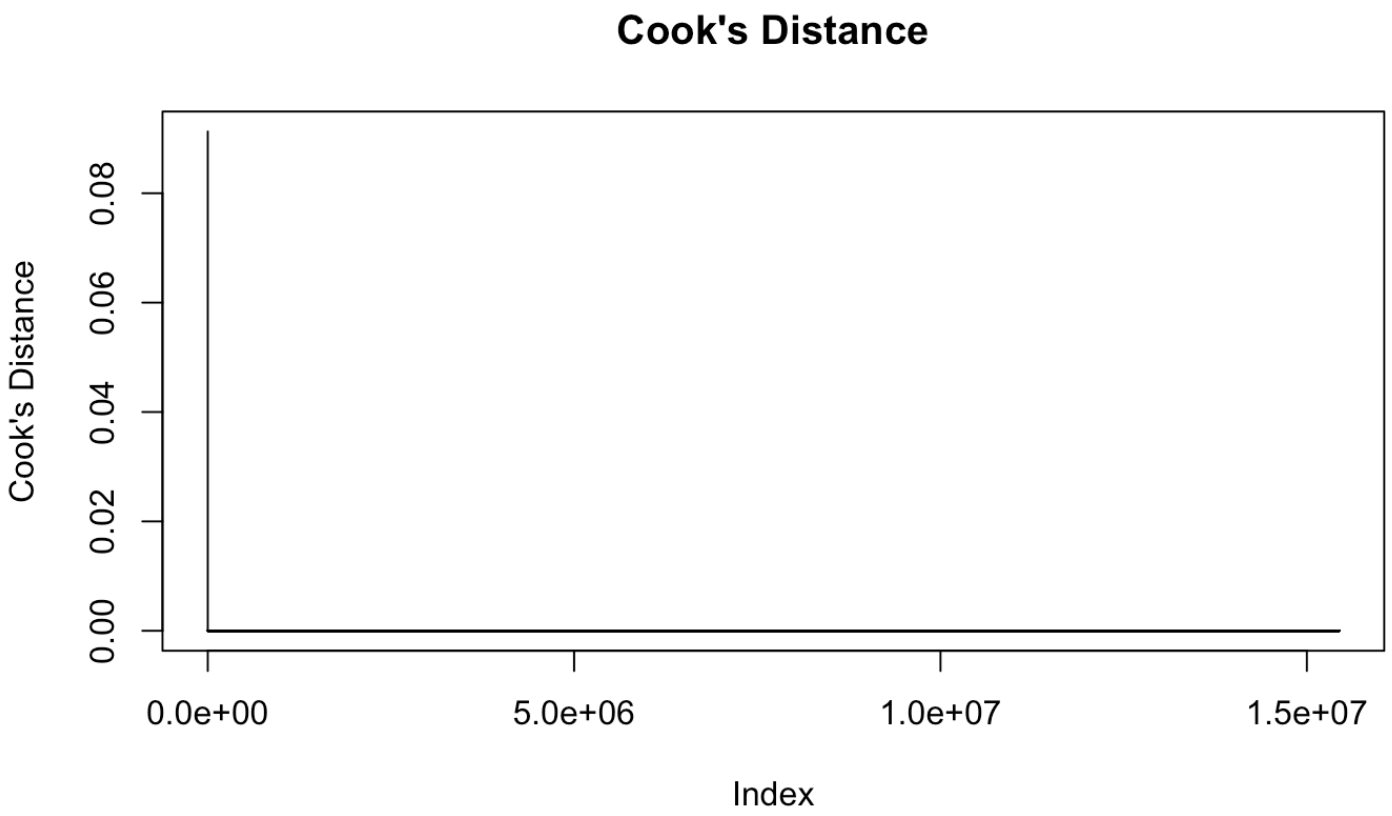
```
# Cook's Distance plot
plot(cooks.distance(standardized_model), main = "Cook's Distance", ylab = "Cook's Dis
tance", type = "h")
abline(h = 1, col = "red", lwd = 2)
```


Cook's Distance
Cook's Distance
0.00
0.02
0.04
0.06
0.08
0.0e+00
5.0e+06
1.0e+07
1.5e+07
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