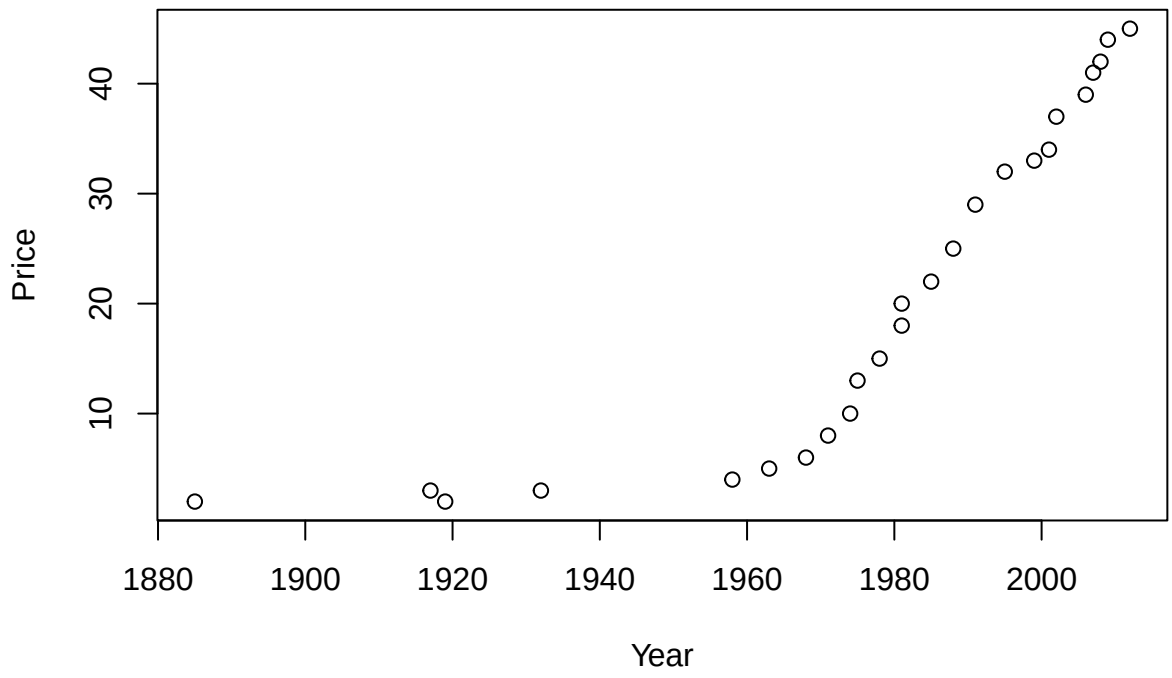
Supplement for Lecture 5: Assessing Conditions

Load Data from Textbook

```
data("USstamps") # Load Data

stamp = USstamps # Shorten Name

rm(USstamps) #Removes Old Object from Environment
```

Scatterplot of Price vs Year

```
plot(Price ~ Year,data=stamp)
```




```
#Remove First Four Years in Data (1885,1917,1919,1932)
#See Exercise 1.33 for Reason Why
```

Fit Linear Regression Models

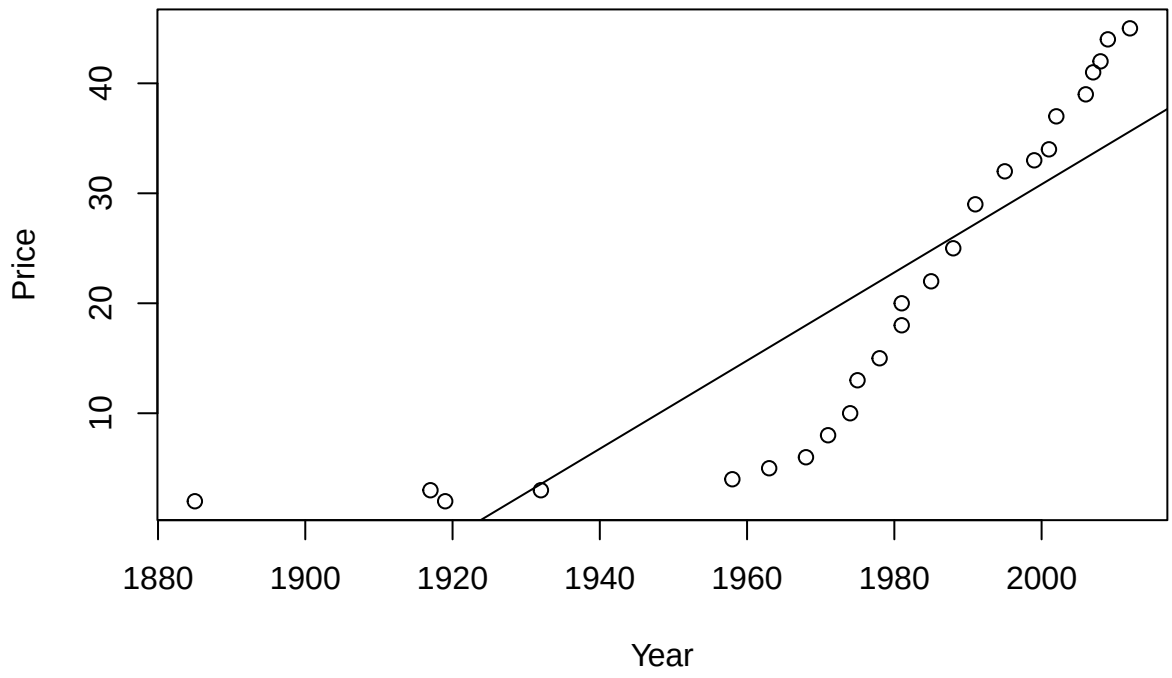
```
#Linear Regression on Original Data
mod1 <- lm(Price~Year,data=stamp)
mod1
```

```
##
## Call:
## lm(formula = Price ~ Year, data = stamp)
##
## Coefficients:
## (Intercept)         Year
##   -770.7811       0.4008
```

```
summary(mod1)
```

```
##
## Call:
## lm(formula = Price ~ Year, data = stamp)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -11.993  -7.001   1.788   5.447  17.273
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept) -770.78108   99.39045  -7.755 7.28e-08 ***
## Year           0.40080    0.05029   7.970 4.57e-08 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 8.03 on 23 degrees of freedom
## Multiple R-squared:  0.7342, Adjusted R-squared:  0.7226
## F-statistic: 63.52 on 1 and 23 DF,  p-value: 4.572e-08
```

```
plot(Price ~ Year,data=stamp)
abline(mod1)
```




```
#Linear Regression on Subsetted Data
```

Saving Fitted Values and Residuals

```
mod1$residuals
```

```
##           1           2           3           4           5           6
##  17.2729657   5.4473637   3.6457636  -0.5646372  -9.9854389 -10.9894392
##           7           8           9          10          11          12
## -11.9934395 -11.1958397 -10.3982399  -7.7990399  -7.0014401  -5.2038403
##          13          14          15          16          17          18
##  -3.2038403  -2.8070406  -1.0094407   1.7881591   3.1849588   2.5817586
##          19          20          21          22          23          24
##   2.7801584   5.3793584   5.7761581   7.3753581   7.9745580   9.5737579
##          25
##   9.3713578
```

```
mod1$fitted.values
```

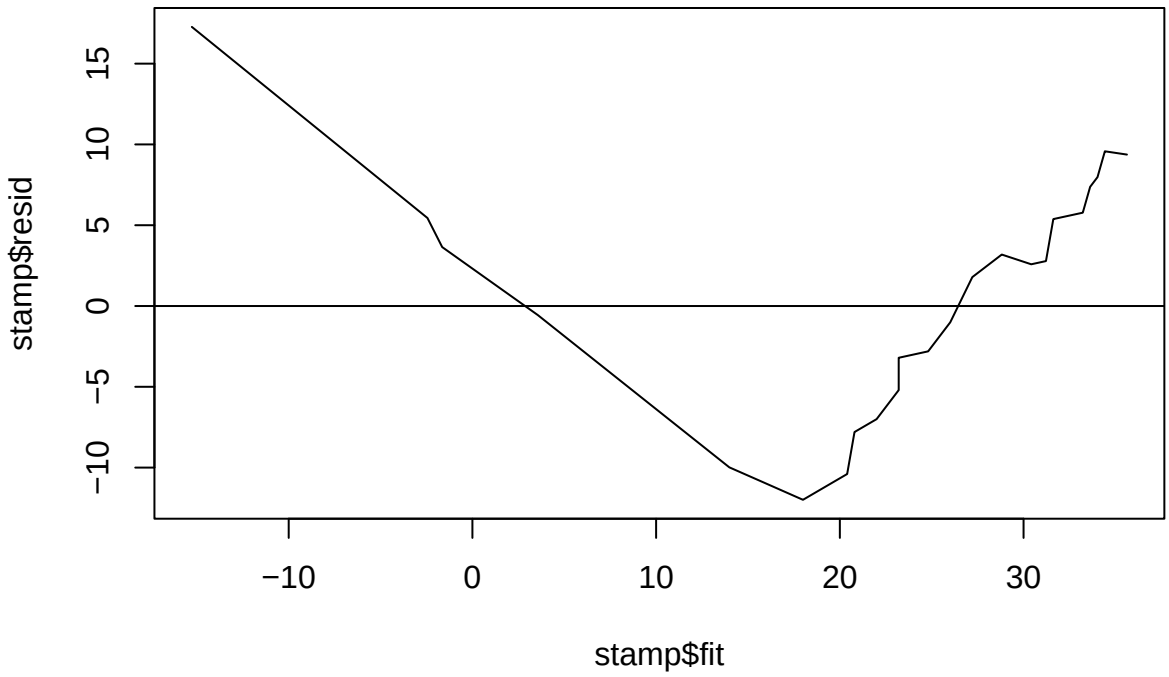
```
##          1          2          3          4          5          6          7
## -15.272966  -2.447364  -1.645764   3.564637  13.985439  15.989439  17.993439
##          8          9         10         11         12         13         14
##  19.195840  20.398240  20.799040  22.001440  23.203840  23.203840  24.807041
##         15         16         17         18         19         20         21
##  26.009441  27.211841  28.815041  30.418241  31.219842  31.620642  33.223842
##         22         23         24         25
```

```
##  33.624642  34.025442  34.426242  35.628642
```

```
stamp$fit=mod1$fitted.values
stamp$resid=mod1$residuals
```

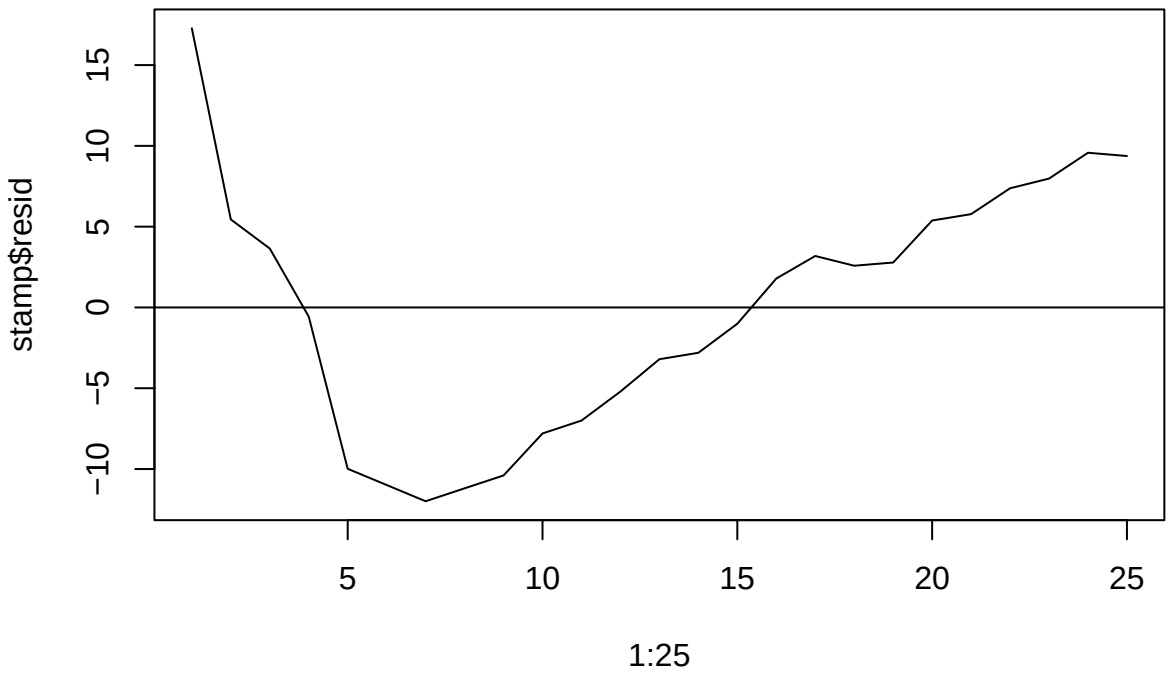
Residuals vs Fit

```
plot(y=stamp$resid,x=stamp$fit,type="l")
abline(h=0) #h=location of horizontal line
```



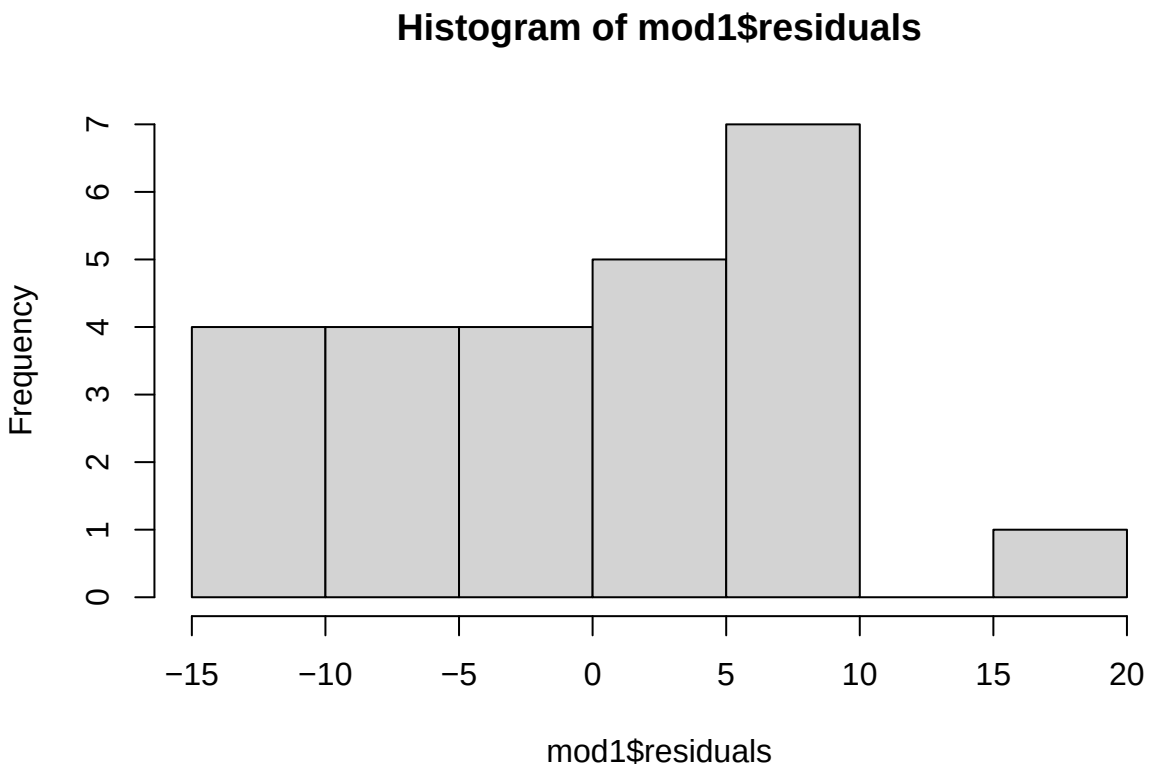
Residuals vs Order (Time)

```
plot(y=stamp$resid,x=1:25,type="l")
abline(h=0) #h=location of horizontal line
```

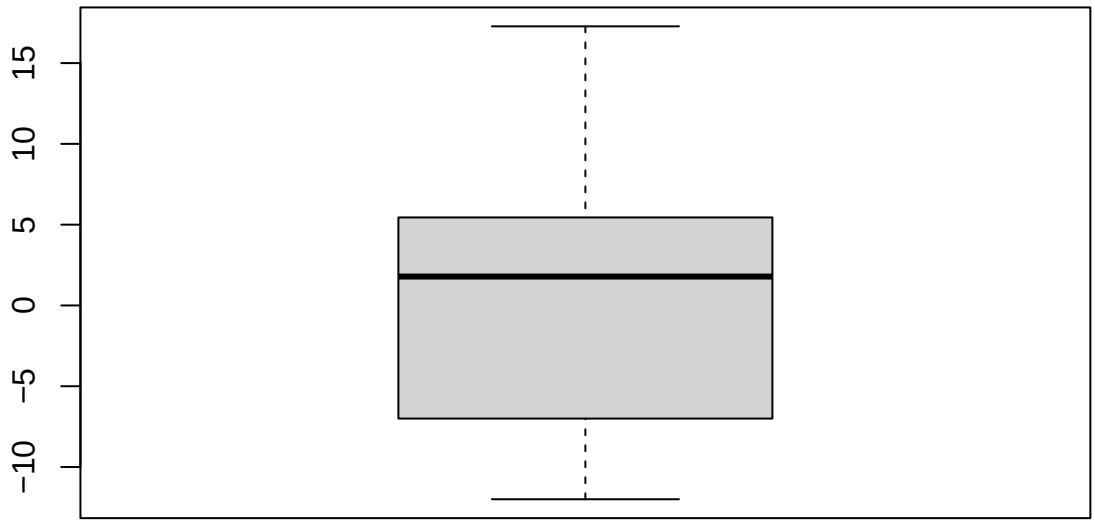


Histogram/Boxplots of Resid

```
hist(mod1$residuals,breaks=5) #Remember: We can always plot residuals directly from model object
```



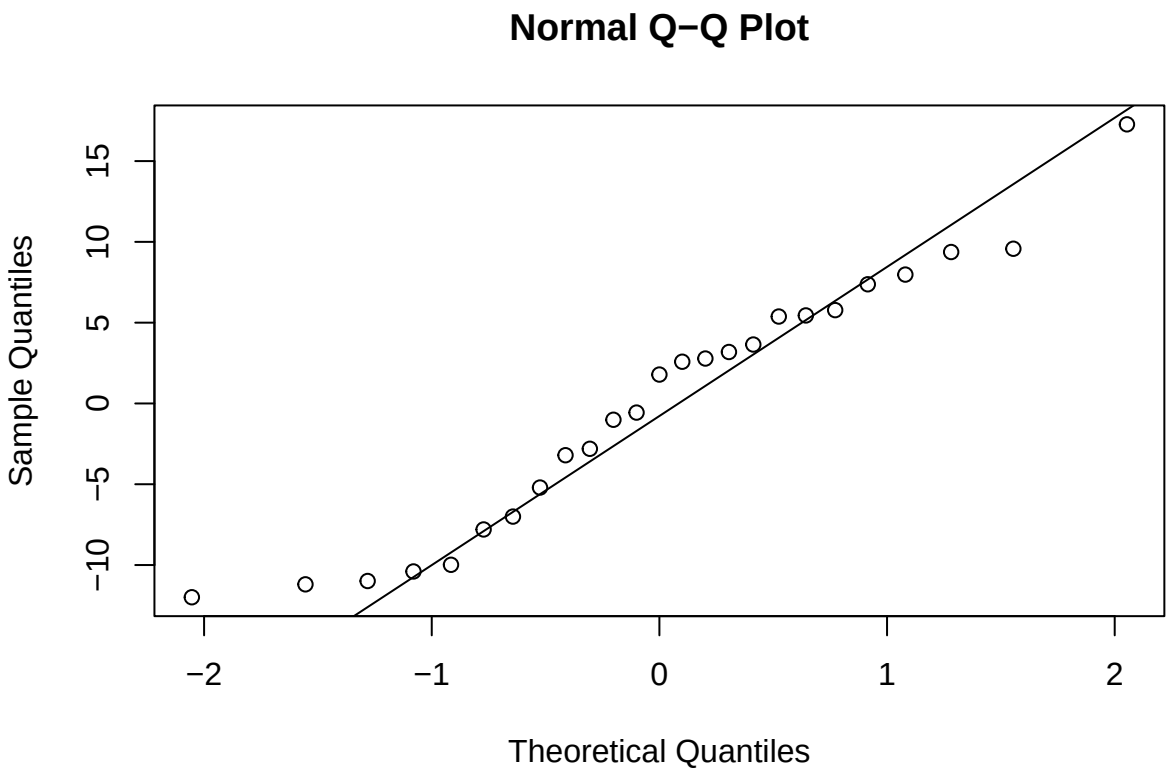

```
#hist(stamp2$resid,breaks=5) #Remember: We can plot residuals that we saved into our dataset

boxplot(stamp$resid)
```




```
#boxplot(mod2$residuals)
```

Normal Plots

```
qqnorm(stamp$resid)
qqline(stamp$resid)
```


Normal Q−Q Plot
Sample Quantiles
−10
−5
0
5
10
15
−2
−1
0
1
2
Theoretical Quantiles