

R for Chapter 3

Running List of Functions Applied to the Data Set, class.data:

```
> attach(class.data)

> reg <- lm(wt ~ ht)

>summary(reg)

> res <- residuals(reg)  ## stores the residuals in the variable "res", ie the e (sub i)'s

> fit <- fitted(reg)  ## stores the fitted values in the variable "fit", ie the Y hat (sub i)'s, the results of plugging the
## original data X-values into the fitted line

> semi.st.res <- res/19.68662  ## forms semi-studentized residuals - value of residual stand error (19.68662) is from
## summary(reg)

> plot(ht,semi.st.res)  ## scatter plot of ht (horizontal) by semi-studentized residuals (vertical) for each data point

## What follows is a description of what is needed for the Modified Levene Test ##

> median(ht)  ## Finds the median of the values stored in ht

> iht <- rep("B",20)  ## constructs a vector with 20 entries and a "B" in each one (ie it repeats "B" 20 times)

> for (i in 1:20) {if (ht[i] > 67.5) iht[i] <- "A"}  ## replaces the ith iht value with an "A" if the ith ht value is above the
## median(ht) which is equal to 67.5

> alt.class.data <- cbind( class.data, res, iht)  ## alters the class.data set by adding a "res" column and an "iht" column

> alt.class.data  ## displays the alt.class.data set (altered class.data) with the new columns added

> library(car)  ## brings in the library that includes the Levene Test  ***SEE END OF NEXT PAGE***

> leveneTest(res ~ iht, data=alt.class.data, center=median)  ## runs the Modified Levene Test analyzing the residuals
## (res) as a function of the group indicator (iht)
## centering each group's residuals at their resp. median
```

End of the the Modified Levene Test - the output of the test is shown below##

```
Levene's Test for Homogeneity of Variance (center = median)
  Df F value Pr(>F)
group 1  0.9463  0.3436
18
```

End of the the Modified Levene Test output##

```

> hist(res)  ## gives a histogram of the residuals
> boxplot(res)  ## gives a boxplot of the residuals
> qqnorm(res)  ## gives the Q-Q plot of the residuals versus what is expected to be when under a normal distribution
                ## it is like a normal probability plot (if it forms a line then the residuals look like they came from a
                ## normal distribution
> shapiro.test(res)  ## performs the Shapiro-Wilk test which uses  $H_0$  : (pop. is some normal dist.) versus
                    ##  $H_a$ : (pop. is not a normal dist.) and rejects  $H_0$  when the test statistic W is small.

```

Begin Lack of Fit Test

```

> anova(lm(wt~ht))  ## Gives the usual (previous) ANOVA for this data - produces SSR and SSE=6976.1 for our
                    ## example
> cht <- factor(ht)  ## Changes the numerical variable ht into a variable that uses these numbers as labels and not
                    ## as numbers
> anova(lm(wt ~ cht))  ## produces an anova with respect to the factor variable - The residuals SS for this model
                    ## is actually the SSPE in the lack of fit test and its mean square is MSPE. In this example,
                    ## SSPE = 4734.2 and MSPE = 430.38
> sslf <- 6976.1 - 4734.2  ## computes the SS for lack of fit (SSLF) as the SSE of the original LS model minus the
                    ## SSPE
> mslf <- sslf/7  ## Mean square for lack of fit - denominator is the (number of distinct levels of X) minus 2
> fstat <- mslf/430.38  ## F test statistic - denominator is the MSPE
> pval <- 1.0 - pf(fstat, 7, 11)  ## produces the p-value for this F test. In this example, 7 is the df of MSLF and 11 is the
                    ## df of MSPE.

```

End Lack of Fit Test

Loading External Libraries:

From time to time we need to use libraries of programs stored on the R system but not included in the installation of R.

Suppose you need to download the set of programs in the library called “car”. This can be accomplished in the following manner. First you must be in a setting in which you are connected to the internet. When in the R workspace window type:

```

> install.packages("car")
    ## You will have to answer a few questions in the process, but it will download onto your computer.
    ## Then type:
> library(car)  ## This brings the library into your active workspace. You should have access to the programs in “car”
                ## now.

```