Applied Statistics HW3 #4 solution.
Arinjay Jain, A20447307, ajain80@hawk.iit,edu

4.1

```
#sort data in ascending order
sortdataFrame <- Ass2data[order(Ass2data$X1), ]
Y<-sortdataFrame$Y
X1<-sortdataFrame$X1
X2<-sortdataFrame$X2
names(sortdataFrame)
# MRL model y = B1*X1+B2*X2+e1
model1<-lm(Y~X1+X2)
# get a summary of the model
summary(model1)

Call:
lm(formula = Y ~ X1 + X2)

Residuals:
     Min       1Q   Median       3Q      Max
-22.5390  -4.2515   0.5995   6.5995  14.9330

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  -0.9225     3.0997  -0.298    0.767
X1           15.0461     0.4900  30.706   <2e-16 ***
X2            0.7587     2.7799   0.273    0.786
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 9.011 on 42 degrees of freedom
Multiple R-squared:  0.9576,   Adjusted R-squared:  0.9556
F-statistic: 473.9 on 2 and 42 DF,  p-value: < 2.2e-16

# the estimated regression function.
b0<-(-0.9225)
b1<-15.0461
b2<-0.7587
yhat<-b0+b1*X1+b2*X2

(Yhat = -0.9225+15.0461*X1+0.7587*X2)

#Large (X2=0): If the number of coppiers serived increases by 1 unit then
#number of minutes spend on the phone increase 15.0461. Y = -0.9225 + 15.0461 #(X1)

#Small (X2=1): If the copier is a small copier time on a service call is
#will increase that time by .7587 in comparison to large coppiers. Y= -0.1638 #+ 15.0461
(X1)
```

4.2

```
#Estimate the effect of copier model X2 on mean service time μy with a 95%
#confidence interval.

confint(model1, level = .95)
                2.5 %    97.5 %
(Intercept) -7.177891  5.332945
X1          14.057283 16.035004
X2          -4.851254  6.368698
```

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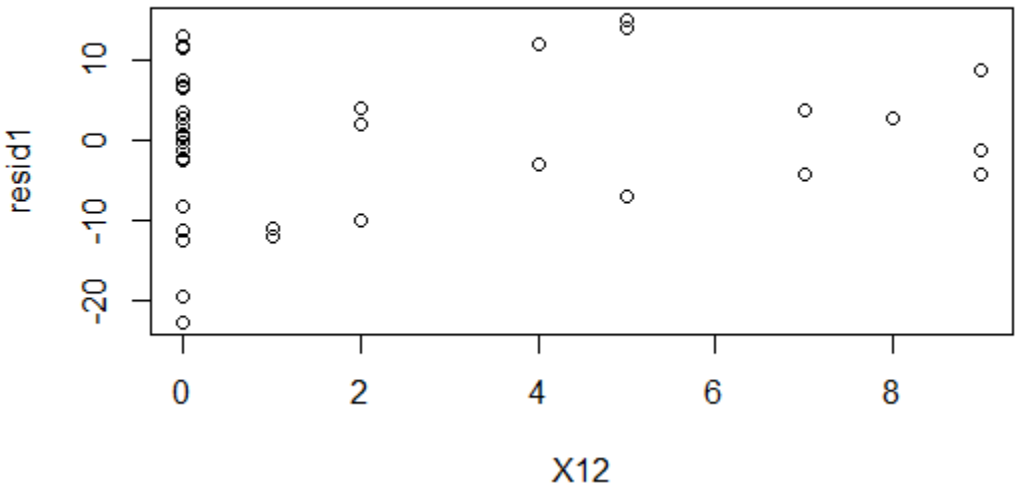
4.3

```
#residuals of model1
resid1<-resid(model1)
# X1 *X2 = X12
X12<-X1*X2
#Plot residual again X12
plot(X12,resid1)
```



Based on the residual plot with the interaction term and the original residual it appears that it would not be benefited for the model to add in an interaction term. Snice we have multiple residuals at single point(X12=0) therefore we lack evidence to conclude that the interaction term would be helpful in the model.

4.4

```
#4 Fit the regression model yi = β0 + β1xi1 + β2xi2 + β12xi1xi2 + ei

model2<-lm(Y~X1+X2+X12)

# get a summary of the model2
summary(model2)

Call:
lm(formula = Y ~ X1 + X2 + X12)
Residuals:
     Min       1Q   Median       3Q      Max
-19.2072  -6.7887  -0.1708   7.1504  14.7441

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   2.8131     3.6468   0.771   0.4449
X1           14.3394     0.6146  23.333   <2e-16 ***
X2           -8.1412     5.5801  -1.459   0.1522
X12           1.7774     0.9746   1.824   0.0755 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
Residual standard error: 8.771 on 41 degrees of freedom
Multiple R-squared:  0.9608,   Adjusted R-squared:  0.9579
F-statistic: 334.6 on 3 and 41 DF,  p-value: < 2.2e-16

#provide the estimated regression function.
```

Yhat2 = 2.8131 + 14.3394 (X1) -8.1412(X2) + 1.7774(X12)

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4.5

```
#T-value from Table Decision Rule
t <- qt(0.975, 41)
c(t)= 2.019541
```

t-test of interaction term X1*X2 (X12) is **1.824**
t-test < T-Value (1.824<2.019) so we cannot reject null hypotheses

Hypotheses:

$H_0: \beta_3 = 0;$

$H_A: \beta_3 \neq 0;$

P value of interaction term X1*X2 (X12) is **0.0755 < 0.10 (α = 10%)** so interaction term cannot be dropped.
Interaction Term(X12): If the number of Interaction Term increases by 1 unit then number of minutes spend increase by 1.7774. This concludes that we have a relationship between the response variable Y and the Interaction Team X12.

Yhat2 = 2.8131 + 14.3394 (X1) -8.1412(X2) + 1.7774(Interaction Term)

```
summary(model2)
Call:
lm(formula = Y ~ X1 + X2 + X12)

Residuals:
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