Assignment 6

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```
if(!require("pacman")) install.packages("pacman")
pacman::p_load(tidyverse, reshape, gplots, ggmap, RStata,haven,
                data.table,margins,pastecs,MASS,tinytex)
search()
theme_set(theme_light())

#getwd()
br<-read_dta('br2.dta')
head(br)

## # A tibble: 6 x 10
##    price  sqft bedrooms baths   age owner  pool traditional fireplace wate
rfront
##    <dbl> <dbl>    <dbl> <dbl> <dbl> <dbl> <dbl>       <dbl>     <dbl>
<dbl>
## 1  66500   741        1     1    18     1     1           1         1
0
## 2  66000   741        1     1    18     0     1           1         0
0
## 3  68500   790        1     1    18     1     0           1         1
0
## 4 102000  2783        2     2    18     1     0           1         1
0
## 5  54000  1165        2     1    35     0     0           1         0
0
## 6 143000  2331        2     2    25     1     0           1         1
0
```

PART A

```
options(scipen = 1)
summary(br)

##      price              sqft         bedrooms        baths
##  Min.   :  22000   Min.   : 662   Min.   :1.00   Min.   :1.000
##  1st Qu.:  99000   1st Qu.:1604   1st Qu.:3.00   1st Qu.:2.000
##  Median : 130000   Median :2186   Median :3.00   Median :2.000
##  Mean   : 154863   Mean   :2326   Mean   :3.18   Mean   :1.973
##  3rd Qu.: 170163   3rd Qu.:2800   3rd Qu.:4.00   3rd Qu.:2.000
##  Max.   :1580000   Max.   :7897   Max.   :8.00   Max.   :5.000
##       age            owner             pool          traditional
##  Min.   : 1.00   Min.   :0.0000   Min.   :0.00000   Min.   :0.0000
##  1st Qu.: 5.00   1st Qu.:0.0000   1st Qu.:0.00000   1st Qu.:0.0000
##  Median :18.00   Median :0.0000   Median :0.00000   Median :1.0000
##  Mean   :19.57   Mean   :0.4889   Mean   :0.07963   Mean   :0.5389
```

```
##  3rd Qu.:25.00   3rd Qu.:1.0000   3rd Qu.:0.00000   3rd Qu.:1.0000
##  Max.   :80.00   Max.   :1.0000   Max.   :1.00000   Max.   :1.0000
##    fireplace       waterfront
##  Min.   :0.000   Min.   :0.00000
##  1st Qu.:0.000   1st Qu.:0.00000
##  Median :1.000   Median :0.00000
##  Mean   :0.563   Mean   :0.07222
##  3rd Qu.:1.000   3rd Qu.:0.00000
##  Max.   :1.000   Max.   :1.00000
```

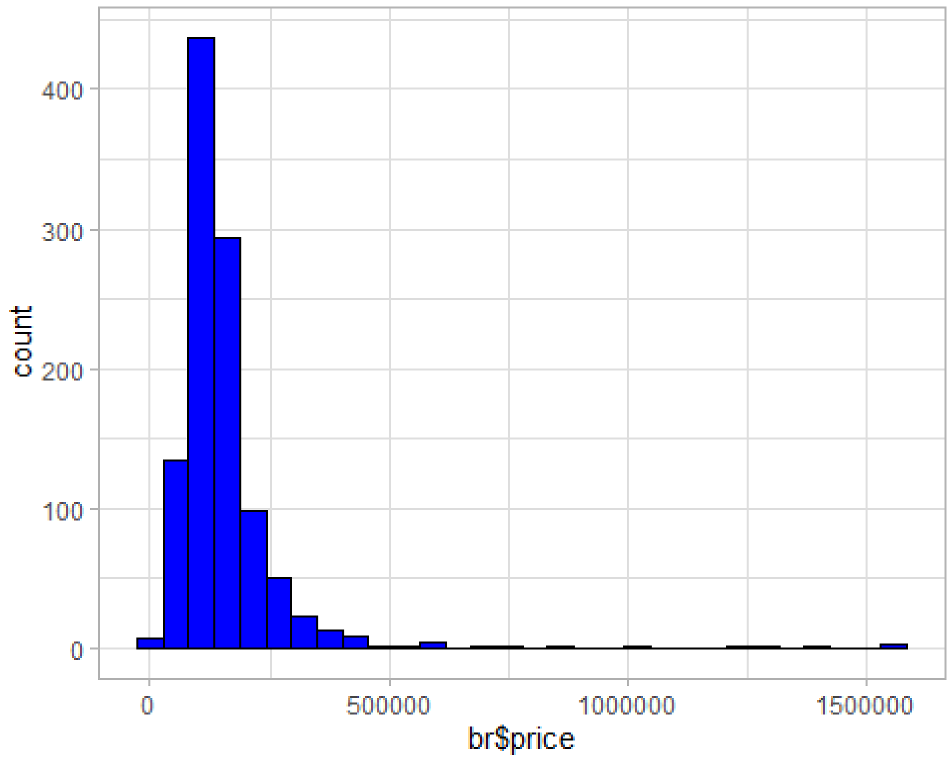
```
stat.desc(br)
```

```
##                     price         sqft      bedrooms         baths
## nbr.val      1.080000e+03 1.080000e+03 1080.00000000 1080.00000000
## nbr.null     0.000000e+00 0.000000e+00    0.00000000    0.00000000
## nbr.na       0.000000e+00 0.000000e+00    0.00000000    0.00000000
## min          2.200000e+04 6.620000e+02    1.00000000    1.00000000
## max          1.580000e+06 7.897000e+03    8.00000000    5.00000000
## range        1.558000e+06 7.235000e+03    7.00000000    4.00000000
## sum          1.672522e+08 2.512013e+06 3434.00000000 2131.00000000
## median       1.300000e+05 2.186500e+03    3.00000000    2.00000000
## mean         1.548632e+05 2.325938e+03    3.17962963    1.97314815
## SE.mean      3.740118e+03 3.067544e+01    0.02158927    0.01862460
## CI.mean.0.95 7.338728e+03 6.019028e+01    0.04236172    0.03654454
## var          1.510756e+10 1.016262e+06    0.50338448    0.37462585
## std.dev      1.229128e+05 1.008098e+03    0.70949593    0.61206687
## coef.var     7.936865e-01 4.334157e-01    0.22313792    0.31019813
##                       age        owner         pool   traditional
## nbr.val       1080.0000000 1080.00000000 1.080000e+03 1080.00000000
## nbr.null         0.0000000  552.00000000 9.940000e+02  498.00000000
## nbr.na           0.0000000    0.00000000 0.000000e+00    0.00000000
## min              1.0000000    0.00000000 0.000000e+00    0.00000000
## max             80.0000000    1.00000000 1.000000e+00    1.00000000
## range           79.0000000    1.00000000 1.000000e+00    1.00000000
## sum          21140.0000000  528.00000000 8.600000e+01  582.00000000
## median          18.0000000    0.00000000 0.000000e+00    1.00000000
## mean            19.5740741    0.48888889 7.962963e-02    0.53888889
## SE.mean          0.5232045    0.01521781 8.241532e-03    0.01517545
## CI.mean.0.95     1.0266135    0.02985984 1.617125e-02    0.02977674
## var            295.6423300    0.25010812 7.335667e-02    0.24871795
## std.dev         17.1942528    0.50010811 2.708444e-01    0.49871630
## coef.var         0.8784197    1.02294841 3.401301e+00    0.92545293
##                  fireplace   waterfront
## nbr.val      1080.00000000 1.080000e+03
## nbr.null      472.00000000 1.002000e+03
## nbr.na          0.00000000 0.000000e+00
## min             0.00000000 0.000000e+00
## max             1.00000000 1.000000e+00
## range           1.00000000 1.000000e+00
## sum           608.00000000 7.800000e+01
```

```
## median          1.00000000 0.000000e+00
## mean            0.56296296 7.222222e-02
## SE.mean         0.01510040 7.880371e-03
## CI.mean.0.95    0.02962947 1.546259e-02
## var             0.24626369 6.706827e-02
## std.dev         0.49624962 2.589754e-01
## coef.var        0.88149604 3.585814e+00
```

HISTOGRAM OF PRICE #warning=False,message=False

```
ggplot(data=br, aes(x=br$price)) +
  geom_histogram(color='black', fill='blue')
```



PART B

```
PRICE=br$price/1000
SQFT=br$sqft/100
lm_b<-lm(log(PRICE)~SQFT+age+bedrooms+baths+owner+pool+traditional+fireplace+
waterfront,data=br)
summary(lm_b)

##
## Call:
## lm(formula = log(PRICE) ~ SQFT + age + bedrooms + baths + owner +
##     pool + traditional + fireplace + waterfront, data = br)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
```

```
## -1.13459 -0.12758  0.00656  0.14785  1.06650
##
## Coefficients:
##               Estimate Std. Error t value  Pr(>|t|)
## (Intercept)  3.9808326  0.0458947  86.738   < 2e-16 ***
## SQFT         0.0299011  0.0014059  21.269   < 2e-16 ***
## age         -0.0062145  0.0005179 -11.999   < 2e-16 ***
## bedrooms    -0.0315060  0.0166109  -1.897  0.058135 .
## baths        0.1901190  0.0205579   9.248   < 2e-16 ***
## owner        0.0674654  0.0177460   3.802  0.000152 ***
## pool        -0.0042748  0.0315812  -0.135  0.892353
## traditional -0.0560926  0.0170267  -3.294  0.001019 **
## fireplace    0.0842748  0.0190150   4.432 0.0000103 ***
## waterfront   0.1099700  0.0333550   3.297  0.001010 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.27 on 1070 degrees of freedom
## Multiple R-squared:  0.7373, Adjusted R-squared:  0.7351
## F-statistic: 333.7 on 9 and 1070 DF,  p-value: < 2.2e-16
```

PART C

```
lm_c<-lm(log(PRICE)~SQFT+age+bedrooms+baths+owner+pool+traditional+fireplace+
waterfront+waterfront : traditional ,data=br)
summary(lm_c)
```

```
##
## Call:
## lm(formula = log(PRICE) ~ SQFT + age + bedrooms + baths + owner +
##     pool + traditional + fireplace + waterfront + waterfront:traditional,
##     data = br)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.13891 -0.12591  0.00672  0.14693  1.05734
##
## Coefficients:
##                          Estimate Std. Error t value Pr(>|t|)
## (Intercept)             3.9711130  0.0459460  86.430  < 2e-16 ***
## SQFT                    0.0300308  0.0014034  21.399  < 2e-16 ***
## age                    -0.0061470  0.0005174 -11.881  < 2e-16 ***
## bedrooms               -0.0313330  0.0165702  -1.891  0.05890 .
## baths                   0.1882577  0.0205208   9.174  < 2e-16 ***
## owner                   0.0683701  0.0177061   3.861  0.00012 ***
## pool                   -0.0023939  0.0315125  -0.076  0.93946
## traditional            -0.0449127  0.0175612  -2.557  0.01068 *
## fireplace               0.0873139  0.0190070   4.594 4.87e-06 ***
## waterfront              0.1653741  0.0399505   4.139 3.75e-05 ***
## traditional:waterfront -0.1721747  0.0687162  -2.506  0.01237 *
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.2693 on 1069 degrees of freedom
## Multiple R-squared:  0.7389, Adjusted R-squared:  0.7364
## F-statistic: 302.5 on 10 and 1069 DF,  p-value: < 2.2e-16
```

PART D

```
lm_d1<-lm(log(PRICE)~SQFT+age+bedrooms+baths+owner+pool+fireplace+waterfront,
data=br)
summary(lm_d1)
```

```
##
## Call:
## lm(formula = log(PRICE) ~ SQFT + age + bedrooms + baths + owner +
##     pool + fireplace + waterfront, data = br)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.15673 -0.12355 -0.00287  0.14356  1.03816
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)  3.9701078  0.0459892  86.327  < 2e-16 ***
## SQFT         0.0301592  0.0014101  21.387  < 2e-16 ***
## age         -0.0061907  0.0005203 -11.899  < 2e-16 ***
## bedrooms    -0.0405182  0.0164592  -2.462 0.013984 *
## baths        0.1894469  0.0206512   9.174  < 2e-16 ***
## owner        0.0650077  0.0178117   3.650 0.000275 ***
## pool         0.0007741  0.0316887   0.024 0.980516
## fireplace    0.0911987  0.0189852   4.804 1.78e-06 ***
## waterfront   0.1225762  0.0332869   3.682 0.000243 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.2712 on 1071 degrees of freedom
## Multiple R-squared:  0.7347, Adjusted R-squared:  0.7327
## F-statistic: 370.7 on 8 and 1071 DF,  p-value: < 2.2e-16
```

```
lm_d2<-lm(log(PRICE)~SQFT+age+bedrooms+baths+owner+pool+fireplace+waterfront+
traditional+SQFT:traditional+age:traditional+bedrooms:traditional+baths :trad
itional+ owner:traditional+pool:traditional+fireplace:traditional+waterfront:
traditional,data=br)
summary(lm_d2)
```

```
##
## Call:
## lm(formula = log(PRICE) ~ SQFT + age + bedrooms + baths + owner +
##     pool + fireplace + waterfront + traditional + SQFT:traditional +
##     age:traditional + bedrooms:traditional + baths:traditional +
```

```
##     owner:traditional + pool:traditional + fireplace:traditional +
##     waterfront:traditional, data = br)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -1.1376 -0.1248  0.0045  0.1462  1.0578
##
## Coefficients:
##                          Estimate Std. Error t value Pr(>|t|)
## (Intercept)             4.0672688  0.0576957  70.495  < 2e-16 ***
## SQFT                    0.0324010  0.0018412  17.598  < 2e-16 ***
## age                    -0.0054674  0.0007292  -7.498 1.37e-13 ***
## bedrooms               -0.0713737  0.0236571  -3.017 0.002614 **
## baths                   0.1831139  0.0288594   6.345 3.29e-10 ***
## owner                   0.0388479  0.0258967   1.500 0.133884
## pool                    0.0021253  0.0419397   0.051 0.959594
## fireplace               0.0578017  0.0296703   1.948 0.051662 .
## waterfront              0.1729789  0.0406915   4.251 2.32e-05 ***
## traditional            -0.3350839  0.0944926  -3.546 0.000408 ***
## SQFT:traditional       -0.0052974  0.0028196  -1.879 0.060549 .
## age:traditional        -0.0012916  0.0010325  -1.251 0.211211
## bedrooms:traditional    0.0989064  0.0335594   2.947 0.003277 **
## baths:traditional       0.0310767  0.0412135   0.754 0.450991
## owner:traditional       0.0586870  0.0353000   1.663 0.096703 .
## pool:traditional       -0.0237596  0.0630941  -0.377 0.706566
## fireplace:traditional   0.0650471  0.0386865   1.681 0.092982 .
## waterfront:traditional -0.2069886  0.0710609  -2.913 0.003657 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.2672 on 1062 degrees of freedom
## Multiple R-squared:  0.7447, Adjusted R-squared:  0.7406
## F-statistic: 182.2 on 17 and 1062 DF,  p-value: < 2.2e-16
```

```r
anova(lm_d1,lm_d2)
```

```
## Analysis of Variance Table
##
## Model 1: log(PRICE) ~ SQFT + age + bedrooms + baths + owner + pool + firep
lace +
##     waterfront
## Model 2: log(PRICE) ~ SQFT + age + bedrooms + baths + owner + pool + firep
lace +
##     waterfront + traditional + SQFT:traditional + age:traditional +
##     bedrooms:traditional + baths:traditional + owner:traditional +
##     pool:traditional + fireplace:traditional + waterfront:traditional
##   Res.Df    RSS Df Sum of Sq      F    Pr(>F)
## 1   1071 78.772
## 2   1062 75.799  9    2.9724 4.6272 5.037e-06 ***
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

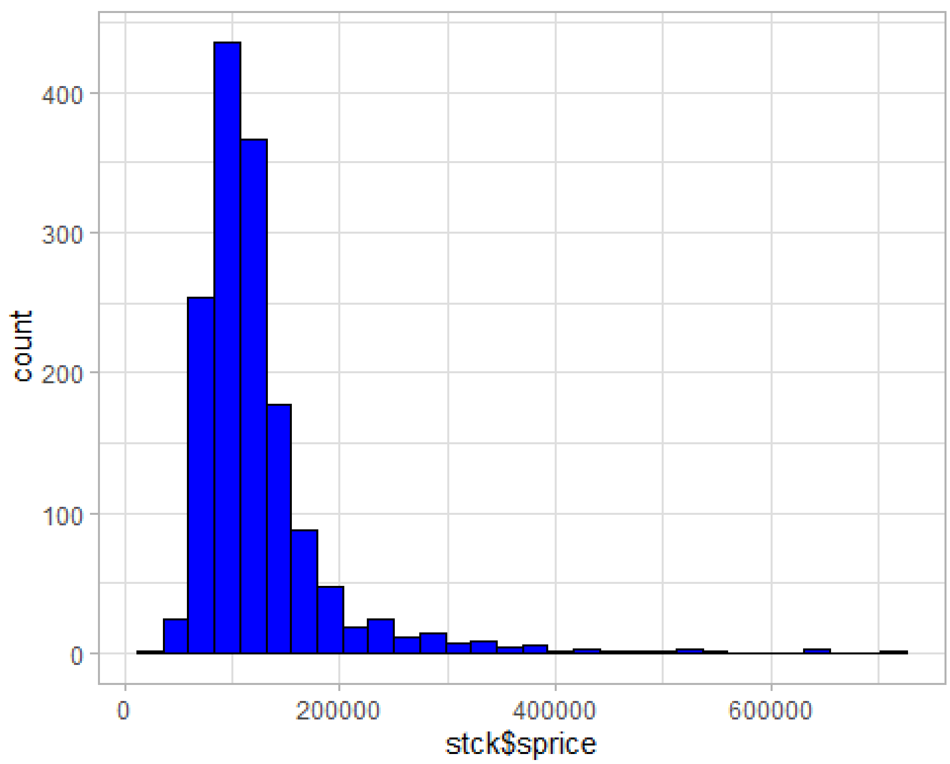
#Question 7.16

```
stck<-read_dta('stckton4.dta')
head(stck)
```

```
## # A tibble: 6 x 7
##   sprice livarea  beds baths lgelot   age  pool
##    <dbl>   <dbl> <dbl> <dbl>  <dbl> <dbl> <dbl>
## 1 138000      17     3   2        1    97     0
## 2 105700      21     4   2.5      0    18     0
## 3  22000       7     2   1        0    49     0
## 4 255000      30     3   3        1    23     0
## 5 203000      21     4   2        1    18     0
## 6 129178      16     3   2        0     2     0
```

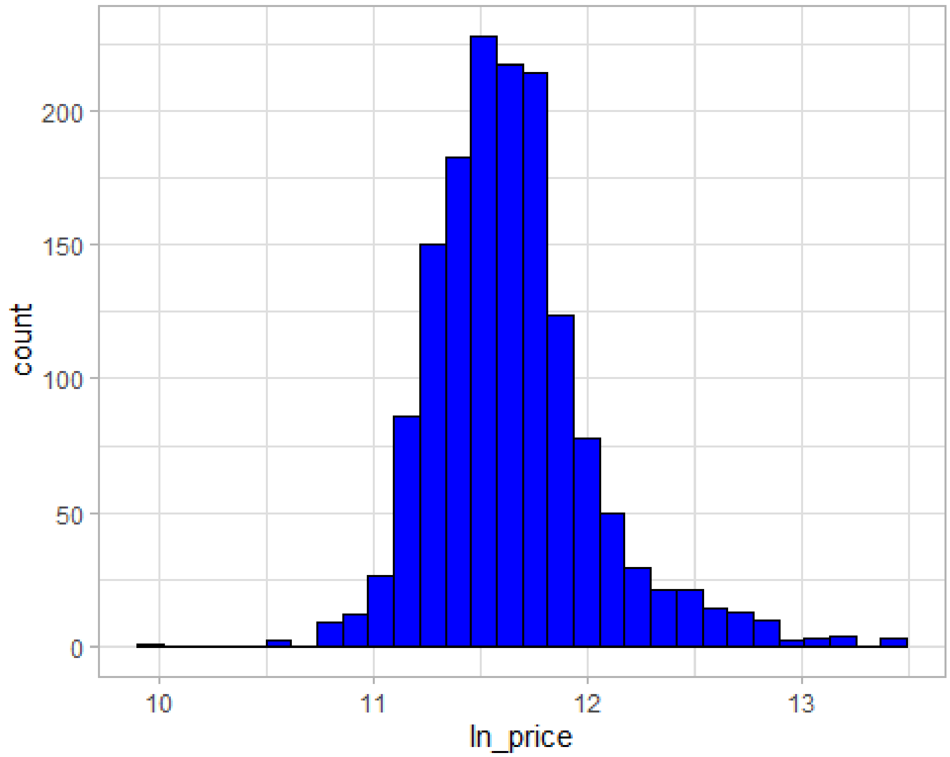
PART a #Histogram

```
ggplot(data=stck, aes(x=stck$sprice)) +
  geom_histogram(color="black", fill="blue")
```



#Histogram of Log(price)

```
ln_price<-log(stck$sprice)
ggplot(data=stck, aes(x=ln_price)) +
  geom_histogram(color="black", fill="blue")
```



PART b

```
PRICE<-stck$sprice/1000
lm_b<-lm(log(PRICE)~livarea+beds+baths+age+lgelot+pool,data=stck)
summary(lm_b)
```

```
##
## Call:
## lm(formula = log(PRICE) ~ livarea + beds + baths + age + lgelot +
##     pool, data = stck)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.29751 -0.11979 -0.00427  0.12671  2.00684
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)  3.9859688  0.0373406 106.746  < 2e-16 ***
## livarea      0.0539316  0.0017080  31.576  < 2e-16 ***
## beds        -0.0382209  0.0113593  -3.365 0.000786 ***
## baths       -0.0102729  0.0165268  -0.622 0.534309
## age         -0.0013113  0.0004601  -2.850 0.004433 **
## lgelot       0.2530908  0.0255382   9.910  < 2e-16 ***
## pool         0.0786611  0.0230548   3.412 0.000662 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
## Residual standard error: 0.2128 on 1493 degrees of freedom
## Multiple R-squared:  0.6884, Adjusted R-squared:  0.6871
## F-statistic: 549.6 on 6 and 1493 DF,  p-value: < 2.2e-16
```

PART d

```
lm_d<-lm(log(PRICE)~livarea+beds+baths+age+lgelot+pool+lgelot:livarea,data=st
ck)
summary(lm_d)

##
## Call:
## lm(formula = log(PRICE) ~ livarea + beds + baths + age + lgelot +
##     pool + lgelot:livarea, data = stck)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.17288 -0.12284 -0.00263  0.12812  2.02143
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)      3.964941   0.037033 107.064  < 2e-16 ***
## livarea          0.058857   0.001864  31.582  < 2e-16 ***
## beds            -0.047996   0.011328  -4.237 2.41e-05 ***
## baths           -0.020062   0.016398  -1.223 0.221356
## age             -0.001612   0.000457  -3.527 0.000433 ***
## lgelot           0.613440   0.063209   9.705  < 2e-16 ***
## pool             0.085349   0.022795   3.744 0.000188 ***
## livarea:lgelot -0.016125   0.002593  -6.217 6.55e-10 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.2102 on 1492 degrees of freedom
## Multiple R-squared:  0.6962, Adjusted R-squared:  0.6948
## F-statistic: 488.5 on 7 and 1492 DF,  p-value: < 2.2e-16
```

PART e

```
#Restricted Model
lm_e1<-lm(log(PRICE)~livarea+beds+baths+age+pool,data=stck)
summary(lm_e1)

##
## Call:
## lm(formula = log(PRICE) ~ livarea + beds + baths + age + pool,
##     data = stck)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.16849 -0.13118 -0.01003  0.12675  2.00675
##
```

```
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)    
## (Intercept)  3.9794107  0.0385303 103.280  < 2e-16 ***
## livarea      0.0606975  0.0016157  37.567  < 2e-16 ***
## beds        -0.0594013  0.0115137  -5.159 2.81e-07 ***
## baths       -0.0262415  0.0169748  -1.546   0.1223    
## age         -0.0007805  0.0004716  -1.655   0.0981 .  
## pool         0.0989178  0.0236994   4.174 3.17e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 0.2196 on 1494 degrees of freedom
## Multiple R-squared:  0.6679, Adjusted R-squared:  0.6667 
## F-statistic: 600.8 on 5 and 1494 DF,  p-value: < 2.2e-16
```

```
#Unrestricted model
lm_e2<-lm(log(PRICE)~livarea+beds+baths+age+lgelot+pool+lgelot:livarea+lgelot:beds+lgelot:baths+lgelot:age+lgelot:pool,data=stck)
summary(lm_e2)
```

```
## 
## Call:
## lm(formula = log(PRICE) ~ livarea + beds + baths + age + lgelot + 
##     pool + lgelot:livarea + lgelot:beds + lgelot:baths + lgelot:age + 
##     lgelot:pool, data = stck)
## 
## Residuals:
##      Min       1Q   Median       3Q      Max 
## -1.09828 -0.12100 -0.00141  0.12783  2.02787 
## 
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)    
## (Intercept)     3.982753   0.038386 103.755  < 2e-16 ***
## livarea         0.060383   0.001925  31.365  < 2e-16 ***
## beds           -0.052190   0.011950  -4.368 1.34e-05 ***
## baths          -0.033442   0.017394  -1.923 0.054714 .  
## age            -0.001598   0.000484  -3.301 0.000986 ***
## lgelot          0.429324   0.140851   3.048 0.002344 ** 
## pool            0.069685   0.025131   2.773 0.005627 ** 
## livarea:lgelot -0.026640   0.004325  -6.159 9.39e-10 ***
## beds:lgelot     0.043412   0.037391   1.161 0.245819    
## baths:lgelot    0.116104   0.051893   2.237 0.025409 *  
## age:lgelot     -0.000219   0.001447  -0.151 0.879738    
## lgelot:pool     0.056183   0.060423   0.930 0.352616    
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 0.2098 on 1488 degrees of freedom
## Multiple R-squared:  0.6982, Adjusted R-squared:  0.696 
## F-statistic:   313 on 11 and 1488 DF,  p-value: < 2.2e-16
```

```r
anova(lm_e1,lm_e2)

## Analysis of Variance Table
##
## Model 1: log(PRICE) ~ livarea + beds + baths + age + pool
## Model 2: log(PRICE) ~ livarea + beds + baths + age + lgelot + pool + lgelo
t:livarea +
##     lgelot:beds + lgelot:baths + lgelot:age + lgelot:pool
##   Res.Df    RSS Df Sum of Sq     F    Pr(>F)
## 1   1494 72.063
## 2   1488 65.471  6    6.5921 24.97 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
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7.1) $\hat{SAL} = 24200 + 1642 GPA + 5022 METRICS$

(a) Without considering GPA and the metric of econometrics if the student has tak[illegible] it or not, the salary will be 24200. ~~[illegible]~~ Salary increases by 1643 if the gpa of a student incr[illegible] by 1 unit. If the student has taken econometrics i.e. METRICS = 1 the sa[illegible] will increase by 5023. otherwise METRICS = 0 there will be no effect if the student has not taken the econometrics as a subject

$R^2 = 0.74$

The equation is able to explain 74% of the variation in ~~gpa~~ salary by the gpa & metric varia[illegible]

(b) $\hat{sal} = \beta_1 + \beta_2 GPA + \beta_3 Metric + \beta_4 female$

If the female = 1, student is female
the salary will decrease. ~~other~~
The beta values will be negative
as we are were are expecting
the female salary to be lower
than male salary - $\boxed{\beta_4 = -ve}$

(c) ~~$\widehat{Sat} = \beta_1 + \beta_2 GPA + \beta_3 \gamma_1$~~

(c) We can add interaction variable of Metric & Female

$$\widehat{Sal} = \beta_1 + \beta_2 GPA + \delta_1 Metrics + \delta_2 fem + \gamma\, female \times Metrics + \epsilon$$

The reference group would be a male student who has not taken econometric

$$E(Sal) = \begin{cases} \beta_1 + \beta_2 GPA, & \text{male \& no econometrics} \\ (\beta_1 + \delta_1) + \beta_2 GPA, & \text{male \& econometrics} \\ (\beta_1 + \delta_2) + \beta_2 GPA, & \text{female \& no econometrics} \\ (\beta_1 + \delta_1 + \delta_2 + \gamma) + \beta_2 GPA & \text{female \& econometrics} \end{cases}$$

7.4) $PRICE = \beta_1 + \beta_2 SQFT + \beta_3 AGE + \delta D92 + \delta_3 D94 + \delta_4 D95 + \delta_5 D96 + e$

(a) $\beta(SQFT) = \beta_2 = 72.7878$

The price of the house increases by 72.7870 if the ~~change~~ increase in sqft. The coefficient is positive as expected as the price of house is directly proportional to sqft of the house. The sqft variable is significant because the p value is less than 0.01.

$\beta_3 = \beta_{(Age)} = -179.4623$.

The price of the house decreases by 177.4623 dollars if the age of the house increases by 1 unit. The expected coefficient was negative as we expect as the age of the house increases

The price of houses decreases.
The variable is statistically significant as the p-value < 0.05

(b) $\delta_1 = -4392.846$

The price of the house in 1992 decreases by 4392.846 wrt the price in 1991 for same size of house & same age of house

$\delta_2 = -10435.47$

The price of house in 1993 decreases by 10435.47 wrt price in 1991 for the same size & same age of house

$\delta_3 = -13173.51$

The price of house in 1994 is ~~decreases~~ ~~by~~ less than 13173.51 from the price in 1991 for same size & same age of house.

$\delta_y = -19040.83$

The price of house in 1995 is less by 19040.83 than the price of the same size & same age of house in 1991.

7.15

(a) from histogram, most houses cost less than \$500,000. Mean of the price is \$154,863 & median is \$130,000. The distribution is highly skewed with a long right tail.

(b) Model estimate

$$\ln(\widehat{price}) = 3.98 + 0.0299\, SQFT - 0.00621\, AGE - 0.0315\, bedrooms + 0.19\, baths + 0.0675\, owner - 0.00427\, pool - 0.0561\, traditional + 0.0843\, fireplace + 0.1099\, waterfront$$

Based on p-value, we can see that bedrooms & pool are statistically insignificant. So, We can remove the variables from the model.

$$\ln(\widehat{Price}) = 3.98 + 0.00294\, SQFT - 0.006\, AGE + 0.19\, baths + 0.0675\, owner - 0.06\, traditional + 0.08\, fireplace + 0.11\, waterfront$$

We expect sqft, bath, owner, fireplace, & waterfront ~~to~~ coefficient to ~~too~~ be positive. As we can see from the output, the coefficients are +ve.

We expect age coefficient to be negative. from o/p we can see the coefficient is negative.

We expect Traditional coeff. to be negative. As the house having traditional style costs less than other styles. from o/p we can see the Traditional coefficient is negative.

The waterfront coefficient should be positive. As the house with waterfront cost more than the other. Here the house with waterfront costs 10.99% more than the house not having waterfront

$R^2 = 0.7373$

73.73% of variation in ln(price) is explained by the variables of the model.

(c) Model estimate with interaction variable.

$\ln(\widehat{Price}) = 3.97 + 0.03\,SQFT - 0.006\,age - 0.0313\,bedrooms + 0.19\,baths + 0.068\,owner - 0.0024\,pool - 0.045\,Traditional + 0.087\,fireplace + 0.165\,waterfront - 0.172\,Traditional \times waterfront$

pools & bedrooms are still statistically insignificant

Waterfront x Traditional :

$-0.172 + 0.165 - 0.045 = 0.052$

A: house with waterfront & is made with traditional style is 5.2% less costlier than house which is not having waterfront and traditional style

$R^2 = 0.7389$

Adding interaction variable does not explain any variation in $\ln(\widehat{price})$

(d) To conduct Chow tests we need 2 model one with traditional and one without traditional and interaction of other variables with traditional :

Restricted

$\ln(\widehat{Price}) = \beta_1 SQFT + \beta_2 age + \beta_3 bedrooms + \beta_4 baths + \delta_1 owner + \delta_2 pool + \delta_3 fireplace + \delta_4 Waterfront + \epsilon$

Unrestricted

$\ln(\widehat{Price}) = \beta_1 SQFT + \beta_2 age + \beta_3 bedrooms + \beta_4 baths + \delta_1 owner + \delta_2 pool + \delta_3 fireplace + \delta_4 Waterfront + \delta_5 traditional + \phi_1 SQFT \times traditional + \phi_2 age \times traditional + \phi_3 \cancel{age}\ bedrooms \times traditional + \phi_4 bath \times traditional + \phi_5 owner \times traditional + \phi_6 pool \times Traditional + \phi_7 fireplace \times traditional + \phi_8 waterfront \times traditional.$

$H_0 : \delta_5 = \phi_1 = \phi_2 = \phi_3 = \phi_4 = \phi_5 = \phi_6 = \phi_7 = \phi_8 = 0$

H_1 : At least one non-zero

$$f_{stat} = \frac{(SSE_R - SSE_U)/J}{(SSE_U)/(N-K)}$$

$$= \frac{(78.772 - 75.799)/9}{75.799/1062}$$

$$= 4.628$$

$f_{critical} = F_{(0.95,\ 9,\ 1062)} = 1.889$

$f_{stat} > f_{critical}$

~~Hence~~, we can reject the null.

e) $\widehat{\ln(price)} = 3.97 + 0.03 \times 25 - 0.006 \times 20 - 0.0313 \times 3 + 0.19 \times 2 + 0.068 + 0.087$

$= 5.0411$

$price = e^{5.0411} = 154.640$

7.16 (a) The histogram plot of price shows that majority of the houses are priced around \$123,694. Maximum price is \$713,000. It is a right skewed distribution.

The histogram for ln(price) looks like a normal distr. This happens because the log fn scales the larger values.

(b) $\widehat{\ln(price)} = 3.986 + 0.054\, livarea - 0.038\, beds - 0.0103\, baths - 0.0013\, age + 0.253\, Lgelot + 0.078\, pool$

The bath variable is not significant at $\alpha = 0.05$

$R^2 = 0.6884$

∴ The 68.84% variation in ln(Price) is explained by the variables in the model.

The coefficient of livarea, lgelot & pool are positive as expected.
The coefficient of age is negative.
The coeff. of beds is negative, which is not as expected.

LIV - As the living areas increases by 100 sqft the price of the increases by 5.4 %.

Beds - As the no of bed increases by 1, the price decreases by 3.8 %.
Baths - As no of bath increases by 1, the price of house decreases by 1.03
Age - As the age of house increases, the price decreases by 0.12 %
Pool - The price of house having pool will be 7.8 % higher than one not having i

(c) for a house whose lot size is larger than 0.5 acres, the price is higher than 25.3% when compared to a house where lot size is less than 0.5 acres with same living area, same no of beds, same no of baths, same age, and with no pool.

(d) Model estimate

$$\ln(\widehat{price}) = 3.965 + 0.059\ livarea - \ldots\ beds - 0.020\ baths - 0.0016\ age + 0.613\ lgelot - 0.01601\ livarea \times lgelot \ldots$$

livarea × lgelot :

This is a slope indicator variable. If the house has a lot ~~area~~ area of more than 0.5 acres, then price increases by $(-0.016 + 0.0548) = 4.3\%$ with 100 sqft increase in living area.

The sign of coeff is -ve which means having a lot size greater than 0.5 reduces the effect of increase in price because of increase in sqft of living area

p-value is almost 0 ∴ we can conclude the coefficient is statistically significant at $\alpha = 0.05$

(e) Restricted model

$$\ln(\widehat{price}) = \beta_1 + \beta_2 \, livarea + \beta_3 \, beds + \beta_4 \, baths + \beta_5 \, age + \delta_1 \, pool + \epsilon$$

Unrestricted model

$$\ln(\widehat{price}) = \beta_1 + \beta_2 \, livarea + \beta_3 \, beds + \beta_4 \, baths + \beta_5 \, age + \delta_1 \, pool + \delta_2 \, lgelot + \phi_1 \, livarea \times lgelot + \phi_2 \, beds \times lgelot + \phi_3 \, baths \times lgelot + \phi_4 \, age \times lgelot + \phi_5 \, pool \times lgelot + \epsilon$$

$$F_{stat} = \frac{(SSE_R - SSE_U)/J}{(SSE_U)/n-K}$$

$$F_{stat} = \frac{(72.082 - 65.471)/6}{(65.471)/1488}$$

$$= 24.97$$

$$F_{critical} = F(0.95, 6, 1488) = 2.1$$

$\therefore$ we can reject the null.