Lignite Converted

Data from Handout

In a study concerning coal conservation into oils, the hydrogenolysis of a Canadian lignite using carbon monoxide and hydrogen mixtures as reducing agents was investigated.

:

```
setwd("F:/Lexar/stat 482 data sets")
lignite.dat = read.csv('lignite.csv')

cor(lignite.dat)
```

```
##             temperature molar.ratio pressure      time conversion
## temperature   1.0000000    0.000000 0.000000 0.0000000  0.5735635
## molar.ratio   0.0000000    1.000000 0.000000 0.0000000  0.3613450
## pressure      0.0000000    0.000000 1.000000 0.0000000  0.4559830
## time          0.0000000    0.000000 0.000000 1.0000000  0.2136524
## conversion    0.5735635    0.361345 0.455983 0.2136524  1.0000000
```

```
attach(lignite.dat)

lignite.mod = lm(conversion ~ temperature + molar.ratio + pressure + time)
summary(lignite.mod)
```

```
##
## Call:
## lm(formula = conversion ~ temperature + molar.ratio + pressure +
##     time)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -7.0250 -3.5125  0.1375  2.9875  7.6750
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) -5.36750   16.55028  -0.324  0.75178
## temperature  0.12500    0.03520   3.552  0.00454 **
## molar.ratio 12.60000    5.63128   2.238  0.04691 *
## pressure     1.98750    0.70391   2.824  0.01656 *
## time         0.09312    0.07039   1.323  0.21269
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 5.631 on 11 degrees of freedom
## Multiple R-squared:  0.7131, Adjusted R-squared:  0.6088
## F-statistic: 6.836 on 4 and 11 DF,  p-value: 0.005123
```

```r
anova(lignite.mod)
```

```
## Analysis of Variance Table
##
## Response: conversion
##             Df Sum Sq Mean Sq F value   Pr(>F)
## temperature  1 400.00  400.00 12.6138 0.004539 **
## molar.ratio  1 158.76  158.76  5.0064 0.046906 *
## pressure     1 252.81  252.81  7.9722 0.016563 *
## time         1  55.50   55.50  1.7502 0.212689
## Residuals   11 348.83   31.71
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
x1 = 2*(temperature-mean(temperature))/ (range(temperature)[2]-
range(temperature)[1])
x2 = 2*(molar.ratio-mean(molar.ratio))/ (range(molar.ratio)[2]-
range(molar.ratio)[1])
x3 = 2*(pressure-mean(pressure))/ (range(pressure)[2]-range(pressure)[1])
x4 = 2*(time-mean(time))/ (range(time)[2]-range(time)[1])

cbind(x1,x2,x3,x4)
```

```
##       x1 x2 x3 x4
##  [1,] -1 -1 -1 -1
##  [2,]  1 -1 -1 -1
##  [3,] -1  1 -1 -1
##  [4,]  1  1 -1 -1
##  [5,] -1 -1  1 -1
##  [6,]  1 -1  1 -1
##  [7,] -1  1  1 -1
##  [8,]  1  1  1 -1
##  [9,] -1 -1 -1  1
## [10,]  1 -1 -1  1
## [11,] -1  1 -1  1
## [12,]  1  1 -1  1
## [13,] -1 -1  1  1
## [14,]  1 -1  1  1
## [15,] -1  1  1  1
## [16,]  1  1  1  1
```

```r
orthog.mod = lm(conversion ~ x1+x2+x3+x4)
summary(orthog.mod)
```

```
##
## Call:
## lm(formula = conversion ~ x1 + x2 + x3 + x4)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -7.0250 -3.5125  0.1375  2.9875  7.6750
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   74.312      1.408  52.785 1.39e-14 ***
## x1             5.000      1.408   3.552  0.00454 **
## x2             3.150      1.408   2.238  0.04691 *
## x3             3.975      1.408   2.824  0.01656 *
## x4             1.862      1.408   1.323  0.21269
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 5.631 on 11 degrees of freedom
## Multiple R-squared:  0.7131, Adjusted R-squared:  0.6088
## F-statistic: 6.836 on 4 and 11 DF,  p-value: 0.005123
```

```r
accepted.mod = lm(conversion ~ x1+x2+x3)
summary(accepted.mod)
```

```
##
## Call:
## lm(formula = conversion ~ x1 + x2 + x3)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -8.8875 -4.7375  0.8375  4.6750  6.8125
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   74.312      1.451  51.209 2.02e-15 ***
## x1             5.000      1.451   3.446  0.00484 **
## x2             3.150      1.451   2.171  0.05073 .
## x3             3.975      1.451   2.739  0.01796 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 5.805 on 12 degrees of freedom
## Multiple R-squared:  0.6675, Adjusted R-squared:  0.5843
## F-statistic: 8.029 on 3 and 12 DF,  p-value: 0.003352
```