FIN 503 Quantitative Finance II Homework 2
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1. (a) $f(0.5) = 0.0089$
   (b) $F(2.5) = 0.8413$
   (c) $Pr(1 < X < 3) = 0.9545$

```
> #a
> dnorm(0.5, 2, 0.5)
[1] 0.008863697
> #b
> pnorm(2.5, 2, 0.5)
[1] 0.8413447
> #c
> pnorm(3, 2, 0.5) - pnorm(1, 2, 0.5)
[1] 0.9544997
```

2. (a) $f(0.5) = 0.3279$
   (b) $F(2.5) = 0.9728$
   (c) $Pr(1 < X < 3) = 0.1666$

```
> #a
> dt(0.5, 5)
[1] 0.3279185
> #b
> pt(2.5, 5)
[1] 0.972755
> #c
> pt(3, 5)-pt(1, 5)
[1] 0.1665591
```

3. (1) Covariance matrix

```
> cov(CRSP[,4:6])
                ge          ibm        mobil
ge    1.882164e-04 8.007660e-05 5.270394e-05
ibm   8.007660e-05 3.061309e-04 3.588748e-05
mobil 5.270394e-05 3.588748e-05 1.670265e-04
```

Correlation matrix

```
> cor(CRSP[,4:6])
             ge       ibm     mobil
ge    1.0000000 0.3335979 0.2972499
ibm   0.3335979 1.0000000 0.1587072
mobil 0.2972499 0.1587072 1.0000000
```

Mean of GE = 0.0010714
Mean of IBM = 0.0007001
Mean of Mobile = 0.0007789

```
> mean(CRSP$ge)
[1] 0.00107138
> mean(CRSP$ibm)
[1] 0.0007000767
> mean(CRSP$mobil)
[1] 0.0007788801
> var(CRSP$ge)
[1] 0.0001882164
> sd(CRSP$ge)
[1] 0.0137192
```

(2)
Variance of GE = 0.0001882
Standard deviation of GE = 0.0137192

(3)

Covariance between GE and Mobile returns = 5.270394e-05

Correlation between GE and Mobile returns = 0.2972499

Since the p-value < 2.2e-16 < 0.05, there is a significant linear relationship between GE's returns and Mobile's returns.

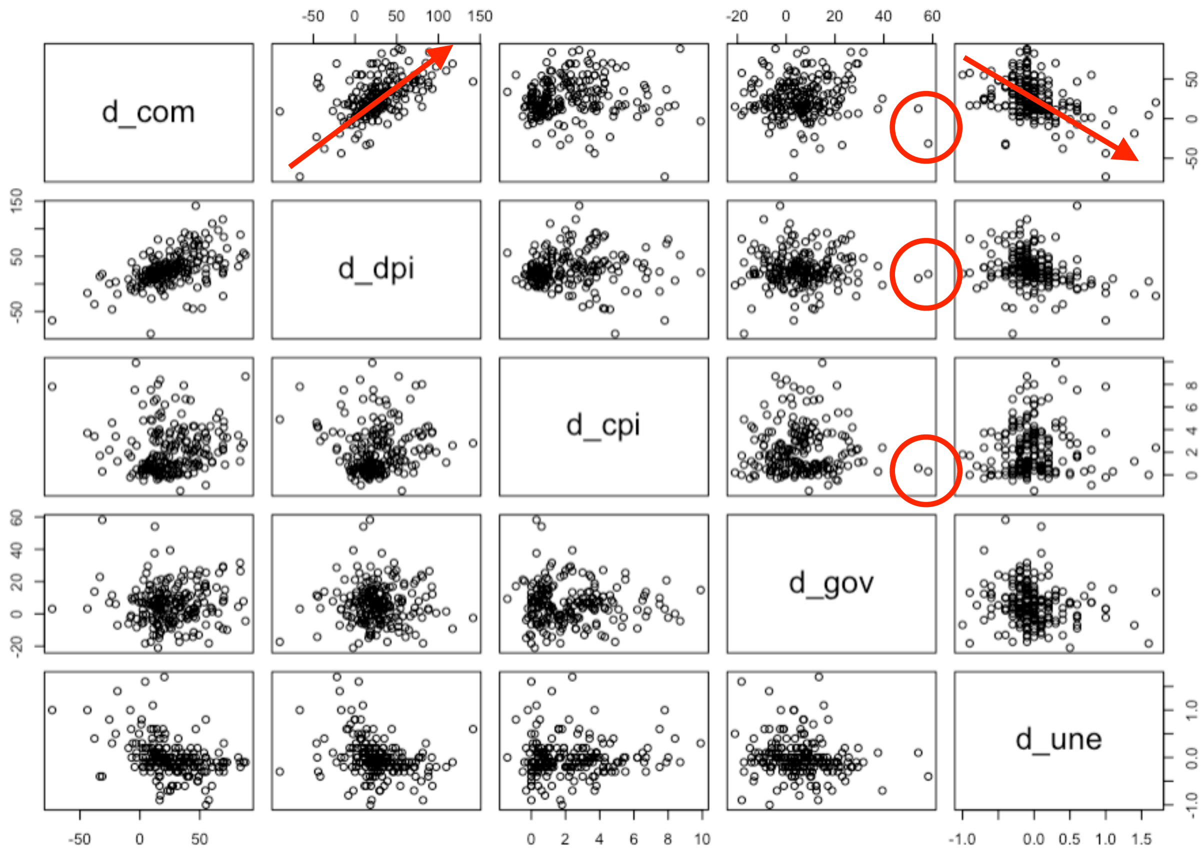
```
> cor.test(CRSP[,4],CRSP[,6])

	Pearson's product-moment correlation

data:  CRSP[, 4] and CRSP[, 6]
t = 15.647, df = 2526, p-value < 2.2e-16
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 0.2612928 0.3323831
sample estimates:
      cor
0.2972499
```

4.

(1)

```
#4
USMacro <- read.delim("~/Desktop/FIN503/data/USMacroG.txt")
attach(USMacro)
d_com <- diff(consumption)
d_dpi <- diff(dpi)
d_cpi <- diff(cpi)
d_gov <- diff(government)
d_une <- diff(unemp)
pairs(cbind(d_com, d_dpi, d_cpi, d_gov, d_une))
```

Scatterplot matrix:



(2)

The outliers I found interesting would be the dots circled in red. However, I think those dots merely indicate two spikes in government expenditures. From the scatterplot, we can observe that d_dpi is positively correlated to d_com, and due is negatively correlated to d_com. Therefore, I consider both the changes in real disposable personal income (d_dpi) and changes in unemployment rate (d_une) suitable for predicting changes in real consumption expenditures (d_com).

Since both d_dpi and d_une are correlated to d_com, there will be multicollinearity problems.

(3)

From the results shown below, we can see that the p-value for both d_dpi and d_unemployment are smaller than 0.001, so they can be useful for predicting changes in consumption.

```
> model <- lm(d_com~d_dpi+d_cpi+d_gov+d_une)
> summary(model)

Call:
lm(formula = d_com ~ d_dpi + d_cpi + d_gov + d_une)

Residuals:
    Min      1Q  Median      3Q     Max 
-60.626 -12.203  -2.678   9.862  59.283 

Coefficients:
              Estimate Std. Error t value Pr(>|t|)    
(Intercept)  14.752317   2.520168   5.854 1.97e-08 ***
d_dpi         0.353044   0.047982   7.358 4.87e-12 ***
d_cpi         0.726576   0.678754   1.070    0.286    
d_gov        -0.002158   0.118142  -0.018    0.985    
d_une       -16.304368   3.855214  -4.229 3.58e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 20.39 on 198 degrees of freedom
Multiple R-squared:  0.3385,	Adjusted R-squared:  0.3252 
F-statistic: 25.33 on 4 and 198 DF,  p-value: < 2.2e-16
```

(4)

```
> anova(model)
Analysis of Variance Table

Response: d_com
           Df Sum Sq Mean Sq F value    Pr(>F)    
d_dpi       1  34258   34258 82.4294 < 2.2e-16 ***
d_cpi       1    253     253  0.6089    0.4361    
d_gov       1    171     171  0.4110    0.5222    
d_une       1   7434    7434 17.8859 3.582e-05 ***
Residuals 198  82290     416                      
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

(5)

First removed: d_gov, changes in government expenditures
Second removed: d_cpi, changes in consumer price index

After removal of the above variables, d_dpi and d_une are kept in the model.

(6) Start AIC = 1228.98, End AIC = 1226.15, the resulting improvement in AIC is 2.83.

```
> step <- stepAIC(model)
Start:  AIC=1228.98
d_com ~ d_dpi + d_cpi + d_gov + d_une

        Df Sum of Sq    RSS    AIC
- d_gov  1       0.1  82291 1227.0
- d_cpi  1     476.2  82767 1228.2
<none>                82290 1229.0
- d_une  1    7433.5  89724 1244.5
- d_dpi  1   22499.9 104790 1276.0

Step:  AIC=1226.98
d_com ~ d_dpi + d_cpi + d_une

        Df Sum of Sq    RSS    AIC
- d_cpi  1     476.5  82767 1226.2
<none>                82291 1227.0
- d_une  1    7604.2  89895 1242.9
- d_dpi  1   22542.0 104833 1274.1

Step:  AIC=1226.15
d_com ~ d_dpi + d_une

        Df Sum of Sq    RSS    AIC
<none>                82767 1226.2
- d_une  1    7380.8  90148 1241.5
- d_dpi  1   22931.9 105699 1273.8
```