Topic 2: Exercise 1

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Importing libraries

```
library(dplyr)
```

Importing data as described by exercise

```
d <- read.csv("../../datasets/Colleges.csv")
```

Replacing binary variable Private with 1 and 0

```
d$Private <- ifelse(d$Private == "Yes", 1, 0)
```

Selecting columns

```
d <- d %>% dplyr::select('Private','Apps','Accept','Enroll','F.Undergrad')
```

Calculating covariances

```
cov_matrix <- cov(d)
cov_matrix
```

```
##                   Private          Apps        Accept       Enroll  F.Undergrad
## Private         0.1986559     -745.3552     -519.2042    -235.1942    -1330.764
## Apps         -745.3552439 14978459.5301  8949859.8119 3045255.9876 15289702.474
## Accept       -519.2042169  8949859.8119  6007959.6988 2076267.7627 10393582.435
## Enroll       -235.1942393  3045255.9876  2076267.7627  863368.3923  4347529.884
## F.Undergrad -1330.7637175 15289702.4742 10393582.4355 4347529.8841 23526579.326
```

Calculating correlations

```
corr_matrix <- cov2cor(cov_matrix)
corr_matrix
```

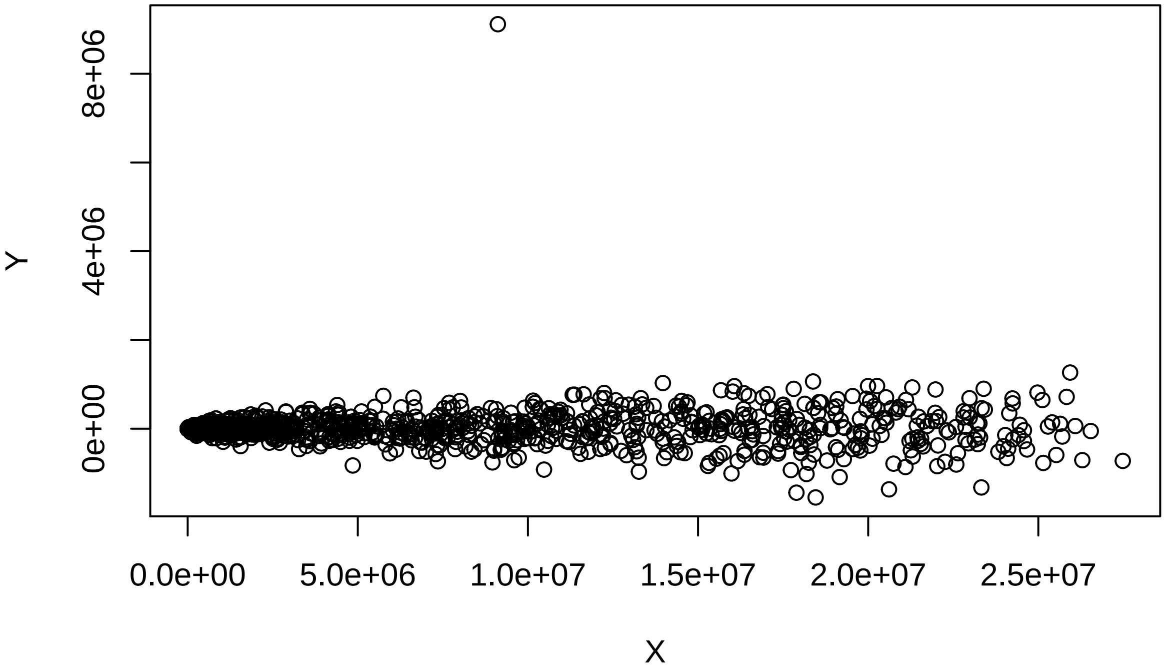
```
##                Private       Apps     Accept     Enroll F.Undergrad
## Private      1.0000000 -0.4320947 -0.4752520 -0.5679078  -0.6155605
## Apps        -0.4320947  1.0000000  0.9434506  0.8468221   0.8144906
## Accept      -0.4752520  0.9434506  1.0000000  0.9116367   0.8742233
## Enroll      -0.5679078  0.8468221  0.9116367  1.0000000   0.9646397
## F.Undergrad -0.6155605  0.8144906  0.8742233  0.9646397   1.0000000
```

What information does the sample covariance provide?

We know that because the Private variable (binary variable) has only 2 possible values, its covariance with other variables is always going to be relatively small, and probably depends uniquely on the variance of that quantitative variable.

And we can prove this by simulating a covariance matrix:

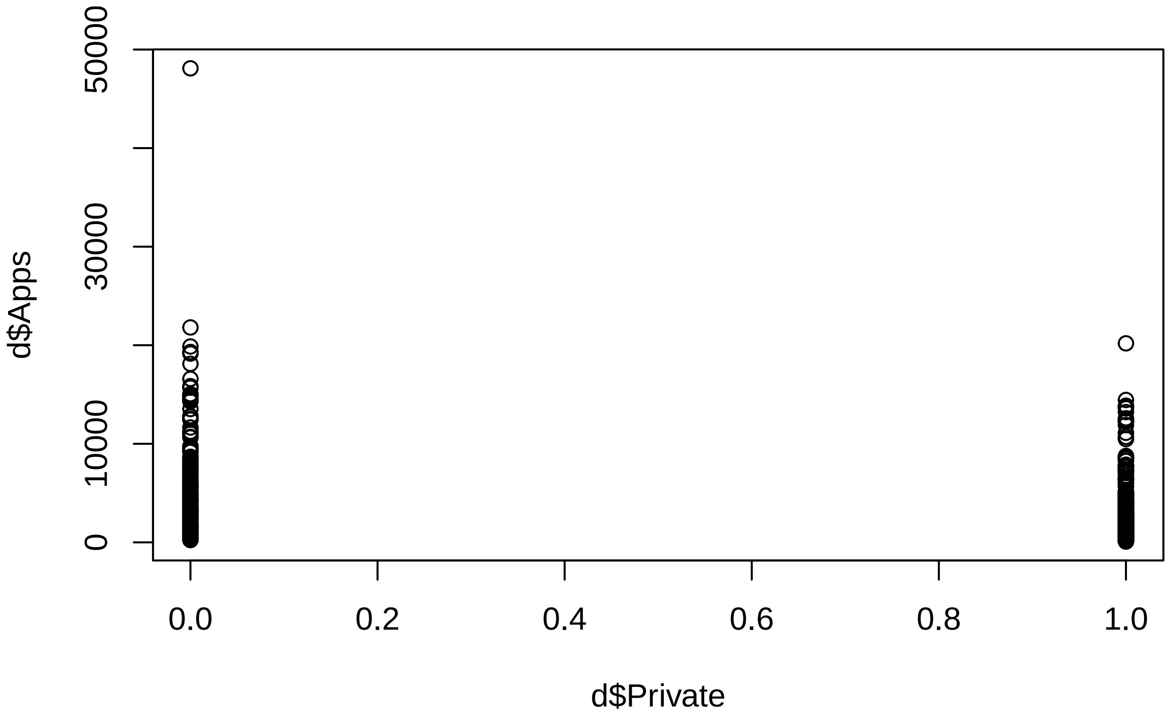
```
size <- 1000
sim <- data.frame(matrix(rep(0,size*777),nrow=777))
names(sim) <- paste("sim",1:size,sep="_")
sim$Private <- d %>% dplyr::select('Private')
for (i in 1:size) {
    sim[i] <- rnorm(length(d$Private),mean=runif(1,min=1,max=100),sd=runif(1,min=1,max=5000))
}
Y <- cov(sim)[1,]
X <- diag(cov(sim))
plot(X,Y)
```



What information does the sample correlation provide?

Scatter plot of our quantitative variables and the Private binary variable

```r
plot(d$Private, d$Apps)
```


d$Apps
d$Private