Topic 2: Exercise 1

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```
library(dplyr)
library(Rcpp)
```

Importing libraries

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

Importing data as described by exercise

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

Replacing binary variable Private with 1 and 0

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

Selecting columns

```
cov_matrix <- cov(data)
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 covariances

```
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
```

Calculating correlations

Experimenting a little bit with the private variable Let's try changing the Yes to 0 and the No to 1 and checking the covariances and correlations

```
d <- read.csv("../../datasets/Colleges.csv")
d$Private <- ifelse(d$Private == "Yes", 0, 1)
data <- d %>% dplyr::select('Private','Apps','Accept','Enroll','F.Undergrad')
```

```
cov_matrix <- cov(data)
cov_matrix
#>                 Private         Apps       Accept       Enroll  F.Undergrad
#> Private       0.1986559 7.453552e+02 5.192042e+02     235.1942     1330.764
#> Apps        745.3552439 1.497846e+07 8.949860e+06 3045255.9876 15289702.474
#> Accept      519.2042169 8.949860e+06 6.007960e+06 2076267.7627 10393582.435
#> Enroll      235.1942393 3.045256e+06 2.076268e+06  863368.3923  4347529.884
#> F.Undergrad 1330.7637175 1.528970e+07 1.039358e+07 4347529.8841 23526579.326
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
```

We get the same numbers with reversed signs.

We define the following function (in julia) to help our understanding:

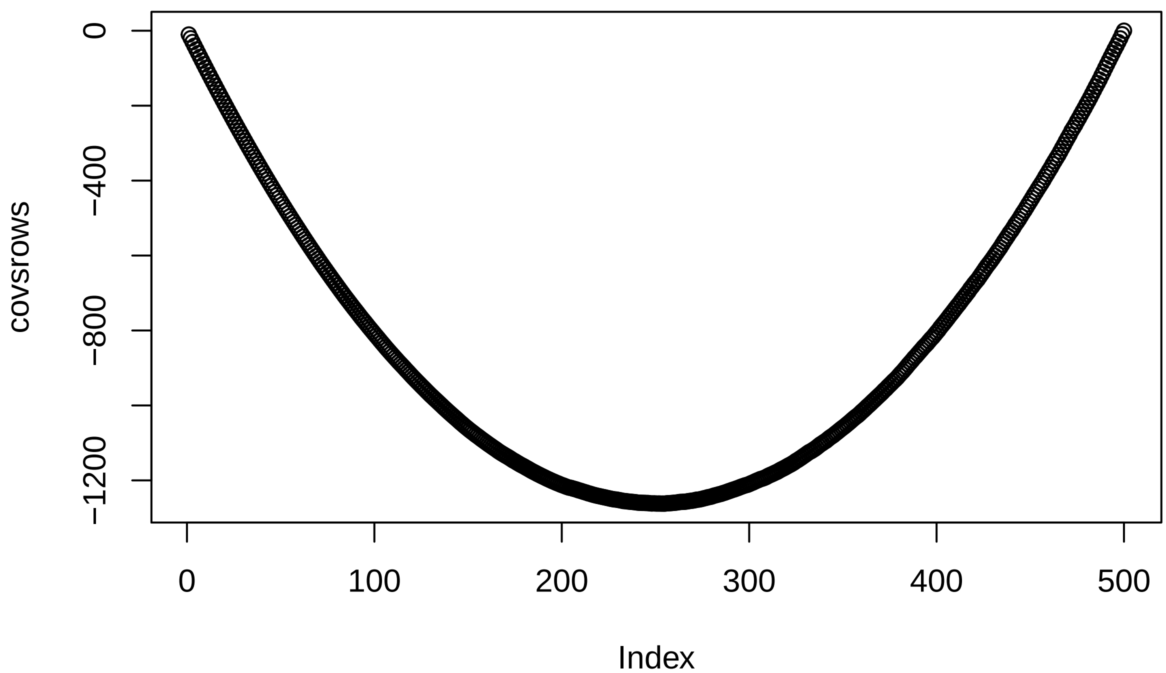
Takes the arguments:

```
- nrows: number of data to simulate (amount of rows)
- simulations: number of different times to simulate and average the results
- fixed_value_col: boolean parameter with true -> assigns a set of values between mins[1] and maxs[1] (
- reverse:
```

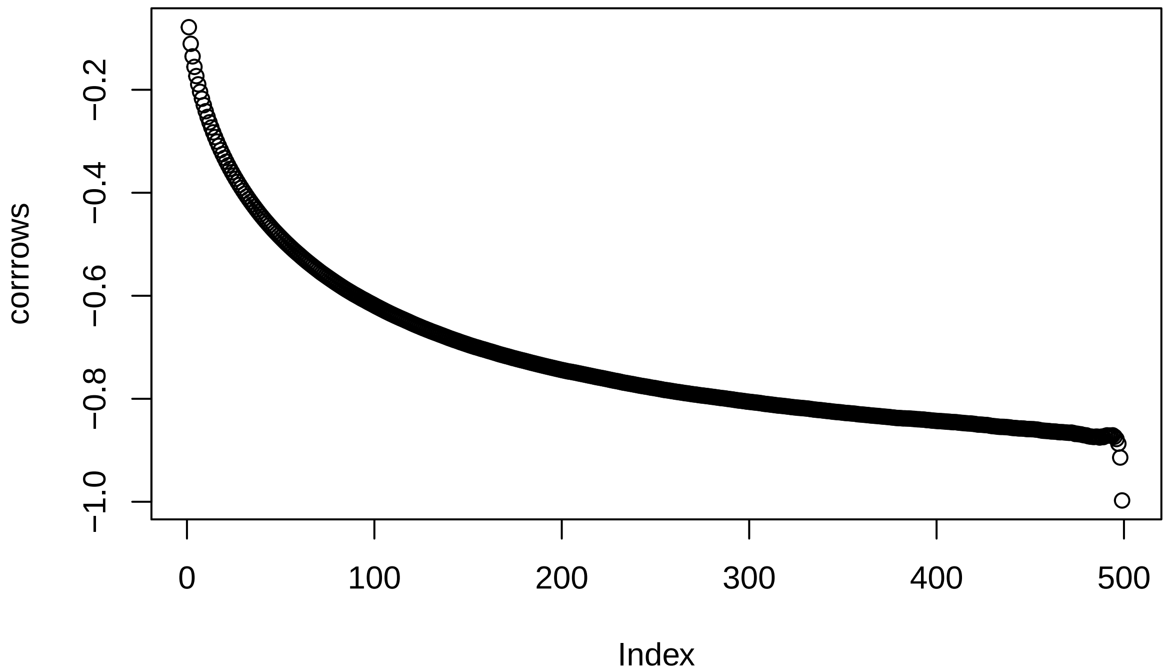
```julia
using Random
using Statistics
using Plots
gr()
#> Plots.GRBackend()

function simulation_general(nrows, simulations; fixed_value_col=false, reverse=false, sim_binaries=true
    # cov and corr matrixes
    covs = zeros(Float64, nrows, simulations)
    corr = zeros(Float64, nrows, simulations)

    # loop
    for s in 1:simulations
        pvtapps = zeros(Float64, nrows, 3)
        if sim_binaries == false
            pvtapps[:,1] = rand(0:1, nrows)
        end

        # random numbers column (quant variable)
        if fixed_value_col == true
            pvtapps[:,2] = rand(mins[1]:maxs[1],nrows)
        else
            if reverse == false
                pvtapps[:,2] = rand(mins[1]:maxs[1],nrows)
                pvtapps[:,3] = rand(mins[2]:maxs[2],nrows)
            else
                pvtapps[:,2] = rand(mins[2]:maxs[2],nrows)
                pvtapps[:,3] = rand(mins[1]:maxs[1],nrows)
            end
        end

        # loop for changing values
        for i in 1:nrows

            if sim_binaries == true
                pvtapps[1:i,1] = ones(i)
            end

            pvtapps[1:i,2] = pvtapps[1:i,3]

            # calculate corr and cov
            covs[i,s] = cov(pvtapps[:,1],pvtapps[:,2])
            corr[i,s] = cor(pvtapps[:,1],pvtapps[:,2])
        end
    end
```

```
    # results
    covsrows = zeros(Float64, nrows)
    corrrows = zeros(Float64, nrows)
    for i in 1:nrows
        covsrows[i] = mean(covs[i,:])
        corrrows[i] = mean(corr[i,:])
    end

    # return matrixes
    return covsrows, corrrows
end
#> simulation_general (generic function with 1 method)

covsrows, corrrows = simulation_general(500,100, reverse=true, sim_binaries=true);
```

```
covsrows <- JuliaCall::julia_eval("covsrows")
plot(covsrows)
```




```
corrrows <- JuliaCall::julia_eval("corrrows")
plot(corrrows)
```



OBSERVATIONS

Now let’s play around changing the size of the values that correspond in the quantitative variable to 1s or 0s in the binary column.

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 will not provide much information.

What information does the sample correlation provide?