Assignment 1 Complex Systems (Vingron part)

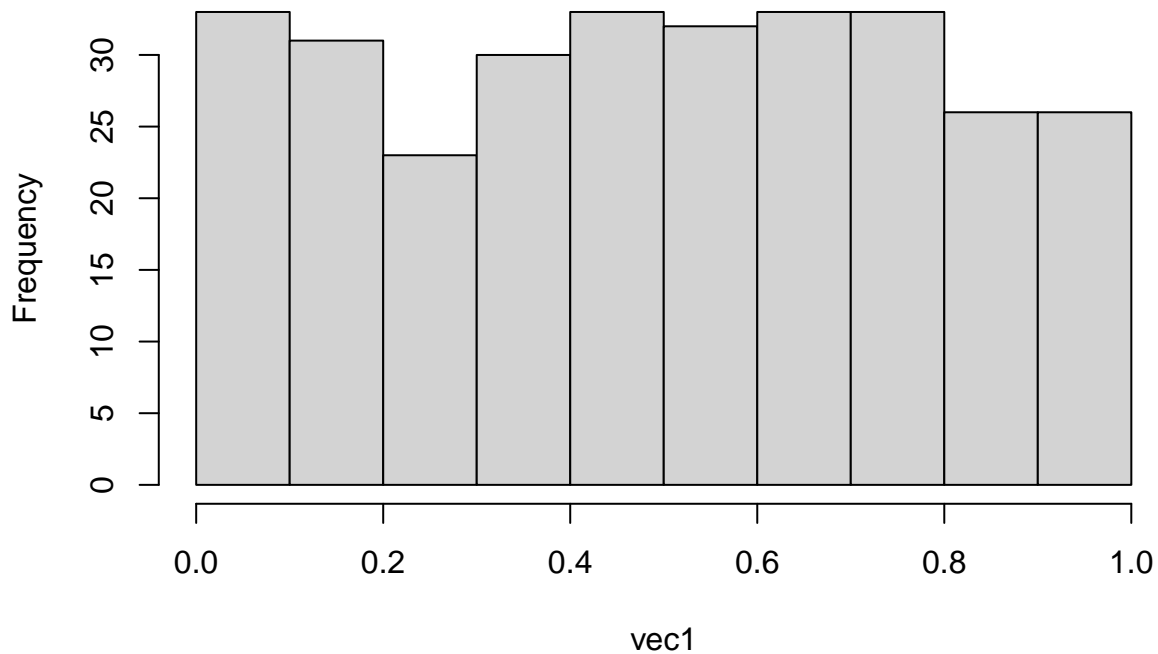Paul Vogler (4979420) and Yiftach Kolb (5195763)

Exercise 4

```
library(infotheo)

#library(rmarkdown) #render

# Generate two vectors of length 300 from the continuous uniform distribution:
vec1 <- runif(300, min = 0, max = 1)
vec2 <- runif(300, min = 0, max = 1)
# Discretize the data to the bins of length 0.1:
h1 <- hist(vec1, breaks = seq(from=0, to=1, by=0.1))
```
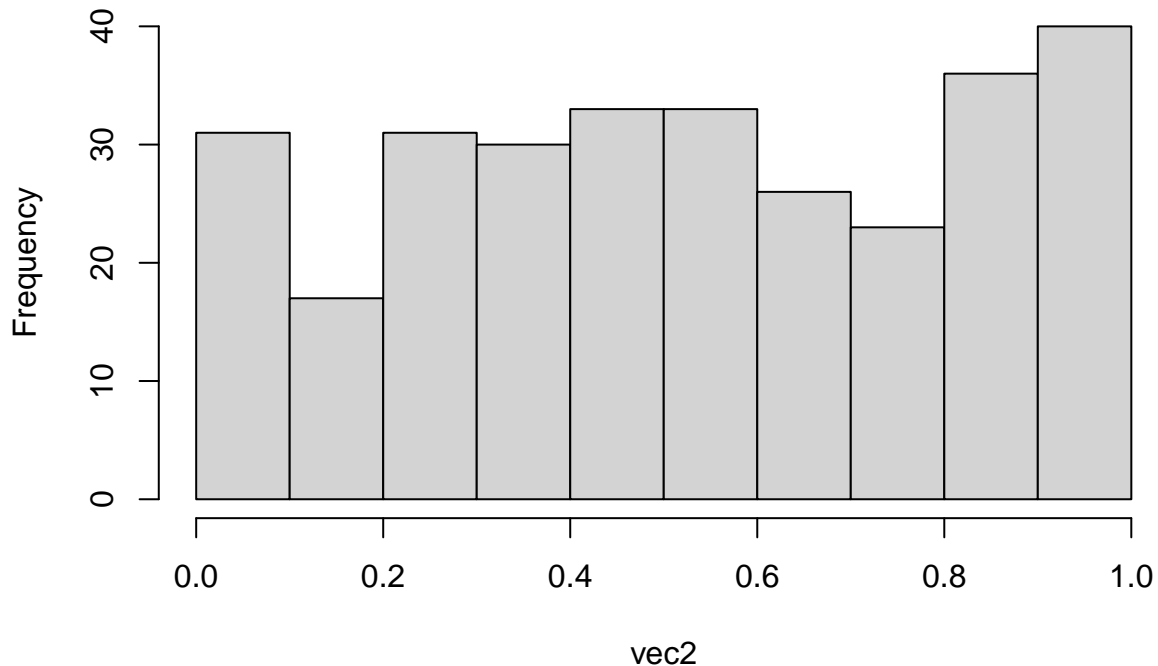
Histogram of vec1


```
h2 <- hist(vec2, breaks = seq(from=0, to=1, by=0.1))
```

Histogram of vec2


```r
# Compute the mutual information:
# We expect the mutual information to be 0 if the variables are independent.
# If they are completely dependent, the mutual information should converge
# towards the entropy of one of the inputs.
mutinformation(h1$counts, h2$counts, method="emp")
```

```
## [1] 1.332179
```

```r
# output: 1.695743
entropy(h1$counts, method="emp")
```

```
## [1] 1.609438
```

```r
# output: 1.834372
entropy(h2$counts, method="emp")
```

```
## [1] 2.025326
```

```r
# output: 2.163956
# We got an output close to the entropies of either of the two inputs,
# therefore they seem to be dependent variables.
# When the number of samples is increased, this also becomes more clear:

# Generate two vectors of length 300 from the continuous uniform distribution:
vec3 <- runif(10000, min = 0, max = 1)
vec4 <- runif(10000, min = 0, max = 1)
# Discretize the data to the bins of length 0.1:
h3 <- hist(vec3, breaks = seq(from=0, to=1, by=0.1))
```
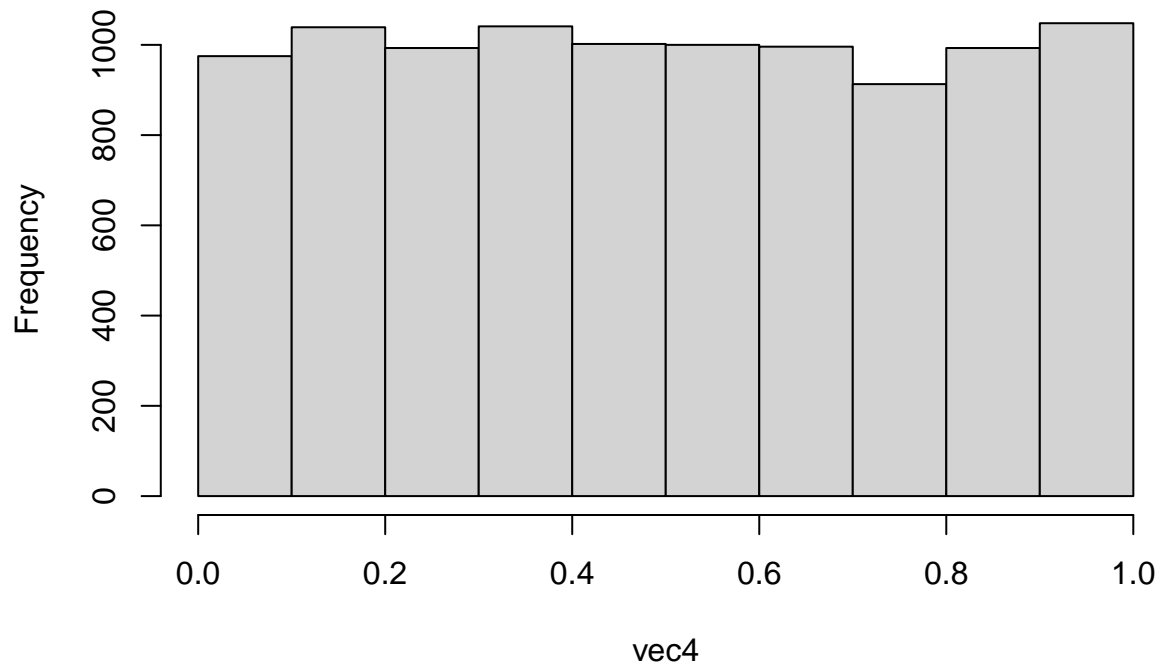
Histogram of vec3
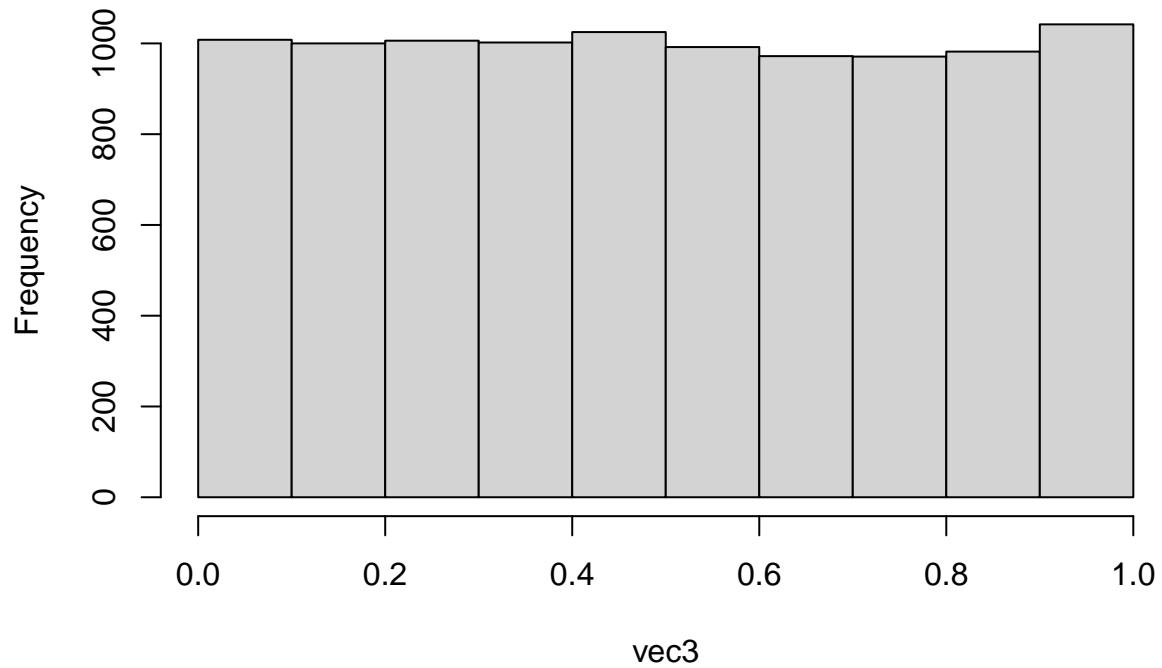

```r
h4 <- hist(vec4, breaks = seq(from=0, to=1, by=0.1))
```

Histogram of vec4


```r
# Compute the mutual information:
mutinformation(h3$counts, h4$counts, method="emp")
```

```
## [1] 2.163956
```

```
# output: 2.302585
entropy(h3$counts, method="emp")
```

```
## [1] 2.302585
```

```
# output: 2.302585
entropy(h4$counts, method="emp")
```

```
## [1] 2.163956
```

```
# output: 2.302585
# Here the mutual information converged to the entropy of both variables
```

Exercises 1,2,3 are below