Practice 2 R: Simulation of time series

A) IID and Gaussian white noises

Do

```
n<-1000
z1<-rnorm(n)
z1
```

We have simulated a sample of n data with standard normal law. In Time Series language, this is a standard Gaussian White Noise. Note that we can do directly

```
z1<-rnorm(100)
z1
```

but the first option gives more programming flexibility.

If we do

```
mu=5
sigma=2
z2<-rnorm(n,mean=mu,sd=sigma)
z2
```

we simulate a sample of a normal random variable with mean 5 and standard deviation 2 or in other words a Gaussian White Noise with mean 5 and standard deviation 2.

Try also

```
m<-1
set.seed(m)
w<-rnorm(1000)
w
```

and choose different values for the value of m, different than 1.

Note that by default R choose a random seed. If we fix the seed, we obtain the same sample repeatedly.

We can plot the graphics of our samples using for example

- `plot(z2,type="l")`

Of course, you can improve the plot using instructions as `xlab`, `ylab` and so on. See the help of the instruction `plot`.

If we do

- `hist(z1,freq=F)`

we obtain the histogram of a standard normal sample. See the help of the instruction `hist`. What happens if we erase `freq=F`?

Repeat the same exercise for different values of n, mu and sigma and observe what happens.

To compare how samples differs from their underlying population do

- `n<-1000`
- `x<-seq(-4,4, length=1000)`
- `hist(rnorm(n), prob=T); points(x,dnorm(x), type="l")`

Try n greater.

It is important also to compute the correlogram.

- `N=10000`
- `mu=5`
- `sigma=2`
- `z<-rnorm(n,mean=mu,sd=sigma)`
- `z`
- `acf(z)`

Observe that it is a correlogram of an IID-noise.

B) Random walk:

With instructions

```
➢ n<-1000
➢ z<-rnorm(n)
➢ z
➢ x<-cumsum(z)
➢ plot(x,type=”o”)
```

we obtain a trajectory of a standard random walk. Do the same for other Gaussian white noises with mean and variance.

Another way to do it is the following:

```
➢ n<-10000
➢ w<-rnorm(n)
➢ x<-w
➢ for (t in 2:n) x[t]<-x[t-1]+w[t]
➢ plot(x,type=”l”)
```

Finally, we can see that first differences are an IID noise:

```
➢ acf(diff(x))
```