Stochastic simulation using Markov-Chain condition

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Data description

Let, a process explains the rainfall condition of Jahangirnagar University such as **1=Low rainfall**, **2=Moderate rainfall**, **3=High rainfall** and the associated transition probability matrix is:

$$\begin{matrix} \frac{2}{5} & \frac{1}{2} & \frac{1}{10} \\ \frac{1}{5} & \frac{7}{10} & \frac{1}{10} \\ \frac{2}{5} & \frac{2}{5} & \frac{1}{5} \end{matrix}$$

with initial distribution is $\mathbf{Pr(X_0=i)=(1/3,1/3,1/3)}$.

Simulation

If a+b+c=1 and we wish to pick a state in **{1,2,3}** with probability a for 1, b for 2 and c for 3, we need only generate a random number u distributed uniformly on **|0,1|** and if **a<u**, pick **1**, if **a<u<a+b**, pick **2** and if **a+b<u<a+b+c=1**, pick **c**.

Results

1.A realization of the process
2.Transition matrix
3.Transition probability matrix 4.Diagram

```
library(diagram)

## Loading required package: shape

# 1.Generation of a realization of the process
n=1000
x=matrix(0,n,1)
set.seed(2022)
u=runif(n,0,1)
a=b=c=1/3
x[1]=ifelse(u[1]<a,1,ifelse(u[1]<(a+b),2,3))
for(i in 1:(n-1)){
if(x[i]==1){
a=2/5
b=1/2
c=1/10
```

```
}
if(x[i]==2){
a=1/5
b=7/10
c=1/10
}
if(x[i]==3){
a=2/5
b=2/5
c=1/5
}
x[i+1]=ifelse(u[i+1]<a,1,ifelse(u[i+1]<(a+b),2,3))
}
U<-round(u,3)
colnames(x)[1]<-"X"
head(cbind(U,x))
```

```
##          U X
## [1,] 0.816 3
## [2,] 0.647 2
## [3,] 0.120 1
## [4,] 0.544 2
## [5,] 0.185 1
## [6,] 0.636 2
```

```
#2.Transition  matrix
n=length(x)
TM<-matrix(0,3,3,1)
for(i in 1:(n-1)){
 if(x[i]==1 & x[i+1]==1){TM[1,1]=TM[1,1]+1}
 if(x[i]==1 & x[i+1]==2){TM[1,2]=TM[1,2]+1}
 if(x[i]==1 & x[i+1]==3){TM[1,3]=TM[1,3]+1}
 if(x[i]==2 & x[i+1]==1){TM[2,1]=TM[2,1]+1}
 if(x[i]==2 & x[i+1]==2){TM[2,2]=TM[2,2]+1}
 if(x[i]==2 & x[i+1]==3){TM[2,3]=TM[2,3]+1}
 if(x[i]==3 & x[i+1]==1){TM[3,1]=TM[3,1]+1}
 if(x[i]==3 & x[i+1]==2){TM[3,2]=TM[3,2]+1}
 if(x[i]==3 & x[i+1]==3){TM[3,3]=TM[3,3]+1}
}
TM
```

```
##      [,1] [,2] [,3]
## [1,]  124  137   22
## [2,]  121  443   56
## [3,]   39   40   17
```

```r
# 3.Transition probability matrix
k<-NULL
for( i in 1:3){
k[i]<-sum(TM[i,])
TM[i,]<-TM[i,]/k[i]
}
TM

##           [,1]      [,2]       [,3]
## [1,] 0.4381625 0.4840989 0.07773852
## [2,] 0.1951613 0.7145161 0.09032258
## [3,] 0.4062500 0.4166667 0.17708333
```

Plot