Practical 1

Realization of Markov Chain

1. Markov Chain
2. State Space
3. Transition Probability Matrix
4. Stochastic matrix
5. Initial Distribution of a Markov Chain
6. Probability Distribution of Xii

Q3.)

RCode:

a = c(0.6, 0.3, 0.1, 0.2, 0.6, 0.2, 0.3, 0.1, 0.6)

p = matrix(a, nrow = 3, ncol = 3)

i = c(0.3, 0.3, 0.4)

r1 = c()

cum = c(0.3, 0.6, 1)

rn = runif(12, 0, 1)

for (i in 1:12) {

if (rn[i] <= cum[1]) {

r1[i] <- 1

} else if (rn[i] <= cum[2] && rn[i] > cum[1]) {

r1[i] <- 2

} else {

r1[i] <- 3

}

}

r1

m = matrix(rep(0,120),nrow = 10, ncol = 12)

m[1,] = r1

m

b = c(0.6,0.9,1,0.2,0.8,1,0.3,0.4,1)

cmat = matrix(b ,nrow=3,ncol = 3)

cmat

cmat=t(cmat)

cmat

for (i in seq(2, 10)) {

for (j in seq(1, 12)) {

r = runif(1, 0, 1)

pstate = m[i - 1, j]

if (r <= cmat[pstate, 1]) {

m[i, j] = 1

} else if (r <= cmat[pstate, 2] && r > cmat[pstate, 1]) {

m[i, j] = 2

} else {

m[i, j] = 3

}

}

}

m

pmf = matrix(rep(0,30), nrow = 10, ncol=3)

pmf

for(i in seq(1,10)){

c1 = c2 = c3 = 0

for(j in seq(1,12)){

if(m[i,j]==1){

c1 = c1+1}

if(m[i,j]==2){

c2 = c2+1}

if(m[i,j]==3){

c3 = c3+1

}

}

pmf[i,1]=c1/12

pmf[i,2]=c2/12

pmf[i,3]=c3/12

}

Pmf

Solution:

> r1

[1] 3 1 1 2 1 3 3 3 1 3 3 1

m

[,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10] [,11] [,12]

[1,] 3 1 1 2 1 3 3 3 1 3 3 1

[2,] 3 2 1 1 1 2 1 1 1 3 2 1

[3,] 3 1 3 1 1 2 1 1 1 3 2 2

[4,] 3 2 1 2 1 2 1 1 1 3 1 2

[5,] 3 2 2 2 1 2 1 1 2 1 1 2

[6,] 3 2 2 3 2 2 1 3 3 1 1 2

[7,] 1 2 2 2 1 1 1 3 3 1 1 1

[8,] 1 2 3 1 3 1 2 3 1 1 1 1

[9,] 2 2 1 1 3 1 3 1 1 1 2 3

[10,] 2 1 3 2 3 2 3 1 3 1 2 3

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| --- |
| > pmf  [,1] [,2] [,3]  [1,] 0.4166667 0.08333333 0.50000000  [2,] 0.5833333 0.25000000 0.16666667  [3,] 0.5000000 0.25000000 0.25000000  [4,] 0.5000000 0.33333333 0.16666667  [5,] 0.4166667 0.50000000 0.08333333  [6,] 0.2500000 0.41666667 0.33333333  [7,] 0.5833333 0.25000000 0.16666667  [8,] 0.5833333 0.16666667 0.25000000  [9,] 0.5000000 0.25000000 0.25000000  [10,] 0.2500000 0.33333333 0.41666667 |
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Q4.)

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| --- |
| > i = c(0.25,0.25,0.25,0.25)  > r1 = c()  > cum = c(0.25, 0.5, 0.75,1)  > rn = runif(15, 0, 1)  > for (i in 1:15) {  + if (rn[i] <= cum[1]) {  + r1[i] <- 1  + } else if (rn[i] <= cum[2] && rn[i] > cum[1]) {  + r1[i] <- 2  + } else if(rn[i] <= cum[3] && rn[i] > cum[2]) {  + r1[i] <- 3  + } else {r1[i] <- 4}  + }  > r1  [1] 2 3 1 3 4 2 3 3 2 2 2 1 1 2 3  > m = matrix(rep(0,150),nrow = 10, ncol = 15)  > m[1,] = r1  > m  [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10] [,11] [,12] [,13] [,14] [,15]  [1,] 2 3 1 3 4 2 3 3 2 2 2 1 1 2 3  [2,] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  [3,] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  [4,] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  [5,] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  [6,] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  [7,] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  [8,] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  [9,] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  [10,] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  > b = c(0.4,0.6,0.7,1,0.1,0.6,0.8,1,0.3,0.7,0.9,1,0,0,0,1)  > cmat = matrix(b ,nrow=4,ncol = 4)  > cmat  [,1] [,2] [,3] [,4]  [1,] 0.4 0.1 0.3 0  [2,] 0.6 0.6 0.7 0  [3,] 0.7 0.8 0.9 0  [4,] 1.0 1.0 1.0 1  > cmat=t(cmat)  > cmat  [,1] [,2] [,3] [,4]  [1,] 0.4 0.6 0.7 1  [2,] 0.1 0.6 0.8 1  [3,] 0.3 0.7 0.9 1  [4,] 0.0 0.0 0.0 1  > for (i in seq(2, 10)) {  + for (j in seq(1, 15)) {  + r = runif(1, 0, 1)  + pstate = m[i - 1, j]  + if (r <= cmat[pstate, 1]) {  + m[i, j] = 1  + } else if (r <= cmat[pstate, 2] && r > cmat[pstate, 1]) {  + m[i, j] = 2  + } else if (r <= cmat[pstate,3] && r > cmat[pstate,2]){  + m[i, j] = 3  + } else {  + m[i,j] = 4  + }  + }  + }  > m  [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10] [,11] [,12] [,13] [,14] [,15]  [1,] 2 3 1 3 4 2 3 3 2 2 2 1 1 2 3  [2,] 4 1 3 1 4 2 3 2 4 3 3 1 2 4 3  [3,] 4 2 4 2 4 4 4 4 4 2 1 1 4 4 3  [4,] 4 4 4 2 4 4 4 4 4 4 1 4 4 4 2  [5,] 4 4 4 3 4 4 4 4 4 4 4 4 4 4 4  [6,] 4 4 4 3 4 4 4 4 4 4 4 4 4 4 4  [7,] 4 4 4 2 4 4 4 4 4 4 4 4 4 4 4  [8,] 4 4 4 3 4 4 4 4 4 4 4 4 4 4 4  [9,] 4 4 4 3 4 4 4 4 4 4 4 4 4 4 4  [10,] 4 4 4 1 4 4 4 4 4 4 4 4 4 4 4  > pmf = matrix(rep(0,40), nrow = 10, ncol=4)  > pmf  [,1] [,2] [,3] [,4]  [1,] 0 0 0 0  [2,] 0 0 0 0  [3,] 0 0 0 0  [4,] 0 0 0 0  [5,] 0 0 0 0  [6,] 0 0 0 0  [7,] 0 0 0 0  [8,] 0 0 0 0  [9,] 0 0 0 0  [10,] 0 0 0 0  > for(i in seq(1,10)){  + c1 = c2 = c3 = c4 = 0  + for(j in seq(1,15)){  + if(m[i,j]==1){  + c1 = c1+1}  + if(m[i,j]==2){  + c2 = c2+1}  + if(m[i,j]==3){  + c3 = c3+1}  + if (m[i,j]==4){  + c4 = c4+1  + }  + }  + pmf[i,1]=c1/15  + pmf[i,2]=c2/15  + pmf[i,3]=c3/15  + pmf[i,4]=c4/15  + }  > pmf  [,1] [,2] [,3] [,4]  [1,] 0.20000000 0.40000000 0.33333333 0.06666667  [2,] 0.20000000 0.20000000 0.33333333 0.26666667  [3,] 0.13333333 0.20000000 0.06666667 0.60000000  [4,] 0.06666667 0.13333333 0.00000000 0.80000000  [5,] 0.00000000 0.00000000 0.06666667 0.93333333  [6,] 0.00000000 0.00000000 0.06666667 0.93333333  [7,] 0.00000000 0.06666667 0.00000000 0.93333333  [8,] 0.00000000 0.00000000 0.06666667 0.93333333  [9,] 0.00000000 0.00000000 0.06666667 0.93333333  [10,] 0.06666667 0.00000000 0.00000000 0.93333333 |
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