دانشگاه تهران

پردیس علوم

دانشکده ریاضی،علوم کامپیوتر و آمار

تولید داده از توزیع kibble به روش RandomWalk و Independent

نویسنده
تارا حریری
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استاد راهنما
دکتر شمه سوار

خرداد ۱۳۹۵

برنامه هایی بنویسید که از توزیع kibble به روش independent و random walk داده تولید کند .

با توجه به روش gibbs از هر ۲ حاشیه ای داده تولید میکنیم و به صورت تو در تو از داده های تولید شده استفاده میکنیم که در این برنامه ها در هر تابع شرطی ۱۰۰۰ تا به صورت independent یا random walk تولید میکنیم و ۵۰۰ تا دوم را میانگین گرفته و به عنوان یک داده ازش استفاده میکنیم.

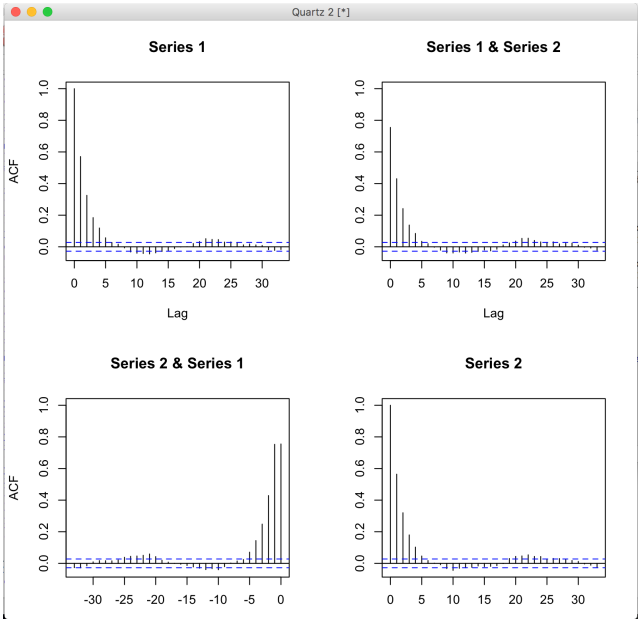
INDEPENDENT:

```
#----------------------------Kibble_Independent ----------------
ro=.75
alfa=2
#Y|X
kibble1=function(x,y) {(1/(1-ro))*((y/(x* ro))^((alfa-1)/2))*exp(-
 (ro*x+y)/(1-ro))*besselI((2*sqrt(ro*x*y))/(1-ro),(alfa-1))}
#X|y
kibble2=function(x,y){ (1/(1-ro))*((x/(y* ro))^((alfa-1)/2))*exp(-
 (ro*y+x)/(1-ro))*besselI((2*sqrt(ro*x*y))/(1-ro),(alfa-1))}
#----------------------------Y| be sharte x----------------------------
y.x=function(ee,x){
zz=c()
for(i in 1:1000){
X0=rgamma(1,2.8,1)
a=min((kibble1(x,X0)*dgamma(ee,3,1))/(kibble1(x,ee)*dgamma(X0,3,1)),1)
u=runif(1)
if(u<a){
zz[i]=X0
ee= X0
}
else{
zz[i]=ee
}
}
mean(zz[500:1000])
}
#----------------------------X| be sharte Y----------------------------

x.y=function(ee,v){
zz=c()
for(i in 1:1000){
X0 =rgamma(1,2.8,1)
a=min((kibble2(X0,v)*dgamma(ee,3,1))/(kibble2(ee,v)*dgamma(X0,3,1)),1)
u=runif(1)
if(u<a){
zz[i]=X0
```

```
ee= X0
}
else{
zz[i]=ee
}
}
mean(zz[500:1000])
}
#--------------------------Main function-----------------------------
f=function(n){
y=c()
x=c()
z=c()
y[1]=1
x[1]=x.y(0.5,y[1])
for(i in 2:n){
y[i]=y.x(y[i-1],x[i-1])
x[i]=x.y(x[i-1],y[i])
}
cbind(x[5000:n],y[5000:n])
}
z=f(10000)
cor(z)
acf(z)
```

OUTPUT:




```
> cor(z)
          [,1]      [,2]
[1,] 1.0000000 0.7550696
[2,] 0.7550696 1.0000000
```

Random Walk:

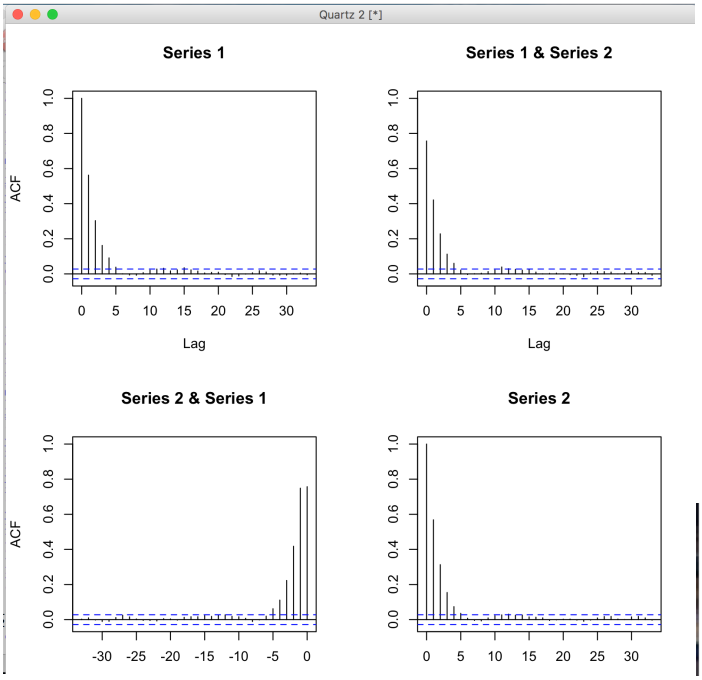
```
#--------------------RANDOM WALK_KIBBLE---------------------
ro=.75
alfa=2
#Y|X
kibble1=function(x,y) {(1/(1-ro))*((y/(x* ro))^((alfa-1)/2))*exp(-
 (ro*x+y)/(1-ro))*besselI((2*sqrt(ro*x*y))/(1-ro),(alfa-1))}
#X|y
kibble2=function(x,y){ (1/(1-ro))*((x/(y* ro))^((alfa-1)/2))*exp(-
 (ro*y+x)/(1-ro))*besselI((2*sqrt(ro*x*y))/(1-ro),(alfa-1))}

#----------y| be sharte x --------------------
y.x=function(ee,x){
i=2
zz=c()
for(i in 1:1000){
y=abs(ee+rnorm(1,0,2))
a=min((kibble1(x,y))/(kibble1(x,ee)),1)
u=runif(1)
if(u<a ){
 zz[i]=y
 ee=y
}
else{
zz[i]= ee

}
}
mean(zz[500:1000])
}
#----------x| be sharte y --------------------
y=rgamma(1,alfa,1)
x.y=function(ee,v){
i=2
zz=c()
for(i in 1:1000){
y=abs(ee+rnorm(1,0,2))
a=min((kibble2(y,v))/(kibble2(ee,v)),1)
u=runif(1)
if(u<a ){
 zz[i]=y
 ee=y
}
```

```
else{
zz[i]= ee
}
}
mean(zz[500:1000])
}
#----------------------Main Function------------
f=function(n){
y=c()
x=c()
z=c()
y[1]=1
x[1]=x.y(1.5,y[1])
for(i in 2:n){
y[i]=y.x(y[i-1],x[i-1])
x[i]=x.y(x[i-1],y[i])
}
cbind(x[5000:n],y[5000:n])
}
z=f(10000)
cor(z)
acf(z)
```

OUTPUT:




```
> cor(z)
          [,1]      [,2]
[1,] 1.000000 0.757141
[2,] 0.757141 1.000000
```

راهنمای متغییر های استفاده شده در سیستم :

Time_Enter = مدت سپری شده از آخرین ورود
TimeEnter_Customer = زمان ورود
Time_Service = مدت خدمت دهی
TimeStartService_Customer= زمان شروع خدمت
WaitLine_Customer= مدت ماندن مشتری در صف
TimeEnd_Customer= زمان پایان خدمت
WaitingInSystem_Customer = مدت ماندن مشتری در سیستم
IdelTime_Banker= مدت بیکاری خدمت دهنده

شبیه سازی یک صف با ۲۰ تا مشتری و با جدول احتمالات زیر : (List.R)

مدت خدمتدهی (دقیقه)	احتمال	احتمال تجمعی	تخصیص ارقام تصادفی
۱	۰/۱۰	۰/۱۰	۰۱-۱۰
۲	۰/۲۰	۰/۳۰	۱۱-۳۰
۳	۰/۳۰	۰/۶۰	۳۱-۶۰
۴	۰/۲۵	۰/۸۵	۶۱-۸۵
۵	۰/۱۰	۰/۹۵	۸۶-۹۵
۶	۰/۰۵	۱/۰۰	۹۶-۰۰

مدتهای بین ورود (دقیقه)	احتمال	احتمال تجمعی	تخصیص ارقام تصادفی
۱	۰/۱۲۵	۰/۱۲۵	۰۰۱-۱۲۵
۲	۰/۱۲۵	۰/۲۵۰	۱۲۶-۲۵۰
۳	۰/۱۲۵	۰/۳۷۵	۲۵۱-۳۷۵
۴	۰/۱۲۵	۰/۵۰۰	۳۷۶-۵۰۰
۵	۰/۱۲۵	۰/۶۲۵	۵۰۱-۶۲۵
۶	۰/۱۲۵	۰/۷۵۰	۶۲۶-۷۵۰
۷	۰/۱۲۵	۰/۸۷۵	۷۵۱-۸۷۵
۸	۰/۱۲۵	۱/۰۰۰	۸۷۶-۰۰۰

برنامه :

```
n=20
#----------Zamane_Vurud----------
Runif_Enter=runif(n,0,1000)
Time_Enter=c()
Time_Enter[1]=0
for(i in 2:n){
 if(Runif_Enter[i]>=1 & Runif_Enter[i]<126)
       Time_Enter[i]=1
 else if(Runif_Enter[i]>=126 & Runif_Enter[i]<251)
              Time_Enter[i]=2
       else if(Runif_Enter[i]>=251 & Runif_Enter[i]<376)
                    Time_Enter[i]=3
             else if(Runif_Enter[i]>=376 & Runif_Enter[i]<501)
                          Time_Enter[i]=4
                   else if(Runif_Enter[i]>=501 & Runif_Enter[i]<626)
                                Time_Enter[i]=5
                         else if(Runif_Enter[i]>=626 & Runif_Enter[i]<751)
                                      Time_Enter[i]=6
                               else if(Runif_Enter[i]>=751 & Runif_Enter[i]<876)
                                            Time_Enter[i]=7
                                     else
                                            Time_Enter[i]=8
}
```

```
#list(Runif_Enter, Time_Enter)
#----------------Khadamat Resani-----------------
Runif_Service=runif(n,0,100)
Time_Service=c()
for(i in 1:n){
 if(Runif_Service[i]>=1 & Runif_Service[i]<11)
        Time_Service[i]=1
 else if(Runif_Service[i]>=11 & Runif_Service[i]<31)
                Time_Service[i]=2
        else if(Runif_Service[i]>=31 & Runif_Service[i]<61)
                        Time_Service[i]=3
                else if(Runif_Service[i]>=61 & Runif_Service[i]<86)
                                Time_Service[i]=4
                        else if(Runif_Service[i]>=86 & Runif_Service[i]<96)
                                        Time_Service[i]=5
                                else
                                        Time_Service[i]=6
                                        }
#list(Runif_Service, Time_Service)
#----------------Calculate-----------------
Number_Customer=c()                             #shomare moshtari
TimeEnter_Customer=c()                  #zamane  vorod
TimeStartService_Customer=c()  #zamane shoro khedmat resani
WaitLine_Customer=c()                   #zamane entezar dar saf
TimeEnd_Customer=c()                    #zamane payan dehi khedmat
WaitingInSysteme_Customer=c()  #zamane dar systeme  moshtari
IdelTime_Banker=c()                             #zamane bikari khedmat dahande dar system
#----------------FIRST CUSTOMER-----------------
Number_Customer[1] = 1
TimeEnter_Customer[1]=0
TimeStartService_Customer[1]=0
WaitLine_Customer[1]=0
TimeEnd_Customer[1]= Time_Service[1]
WaitingInSystem_Customer[1]=Time_Service[1]
IdelTime_Banker[1]=0
#-----------------------------------
Sum_Mean_Waiting_List=0
Counter_Waiting_List = 0
Sum_Bikari=0
Sum_Service=0
#-----------------------------------
for(i in 2:n){
 Number_Customer[i]=i
 sum=0
 for(j in 1:i){
        sum = sum + Time_Enter[j]
        }
 TimeEnter_Customer[i] = sum

 if(TimeEnd_Customer[i-1]< TimeEnter_Customer[i]){
        TimeStartService_Customer[i]= TimeEnter_Customer[i]
        WaitLine_Customer[i]=0
        WaitingInSystem_Customer[i]= Time_Service[i]
        IdelTime_Banker[i]= TimeEnter_Customer[i]-TimeEnd_Customer[i-1]
```

```
 }
 else{
        TimeStartService_Customer[i]= TimeEnd_Customer[i-1]
        WaitLine_Customer[i]= TimeEnd_Customer[i-1]-TimeEnter_Customer[i]
        WaitingInSystem_Customer[i]= WaitLine_Customer[i]+ Time_Service[i]
        IdelTime_Banker[i]=0

        Counter_Waiting_List= Counter_Waiting_List+1
 }
 TimeEnd_Customer[i]= TimeStartService_Customer [i]+ Time_Service[i]

 Sum_Mean_Waiting_List= Sum_Mean_Waiting_List+WaitLine_Customer[i]
 Sum_Bikari= Sum_Bikari+IdelTime_Banker[i]
 Sum_Service= Sum_Service+ Time_Service[i]
}

cbind(Time_Enter, TimeEnter_Customer, Time_Service, TimeStartService_Customer,
 WaitLine_Customer,TimeEnd_Customer, WaitingInSystem_Customer, IdelTime_Banker)

Mean_Waiting_List= Sum_Mean_Waiting_List/n
Mean_Waiting_List

P_Waiting_List= Counter_Waiting_List/n
P_Waiting_List

P_Bikari_List= Sum_Bikari/TimeEnd_Customer[n]
P_Bikari_List

mean_Service=Sum_Service/n
mean_Service
```

خروجی :

	Time_Enter	TimeEnter_Customer	Time_Service	TimeStartService_Customer	WaitLine_Customer	TimeEnd_Customer	WaitingInSystem_Customer	IdelTime_Banker
[1,]	0	0	1	0	0	1	1	0
[2,]	6	6	3	6	0	9	3	5
[3,]	8	14	4	14	0	18	4	5
[4,]	2	16	5	18	2	23	7	0
[5,]	2	18	2	23	5	25	7	0
[6,]	5	23	4	25	2	29	6	0
[7,]	7	30	4	30	0	34	4	1
[8,]	4	34	5	34	0	39	5	0
[9,]	6	40	4	40	0	44	4	1
[10,]	4	44	4	44	0	48	4	0
[11,]	1	45	4	48	3	52	7	0
[12,]	1	46	4	52	6	56	10	0
[13,]	5	51	3	56	5	59	8	0
[14,]	6	57	4	59	2	63	6	0
[15,]	5	62	4	63	1	67	5	0
[16,]	8	70	4	70	0	74	4	3
[17,]	8	78	1	78	0	79	1	4
[18,]	2	80	4	80	0	84	4	1
[19,]	1	81	4	84	3	88	7	0
[20,]	1	82	2	88	6	90	8	0

```
> Mean_Waiting_List= Sum_Mean_Waiting_List/n
> Mean_Waiting_List
[1] 1.75
>
> P_Waiting_List= Counter_Waiting_List/n
> P_Waiting_List
[1] 0.6
>
> P_Bikari_List= Sum_Bikari/TimeEnd_Customer[n]
> P_Bikari_List
[1] 0.2222222
>
> mean_Service=Sum_Service/n
> mean_Service
[1] 3.45
```

۱-در مثال صف توزیع ورود بین ۱ و ۱۰ دقیقه یکتواخت باشد . برای ۲۰ مشتری جدول شبیه سازی ایجاد کنید و تجزیه و تحلیل لازم را اجام دهید.
(List_Soale1.R)

برنامه :

```
n=20
#------------------------Zamane_Vurud-----------------------------
Runif_Enter=runif(n,0,1250)
Time_Enter=c()
Time_Enter[1]=0
for(i in 2:n){
 if(Runif_Enter[i]>=1 & Runif_Enter[i]<11)
    Time_Enter[i]=1
 else if(Runif_Enter[i]>=11 & Runif_Enter[i]<21)
        Time_Enter[i]=2
    else if(Runif_Enter[i]>=21 & Runif_Enter[i]<31)
            Time_Enter[i]=3
        else if(Runif_Enter[i]>=31 & Runif_Enter[i]<41)
                Time_Enter[i]=4
            else if(Runif_Enter[i]>=41 & Runif_Enter[i]<51)
                    Time_Enter[i]=5
                else if(Runif_Enter[i]>=51 & Runif_Enter[i]<61)
                        Time_Enter[i]=6
                    else if(Runif_Enter[i]>=61 & Runif_Enter[i]<71)
                            Time_Enter[i]=7
                        else if(Runif_Enter[i]>= 71 &
 Runif_Enter[i]<81)
                            Time_Enter[i]=8
                            else if(Runif_Enter[i]>= 81 &
 Runif_Enter[i]<91)
                                Time_Enter[i]=9
                                else
                                    Time_Enter[i]=10
}
#list(Runif_Enter, Time_Enter)
#------------------------Khadamat Resani--------------------------
Runif_Service=runif(n,0,100)
Time_Service=c()
for(i in 1:n){
 if(Runif_Service[i]>=1 & Runif_Service[i]<11)
    Time_Service[i]=1
 else if(Runif_Service[i]>=11 & Runif_Service[i]<31)
```

```
        Time_Service[i]=2
    else if(Runif_Service[i]>=31 & Runif_Service[i]<61)
            Time_Service[i]=3
        else if(Runif_Service[i]>=61 & Runif_Service[i]<86)
                Time_Service[i]=4
            else if(Runif_Service[i]>=86 & Runif_Service[i]<96)
                    Time_Service[i]=5
                else
                    Time_Service[i]=6
                    }
#list(Runif_Service, Time_Service)
#--------------------------Calculate---------------------------------
-
Number_Customer=c()              #shomare moshtari
TimeEnter_Customer=c()           #zamane  vorod
TimeStartService_Customer=c()    #zamane shoro khedmat resani
WaitLine_Customer=c()            #zamane entezar dar saf
TimeEnd_Customer=c()         #zamane payan dehi khedmat
WaitingInSystem_Customer=c() #zamane dar systeme  moshtari
IdelTime_Banker=c()              #zamane bikari khedmat dahande dar
 system
#----------------------------FIRST CUSTOMER-------------------------
-
Number_Customer[1] = 1
TimeEnter_Customer[1]=0
TimeStartService_Customer[1]=0
WaitLine_Customer[1]=0
TimeEnd_Customer[1]= Time_Service[1]
WaitingInSystem_Customer[1]=Time_Service[1]
IdelTime_Banker[1]=0
#-----------------------------------------------------------
Sum_Mean_Waiting_List=0
Counter_Waiting_List = 0
Sum_Bikari=0
Sum_Service=0
#-----------------------------------------------------------
for(i in 2:n){
 Number_Customer[i]=i
 sum=0
 for(j in 1:i){
     sum = sum + Time_Enter[j]
     }
 TimeEnter_Customer[i] = sum
```

```
 if(TimeEnd_Customer[i-1]< TimeEnter_Customer[i]){
    TimeStartService_Customer[i]= TimeEnter_Customer[i]
    WaitLine_Customer[i]=0
    WaitingInSystem_Customer[i]= Time_Service[i]
    IdelTime_Banker[i]= TimeEnter_Customer[i]-TimeEnd_Customer[i-1]
 }
 else{
    TimeStartService_Customer[i]= TimeEnd_Customer[i-1]
    WaitLine_Customer[i]= TimeEnd_Customer[i-1]-TimeEnter_Customer[i]
    WaitingInSystem_Customer[i]= WaitLine_Customer[i]+ Time_Service[i]
    IdelTime_Banker[i]=0

    Counter_Waiting_List= Counter_Waiting_List+1
 }
 TimeEnd_Customer[i]= TimeStartService_Customer [i]+ Time_Service[i]


 Sum_Mean_Waiting_List= Sum_Mean_Waiting_List+WaitLine_Customer[i]
 Sum_Bikari= Sum_Bikari+IdelTime_Banker[i]
 Sum_Service= Sum_Service+ Time_Service[i]
}

cbind(Time_Enter, TimeEnter_Customer, Time_Service,
 TimeStartService_Customer, WaitLine_Customer,TimeEnd_Customer,
 WaitingInSystem_Customer, IdelTime_Banker)

Mean_Waiting_List= Sum_Mean_Waiting_List/n
Mean_Waiting_List

P_Waiting_List= Counter_Waiting_List/n
P_Waiting_List

P_Bikari_List= Sum_Bikari/TimeEnd_Customer[n]
P_Bikari_List

mean_Service=Sum_Service/n
mean_Service
```

خروجی :

	Time_Enter	TimeEnter_Customer	Time_Service	TimeStartService_Customer	WaitLine_Customer	TimeEnd_Customer	WaitingInSystem_Customer	IdelTime_Banker
[1,]	0	0	6	0	0	6	6	0
[2,]	10	10	3	10	0	13	3	4
[3,]	1	11	2	13	2	15	4	0
[4,]	5	16	2	16	0	18	2	1
[5,]	9	25	2	25	0	27	2	7
[6,]	4	29	3	29	0	32	3	2
[7,]	9	38	3	38	0	41	3	6
[8,]	7	45	4	45	0	49	4	4
[9,]	4	49	4	49	0	53	4	0
[10,]	7	56	4	56	0	60	4	3
[11,]	3	59	6	60	1	66	7	0
[12,]	9	68	1	68	0	69	1	2
[13,]	10	78	1	78	0	79	1	9
[14,]	8	86	3	86	0	89	3	7
[15,]	4	90	2	90	0	92	2	1
[16,]	6	96	3	96	0	99	3	4
[17,]	9	105	3	105	0	108	3	6
[18,]	5	110	4	110	0	114	4	2
[19,]	3	113	3	114	1	117	4	0
[20,]	6	119	2	119	0	121	2	2

```
> Mean_Waiting_List= Sum_Mean_Waiting_List/n
> Mean_Waiting_List
[1] 0.2
>
> P_Waiting_List= Counter_Waiting_List/n
> P_Waiting_List
[1] 0.2
>
> P_Bikari_List= Sum_Bikari/TimeEnd_Customer[n]
> P_Bikari_List
[1] 0.4958678
>
> mean_Service=Sum_Service/n
> mean_Service
[1] 2.75
```

تحلیل:
با تغییردر توزیع مدت ورود میبینیم که متوسط مدت زمان انتظار کاهش یافته است و احتمال بیکاری خدمت کننده نیز افزایش یافته است اما متوسط خدمت دهی تغییر چندانی نکرده است و احتمال انتظار در صف نیز کاهش یافته است.

۲-فرض کنید که توزیع خدمت دهی به صورت زیر تغییر کند . برای ۲۰ مشتری جدول شبیه سازی ایجاد کنید و تجزیه و تحلیل لازم را انجام دهید . (List_Soale2.R)

مدت خدمتدهی (دقیقه)	۱	۲	۳	۴	۵	۶
احتمال	۰/۰۵	۰/۱۰	۰/۲۰	۰/۳۰	۰/۲۵	۰/۱۰

برنامه:

```
n=20
#----------Zamane_Vurud----------
Runif_Enter=runif(n,0,1000)
Time_Enter=c()
Time_Enter[1]=0
for(i in 2:n){
 if(Runif_Enter[i]>=1 & Runif_Enter[i]<126)
       Time_Enter[i]=1
 else if(Runif_Enter[i]>=126 & Runif_Enter[i]<251)
             Time_Enter[i]=2
       else if(Runif_Enter[i]>=251 & Runif_Enter[i]<276)
                   Time_Enter[i]=3
             else if(Runif_Enter[i]>=376 & Runif_Enter[i]<501)
                         Time_Enter[i]=4
                   else if(Runif_Enter[i]>=501 & Runif_Enter[i]<626)
                               Time_Enter[i]=5
                         else if(Runif_Enter[i]>=626 & Runif_Enter[i]<751)
                                     Time_Enter[i]=6
                               else if(Runif_Enter[i]>=751 & Runif_Enter[i]<876)
                                           Time_Enter[i]=7
                                     else
                                           Time_Enter[i]=8
}
#----------Khadamat Resani----------
Runif_Service=runif(n,0,100)
Time_Service=c()
for(i in 1:n){
 if(Runif_Service[i]>=1 & Runif_Service[i]<6)
       Time_Service[i]=1
 else if(Runif_Service[i]>=6 & Runif_Service[i]<16)
             Time_Service[i]=2
       else if(Runif_Service[i]>=16 & Runif_Service[i]<36)
                   Time_Service[i]=3
             else if(Runif_Service[i]>=36 & Runif_Service[i]<66)
                         Time_Service[i]=4
                   else if(Runif_Service[i]>=66 & Runif_Service[i]<91)
                               Time_Service[i]=5
```

```
                    else
                        Time_Service[i]=6
                        }
#list(Runif_Service, Time_Service)
#-----------------Calculate-----------------------
Number_Customer=c()                 #shomare moshtari
TimeEnter_Customer=c()              #zamane  vorod
TimeStartService_Customer=c()   #zamane shoro khedmat resani
WaitLine_Customer=c()               #zamane entezar dar saf
TimeEnd_Customer=c()                #zamane payan dehi khedmat
WaitingInSystem_Customer=c()    #zamane dar systeme  moshtari
IdelTime_Banker=c()                 #zamane bikari khedmat dahande dar system
#-----------------FIRST CUSTOMER-----------------
Number_Customer[1] = 1
TimeEnter_Customer[1]=0
TimeStartService_Customer[1]=0
WaitLine_Customer[1]=0
TimeEnd_Customer[1]= Time_Service[1]
WaitingInSystem_Customer[1]=Time_Service[1]
IdelTime_Banker[1]=0
#-------------------------------------
for(i in 2:n){
 Number_Customer[i]=i
 sum=0
 for(j in 1:i){
       sum = sum + Time_Enter[j]
       }
 TimeEnter_Customer[i] = sum
 if(TimeEnd_Customer[i-1]< TimeEnter_Customer[i]){
       TimeStartService_Customer[i]= TimeEnter_Customer[i]
       WaitLine_Customer[i]=0
       WaitingInSystem_Customer[i]= Time_Service[i]
       IdelTime_Banker[i]= TimeEnter_Customer[i]-TimeEnd_Customer[i-1]
 }
 else{
       TimeStartService_Customer[i]= TimeEnd_Customer[i-1]
       WaitLine_Customer[i]= TimeEnd_Customer[i-1]-TimeEnter_Customer[i]
       WaitingInSystem_Customer[i]= WaitLine_Customer[i]+ Time_Service[i]
       IdelTime_Banker[i]=0

       Counter_Waiting_List= Counter_Waiting_List+1
 }
 TimeEnd_Customer[i]= TimeStartService_Customer [i]+ Time_Service[i]

Sum_Mean_Waiting_List= Sum_Mean_Waiting_List+WaitLine_Customer[i]
 Sum_Bikari= Sum_Bikari+IdelTime_Banker[i]
 Sum_Service= Sum_Service+ Time_Service[i]
```

```
}

cbind(Time_Enter, TimeEnter_Customer, Time_Service, TimeStartService_Customer,
 WaitLine_Customer,TimeEnd_Customer, WaitingInSystem_Customer, IdelTime_Banker)

Mean_Waiting_List= Sum_Mean_Waiting_List/n
Mean_Waiting_List
P_Waiting_List= Counter_Waiting_List/n
P_Waiting_List
P_Bikari_List= Sum_Bikari/TimeEnd_Customer[n]
P_Bikari_List
mean_Service=Sum_Service/n
mean_Service
```

خروجی:

	Time_Enter	TimeEnter_Customer	Time_Service	TimeStartService_Customer	WaitLine_Customer	TimeEnd_Customer	WaitingInSystem_Customer	IdelTime_Banker
[1,]	0	0	4	0	0	4	4	0
[2,]	3	3	5	4	1	9	6	0
[3,]	7	10	4	10	0	14	4	1
[4,]	6	16	3	16	0	19	3	2
[5,]	5	21	5	21	0	26	5	2
[6,]	2	23	6	26	3	32	9	0
[7,]	5	28	3	32	4	35	7	0
[8,]	4	32	4	35	3	39	7	0
[9,]	5	37	5	39	2	44	7	0
[10,]	5	42	6	44	2	50	8	0
[11,]	5	47	3	50	3	53	6	0
[12,]	4	51	5	53	2	58	7	0
[13,]	1	52	4	58	6	62	10	0
[14,]	2	54	5	62	8	67	13	0
[15,]	8	62	3	67	5	70	8	0
[16,]	8	70	3	70	0	73	3	0
[17,]	2	72	5	73	1	78	6	0
[18,]	5	77	3	78	1	81	4	0
[19,]	6	83	2	83	0	85	2	2
[20,]	1	84	5	85	1	90	6	0

```
> Mean_Waiting_List= Sum_Mean_Waiting_List/n
> Mean_Waiting_List
[1] 4.6
>
> P_Waiting_List= Counter_Waiting_List/n
> P_Waiting_List
[1] 1.75
>
> P_Bikari_List= Sum_Bikari/TimeEnd_Customer[n]
> P_Bikari_List
[1] 0.8555556
>
> mean_Service=Sum_Service/n
> mean_Service
[1] 10.7
```

تحلیل :

تمامی مقادیر به طور چشمگیری افزایش یافته است.

۳- در مورد ۲۰ مشتری دیگر اجرا کنید.(Liste_Soale3.R)
برنامه:

```
n=40
#------------------------Zamane_Vurud-----------------------------
Runif_Enter=runif(n,0,1000)
Time_Enter=c()
Time_Enter[1]=0
for(i in 2:n){
 if(Runif_Enter[i]>=1 & Runif_Enter[i]<126)
    Time_Enter[i]=1
 else if(Runif_Enter[i]>=126 & Runif_Enter[i]<251)
        Time_Enter[i]=2
    else if(Runif_Enter[i]>=251 & Runif_Enter[i]<276)
            Time_Enter[i]=3
        else if(Runif_Enter[i]>=376 & Runif_Enter[i]<501)
                Time_Enter[i]=4
            else if(Runif_Enter[i]>=501 & Runif_Enter[i]<626)
                    Time_Enter[i]=5
                else if(Runif_Enter[i]>=626 & Runif_Enter[i]<751)
                        Time_Enter[i]=6
                    else if(Runif_Enter[i]>=751 & Runif_Enter[i]<876)
                            Time_Enter[i]=7
                        else
                            Time_Enter[i]=8
}
#list(Runif_Enter, Time_Enter)
#------------------------Khadamat Resani--------------------------
Runif_Service=runif(n,0,100)
Time_Service=c()
for(i in 1:n){
 if(Runif_Service[i]>=1 & Runif_Service[i]<11)
    Time_Service[i]=1
 else if(Runif_Service[i]>=11 & Runif_Service[i]<31)
        Time_Service[i]=2
    else if(Runif_Service[i]>=31 & Runif_Service[i]<61)
            Time_Service[i]=3
        else if(Runif_Service[i]>=61 & Runif_Service[i]<86)
                Time_Service[i]=4
            else if(Runif_Service[i]>=86 & Runif_Service[i]<96)
                    Time_Service[i]=5
                else
                    Time_Service[i]=6
                    }
```

```
#list(Runif_Service, Time_Service)
#--------------------------Calculate---------------------------------
 -
Number_Customer=c()              #shomare moshtari
TimeEnter_Customer=c()           #zamane  vorod
TimeStartService_Customer=c()    #zamane shoro khedmat resani
WaitLine_Customer=c()            #zamane entezar dar saf
TimeEnd_Customer=c()         #zamane payan dehi khedmat
WaitingInSystem_Customer=c() #zamane dar systeme  moshtari
IdelTime_Banker=c()              #zamane bikari khedmat dahande dar
 system
#----------------------------FIRST CUSTOMER-------------------------
 -
Number_Customer[1] = 1
TimeEnter_Customer[1]=0
TimeStartService_Customer[1]=0
WaitLine_Customer[1]=0
TimeEnd_Customer[1]= Time_Service[1]
WaitingInSystem_Customer[1]=Time_Service[1]
IdelTime_Banker[1]=0
#-----------------------------------------------------------
Sum_Mean_Waiting_List=0
Counter_Waiting_List = 0
Sum_Bikari=0
Sum_Service=0
#-----------------------------------------------------------
for(i in 2:n){
 Number_Customer[i]=i
 sum=0
 for(j in 1:i){
     sum = sum + Time_Enter[j]
     }
 TimeEnter_Customer[i] = sum

 if(TimeEnd_Customer[i-1]< TimeEnter_Customer[i]){
     TimeStartService_Customer[i]= TimeEnter_Customer[i]
     WaitLine_Customer[i]=0
     WaitingInSystem_Customer[i]= Time_Service[i]
     IdelTime_Banker[i]= TimeEnter_Customer[i]-TimeEnd_Customer[i-1]
 }
 else{
     TimeStartService_Customer[i]= TimeEnd_Customer[i-1]
     WaitLine_Customer[i]= TimeEnd_Customer[i-1]-TimeEnter_Customer[i]
     WaitingInSystem_Customer[i]= WaitLine_Customer[i]+ Time_Service[i]
```

```
    IdelTime_Banker[i]=0
    if(i>20)
    Counter_Waiting_List= Counter_Waiting_List+1
 }
 TimeEnd_Customer[i]= TimeStartService_Customer [i]+ Time_Service[i]
 if(i>20){
 Sum_Mean_Waiting_List= Sum_Mean_Waiting_List+WaitLine_Customer[i]
 Sum_Bikari= Sum_Bikari+IdelTime_Banker[i]
 Sum_Service= Sum_Service+ Time_Service[i]
 }
}

cbind(Time_Enter[21:n], TimeEnter_Customer[21:n], Time_Service[21:n],
 TimeStartService_Customer[21:n],
 WaitLine_Customer[21:n],TimeEnd_Customer[21:n],
 WaitingInSystem_Customer[21:n], IdelTime_Banker[21:n])

Mean_Waiting_List= Sum_Mean_Waiting_List/20
Mean_Waiting_List

P_Waiting_List= Counter_Waiting_List/20
P_Waiting_List

P_Bikari_List= Sum_Bikari/TimeEnd_Customer[n]
P_Bikari_List

mean_Service=Sum_Service/20
mean_Service
```

خروجی:

```
      [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8]
 [1,]    2  101    3  102    1  105    4    0
 [2,]    2  103    3  105    2  108    5    0
 [3,]    2  105    2  108    3  110    5    0
 [4,]    2  107    2  110    3  112    5    0
 [5,]    4  111    2  112    1  114    3    0
 [6,]    7  118    3  118    0  121    3    4
 [7,]    4  122    1  122    0  123    1    1
 [8,]    5  127    1  127    0  128    1    4
 [9,]    5  132    4  132    0  136    4    4
[10,]    5  137    2  137    0  139    2    1
[11,]    6  143    3  143    0  146    3    4
[12,]    8  151    2  151    0  153    2    5
[13,]    1  152    3  153    1  156    4    0
[14,]    7  159    3  159    0  162    3    3
[15,]    5  164    3  164    0  167    3    2
[16,]    4  168    4  168    0  172    4    1
[17,]    6  174    5  174    0  179    5    2
[18,]    6  180    2  180    0  182    2    1
[19,]    6  186    5  186    0  191    5    4
[20,]    6  192    3  192    0  195    3    1
```

```
> Mean_Waiting_List= Sum_Mean_Waiting_List/20
> Mean_Waiting_List
[1] 0.55
>
> P_Waiting_List= Counter_Waiting_List/20
> P_Waiting_List
[1] 0.3
>
> P_Bikari_List= Sum_Bikari/TimeEnd_Customer[n]
> P_Bikari_List
[1] 0.1897436
>
> mean_Service=Sum_Service/20
> mean_Service
[1] 2.8
```

مقایسه:

تمامی آیتم ها کاهش یافته است.

۴-میانگین وزن دار زمانی تعداد مشتریان در سیستم و میانگین وزندار زمانی تعداد مشتری در صف انتظار را تعیین کنید.
برنامه :

```
n=20
#------------------------Zamane_Vurud----------------------------
Runif_Enter=runif(n,0,1000)
Time_Enter=c()
Time_Enter[1]=0
for(i in 2:n){
 if(Runif_Enter[i]>=1 & Runif_Enter[i]<126)
    Time_Enter[i]=1
 else if(Runif_Enter[i]>=126 & Runif_Enter[i]<251)
        Time_Enter[i]=2
    else if(Runif_Enter[i]>=251 & Runif_Enter[i]<276)
            Time_Enter[i]=3
        else if(Runif_Enter[i]>=376 & Runif_Enter[i]<501)
                Time_Enter[i]=4
            else if(Runif_Enter[i]>=501 & Runif_Enter[i]<626)
                    Time_Enter[i]=5
                else if(Runif_Enter[i]>=626 & Runif_Enter[i]<751)
                        Time_Enter[i]=6
                    else if(Runif_Enter[i]>=751 & Runif_Enter[i]<876)
                            Time_Enter[i]=7
                        else
                            Time_Enter[i]=8
}
#list(Runif_Enter, Time_Enter)
#------------------------Khadamat Resani--------------------------
Runif_Service=runif(n,0,100)
Time_Service=c()
for(i in 1:n){
 if(Runif_Service[i]>=1 & Runif_Service[i]<11)
    Time_Service[i]=1
 else if(Runif_Service[i]>=11 & Runif_Service[i]<31)
        Time_Service[i]=2
    else if(Runif_Service[i]>=31 & Runif_Service[i]<61)
            Time_Service[i]=3
        else if(Runif_Service[i]>=61 & Runif_Service[i]<86)
                Time_Service[i]=4
            else if(Runif_Service[i]>=86 & Runif_Service[i]<96)
                    Time_Service[i]=5
                else
                    Time_Service[i]=6
```

```
                    }
#list(Runif_Service, Time_Service)
#-------------------------Calculate---------------------------------
 -
Number_Customer=c()              #shomare moshtari
TimeEnter_Customer=c()           #zamane  vorod
TimeStartService_Customer=c()    #zamane shoro khedmat resani
WaitLine_Customer=c()            #zamane entezar dar saf
TimeEnd_Customer=c()         #zamane payan dehi khedmat
WaitingInSystem_Customer=c() #zamane dar systeme  moshtari
IdelTime_Banker=c()              #zamane bikari khedmat dahande dar
 system
#----------------------------FIRST CUSTOMER-------------------------
 -
Number_Customer[1] = 1
TimeEnter_Customer[1]=0
TimeStartService_Customer[1]=0
WaitLine_Customer[1]=0
TimeEnd_Customer[1]= Time_Service[1]
WaitingInSystem_Customer[1]=Time_Service[1]
IdelTime_Banker[1]=0
#-----------------------------------------------------------
counter_Waiting_list=0
Sum_Bikari=0
Sum_Saf=0
#-----------------------------------------------------------
for(i in 2:n){
 Number_Customer[i]=i
 sum=0
 for(j in 1:i){
     sum = sum + Time_Enter[j]
     }
 TimeEnter_Customer[i] = sum

 if(TimeEnd_Customer[i-1]< TimeEnter_Customer[i]){
     TimeStartService_Customer[i]= TimeEnter_Customer[i]
     WaitLine_Customer[i]=0
     WaitingInSystem_Customer[i]= Time_Service[i]
     IdelTime_Banker[i]= TimeEnter_Customer[i]-TimeEnd_Customer[i-1]
 }
 else{
     TimeStartService_Customer[i]= TimeEnd_Customer[i-1]
     WaitLine_Customer[i]= TimeEnd_Customer[i-1]-TimeEnter_Customer[i]
     WaitingInSystem_Customer[i]= WaitLine_Customer[i]+ Time_Service[i]
```

```
    IdelTime_Banker[i]=0

    }

 TimeEnd_Customer[i]= TimeStartService_Customer [i]+ Time_Service[i]

 counter_Waiting_list= counter_Waiting_list+WaitingInSystem_Customer[i]
 Sum_Bikari= Sum_Bikari+IdelTime_Banker[i]
 Sum_Saf= Sum_Saf+WaitLine_Customer[i]

}


cbind(Time_Enter, TimeEnter_Customer, Time_Service,
 TimeStartService_Customer, WaitLine_Customer,TimeEnd_Customer,
 WaitingInSystem_Customer, IdelTime_Banker)


counter_Waiting_list/(TimeEnd_Customer[n]-Sum_Bikari)
Sum_Saf/(Sum_Bikari-Sum_Saf)
```

خروجی:

```
> counter_Waiting_list/(TimeEnd_Customer[n]-Sum_Bikari)
[1] 1.142857
> Sum_Saf/(Sum_Bikari-Sum_Saf)
[1] 0.4242424
```