

Assignment-3

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Q 1 Simulate 5000 sample of exponential with mean 5. Draw the histogram and the calculate the mean, maximum and minimum

Code for C++

```

1 #include <iostream>
2 #include <cmath>
3 #include <cstdlib>
4 #include <stdio.h>
5
6 using namespace std;
7
8 int main() {
9     unsigned long int m=pow(2,31)-1;
10    int a=16807,x=12131415,k,r,q;
11    float u,num,max=0,min=1234,mean=0    ;
12    for(int i=0;i<5000;i++){
13        q=floor(m/a);
14        k=floor(x/q);
15        r=(int)m%a;
16        x=(a*(x%q)-k*r);
17        if(x<0)
18            x+=m;
19        u=(float)x/m;
20        num=-5*log(1-u);
21        if(num>max)
22            max=num;
23        if(num<min)
24            min=num;
25        mean=(mean*i+num)/(i+1);
26    }
27    cout<<"mean ="<<mean<<" "<<"maximum="<<max<<" minimum="<<min<<endl;
28    return 0;
29 }

```

The output of the code is as follows:

```

1 mean =5.19439 maximum=57.7706 minimum=0.000515309

```

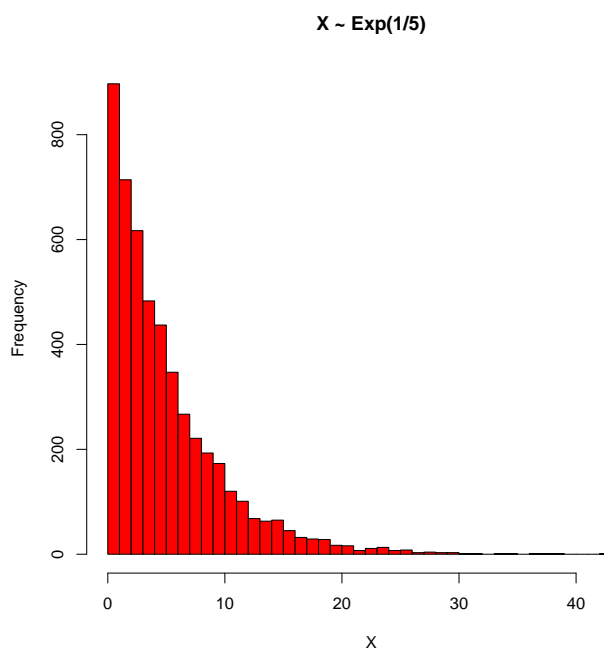
The code in R is shown below:

```
1 x=runif(5000);
2 x<-log(1-x)*(-5);
3 print('Maximum: ');
4 print(max(x));
5 print('Minimum: ');
6 print(min(x));
7 print('Mean calculated: ');
8 print(mean(x));
9 hist(x,main="X ~ Exp(1/5)", xlab="X",ylab="Frequency",xlim=c(0,45),ylim=
  c(0,900),breaks=50,col="red");
```

The output of the R is shown below:

```
1 [1] "Maximum:"
2 [1] 42.48027
3 [1] "Minimum:"
4 [1] 0.001001374
5 [1] "Mean calculated:"
6 [1] 5.060602
```

The histogram is shown below:



(a) $X \sim \text{Exp}(1/5)$

Q 2 Simulate 5000 sample of Gamma with parameter $n = 5$ and $\lambda = 5$. Draw the histogram and the calculate the mean, maximum and minimum.

Code for C++

```

1 #include <iostream>
2 #include <cmath>
3 #include <cstdlib>
4 #include <stdio.h>
5
6 using namespace std;
7
8 int main() {
9     unsigned long int m=pow(2,31)-1;
10    int a=16807,x=12131415,k,r,q;
11    float u,rand,max=0,min=1234,mean=0,arr[5],temp;
12    for(int i=0;i<5;i++){
13        arr[i]=0.0;
14        for(int i=0;i<5005;i++){
15            q=floor(m/a);
16            k=floor(x/q);
17            r=(int)m%a;
18            x=(a*(x%q)-k*r);
19            if(x<0)
20            {
21                x+=m;
22            }
23            u=float(x)/m;
24            arr[i%5]=u;
25            if(i>=5){
26                temp=(arr[0])*(arr[1])*(arr[2])*(arr[3])*(arr[4]);
27                rand=-0.2*log(temp);
28                if(rand>max)max=rand;
29                if(rand<min)min=rand;
30                mean=(mean*i+rand)/(i+1);}
31        }
32    cout<<"mean ="<<mean<<" "<<"maximum="<<max<<" minimum="<<min<<endl;
33    return 0;
34 }
```

The output of the code is as follows:

```

1 mean =0.982975 maximum=3.98698 minimum=0.0928889
```

The code in R is shown below:

```

1 u=runif(5005);
2 v=NULL;
3 gamma=NULL;
4 for(i in 1:5004){
5 v[(i%%5)+1]<-u[i];
6 if(i>=5){
7 temp=(v[1])*(v[2])*(v[3])*(v[5])*(v[4]);
8 gamma[i-4]=log(temp)*(-0.2);
9 }
10 }
11 print('Maximum: ');print(max(gamma));
12 print('Minimum: ');print(min(gamma));
13 print('Mean calculated: ');print(mean(gamma));
14 hist(gamma,main="X ~ Gamma(5,5)", xlab="X",ylab="Frequency",xlim=c
      (0,3.5),ylim=c(0,120),breaks=200,col="blue");

```

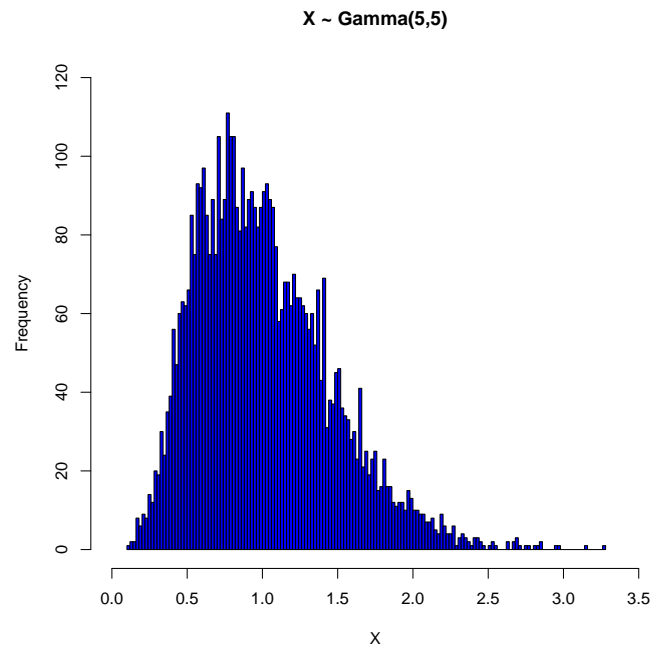
The output of the R is shown below:

```

1 [1] "Maximum:"
2 [1] 3.154996
3 [1] "Minimum:"
4 [1] 0.06546963
5 [1] "Mean calculated:"
6 [1] 0.986534

```

The histogram is shown below:



(b) $X \sim \text{Gamma}(5, 5)$

Q 3 Use the rejection method to generate from

$$f(x) = 20x(1-x)^3, 0 < x < 1$$

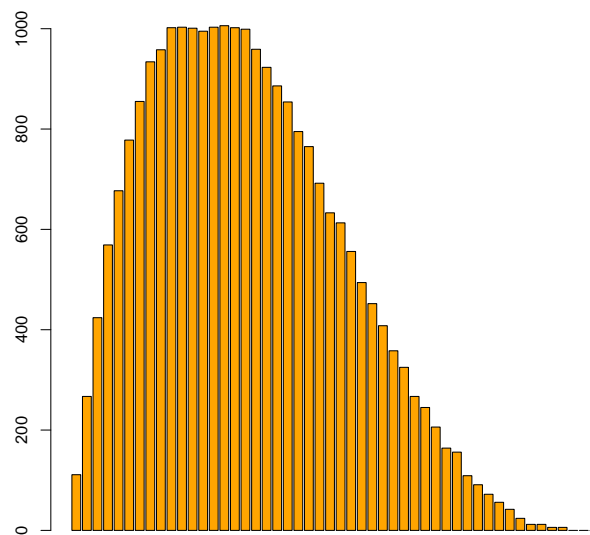
The code in R is shown below:

```

1 f<-function(x)
2 {
3   return (20*x*(1-x)^3);
4 }
5 m<-2^13;
6 a<-189;
7 b<-56;
8 x<-4;
9 y<-2471;
10 cg<-2;
11 freq<-array(0,50);
12 for(i in 1:50000)
13 {
14   x<-(a*x+b)%m;
15   u<-as.double(x)/m;
16   y<-(a*y+b+7)%m;
17   v<-as.double(y)/m;
18   if(cg*u<=f(v))
19     freq[v*50+1]<-freq[v*50+1]+1;
20 }
21 barplot(freq, col = "orange");

```

The histogram formed is as follows:



(c) $f(x) = 20x(1-x)^3, 0 < x < 1$