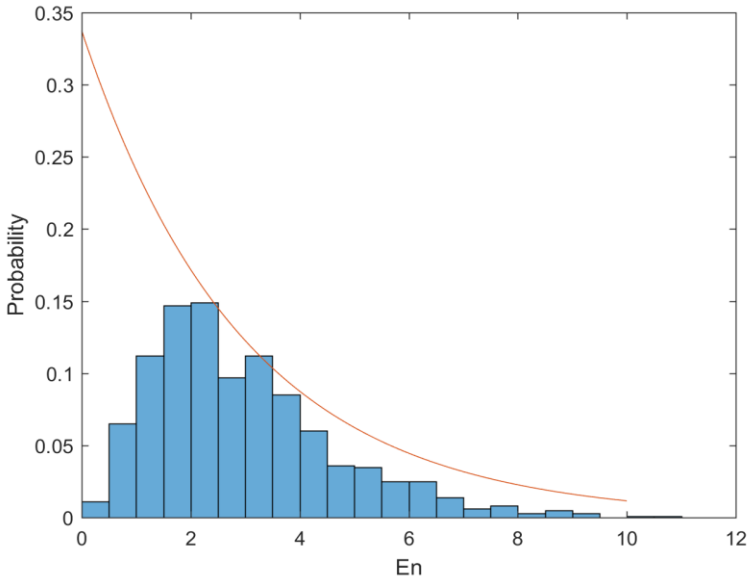
For part d, I used the algorithm as mentioned in the theory.

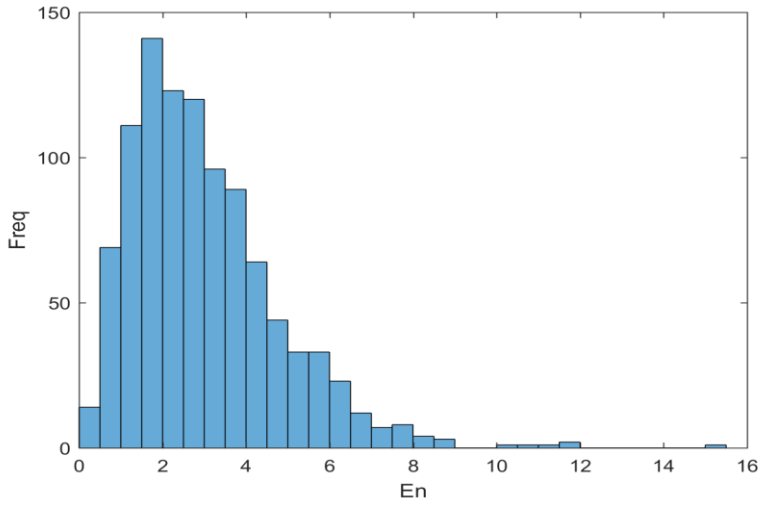
4. Results and Observations

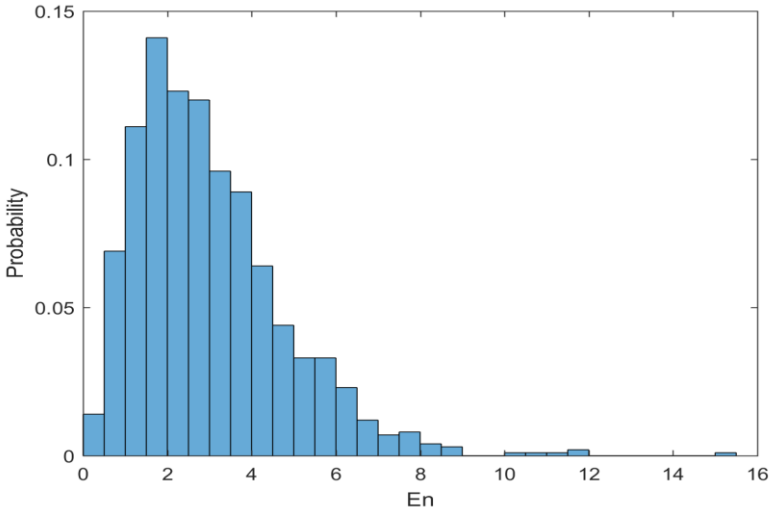
Comparing the empirical distributions in part b,

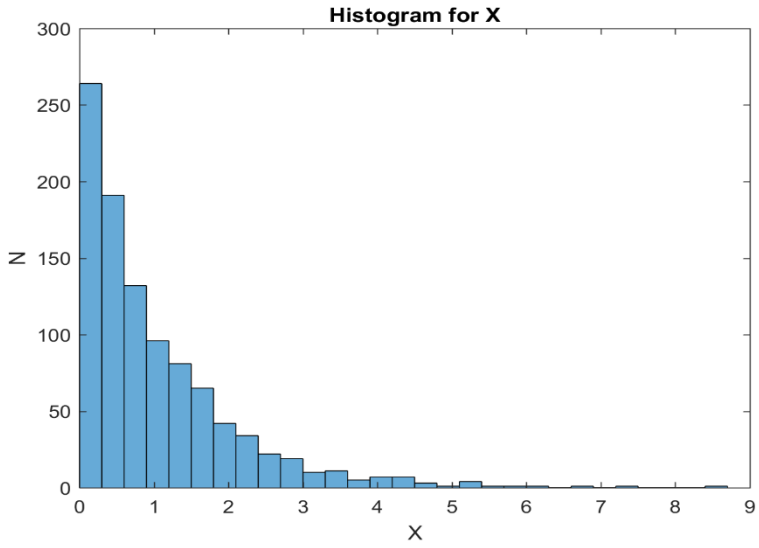


For part c,

n = 3
Expected Value = 2.9985
Variance = 3.1900
Elapsed Time = 0.843689 seconds
While analytically, the mean and variance should have been 3, but after simulation the values are as mentioned above. I expect the values to get closer as n increases. The time is calculated using tic toc function. The histogram shows approximations for the pdf for value n = 3, Erlang-3 distribution.



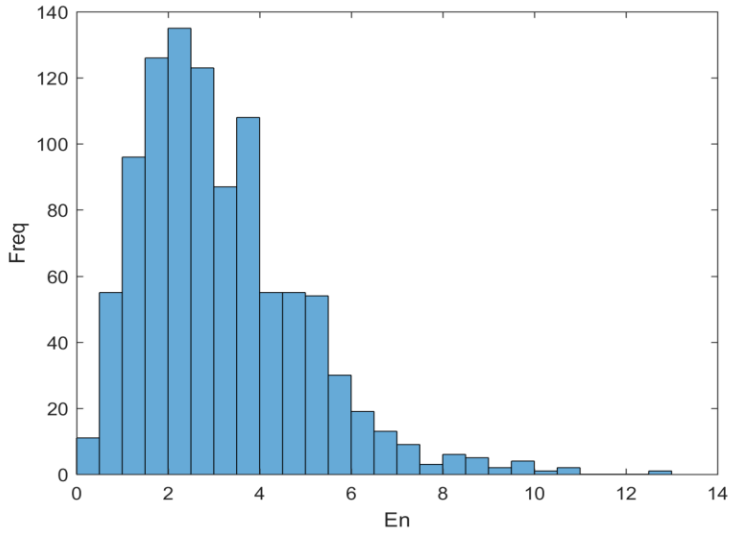


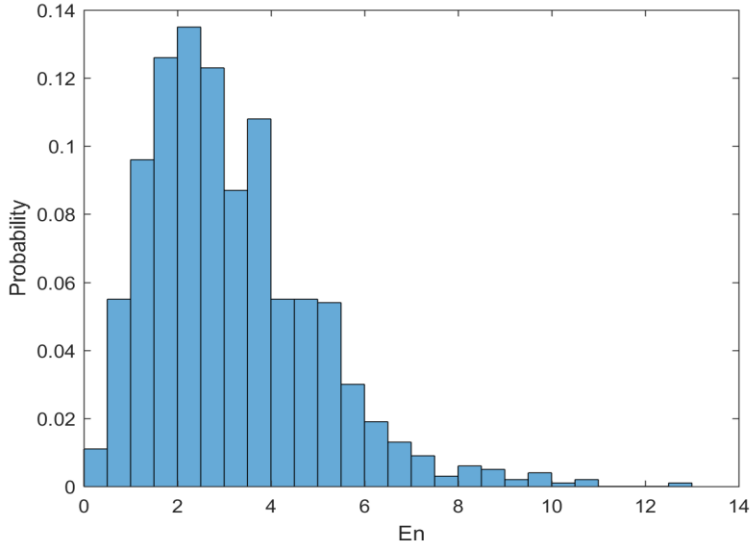


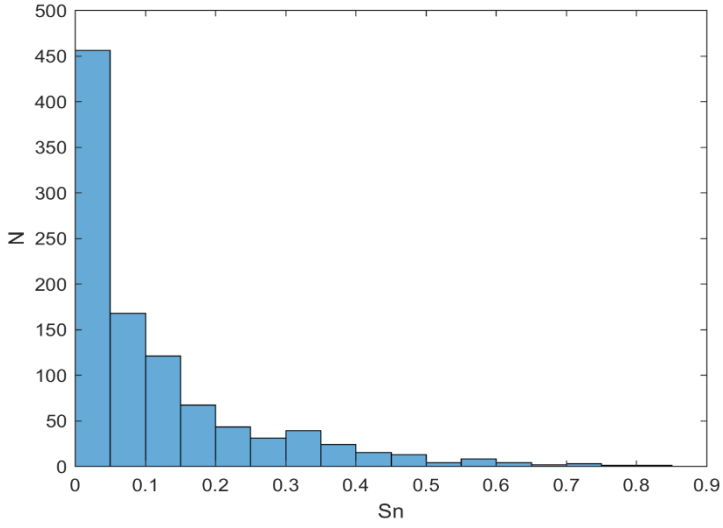
For part d,

n = 3
Expected Value = 3.1508
Variance = 3.1909
Elapsed Time = 0.665127 seconds

While analytically, the mean and variance should have been 3, but after simulation the values are as mentioned above. I expect the values to get closer as n increases. The time is calculated using tic toc function. The histogram shows approximations for the pdf for value n = 3. It represents Erlang-3 distribution. As we can see, the second method is thus computationally more efficient and takes lesser time to generate the samples.


Freq
En
0
20
40
60
80
100
120
140
0
2
4
6
8
10
12
14


Probability
En
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0
2
4
6
8
10
12
14


N
Sn
0
50
100
150
200
250
300
350
400
450
500
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9

For part e,

n = 3
Expected Value = 3.0271
Variance = 3.1387
Elapsed Time = 0.459213 seconds

While analytically, the mean and variance should have been 3, but after simulation the values are as mentioned above. I expect the values to get closer as n increases. The time is calculated using tic toc function. As we can see, the third method is thus computationally most efficient and takes least time to generate the samples.

5. Codes

b)

```
clc;
clear all;

n = 3;
l = 1;
E = zeros(1,1000);

for i = 1:n

    Y = rand(1,1000);
    X = -log(Y);
    E = E + X;

end

M = mean(E);
V = var(E);

figure
histogram(E,'normalization','prob')
xlabel('En');
ylabel('Probability');
hold on
x = 0:0.1:10;
y = exppdf(x,M);
plot(x,y);
```

c)

```
clc;
clear all;

tic
n = 3;
l = 1;
```

```
E = zeros(1,1000);
S = zeros(1,1000);

for i = 1:n

    Y = rand(1,1000);
    X = -log(Y);
    E = E + X;
    pdf = (l*E).^(n-1).*exp(-E*l)*l/(factorial(n-1));
end

S = S + (E/i);

figure
histogram(E)
xlabel('En');
ylabel('Freq');
figure
histogram(E,'normalization','prob')
xlabel('En');
ylabel('Probability');
figure
histogram(X)
title('Histogram for X');
xlabel('X');
ylabel('N');

M = mean(E);
V = var(E);

toc
```

d)

```
clc;
clear all;

tic
n = 3;
l = 1;
S = ones(1,1000);

for i = 1:n
    Y = rand(1,1000);
    S = S.*Y;
end

E = -log(S);

figure
histogram(E)
xlabel('En');
ylabel('Freq');
figure
histogram(E,'normalization','prob')
xlabel('En');
```

```
ylabel('Probability');
figure
histogram(S)
xlabel('Sn');
ylabel('N');

M = mean(E);
V = var(E);
toc
```

e)

```
clc;
clear all;

tic
c = 0.27067;
E = zeros(1,1000);
count = 1;

while count<1001

    U = rand;
    Y = rand;
    H = Y.^2.*exp(-Y)/(c*2);

    if (U <= H)
        E(count) = Y;
        count = count+1;
    end
end

figure
histogram(E)
xlabel('En');
ylabel('Freq');

M = mean(E);
V = var(E);

toc
```