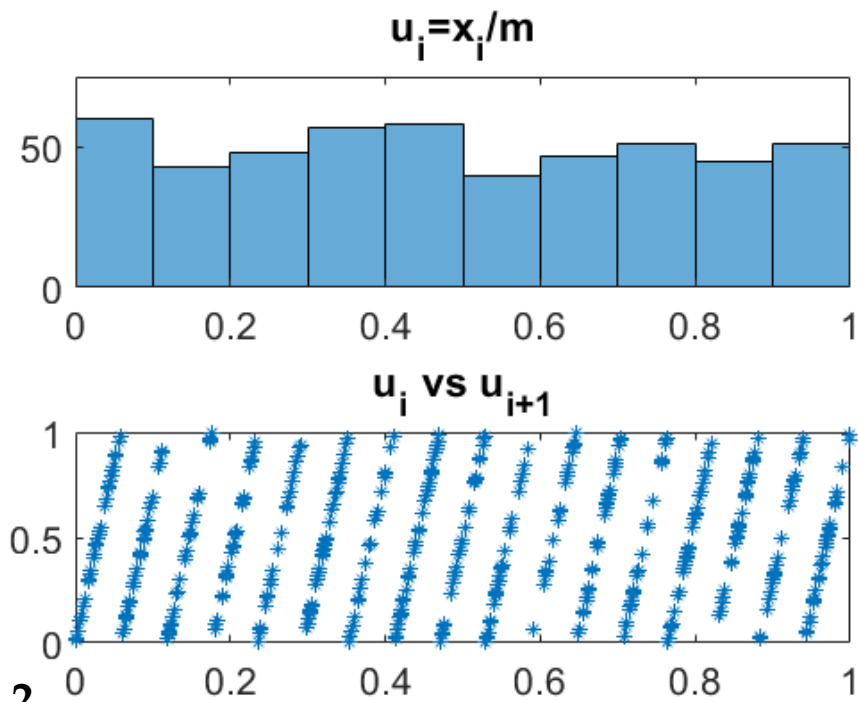
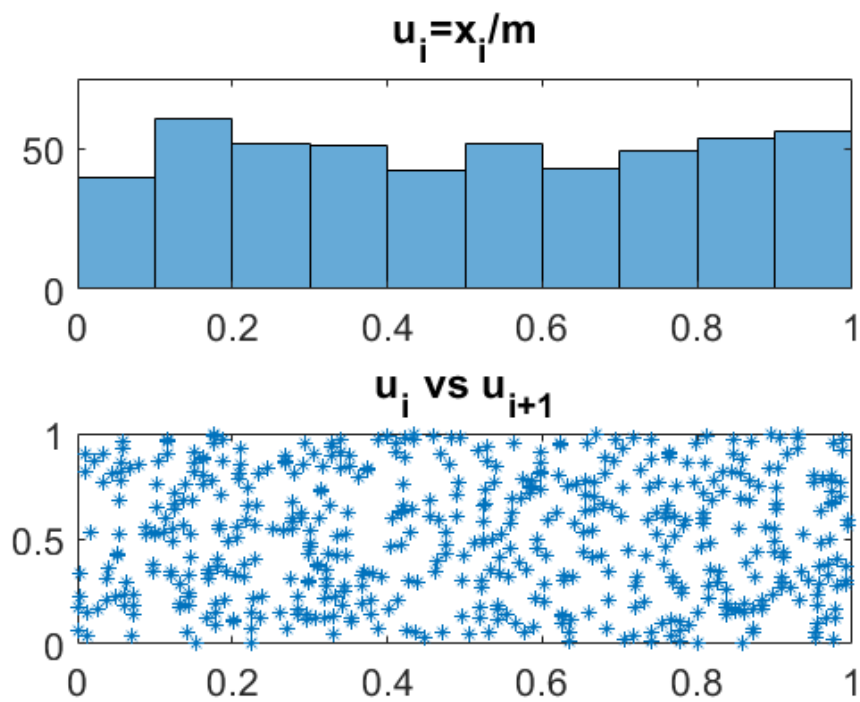


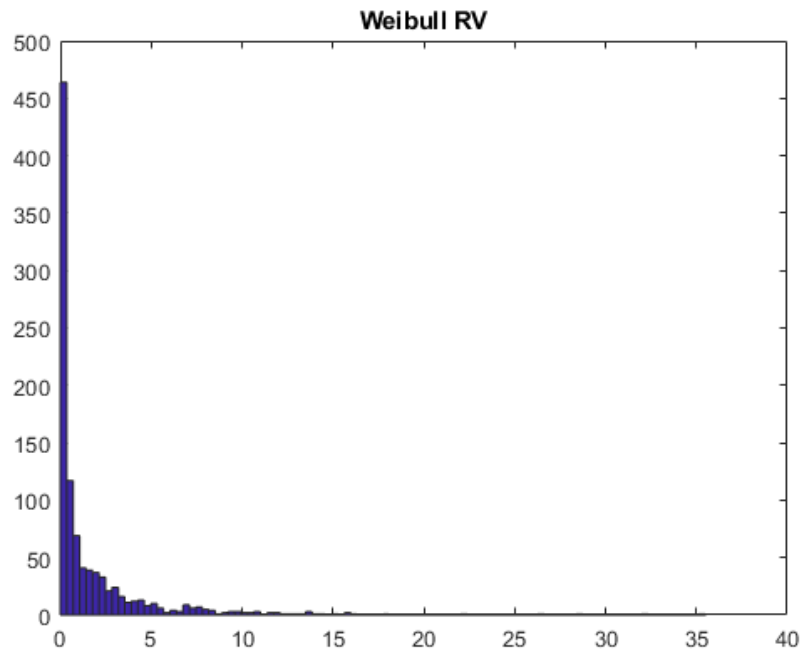
## Problem 1



## Problem 2

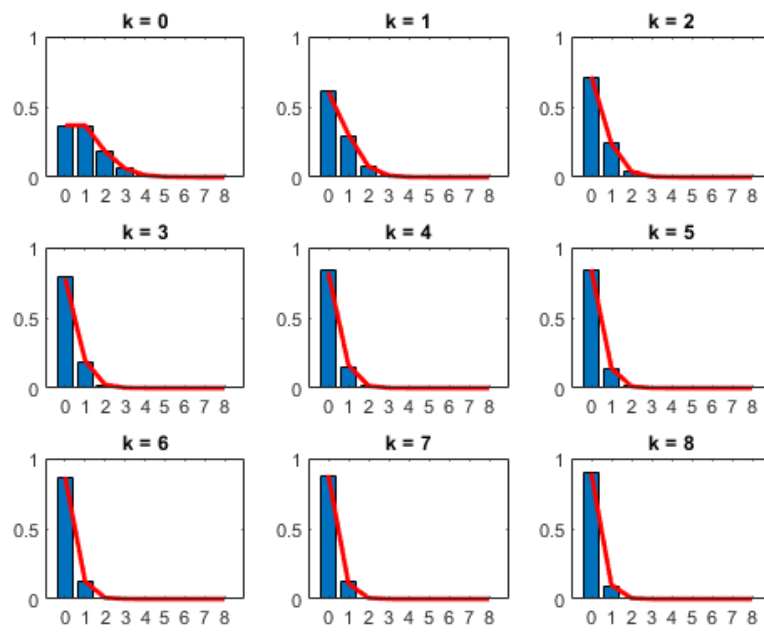


### Problem 3



### Problem 4

$Y_K$  vs  $\text{Pois}(\lambda = \frac{1}{k+1})$



## MATLAB Code for Problems 1, 2, 3:

```
1 clc
2 clear
3 %Diary
4 dfile = 'MATLAB_Output_OM.txt';
5 if exist(dfile, 'file') ; delete(dfile); end
6 diary(dfile)
7 diary on
8
9 %Introduction
10 fprintf('
    _____\n'
    );
11 fprintf('\t Oscar Martinez \t HW 8 \t STA 5106\n');
12 fprintf('
    _____\n'
    );
13
14 %-----Problem 1:-----
15 fprintf('-----Problem 1-----\n');
16
17 m = 2^(13)-1;
18 a = 17;
19 x(1) = 100;
20
21 for k = 2:500
22     x(k) = mod(a*x(k-1),m);
23 end
24 u1=x/m;
25 u2=u1(2:end);
26
27 figure(1);
28 subplot(211);
29 histogram(u1)
30 grid off;
31 set(gca, 'fontsize', 16);
32 title('u_i=x_i/m')
33 axis([0 1 0 75]);
34
35 subplot(212);
36 plot(u1(1:end-1),u2,'*')
37 set(gca, 'fontsize', 16);
38 title('u_i vs u_{i+1}')
```

```
39
40 %-----Problem 2:-----
41 fprintf('-----Problem 2-----\n');
42 clear
43
44 m = 2^(13)-1;
45 a = 85;
46 x(1) = 100;
47
48 for k = 2:500
49     x(k) = mod(a*x(k-1),m);
50 end
51 u1=x/m;
52 u2=u1(2:end);
53
54 figure(2);
55 subplot(211);
56 histogram(u1)
57 grid off;
58 set(gca, 'fontsize', 16);
59 title('u_i=x_i/m')
60 axis([0 1 0 75]);
61
62 subplot(212);
63 plot(u1(1:end-1),u2,'*')
64 set(gca, 'fontsize', 16);
65 title('u_i vs u_{i+1}')
66
67 %-----Problem 3:-----
68 fprintf('-----Problem 3-----\n');
69 clear
70
71 m=2^31 - 1; %Common Mod
72 a=7; %Prime root
73 x(1) = 100;
74
75 for k = 2:1000 %gen rand from U(0,1)
76     x(k) = mod(a*x(k-1),m);
77 end
78 u1=x/m;
79
80 F_inv = @(y,a,b) ( (-log(1-y)/a).^(1/b) ); %Inverse Weibull CDF
81 X=F_inv(u1,1,0.5); %Weibull vars
82 figure(3);
83 hist(X,100);
```

```
84 title('Weibull RV');
85
86 %——Problem 4:——
87 fprintf('——Problem 4——\n');
88 clear
89
90 rng('default')
91 %Part c
92 m = 3000;
93 for j = 1:m;
94     %Part a
95     n=200;
96     rng(j); %Set Seed
97     y=rand(1,n);
98     Exp_inv = @(y) (-log(1-y));
99     X = Exp_inv(y);
100    Z(1)=1;
101    for i = 2:n
102        Z(i)=(X(i) >= max(X(1:i-1)));
103    end
104
105    %Part b
106    Z_NZ = find(Z); %non-zero elts of Z
107    Z_Dist = diff(Z_NZ)-1; %Distance b/w non/zero elts of Z
108    for K=0:8 %Tally up Distances
109        Y(j,K+1) = sum(Z_Dist == K); %count of 'k' = Y(k+1)
110    end
111 end
112
113 for k = 1:K+1
114     re(k,:) = hist(Y(:,k),0:8);
115     re(k,:) = re(k,+)/m;
116     rp(k,:) = poisspdf(0:8, 1/k);
117     figure(4);
118     subplot(3,3,k);
119     bar (0:8, re(k,:));
120     hold on;
121     plot(0:8, rp(k,:), 'r-', 'linewidth', 2);
122     title(['k = ', num2str(k-1)]);
123     axis([-1 9 0 1]);
124 end
125
126 diary off
```

## Problem 5

```
In [3]: ## congruential generator exp
from numpy import *
from matplotlib import pyplot

m = 2**13-1
a = 17

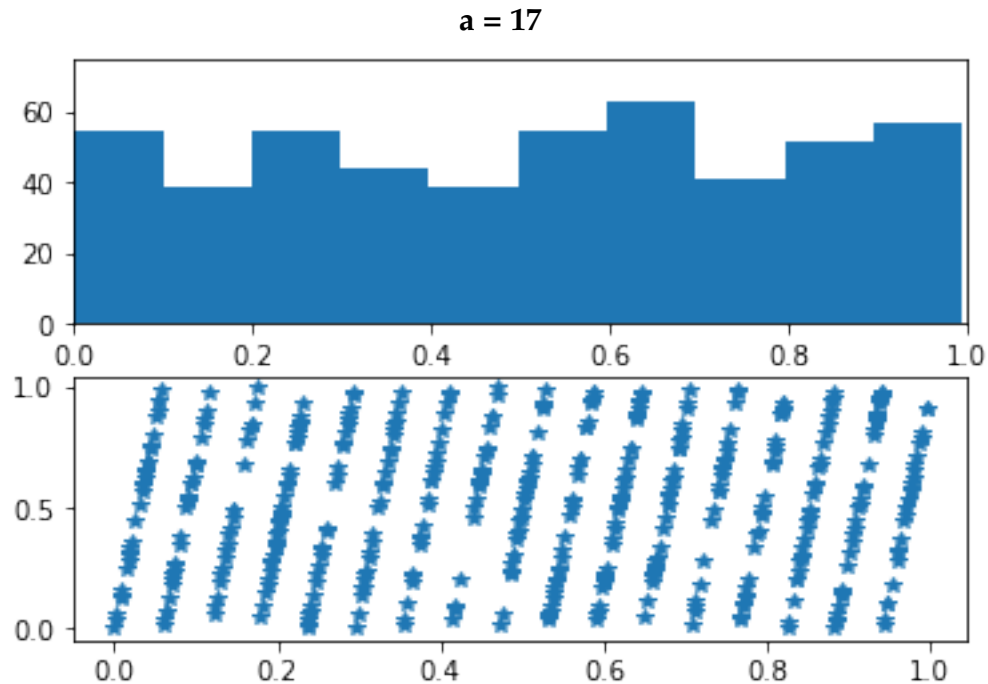
N = 500
x = zeros(N)
x[0] = 1

for k in range(1,N):
    x[k] = mod(a*x[k-1],m)

u1 = x/m
u2 = u1[1:N]

# plot the estimate
pyplot.subplot(211)
pyplot.hist(u1,10)
pyplot.xlim(0, 1)
pyplot.ylim(0, 75)
pyplot.subplot(212)
pyplot.plot(u1[0:N-1], u2, 'r*')

pyplot.show()
```



## Problem 6

```
In [2]: ## congruential generator exp
from numpy import *
from matplotlib import pyplot
```

```
m = 2**13-1
a = 85
```

```
N = 500
x = zeros(N)
x[0] = 1
```

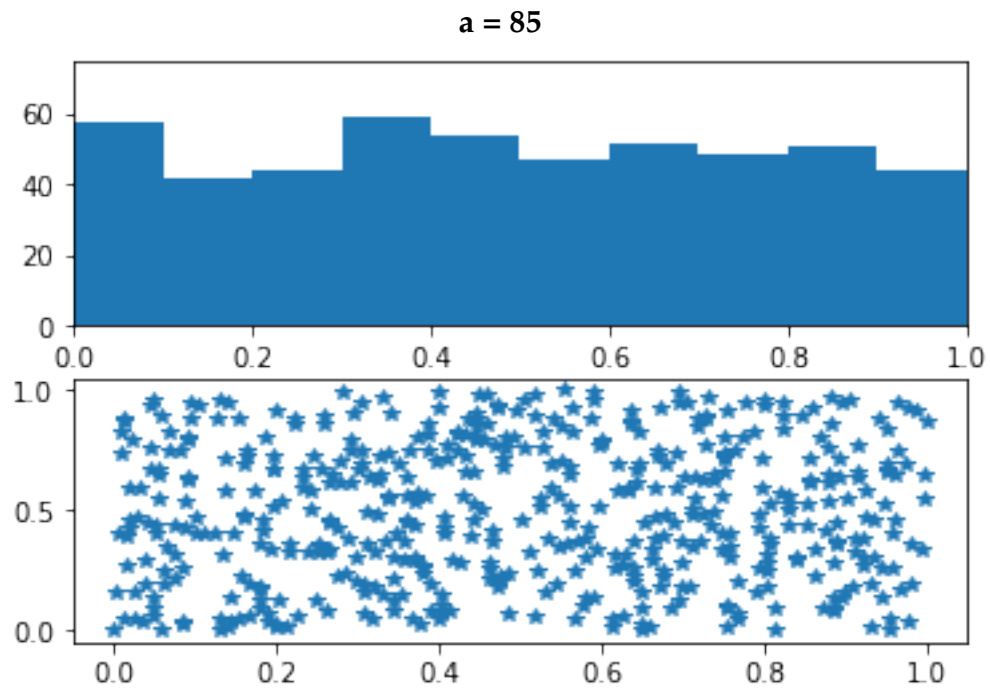
```
for k in range(1,N):
    x[k] = mod(a*x[k-1],m)
```

```
u1 = x/m
u2 = u1[1:N]
```

```
# plot the estimate
pyplot.subplot(211)
pyplot.hist(u1,10)
pyplot.xlim(0, 1)
```

```
pyplot.ylim(0, 75)
pyplot.subplot(212)
pyplot.plot(u1[0:N-1], u2, 'r*')

pyplot.show()
```



## Problem 7

```
In [19]: from numpy import *
from matplotlib import pyplot

del x
m = 2**13-1
a = 85

N = 1000
x = zeros(N)
x[0] = 1

for k in range(1,N):
    x[k] = mod(a*x[k-1],m)

y = x/m
```



```
def weib_inv(y,a,b):  
    return (-log(1 - y) / a)**(1 / b)
```

```
X = weib_inv(y, 1, 0.5)  
pyplot.hist(X,100)  
pyplot.xlim(0, 75)  
pyplot.ylim(0, 550)
```

```
Out[19]: (0, 550)
```

