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Su24 ECE 131A Project

1a.

A five-sided dice will have a probability of 1/5 for each side.

Toss	Probability
10	0.80
50	0.68
100	0.55
500	0.61
1000	0.60

1b.

3 of the 5 numbers are odd. Adding the probability of the odd numbers results in the probability of obtaining an odd number.

$S = \{1,3,5\}$

$P = \frac{1}{5} + \frac{1}{5} + \frac{1}{5} = \frac{3}{5} = 0.6$

1c.

As the number of tosses increases, the estimated results approach the mathematical analysis. This demonstrates the Law of Large numbers.

1d.

$P = [\frac{2}{7}, \frac{2}{7}, \frac{1}{7}, \frac{1}{7}, \frac{1}{7}]$

Toss	Probability
10	0.20
50	0.48
100	0.60
500	0.5580
1000	0.5460

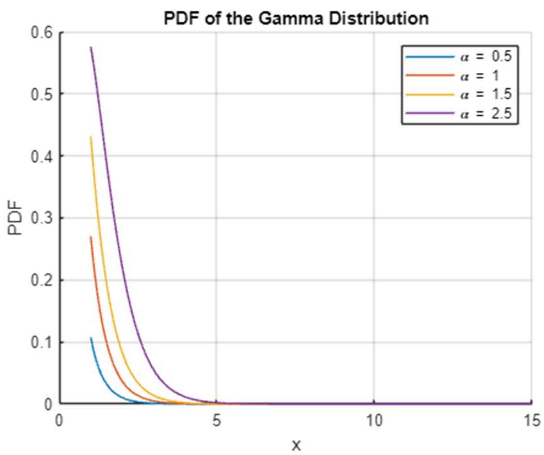
$S = \{1,3,5\}$

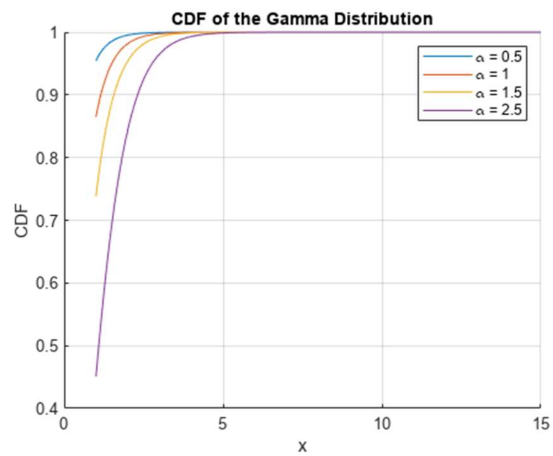
$P = \frac{2}{7} + \frac{1}{7} + \frac{1}{7} = \frac{4}{7} = 0.5714$

As the number of tosses increases, the estimated results approach the mathematical analysis.

2a.

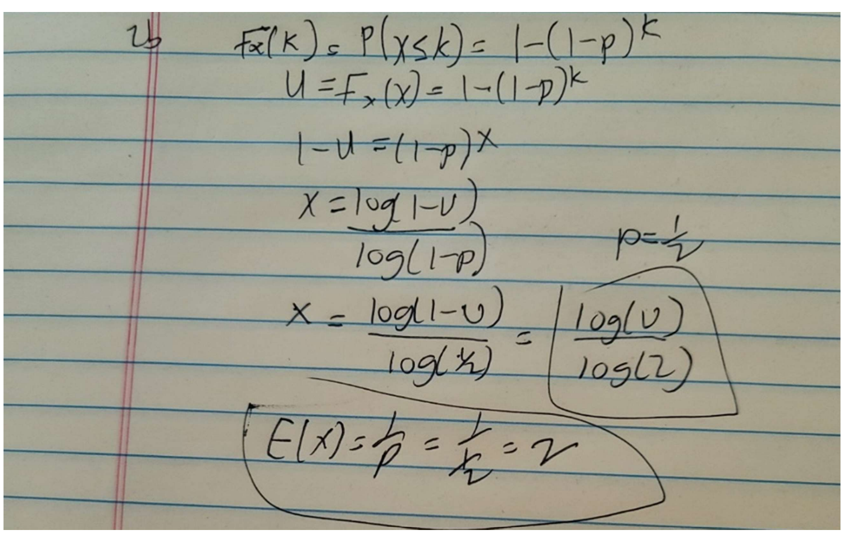
The gamma distribution is dependent on α, shape parameter, and λ, rate parameter.





2b.

By setting the CDF of the geometric distribution equal to a variable and solving for x, we obtain the transformation. Plugging the provided parameter, ½ , we obtain the average number of comparisons, or the expected value/mean.



2b

$F_X(k) = P(X \le k) = 1-(1-p)^k$

$U = F_X(x) = 1-(1-p)^k$

$1-U = (1-p)^x$

$x = \frac{\log(1-U)}{\log(1-p)}$

$p = \frac{1}{2}$

$x = \frac{\log(1-U)}{\log(\frac{1}{2})} = \frac{\log(U)}{\log(2)}$

$E(X) = \frac{1}{p} = \frac{1}{\frac{1}{2}} = 2$

2c

Setting k=0, the poisson random variable will become exponentially distributed.

$p(N=k) = \frac{\alpha^k}{k!} e^{-\alpha}$

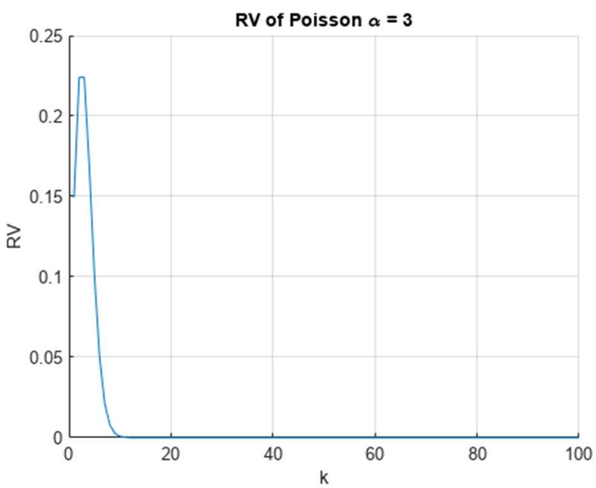
$p(N=0) = \frac{\alpha^0}{0!} e^{-\lambda t} = e^{-\lambda t}$ $\quad f(x) = \lambda e^{-\lambda t}$

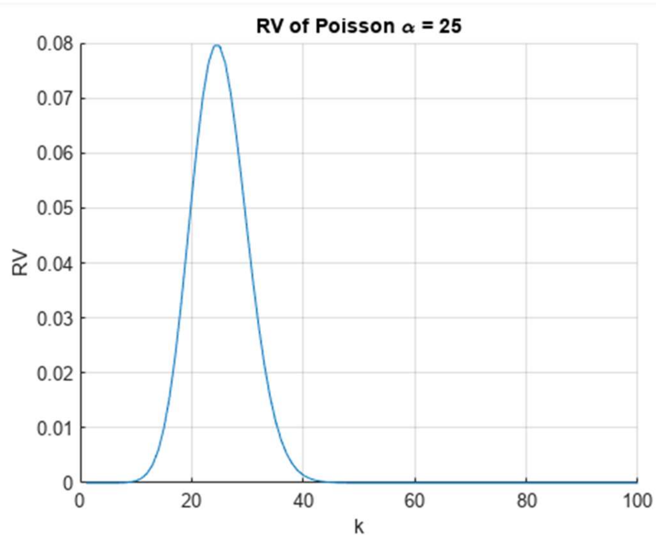
if λ is exponential ~~[illegible]~~

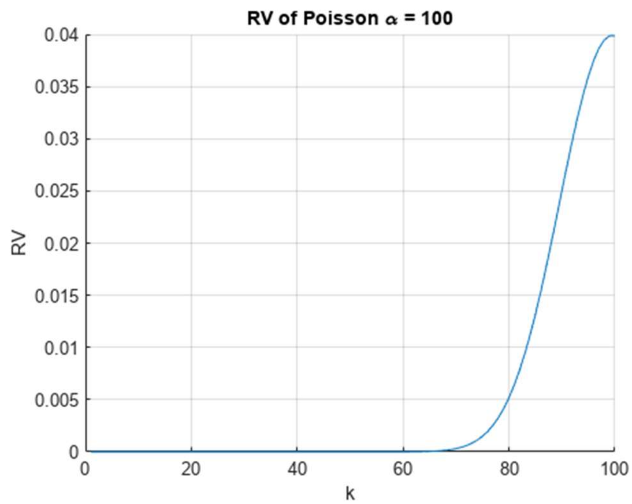
where $\lambda t = \alpha$

then poisson becomes exponential

Different α parameters will offset the mean further down.

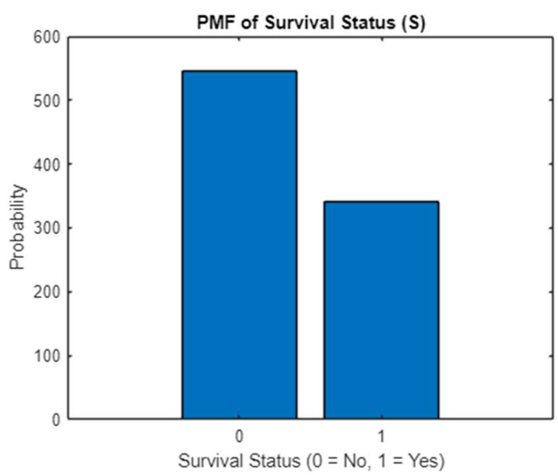


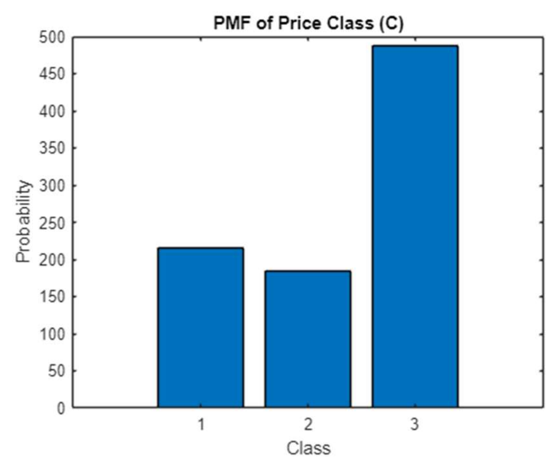


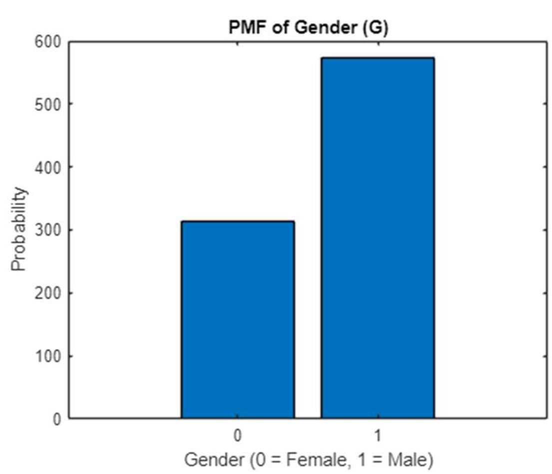


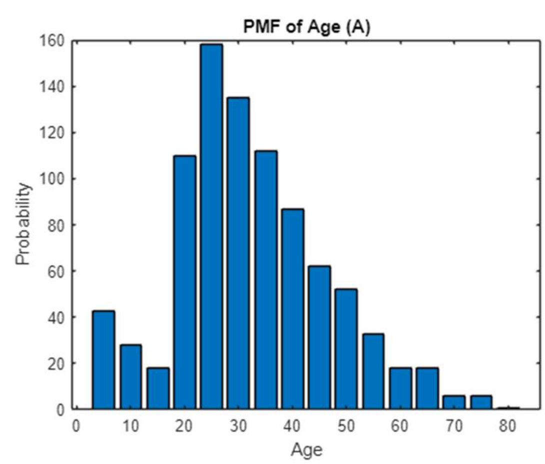
3a.

Each data set was plotted out. The age was parsed into bins of 5 years.









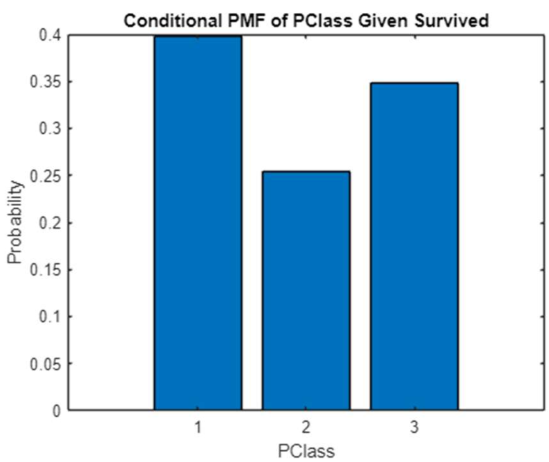
3b.

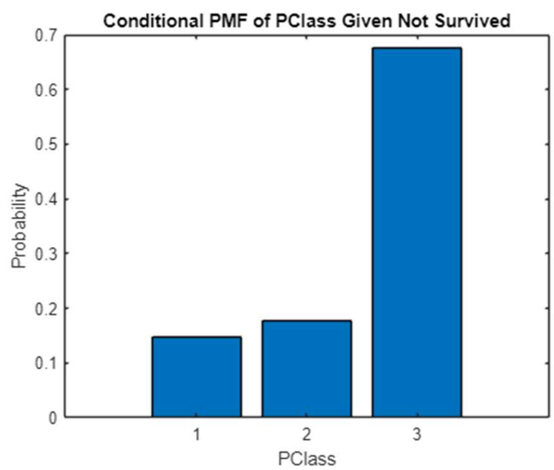
This is a list of all the probabilites for each condition given survived and not survived.

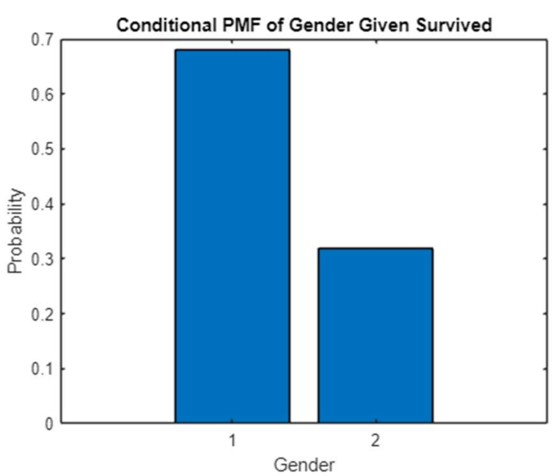
Condition (Survived)	Probability
P(S=1)	0.3856
P(C=1 | S=1)	0.3977
P(C=2 | S=1)	0.2544
P(C=3 | S=1)	0.3480
P(G=0 | S=1)	0.6813
P(G=1 | S=1)	0.3187
P(0≤A<5 | S=1)	0.0965
P(5≤A<10 | S=1)	0.0234
P(10≤A<15 | S=1)	0.0322
P(15≤A<20 | S=1)	0.1199
P(20≤A<25 | S=1)	0.1550
P(25≤A≤<30 | S=1)	0.1491
P(30≤A≤<35 | S=1)	0.1404
P(35≤A≤<40 | S=1)	0.0936
P(40≤A≤<45 | S=1)	0.0614
P(45≤A≤<50 | S=1)	0.0643
P(50≤A≤<55 | S=1)	0.0292
P(55≤A≤<60 | S=1)	0.0205
P(60≤A≤<65 | S=1)	0.0117
P(65≤A≤<70 | S=1)	0
P(70≤A≤<75 | S=1)	0
P(75≤A≤<80 | S=1)	0.0029

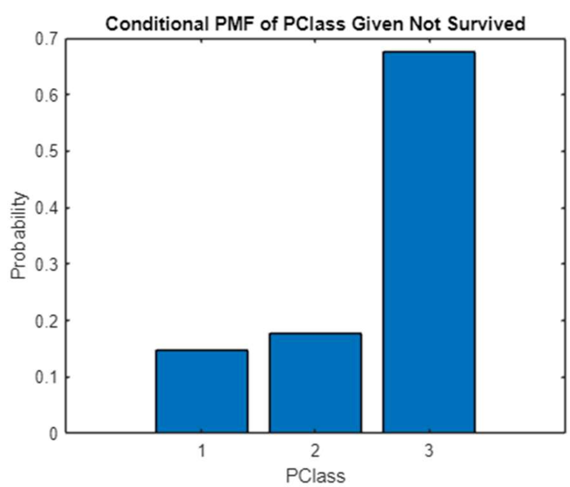
Condition (Not Survived	Probability
P(S=0)	0.6144
P(C=1 | S=0)	0.1468
P(C=2 | S=0)	0.1780
P(C=3 | S=0)	0.6752
P(G=0 | S=0)	0.1486
P(G=1 | S=0)	0.8514
P(0≤A<5 | S=0)	0.0294
P(5≤A<10 | S=0)	0.0294
P(10≤A<15 | S=0)	0.0183
P(15≤A<20 | S=0)	0.1596
P(20≤A<25 | S=0)	0.1945
P(25≤A≤<30 | S=0)	0.1706
P(30≤A≤<35 | S=0)	0.0954

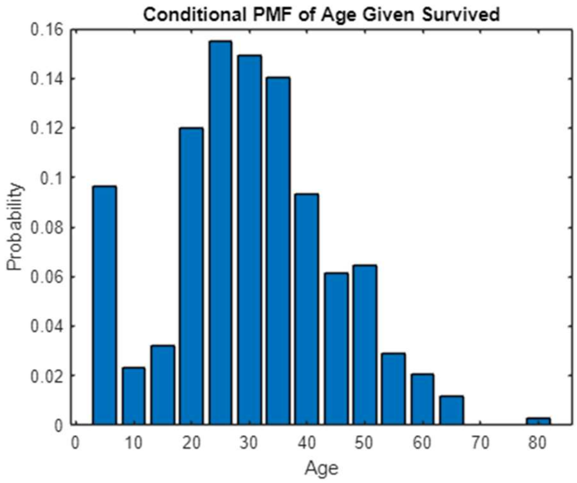
P(35≤A≤<40 | S=0)	0.0954
P(40≤A≤<45 | S=0)	0.0679
P(45≤A≤<50 | S=0)	0.0477
P(50≤A≤<55 | S=0)	0.0294
P(55≤A≤<60 | S=0)	0.0239
P(60≤A≤<65 | S=0)	0.0220
P(65≤A≤<70 | S=0)	0.0092
P(70≤A≤<75 | S=0)	0.0073
P(75≤A≤<80 | S=0)	0



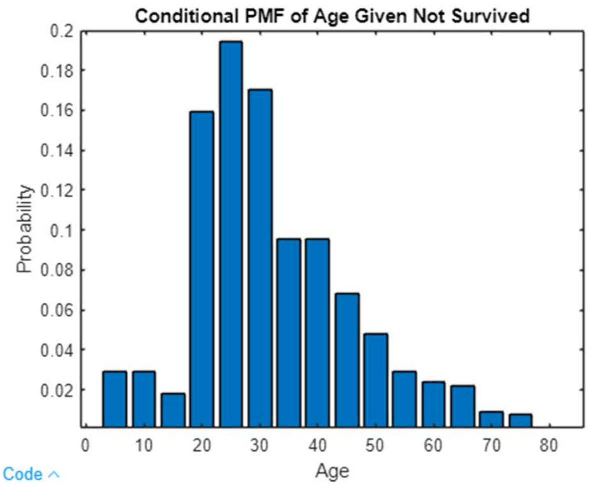







Conditional PMF of Age Given Survived
Probability
Age
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
10
20
30
40
50
60
70
80

Code ^


Conditional PMF of Age Given Not Survived
Probability
Age
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
10
20
30
40
50
60
70
80

3c.

Using this given assumption, the probability of the union of the conditions, class, gender and age, given survived or not survived are just the individual conditions multiplied by each of the conditions given survived or not survived separately. This would assume that the conditions are all independent.

$$P(C, G, A|S = 0) = (C|S = 0)P(G|S = 0)P(A|S = 0)$$

and

$$P(C, G, A|S = 1) = (C|S = 1)P(G|S = 1)P(A|S = 1)$$

$$P(S = 1, C = 1, G = 0, A \leq 40) = P(C = 1 \mid S = 0) * P(G = 0 \mid S = 0) * P(A \leq 40 \mid S = 0)$$
$$= 0.2194$$

$$P(S = 0, C = 1, G = 0, A \leq 40) = P(C = 1 \mid S = 0) * P(G = 0 \mid S = 0) * P(A \leq 40 \mid S = 0)$$
$$= 0.0173$$

3d.

Using the results from 3c and bayes rule, we can predict whether a female whose age is under 40 and who is in first class will survive or not.

$$P(C = 1, G = 0, A \leq 40 \mid \mathrm{S} = 0) = \frac{P(C = 1 \mid S = 0) * P(G = 0 \mid S = 0) * P(A \leq 40 \mid S = 0)}{P(S = 0)}$$
$$= 0.0281$$

$$P(C = 1, G = 0, A \leq 40 \mid \mathrm{S} = 1) = \frac{P(C = 1 \mid S = 1) * P(G = 0 \mid S = 1) * P(A \leq 40 \mid S = 1)}{P(S = 1)}$$
$$= 0.5691$$

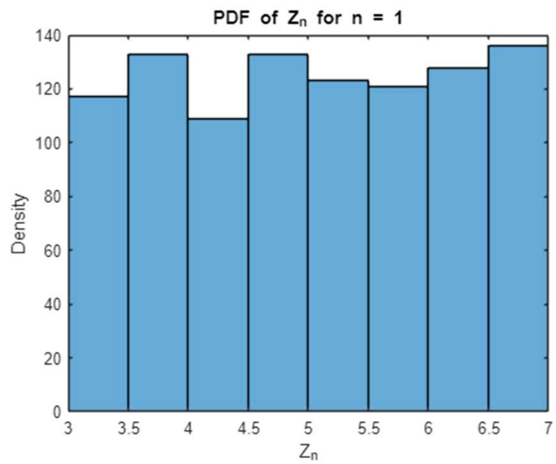
4a.

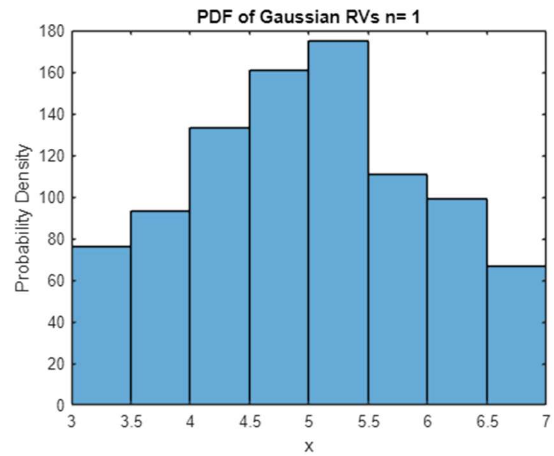
With a uniform continuous random variable taking values in the interval (3,7), the mean and variance are calculated below.

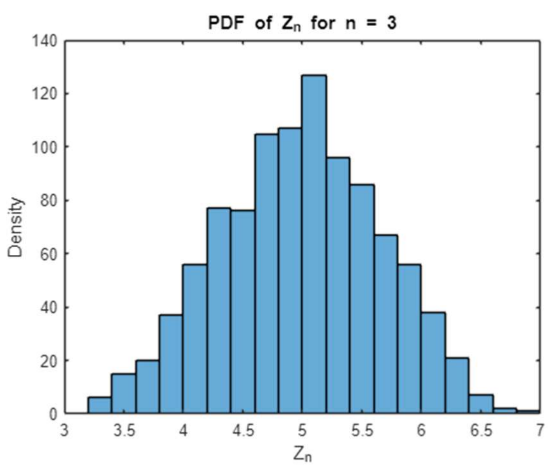
$$\mu = 5$$

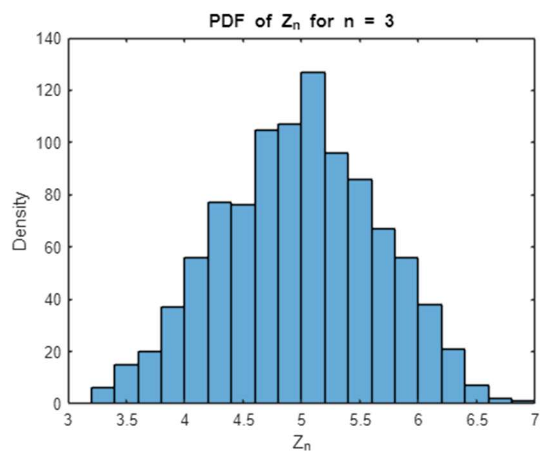
$$\sigma^2 = \frac{4}{3}$$

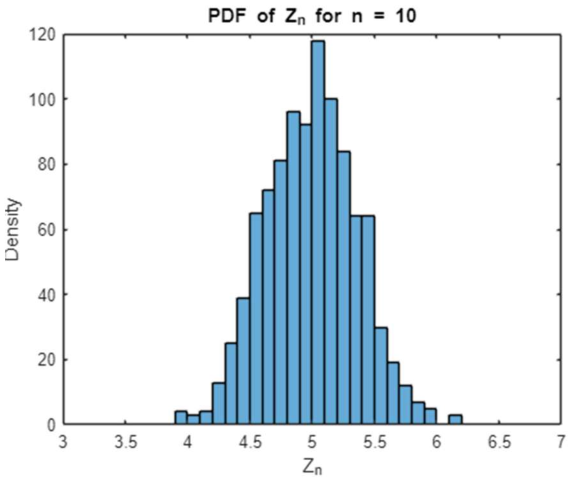
As more samples are used to calculate Zn, the distribution of Zn becomes more gaussian.

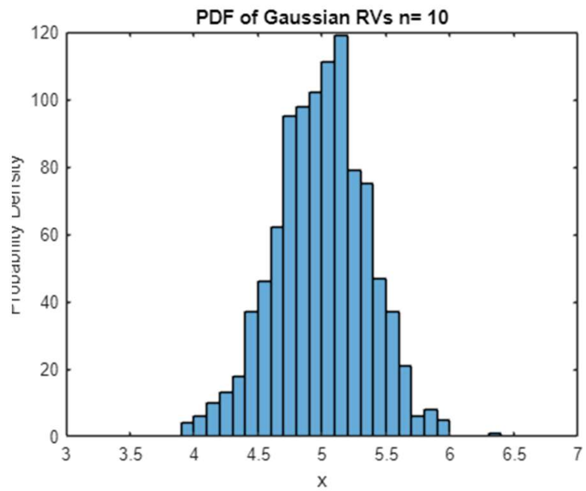


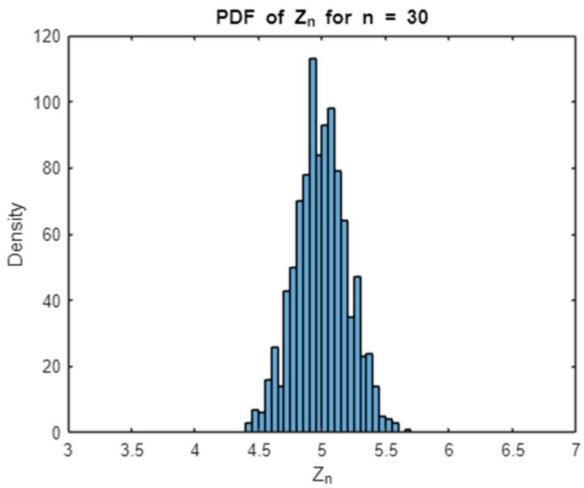


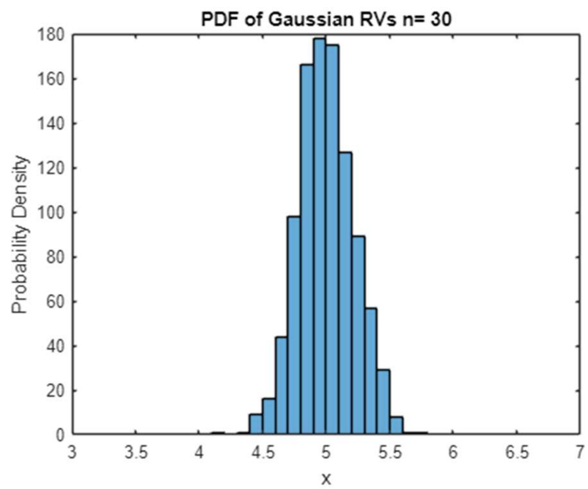


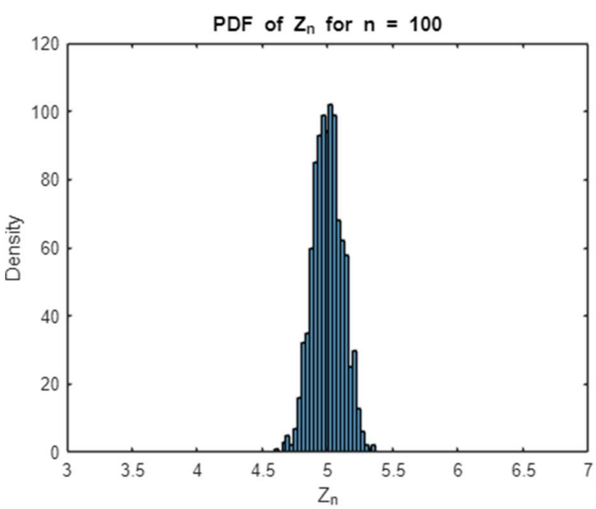


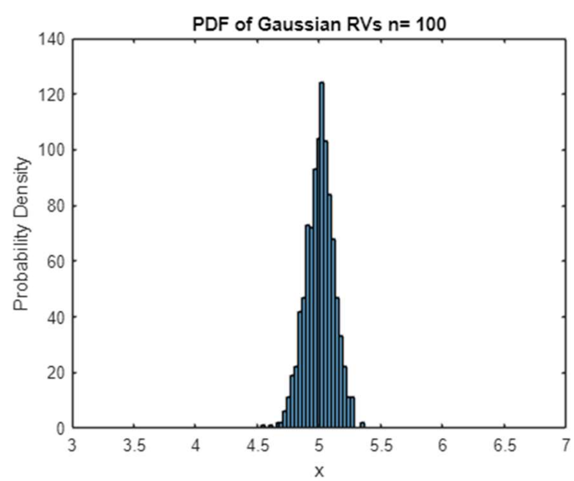

PDF of Z$_n$ for n = 10
Density
Z$_n$
0 20 40 60 80 100 120
3 3.5 4 4.5 5 5.5 6 6.5 7


PDF of Gaussian RVs n= 10
x
0 20 40 60 80 100 120
3 3.5 4 4.5 5 5.5 6 6.5 7


PDF of Z$_n$ for n = 30
Density
Z$_n$
0 20 40 60 80 100 120
3 3.5 4 4.5 5 5.5 6 6.5 7


PDF of Gaussian RVs n= 30
Probability Density
x
0 20 40 60 80 100 120 140 160 180
3 3.5 4 4.5 5 5.5 6 6.5 7


PDF of Z$_n$ for n = 100
Density
Z$_n$
0 20 40 60 80 100 120
3 3.5 4 4.5 5 5.5 6 6.5 7


PDF of Gaussian RVs n= 100
Probability Density
x
0 20 40 60 80 100 120 140
3 3.5 4 4.5 5 5.5 6 6.5 7

4b.

$$Z_n = \frac{1}{n}\sum_{i=1}^{n} x_i$$

$$a = 3 \qquad b = 7$$

$$S_n = \sum_{i=1}^{n} x_i$$

$$E[x_i] = \mu = \frac{a+b}{2} = 5 \qquad \sigma^2 = VAR(x_i) = \frac{(b-a)^2}{12} = \frac{16}{12} = \frac{4}{3}$$

$$E[S_n] = n\mu \qquad \cancel{E[Z_n] = \frac{1}{\sigma\sqrt{n}} E[S_n - n\mu]}$$

$$E[S_n] = n\mu \qquad VAR(S_n) = n\sigma^2$$

$$E[Z_n] = E\left[\frac{1}{n} S_n\right] = \frac{1}{n} n\mu = \mu$$

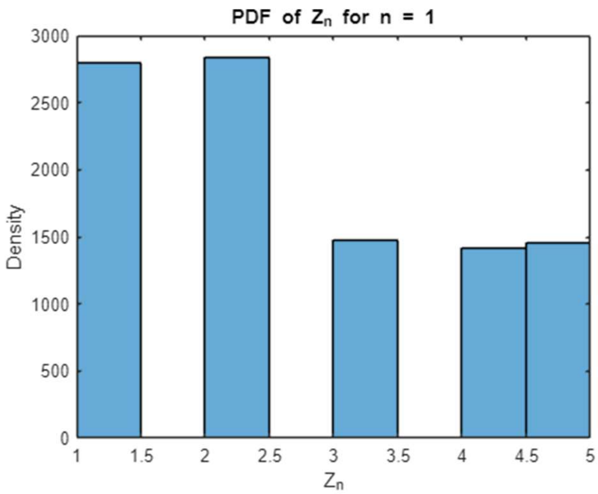
~~EE~~

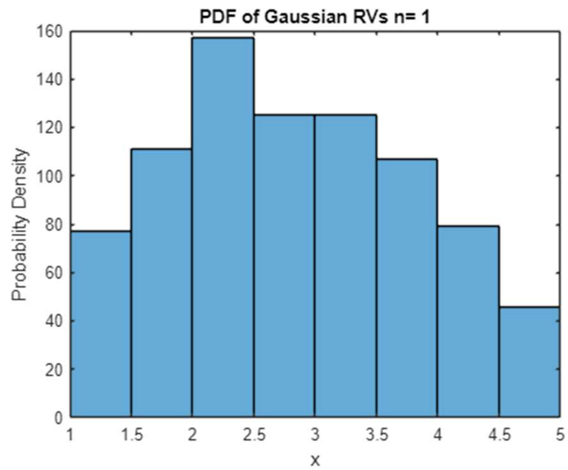
$$VAR\left[\frac{1}{n} S_n\right] = \frac{1}{n^2} VAR[S_n] = \frac{1}{n^2} n\sigma^2 = \frac{\sigma^2}{n} \qquad \frac{4/3}{n}$$

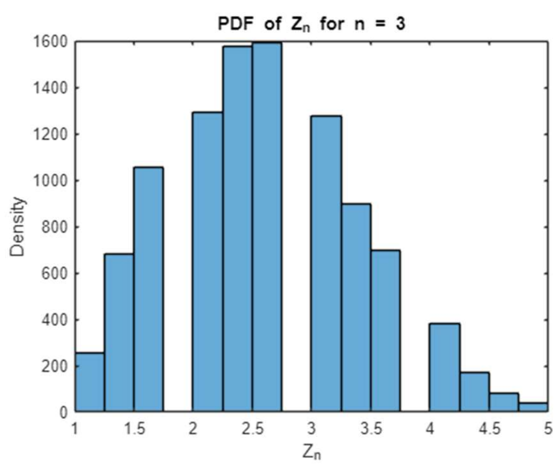
4d.

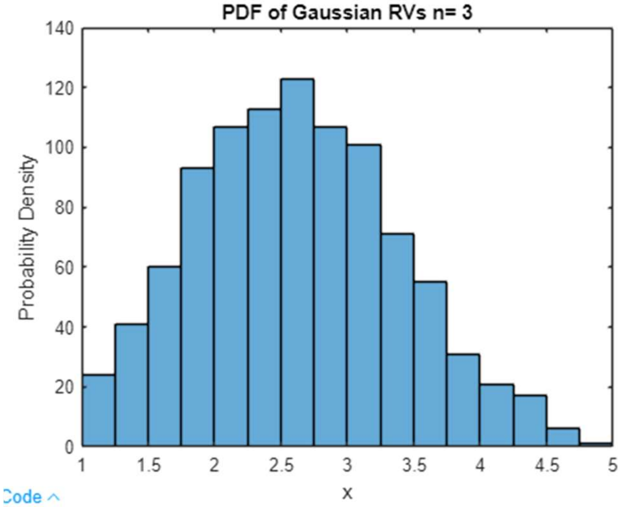
$$\mu = 2.57$$

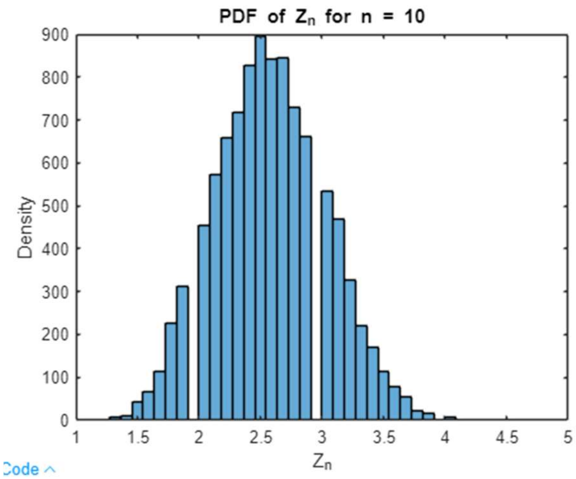
$$\sigma^2 = 1.96$$

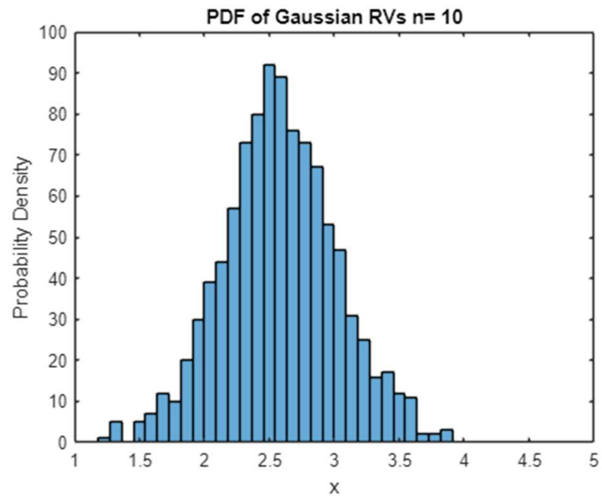




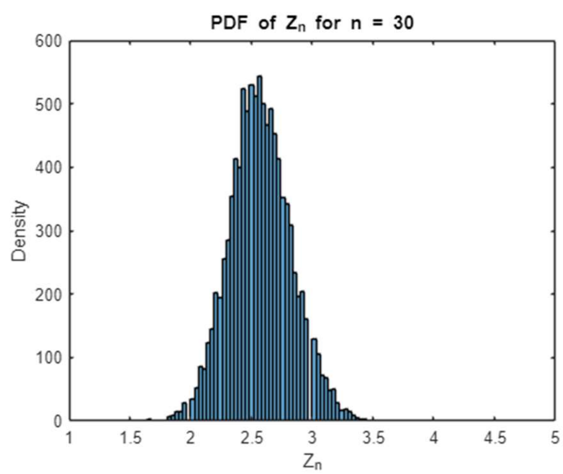


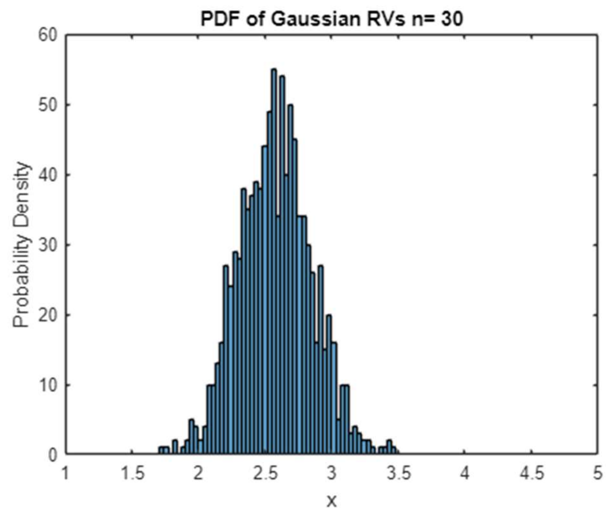


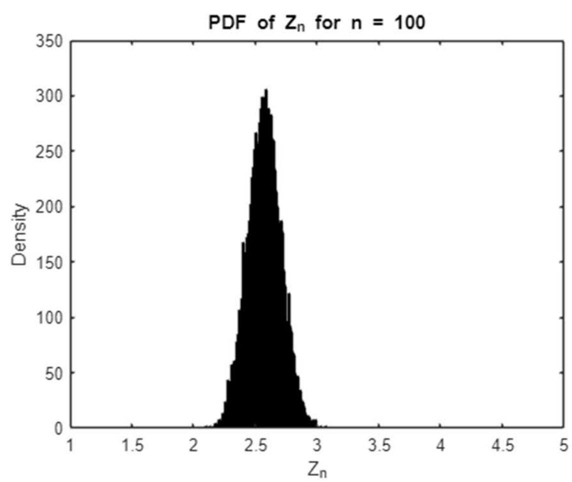

PDF of Zn for n = 10
Density
Zn
0 100 200 300 400 500 600 700 800 900
1 1.5 2 2.5 3 3.5 4 4.5 5

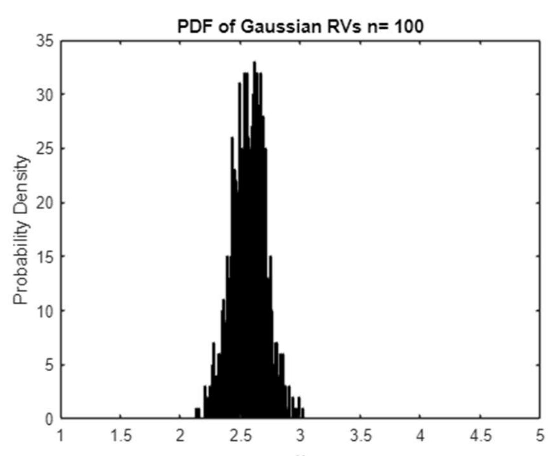

PDF of Gaussian RVs n= 10
Probability Density
x
0 10 20 30 40 50 60 70 80 90 100
1 1.5 2 2.5 3 3.5 4 4.5 5

Code ^


PDF of Zn for n = 30
Density
Zn
0 100 200 300 400 500 600
1 1.5 2 2.5 3 3.5 4 4.5 5


PDF of Gaussian RVs n= 30
Probability Density
x
0 10 20 30 40 50 60
1 1.5 2 2.5 3 3.5 4 4.5 5


PDF of Zn for n = 100
Density
Zn
0 50 100 150 200 250 300 350
1 1.5 2 2.5 3 3.5 4 4.5 5


PDF of Gaussian RVs n= 100
Probability Density
x
0 5 10 15 20 25 30 35
1 1.5 2 2.5 3 3.5 4 4.5 5

$P = [\,2/7,\ 2/7,\ 1/7,\ 1/7,\ 1/7\,]$

$$E[X] = \sum_{i=1}^{n} x_i P(X = x_i)$$

$$= 1 \cdot \tfrac{2}{7} + 2 \cdot \tfrac{2}{7} + 3 \cdot \tfrac{1}{7} + 4 \cdot \tfrac{1}{7} + 5 \cdot \tfrac{1}{7} = \tfrac{18}{7} = 2.57$$

$$\cancel{\text{VAR}}(X) = E(X^2) = \sum_{i=1}^{n} x^2 P(X = x_i)$$

$$E(X^2) = 1^2 \tfrac{2}{7} + 2^2 \tfrac{2}{7} + 3^2 \tfrac{1}{7} + 4^2 \tfrac{1}{7} + 5^2 \tfrac{1}{7}$$

$$E(X^2) = \tfrac{60}{7} = 8.57$$

$$\cdot\, VAR(X) = E(X^2) - (E(X))^2 = 8.57 - 2.57^2$$

$$= 1.96$$

$$E[Z_n] = \mu = 2.57$$

$$VAR[Z_n] = \frac{\sigma^2}{n} = \frac{1.96}{n} \qquad \sigma = \sqrt{\frac{1.96}{n}}$$

Appendix (Matlab Code)

```
%%1

t = 10;

num = randi([1, 5], 1, t);

prob_odd_count_10 = sum(mod(num,2))/t


t = 50;

num = randi([1, 5], 1, t);

prob_odd_count_50 = sum(mod(num,2))/t


t = 100;

num = randi([1, 5], 1, t);

prob_odd_count_100 = sum(mod(num,2))/t


t = 500;

num = randi([1, 5], 1, t);

prob_odd_count_500 = sum(mod(num,2))/t


t = 1000;

num = randi([1, 5], 1, t);

prob_odd_count_1000 = sum(mod(num,2))/t


%1,3,5

math_analy_prob_odd = 3/5


%d
```

```
P = [2/7, 2/7, 1/7, 1/7, 1/7];

t = 10;
outcomes = randsample(1:5, t, true, P);
d_prob_odd_count_10 = sum(mod(outcomes,2))/t

t = 50;
outcomes = randsample(1:5, t, true, P);
d_prob_odd_count_50 = sum(mod(outcomes,2))/t

t = 100;
outcomes = randsample(1:5, t, true, P);
d_prob_odd_count_100 = sum(mod(outcomes,2))/t

t = 500;
outcomes = randsample(1:5, t, true, P);
d_prob_odd_count_500 = sum(mod(outcomes,2))/t

t = 1000;
outcomes = randsample(1:5, t, true, P);
d_prob_odd_count_1000 = sum(mod(outcomes,2))/t

%P = [2/7, 2/7, 1/7, 1/7, 1/7];
% 1,2,3
d_math_analy_prob_odd = (2+1+1)/7
```

```
%%2
x = linspace(1, 15, 1000);
figure;
hold on;
title('PDF of the Gamma Distribution');
xlabel('x');
ylabel('PDF');
grid on;

lambda = 0.5;
alpha_values = [0.5, 1, 1.5, 2.5];



alpha = alpha_values(1);
pdf = gampdf(x, alpha, lambda); % Compute PDF
plot(x, pdf, 'DisplayName', ['\alpha = ', num2str(alpha)]);
alpha = alpha_values(2);
pdf = gampdf(x, alpha, lambda); % Compute PDF
plot(x, pdf, 'DisplayName', ['\alpha = ', num2str(alpha)]);
alpha = alpha_values(3);
pdf = gampdf(x, alpha, lambda); % Compute PDF
plot(x, pdf, 'DisplayName', ['\alpha = ', num2str(alpha)]);
alpha = alpha_values(4);
pdf = gampdf(x, alpha, lambda); % Compute PDF
plot(x, pdf, 'DisplayName', ['\alpha = ', num2str(alpha)]);
legend show;
```

```
hold off;


figure;
hold on;
title('CDF of the Gamma Distribution');
xlabel('x');
ylabel('CDF');
grid on;
alpha = alpha_values(1);
cdf = gamcdf(x, alpha, lambda); % Compute CDF
plot(x, cdf, 'DisplayName', ['\alpha = ', num2str(alpha)]);
alpha = alpha_values(2);
cdf = gamcdf(x, alpha, lambda); % Compute CDF
plot(x, cdf, 'DisplayName', ['\alpha = ', num2str(alpha)]);
alpha = alpha_values(3);
cdf = gamcdf(x, alpha, lambda); % Compute CDF
plot(x, cdf, 'DisplayName', ['\alpha = ', num2str(alpha)]);
alpha = alpha_values(4);
cdf = gamcdf(x, alpha, lambda); % Compute CDF
plot(x, cdf, 'DisplayName', ['\alpha = ', num2str(alpha)]);
legend show;
hold off;


%c
t = 100
k = linspace(1, t, t);
```

```
alpha_values = [3, 25, 100];


figure;
hold on;
title('RV of Poisson \alpha = 3');
xlabel('k');
ylabel('RV');
grid on;
alpha = alpha_values(1);
Poisson_RV = (alpha.^k).*exp(-alpha)./factorial(k);
plot(k, Poisson_RV, 'DisplayName', ['\alpha = ', num2str(alpha)]);
hold off;


figure;
hold on;
title('RV of Poisson \alpha = 25');
xlabel('k');
ylabel('RV');
grid on;
alpha = alpha_values(2);
Poisson_RV = (alpha.^k).*exp(-alpha)./factorial(k);
plot(k, Poisson_RV, 'DisplayName', ['\alpha = ', num2str(alpha)]);
hold off;


figure;
hold on;
```

```
title('RV of Poisson \alpha = 100');
xlabel('k');
ylabel('RV');
grid on;
alpha = alpha_values(3);
Poisson_RV = (alpha.^k).*exp(-alpha)./factorial(k);
plot(k, Poisson_RV, 'DisplayName', ['\alpha = ', num2str(alpha)]);
hold off;

%3
data = readtable('modified_titanic.xlsx');
S = data.Survived;
C = data.Pclass;
G = data.Sex;
A = data.Age;

n=887;

pmf_S = histcounts(S);
figure;
x = 0:1:1;
bar(x,pmf_S);
title('PMF of Survival Status (S)');
xlabel('Survival Status (0 = No, 1 = Yes)');
ylabel('Probability');
```

```
pmf_C = histcounts(C);

figure;

bar(pmf_C);

x = 1:3:3;

title('PMF of Price Class (C)');

xlabel('Class');

ylabel('Probability');


pmf_G = histcounts(G);

figure;

x = 0:1:1;

bar(x,pmf_G);

title('PMF of Gender (G)');

xlabel('Gender (0 = Female, 1 = Male)');

ylabel('Probability');


[pmf_A,edges] = histcounts(A);

figure;

bar(edges(2:length(edges)),pmf_A);

title('PMF of Age (A)');

xlabel('Age');

ylabel('Probability');


%Survived

SCount = 0;

for i = 1:n
```

```
    if data.Survived(i) == 1
        SCount = SCount + 1;
    end
end
P_SCount = SCount/n

PClass1_Count=0;
for i = 1:n
    if data.Survived(i) == 1 && data.Pclass(i) == 1
        PClass1_Count = PClass1_Count + 1;
    end
end
P_PClass_Count(1) = PClass1_Count/SCount

PClass2_Count=0;
for i = 1:n
    if data.Survived(i) == 1 && data.Pclass(i) == 2
        PClass2_Count = PClass2_Count + 1;
    end
end
P_PClass_Count(2) = PClass2_Count/SCount

PClass3_Count=0;
for i = 1:n
    if data.Survived(i) == 1 && data.Pclass(i) == 3
        PClass3_Count = PClass3_Count + 1;
```

```
    end
end
P_PClass_Count(3) = PClass3_Count/SCount

GCount=0;
for i = 1:n
    if data.Survived(i) == 1 && data.Sex(i) == 0
        GCount = GCount + 1;
    end
end
P_GCount(1) = GCount/SCount

GCount=0;
for i = 1:n
    if data.Survived(i) == 1 && data.Sex(i) == 1
        GCount = GCount + 1;
    end
end
P_GCount(2) = GCount/SCount



max_age = 80;
age_bin = 5;
P_ACount(max_age/age_bin) = 0;
for j = 1:max_age/age_bin
```

```
    ACount = 0;
    min_age_bin = j*5-5;
    max_age_bin = j*5;
    for i = 1:n
        if data.Survived(i) == 1 && data.Age(i) > min_age_bin && data.Age(i) <= max_age_bin
            ACount = ACount + 1;
        end
    end
    P_ACount(j) = ACount/SCount;
end
P_ACount

%Not Survived
SCount_n = 0;
for i = 1:n
    if data.Survived(i) == 0
        SCount_n = SCount_n + 1;
    end
end
P_SCount_n = SCount_n/n

PClass1_Count_n=0;
for i = 1:n
    if data.Survived(i) == 0 && data.Pclass(i) == 1
        PClass1_Count_n = PClass1_Count_n + 1;
    end
```

```
end
P_PClass_Count_n(1) = PClass1_Count_n/SCount_n

PClass2_Count_n=0;
for i = 1:n
  if data.Survived(i) == 0 && data.Pclass(i) == 2
    PClass2_Count_n = PClass2_Count_n + 1;
  end
end
P_PClass_Count_n(2) = PClass2_Count_n/SCount_n

PClass3_Count_n=0;
for i = 1:n
  if data.Survived(i) == 0 && data.Pclass(i) == 3
    PClass3_Count_n = PClass3_Count_n + 1;
  end
end
P_PClass_Count_n(3) = PClass3_Count_n/SCount_n

GCount_n=0;
for i = 1:n
  if data.Survived(i) == 0 && data.Sex(i) == 0
    GCount_n = GCount_n + 1;
  end
end
P_GCount_n(1) = GCount_n/SCount_n
```

```
GCount_n=0;
for i = 1:n
  if data.Survived(i) == 0 && data.Sex(i) == 1
    GCount_n = GCount_n + 1;
  end
end
P_GCount_n(2) = GCount_n/SCount_n



P_ACount_n(max_age/age_bin) = 0;
max_age = 80;
age_bin = 5;
for j = 1:max_age/age_bin
  ACount_n = 0;
  min_age_bin = j*5-5;
  max_age_bin = j*5;
  for i = 1:n
    if data.Survived(i) == 0 && data.Age(i) > min_age_bin && data.Age(i) <= max_age_bin
      ACount_n = ACount_n + 1;
    end
  end
  P_ACount_n(j) = ACount_n/SCount_n;
end
P_ACount_n
```

```
figure;

x = 1:1:3;

bar(x,P_PClass_Count);

title('Conditional PMF of PClass Given Survived');

xlabel('PClass');

ylabel('Probability');


figure;

x = 1:1:3;

bar(x,P_PClass_Count_n);

title('Conditional PMF of PClass Given Not Survived');

xlabel('PClass');

ylabel('Probability');


figure;

x = 1:1:2;

bar(x,P_GCount);

title('Conditional PMF of Gender Given Survived');

xlabel('Gender');

ylabel('Probability');


figure;

x = 1:1:2;

bar(x,P_GCount_n);

title('Conditional PMF of Gender Given Not Survived');

xlabel('Gender');
```

```
ylabel('Probability');

figure;
bar(edges(2:length(edges)),P_ACount);
title('Conditional PMF of Age Given Survived');
xlabel('Age');
ylabel('Probability');

figure;
bar(edges(2:length(edges)),P_ACount_n);
title('Conditional PMF of Age Given Not Survived');
xlabel('Age');
ylabel('Probability');

%c
P_S1_Alteq40 = sum(P_ACount(1:8))
P_S1_C1 = P_PClass_Count(1)
P_S1_G0 = P_GCount(1) %Female
P_S1_C1_G0_Alteq40 = P_S1_C1*P_S1_G0*P_S1_Alteq40

P_S0_Alteq40 = sum(P_ACount_n(1:8))
P_S0_C1 = P_PClass_Count_n(1)
P_S0_G0 = P_GCount_n(1) %Female
P_S0_C1_G0_Alteq40 = P_S0_C1*P_S0_G0*P_S0_Alteq40

%d
```

```
P_S1_given_C1_G0_Alteq40 = P_S1_C1_G0_Alteq40/P_SCount
P_S0_given_C1_G0_Alteq40 = P_S0_C1_G0_Alteq40/P_SCount_n


%Q4a
n_values = [1,3,10,30,100];
samples = 1000;
Zn(samples) = 0;
for k = 1:length(n_values)
  n = n_values(k);
  Zn(samples) = 0;
  for i = 1:samples
    Xi = 3 + 4*rand(n, 1);
    Zn(i) = 1/n*sum(Xi);
  end
  figure;
  histogram(Zn);
  title(['PDF of Z_n for n = ', num2str(n)]);
  xlabel('Z_n');
  ylabel('Density');
  xlim([3 7]);
end

%b
VAR(length(n_values))= 0;
for k = 1:length(n_values)
```

```
    n = n_values(k);
    VAR(k) = 1.33/n;
end

%c
mu = 5;
samples = 1000;
for k = 1:length(n_values)
    n = n_values(k);
    sigma = sqrt(1.33/n);
    X = mu + sigma * randn(samples, 1);
    figure;
    histogram(X);
    title(['PDF of Gaussian RVs n= ', num2str(n)]);
    xlabel('x');
    ylabel('Probability Density');
    xlim([3 7]);
end

%Q4d - redo abc, fair 5-sided die that is described in Problem 1(d).
P = [2/7, 2/7, 1/7, 1/7, 1/7];

n_values = [1,3,10,30,100];
samples = 10000;
Zn(samples) = 0;
for k = 1:length(n_values)
```

```
    n = n_values(k);
    Zn(samples) = 0;
    for i = 1:samples
        Xi = randsample(1:5, n, true, P);
        Zn(i) = 1/n*sum(Xi);
    end
    figure;
    histogram(Zn, 'BinWidth', 1/(n+1));
    title(['PDF of Z_n for n = ', num2str(n)]);
    xlabel('Z_n');
    ylabel('Density');
    xlim([1 5]);
end

%b
VAR(length(n_values))= 0;
for k = 1:length(n_values)
    n = n_values(k);
    VAR(k) = 1.96/n;
end

%c
mu = 18/7;
samples = 1000;
for k = 1:length(n_values)
    n = n_values(k);
```

```
    sigma = sqrt(96/(49*n));

    X = mu + sigma * randn(samples, 1);

    figure;

    histogram(X, 'BinWidth', 1/(n+1));

    title(['PDF of Gaussian RVs n= ', num2str(n)]);

    xlabel('x');

    ylabel('Probability Density');

    xlim([1 5]);

end
```