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Su24 ECE 131A Project

1a

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

1b.

1c.

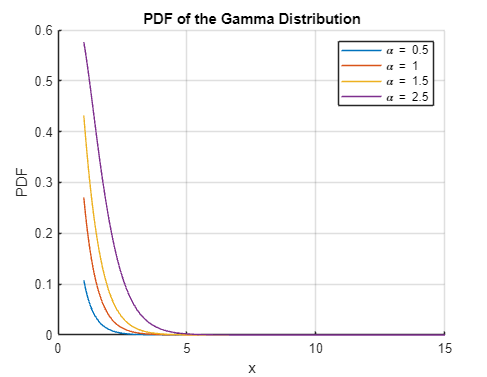
As the number of tosses increases, the estimated results approach the mathematical analysis.

1d.

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

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

2a.

A graph with colored lines and numbers

Description automatically generated

2b.

A paper with writing on it

Description automatically generated

2c

A piece of paper with writing on it

Description automatically generated

A graph of a line

Description automatically generated

A graph of a function

Description automatically generated

A graph with a line

Description automatically generated

3a.

A graph of a blue bar

Description automatically generatedA graph of a number of blue rectangular bars

Description automatically generated

A graph with blue rectangular bars

Description automatically generated A graph of age and age

Description automatically generated with medium confidence

3b.

|  |  |
| --- | --- |
| 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 |

A graph of blue rectangular bars

Description automatically generatedA graph with blue rectangular bars

Description automatically generated

A graph of a bar graph

Description automatically generated with medium confidenceA graph of a bar graph

Description automatically generated

A graph of age and age

Description automatically generatedA graph of age and age

Description automatically generated

3c.

3d.

4a.

A graph of a graph

Description automatically generated A graph of a number of blue bars

Description automatically generated with medium confidence

A graph of a diagram

Description automatically generated A graph of a diagram

Description automatically generated

A graph of a diagram

Description automatically generatedA graph of a diagram

Description automatically generated

A graph of a graph of a graph

Description automatically generated A graph of a graph of a number of objects

Description automatically generated with medium confidence

A graph of a graph of a graph

Description automatically generated A graph of a tall tower with Burj Khalifa in the background

Description automatically generated

4b.

A piece of paper with writing on it

Description automatically generated

4d.

A graph of a graph

Description automatically generated A graph of a diagram

Description automatically generatedA graph of a diagram

Description automatically generated A graph of a diagram

Description automatically generated

A graph of a diagram

Description automatically generated A graph of a diagram

Description automatically generated

A graph of a graph of a number of lines with Burj Khalifa in the background

Description automatically generated with medium confidence A graph of a graph of a diagram with Burj Khalifa in the background

Description automatically generated with medium confidence

A graph of a graph of a graph

Description automatically generated A graph of a black column

Description automatically generated

A piece of paper with writing on it

Description automatically generated

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