Group Simulation Activity 2

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1 Question 1

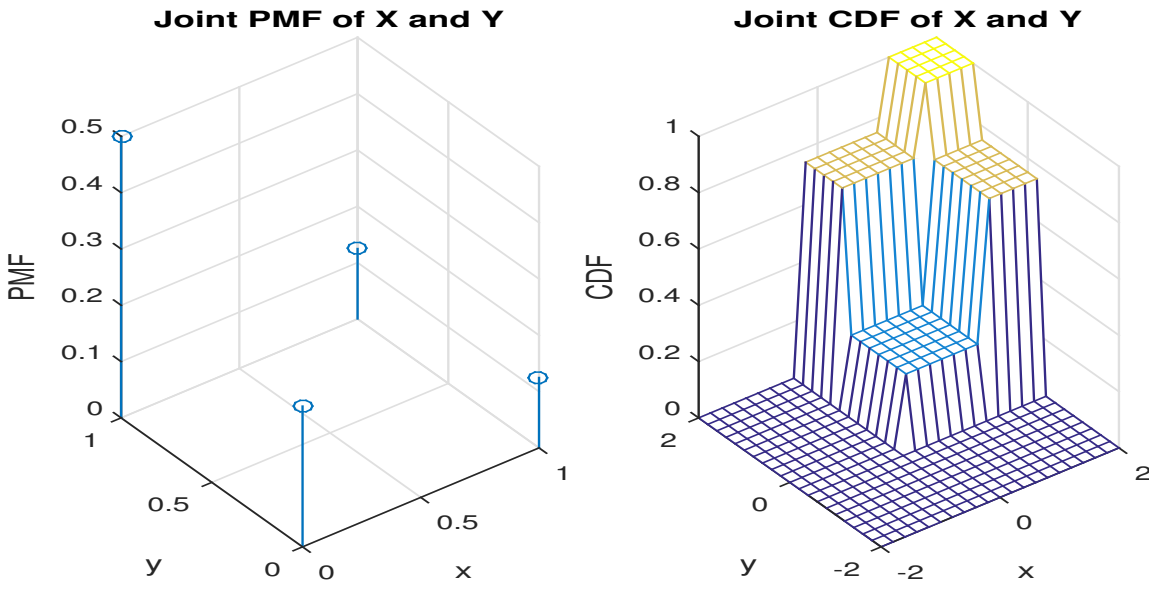


Figure 1: Produced Joint PMF and Joint CDF from the provided data

```
H =

    0.2500    0.1233
    0.4997    0.1269


x_mpdf =

    0.7498    0.2502


y_mpdf =

    0.3734    0.6266
```

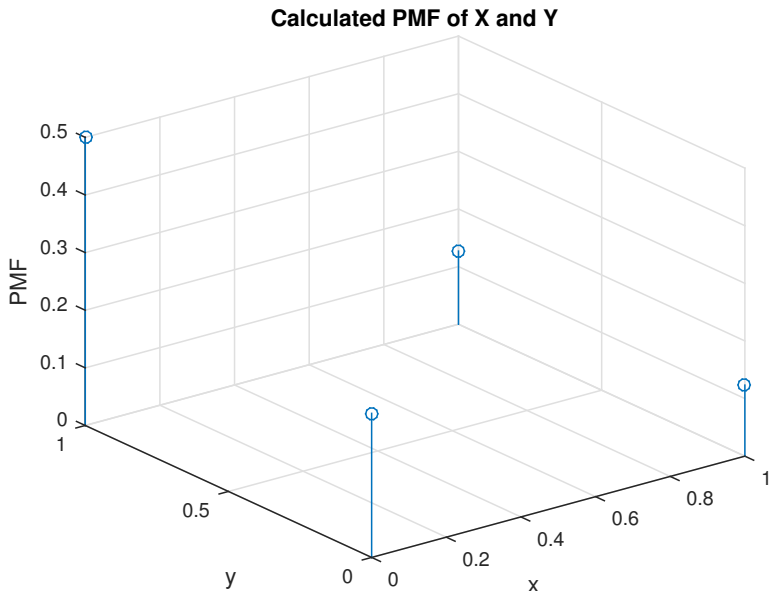
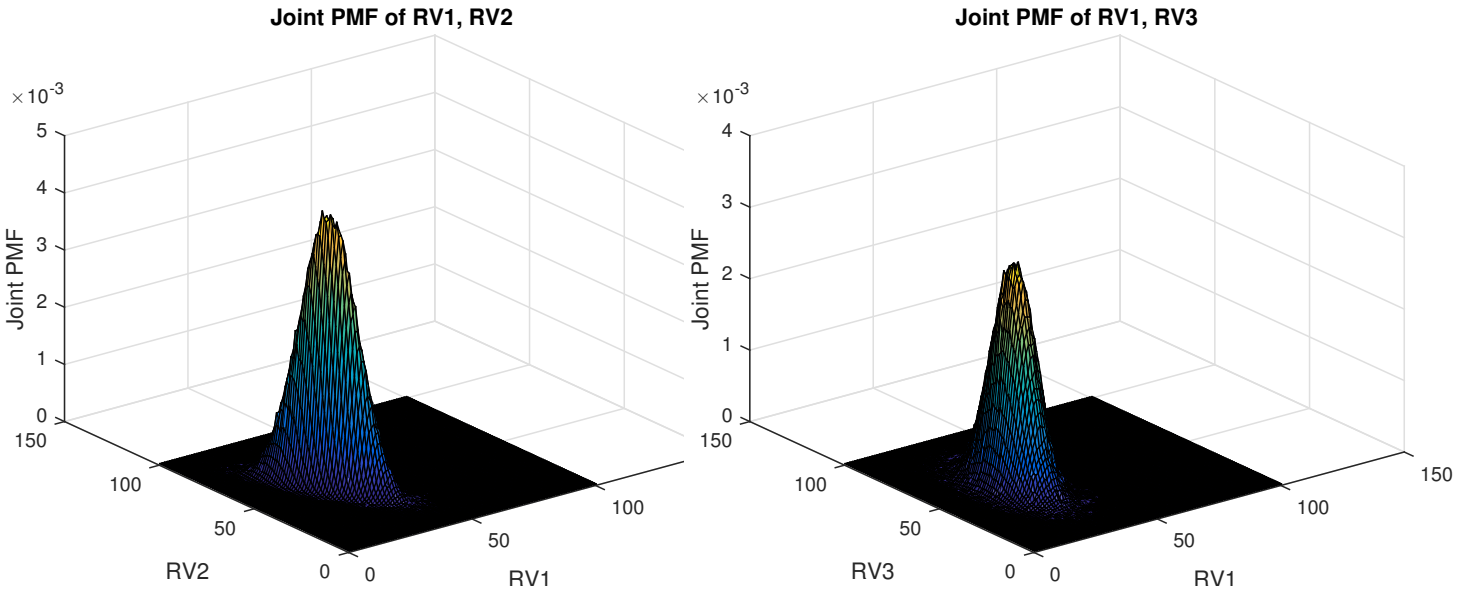


Figure 2: Joint PMF from H

Using the table provided, it can be determined that $p_x(x) = [0.75, 0.25]$ for $x = [0, 1]$, and that $p_y(y) = [0.375, 0.625]$ for $y = [0, 1]$. The estimated marginal pdfs are very close to the theoretical ones, with the probabilities differing by less than 0.01.

2 Question 2



In both cases it appears the two sets of RV's are negatively correlated because small values of one RV are associated with large values of the other RV.

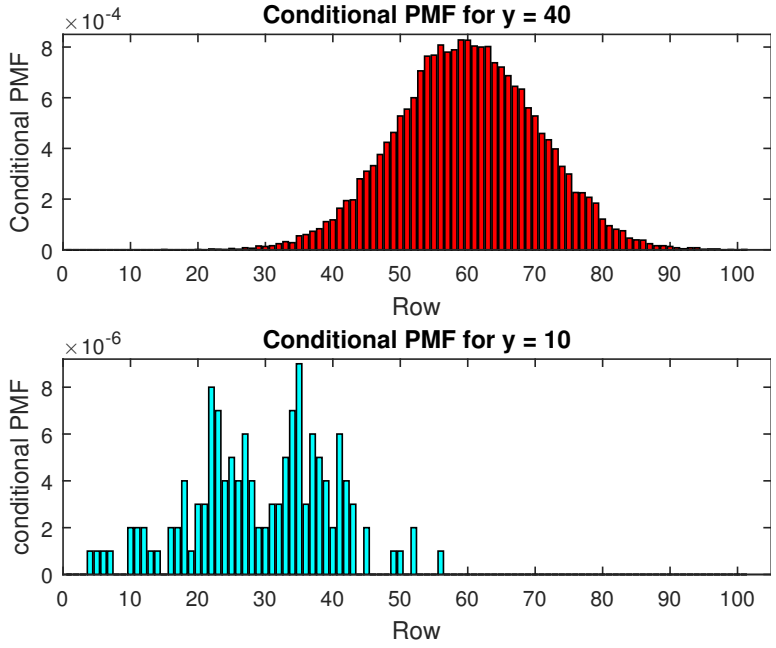
```
Correlation coefficient between RV1 and RV2:
ans =

    1.0000   -0.7492
```

```
   -0.7492   1.0000

Correlation coefficient between RV1 and RV3:
ans =

    1.0000   -0.0005
   -0.0005    1.0000
```

As anticipated, the correlation coefficients are negative in both cases.

3 Question 3

```
The total PMF between rows 20 and 70 is
total =

    0.9435
```



4 Appendix

4.1 Question 1

```
clear all;
close all;
clc;
%Q1
%I
x=[0,1];
y=[0,1];
S=0;
for i=1:1:2
    for j=1:1:2
        if i==2
            P(j,i)=1/8;
        else if j==1
                P(j,i)=1/4;
            else
                P(j,i)=1/2;
            end
        end
    end
end


X=linspace(-2,2,21);
Y=linspace(-2,2,21);
%z=[length(X2),length(Y2)];

for X1=1:1:21
    for Y1=1:1:21
        if X1<10 || Y1<10
            z(X1,Y1)=0;
        else if X1<=16 && Y1<=16
                z(X1,Y1)=1/4;
             else if X1<=16 && Y1>16
                     z(X1,Y1)=3/4;
                 else if X1>16 && Y1<=16
                         z(X1,Y1)=3/4;
                     else
                         z(X1,Y1)=1;
                     end
                 end
            end
        end
    end
end


subplot(1,2,1)
stem3(x,y,P);
xlabel('x')
ylabel('y')
zlabel('PMF')
title('Joint PMF of X and Y')

subplot(1,2,2)
mesh(X,Y,z)
xlabel('x')
ylabel('y')
zlabel('CDF')
title('Joint CDF of X and Y')

%II

%D: Dummy variable used to aplly weight on a
    probability

%  !! XY array holding all X and Y !!

for n=1:1:100000
    D(n)=randi(1000);
    if D(n)<500
        XY(1,n)=0;
        XY(2,n)=1;
    else if D(n)<750
            XY(1,n)=0;
            XY(2,n)=0;
        else if D(n)<875
                XY(1,n)=1;
                XY(2,n)=0;
            else
                XY(1,n)=1;
                XY(2,n)=1;
            end
        end
    end
end

%III

%Count occurences of each value and store
%in vector H

H = zeros(2);

for n = 1:1:100000
    if XY(1,n)==0
        if XY(2,n)==0
            H(1,1) = H(1,1) + 1;
        else
            H(2,1) = H(2,1) + 1;
        end
    else
        if XY(2,n)==0
            H(1,2) = H(1,2) + 1;
        else
            H(2,2) = H(2,2) + 1;
        end
    end
end

H = H/100000

figure
stem3(x,y,H);
xlabel('x')
ylabel('y')
```

```
zlabel('PMF')
title('Calculated PMF of X and Y')

%When the two PDF plots are compared, it is clear
    that they are essentially the same, with a
    difference of less than 0.01 for each
    probability. As the number of trials approaches
    infinty, the estimation will approach the
    theoretical values.

%IV

%Calculate the marginal pdf for x and y

x_count = zeros(1,2);
y_count = zeros(1,2);

for n = 1:1:100000
    if XY(1,n) == 0
        x_count(1,1) = x_count(1,1) + 1;
    else
        x_count(1,2) = x_count(1,2) + 1;
    end
    if XY(2,n) == 0
        y_count(1,1) = y_count(1,1) + 1;
    else
        y_count(1,2) = y_count(1,2) + 1;
    end
end

x_mpdf = x_count/100000
y_mpdf = y_count/100000
```

4.2 Question 2

```
RV1 = load('RV1.mat'); % LOAD RV1-RV3 from file
RV1 = RV1.RV1;       % specify the variable in the
    MAT-file using dot notation,
                     % making it able to access
                         each item like elements in
                         an array
RV2 = load('RV2.mat');
RV2 = RV2.RV2;
RV3 = load('RV3.mat');
RV3 = RV3.RV3;

JPMF1 = zeros(101, 101); % Joint pmf of RV1, RV2.
    JPMF is set as a Matrix as an input for surf()
JPMF2 = zeros(101, 101); % Joint pmf of RV1, RV3

for i = 1:1000000
  JPMF1(RV1(i)+1, RV2(i)+1) = JPMF1(RV1(i)+1,
      RV2(i)+1)+1; %for each element both in RV1
      and RV2/RV3, increase total
  JPMF2(RV1(i)+1, RV3(i)+1) = JPMF2(RV1(i)+1,
      RV3(i)+1)+1;
end

for i = 1:101
  for j = 1:101
    JPMF1(i, j) = JPMF1(i, j) / 1000000; % divide
        by number of elements to determine joint PMF
    JPMF2(i, j) = JPMF2(i, j) / 1000000;
  end
end


figure
surf(JPMF1)
title('Joint PMF of RV1, RV2')
xlabel('RV1')
ylabel('RV2')
zlabel('Joint PMF')

figure
surf(JPMF2)
title('Joint PMF of RV1, RV3')
xlabel('RV1')
ylabel('RV3')
zlabel('Joint PMF')
%%Finding the correlation coefficient

fprintf('Correlation coefficient between RV1 and
    RV2:')
%%corr(RV1, RV2)
corrcoef(RV1,RV2)
fprintf('Correlation coefficient between RV1 and
    RV3:')
%%corr(RV1, RV3)
corrcoef(RV1,RV3)
```

4.3 Question 3

```
% PART 1
load('H.mat')

total = 0;
ytotal_40 = zeros(1,101);
ytotal_10= zeros(1,101);

for i = 20:70

  for j = 1:101

    total = total +H (i,j) ;

  end
end
% printing the PMF of rows 20 to 70 and all columns
    within
fprintf('The total PMF between rows 20 and 70 is');
total

% PART 2

%getting CPMF for all rows of column 40
for i =1:101
```

```
    ytotal_40(i) = H(i,40);

end

%getting CPMF for all rows of column 10
for i =1:101

    ytotal_10(i) = H(i,10);

end

subplot(2,1,1);
bar(ytotal_40,'r');
axis([0,105,0,.00085]);
title('Conditional PMF for y = 40')
xlabel('Row');
ylabel('Conditional PMF');


subplot(2,1,2);
bar(ytotal_10, 'c' );
axis([0,105,0,.0000092]);
title('Conditional PMF for y = 10')
xlabel('Row');
ylabel('conditional PMF');
```