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ET601: Problem Set 2 Solution

1. Here is a new script for the probability calculation part:

```
%% Probability Calculation
Dice_Support = 1:6;
```

```
% Part a
S = zeros(1,6^Number_Dice); % Preallocation
for k1 = Dice_Support
    for k2 = Dice_Support
            S(6*(k1-1)+k2) = k1+k2;
    end
end
S
```

```
% Part a (another solution)
S = zeros(1,6^Number_Dice); % Preallocation
k = 1;
for k1 = Dice_Support
    for k2 = Dice_Support
            S(k) = k1+k2;
            k = k+1;
    end
end
S
```

```
% Part b
SS = zeros(6,6); % Preallocation
for k1 = Dice_Support
    for k2 = Dice_Support
            SS(k1,k2) = k1+k2;
    end
end
SS
```

```
Size_SampleSpace = length(S);
Number_11 = sum(S==11)
Number_12 = sum(S==12)
% Count all possible cases at once
N_S = hist(S,S_Support)

P = sym(N_S)/Size_SampleSpace

figure
stem(S_Support,P)
```

The codes is verified by the displayed results in the command window:

```
S =

  Columns 1 through 15

     2     3     4     5     6     7     3     4     5     6     7     8     4     5     6

  Columns 16 through 30

     7     8     9     5     6     7     8     9    10     6     7     8     9    10    11

  Columns 31 through 36

     7     8     9    10    11    12


SS =

     2     3     4     5     6     7
     3     4     5     6     7     8
     4     5     6     7     8     9
     5     6     7     8     9    10
     6     7     8     9    10    11
     7     8     9    10    11    12
```

2. See the script `SumofThreeDice.m` provided below.

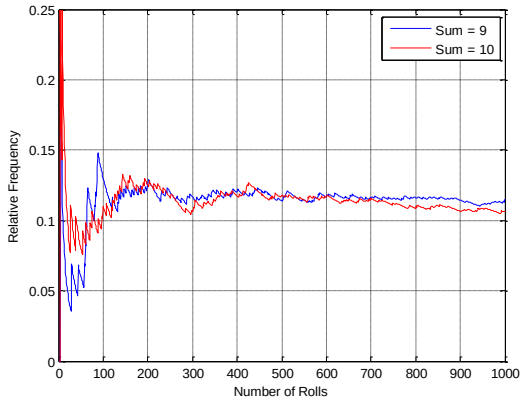
```
close all; clear all;

% Part (a)
N = 1e3;
D = randi([1,6],3,N);

% Part (b)
S = sum(D);

% Part (c)
RF9 = cumsum(S==9)./(1:N);
plot(1:N,RF9)
xlabel('Number of Rolls')
ylabel('Relative Frequency')
grid on

% Part (d)
RF10 = cumsum(S==10)./(1:N);
hold on
plot(1:N,RF10,'r')
legend('Sum = 9', 'Sum = 10')

% Part (e)
figure
hist(S,3:18)
```

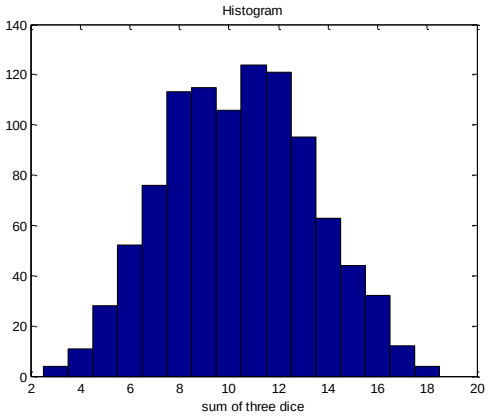
```
N_S_Sim = hist(S,3:18);
title('Histogram')
xlabel('sum of three dice')

% Part (f): Probability Calculation
range = 1:6;
S = [];
for k1 = range
    for k2 = range
        for k3 = range
            S = [S (k1+k2+k3)];
        end
    end
end
Size_SampleSpace = length(S);
N_S = hist(S,3:18);
P = sym(N_S/Size_SampleSpace)

% Part (g)
figure
stem(3:18,P)
hold on
RF = N_S_Sim./N;
plot(3:18,RF,'rx')
legend('probability','relative frequency')
xlabel('sum of three dice')
grid on
```

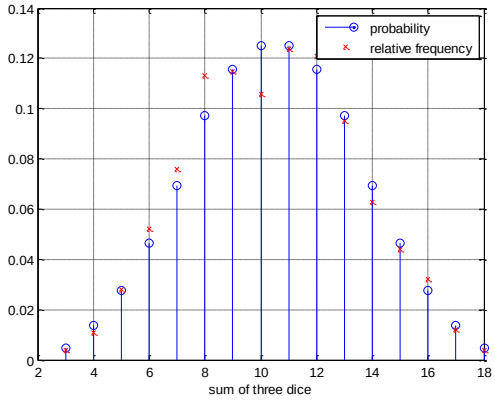
The command window displays the probabilities involved with the sum of three dice. The *n*th number in the results give the probability that the sum is *n*.

```
>> SumofThreeDice

P =

[ 1/216, 1/72, 1/36, 5/108, 5/72, 7/72, 25/216, 1/8, 1/8,
25/216, 7/72, 5/72, 5/108, 1/36, 1/72, 1/216]
```

The corresponding three figures generated in parts (c,d), (e), and (g) are shown below.







3. See the script below. The script from HW1 is also included.

```
% HW1Q2
% Part (a)
x = 1:7
% Part (b)
y = cumsum(x)
% Part (c)
y = x.*(x+1)/2
```

```
% HW2Q3
n = 7; % The length of vector x.
z = zeros(1,7); % Preallocation
z(1) = x(1);
for k = 2:n
    z(k) = z(k-1)+x(k);
end
z
```

The results are verified in the command window:

```
y =

     1     3     6    10    15    21    28


z =

     1     3     6    10    15    21    28
```

4. See the script below. Note that two solutions are provided. The first one uses multi-dimensional array. The second one uses for loop.

```
close all; clear all;
tic
N = 1e3;
% A: At least one six in 4 tosses of a fair dice
p = cumsum((sum((randi(6,N,4) == 6),2) >= 1))./(1:N)';
plot(1:N,p)
hold on
xlabel('number of rolls')
ylabel('relative frequency')
```

```
% B: At least one double six in 24 tosses of a pair of dice
plot(1:N,p,'r')
```

```
% Technique 1 - multidimensional array
p = (sum(sum(randi(6,2,24,N)==6,1)==2,2)>=1);
p = reshape(p,1,prod(size(p)));
p = cumsum(p) ./(1:N);
```

```
% % Technique 2 - for loop
% c = zeros(1,N);
% for k= 1:N
%     s = (sum((sum(randi(6,2,24)==6,1)==2))>=1);
%     if k==1
%         c(k) = s;
%     else
%         c(k) = c(k-1)+s;
%     end
% end
% plot(1:N,c./(1:N),'r')
% %
```

```
ylim([0 1])
grid on
toc
legend('Event A: At least one six in 4 tosses of a fair
dice',...
```

```
    'Event B: At least one double six in 24 tosses of a pair
of dice')
```