Program Assignment 1, EE5352

1. Using the histogram pseudocode given on the last 3 pages, construct a histogram function which inputs an array \( x \) of dimension \( N_x \) and a parameter \( N_y \), which is the number of desired histogram bins. The outputs are a histogram array \( y \) of dimension \( N_y \) and a second array \( z \) of dimension \( N_y \). After calculating a histogram, you can plot \( y \) versus \( z \).

2. Using a random number generator, generate 3000 pseudorandom numbers uniformly distributed between \(-0.5\) and \(0.5\), and store them in an array \( x \). \( N_x \) is therefore 3000. Plot the histogram produced if \( N_y = 20 \).

3. Generate and plot the histogram of array \( x_1 \) if \( x_1 \) is generated as follows.

   For \( i = 1 \) to 2999
   \( x_1(i) = x(i) + 2 \cdot x(i+1) \)
   end

4. Generate and plot the histogram of array \( x_2 \) if \( x_2 \) is generated as follows.

   For \( i = 1 \) to 2998
   \( x_2(i) = x(i) + 1.5 \cdot x(i+1) + 2 \cdot x(i+2) \)
   end
Pseudocode for the histogram function is given below.

Given:
Nx data samples in an array x
Ny, which is the desired number of bins in the histogram, and
Nsmt, which is related to the amount of histogram smoothing to use

Create arrays x, y, z with dimensions Nx, Ny, and Ny respectively

GET MAX AND MIN OF x

Xm=x(1)
Xn=Xm

For i = 2 to Nx
IF(x(i) > Xm) Xm=x(i)
IF(x(i) < Xn) Xn=x(i)
End

B=(Ny-.02)/(Xm-Xn)
A=1.01-B*Xn

For i = 1 to Ny
y(i)=0.
End

CALCULATE BIN ARRAY y

For i = 1 to Nx
II=A+B·x(i)
y(II)=y(II)+1.
End

SMOOTH y AND PUT IT IN z

Xv=1./(2·Nsmt+1.)
I1=Nsmt+1
I2=Ny-Nsmt
Np=2·Nsmt+1

For i= I1 to I2
S=0.
J1=i-Nsmt-1

...
For \( j = 1 \) to \( N_p \)
    \( J_1 = J_1 + 1 \)
    \( S = S + y(J_1) \)
End

\( z(i) = XV \cdot S \)
End

IF (Nsmt = 0) GO TO 9

\( N_p = 1.5 \cdot NSMT + .5 \)
\( XV = 1./N_p \)

For \( i = 1 \) to \( I_1 - 1 \)
    \( S = 0. \)
    For \( j = 1 \) to \( N_p \)
        \( S = S + y(i + j - 1) \)
    End

\( z(i) = XV \cdot S \)
End

For \( i = I_2 + 1 \) to \( N_y \)
    \( S = 0. \)
    For \( j = 1 \) to \( N_p \)
        \( S = S + Y(I - J + 1) \)
    End

\( z(i) = XV \cdot S \)
End

PUT SMOOTHED Z BACK INTO Y

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For \( i = 1 \) to \( N_y \)
    \( y(i) = z(i) \)
End

PUT X-AXIS INTO Z

For \( i = 1 \) to \( N_y \)
    \( z(i) = (i - A) / B \)
End

NORMALIZE Y SO THAT ITS INTEGRAL IS 1.

\( G = 0. \)
For \( i = 1 \) to \( N_y \)
    \( G = G + y(i) \)
End

\( V = B / G \)
For $i=1$ to $Ny$
\[ y(i)=V\cdot y(i) \]
End

The final histogram is $y(i)$ versus $z(i)$ for $i=1$ to $Ny$