# Week 8 Tutorial 1

The purpose of this program is to demonstrate how to create both normal and uniform distributions and to plot them in a histogram plot. The histogram() function will also be used to create a table of frequencies.

```
% Always clear workspace variables before a new tutorial or program.
clear
clc
close all % Close any currently open plot figure windows
```

Edit the code below and update the variable named **name** with your name for this tutorial in the code below.

```
name="";
fprintf("Output for Tutorial_08_1 run by %s.\n\n", name)
```

## Input

Using the randn() function to create a row vector of 100,000 values with a mean of 50 and stdev of 15. Refer to your notes from previous chapters if you do not remember how to do this.

```
% Create a row vector of 100,000 values with a mean of 50 and stdev of 15
normal = ;
% Using the rand() function to create a uniform distribution from 0 to 100
uniform = 100*rand(1,100000) + 0;
```

Here we'll create some "bins". Bins are the containers that values will be stored in. The bin center is the value at the center of the bin.

```
binCenters = 2.5:5:97.5;
% Bin boundaries are the left and right boundaries of the bins
binBoundaries = 0:5:100;
```

## Creating The Plots

### Plot 1 - Normal Distribution

Create a histogram with the normal and uniform distribution datasets.

```
% Open figure 1


% Create 2 subplots, one on top of the other, activate plot 1


```

Here, we will create a histogram of the normal distribution using the binCenters vector to define the bins to use. You'll see the `set()` command, this is used to update the property of some object, here we are updating the tick values to appear at the boundaries of the bins.

```
histogram(normal, binBoundaries)
% Set the tick mark labels at each bin center
```

```
set(gca,'xtick', binCenters)
% Set the axis limits
axis([0 100 0 2500])
% override the y axis limits with autoscaling
axis 'auto y'
```

These next two commands control the face color and edge color of the bars on the histogram. These could be set in the original `histogram()` function or later using the `set()` function. The `findobj()` function is a powerful function to find graphical objects. In order to use `set()` we need the "handle" of the object we want to change. We find that here with `findobj()` where **gca** stands for get current axes (remember axes in matlab is the entire plot).

Once we have the handle of the axes (the current histogram), we can set the face and edge colors how we want using the axes' property names like **FaceColor** and **EdgeColor**. It should be noted that the resulting handle of the plot is a an array of two structs as you'll see printed out since I have not suppressed the output.

```
% Get the handle to the current plot (returns a 2x1 "Group" or array)
h = findobj(gca)
```

Now that we have the handle, we can see the various properties of the plot struct (which is the second element in the array)

```
% Display the properties we can work with
h(2)
% Update the properties of the plot with the handle and property names
set(h(2),'FaceColor','g','EdgeColor','k')
```

Notice here, we are using our previous `labelPlot()` function, you'll either need to copy the file into this current folder or, add the function to your path.

```
% Use your LabelPlot() function to label the graph
labelPlot('Normal Distribution','Bin Boundaries','Frequency')
```

**Plot 2 - Uniform distribution**

```
% Create the second plot in figure window 1
subplot(2,1,2)
% Make a historgram of the uniform distribution, it's the same as the
% normal distrubution, just use the uniform data instead.
histogram(uniform, binBoundaries)

% The following lines control the second graph as described above
set(gca,'xtick',binCenters)
axis([0 100 0 2500])
axis 'auto y'
```

Here, we will update the edge and face colors of this histogram to have a red face color with a white edge color. However, this time we'll use the structure properties directly which is slightly more intuitive.

```
% Get the handle to the current plot
h = findobj(gca);
% Update the properties of the plot with the handle and property names
h(2).FaceColor = 'r'
h(2).EdgeColor = 'w'
```

Label this plot just like the previous one.

```
labelPlot('Uniform Distribution','Bin Boundaries','Frequency')
```

We can also use the properties of histograms to get other information, like bin counts and more.

Here is how we might go about finding and editing properties if we don't know what object we're looking for yet.

First, let's just run `findob()` and see what comes back, this will find ALL graphic objects.

```
findobj()
```

So, we can see there is Root (ignore that for now), Figure, two Axes and two Histograms. If we want to get propertes from the Histogram objects, we can filter `findobj` by finding only Histogram objects.

```
histograms = findobj('Type', 'Histogram')
```

Great, now we have just the histogram objects, let's see what the first one looks like.

```
histograms(1)
```

We can see by the data that this is the uniform distribution, we know this because the values are relatively consistent. Also, if we look at FaceColor and EdgeColor these numbers are for the R, G, B components and [1 0 0] means red, [1, 1, 1] means white ([0 0 0] would be black)

We can also see that there is lots of information we can pull from here, such as the data and values, and even more if we "Show all properties"

Let's create a table of the data by extracting the information from the histogram. Note, the order of your histograms may be different so adjust the subscript as necessary.

```
% We know the first Histogram object was the uniform distribution
freqUniform = histograms(1).BinCounts;
freqNormal = histograms(2).BinCounts;

% Print the heading of the table
fprintf(' Bin      Normal    Uniform \n')
fprintf('Center  Frequency  Frequency \n')
% Create a matrix named table with three rows
table = [binCenters; freqNormal; freqUniform];
% Print the table values three per line
fprintf(' %4.1f \t  %5i \t %5i\n',table)
```

## Example Output:

Run this tutorial from the **Command Window** and ensure your output matches the following.

```
Output for Tutorial_08_1 run by Geoff Berl.


h =

  2×1 graphics array:

  Axes
  Histogram


ans =

  Histogram with properties:

            Data: [39.7478 40.3765 38.1686 44.9454 44.6255 39.2851 52.6492 41.3068 63.2654 46.18
          Values: [78 259 604 1363 2494 4338 6819 9427 11762 12940 13071 11659 9340 6790 4271 24
         NumBins: 20
        BinEdges: [0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100]
        BinWidth: 5
       BinLimits: [0 100]
    Normalization: 'count'
        FaceColor: 'auto'
        EdgeColor: [0 0 0]

  Show all properties


h =

  2×1 graphics array:

  Axes
  Histogram


h =

  2×1 graphics array:

  Axes
  Histogram


ans =

  6×1 graphics array:
```

```
  Root
  Figure       (1)
  Axes         (Uniform Distribution)
  Axes         (Normal Distribution)
  Histogram
  Histogram


histograms =

  2×1 Histogram array:

  Histogram
  Histogram


ans =

  Histogram with properties:

            Data: [76.2919 69.0112 58.7075 46.3266 23.6208 34.9683 28.5313 89.4486 51.5000 42.50
          Values: [5041 5026 5012 5067 4908 5115 4892 4880 5045 4981 4923 5027 5004 4983 5041 51
         NumBins: 20
        BinEdges: [0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100]
        BinWidth: 5
       BinLimits: [0 100]
    Normalization: 'count'
        FaceColor: [1 0 0]
        EdgeColor: [1 1 1]

  Show all properties
```

| Bin Center | Normal Frequency | Uniform Frequency |
|---|---|---|
| 2.5 | 78 | 5041 |
| 7.5 | 259 | 5026 |
| 12.5 | 604 | 5012 |
| 17.5 | 1363 | 5067 |
| 22.5 | 2494 | 4908 |
| 27.5 | 4338 | 5115 |
| 32.5 | 6819 | 4892 |
| 37.5 | 9427 | 4880 |
| 42.5 | 11762 | 5045 |
| 47.5 | 12940 | 4981 |
| 52.5 | 13071 | 4923 |
| 57.5 | 11659 | 5027 |
| 62.5 | 9340 | 5004 |
| 67.5 | 6790 | 4983 |
| 72.5 | 4271 | 5041 |
| 77.5 | 2455 | 5195 |
| 82.5 | 1316 | 5040 |
| 87.5 | 596 | 4913 |
| 92.5 | 237 | 4993 |
| 97.5 | 96 | 4914 |

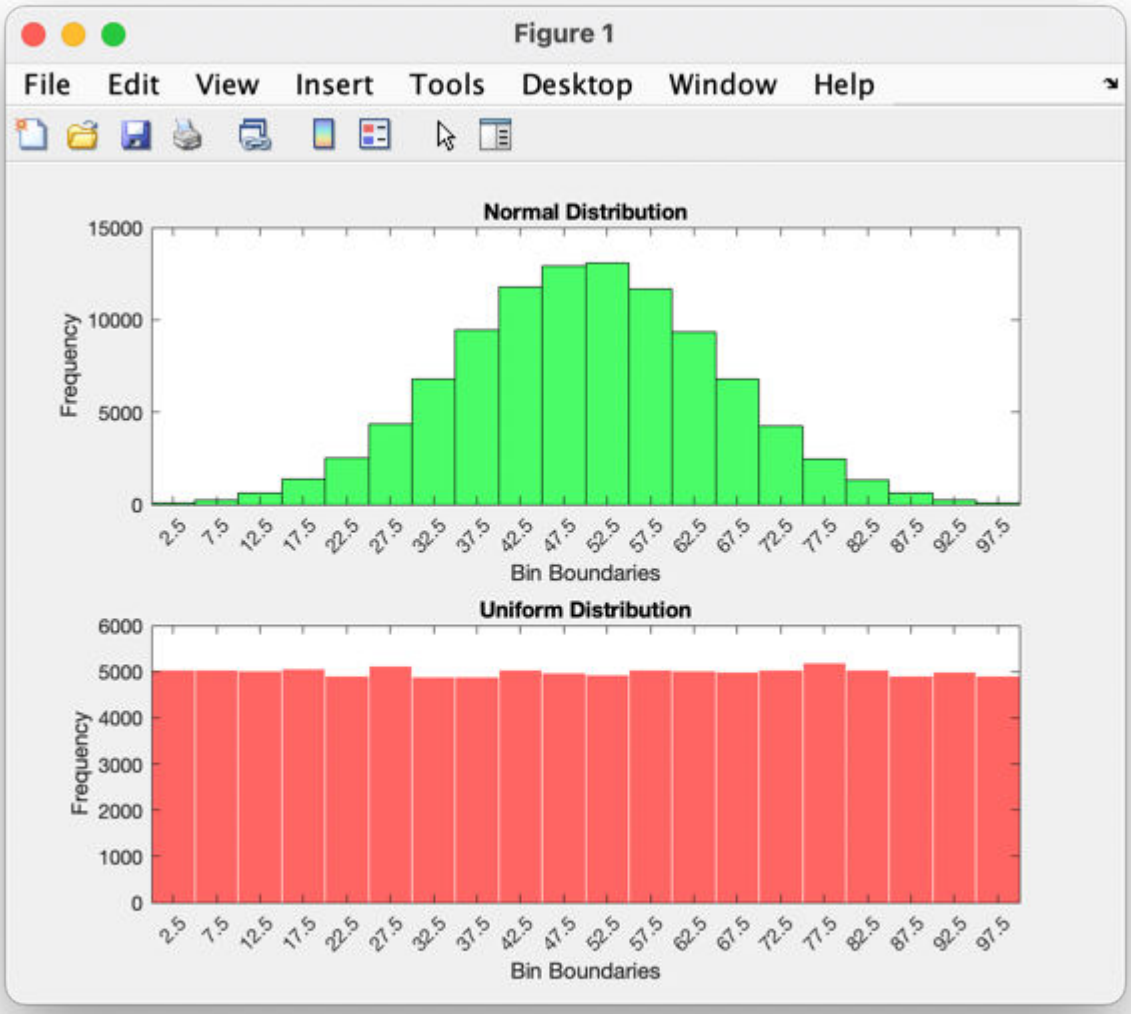
Figure 1
File Edit View Insert Tools Desktop Window Help
Normal Distribution
Frequency
15000
10000
5000
0
2.5 7.5 12.5 17.5 22.5 27.5 32.5 37.5 42.5 47.5 52.5 57.5 62.5 67.5 72.5 77.5 82.5 87.5 92.5 97.5
Bin Boundaries
Uniform Distribution
Frequency
6000
5000
4000
3000
2000
1000
0
2.5 7.5 12.5 17.5 22.5 27.5 32.5 37.5 42.5 47.5 52.5 57.5 62.5 67.5 72.5 77.5 82.5 87.5 92.5 97.5
Bin Boundaries