CS/INFO 3300
Homework 5
Due 11:59 PM, Wed Mar 19

Maps

1. Map yourself! Find the longitude and latitude coordinates of three places you have lived, or want to live. Use d3 to create a map of the US or the world, as appropriate. See Piazza for links to JSON geographic files. Select a projection for the map. Consult the d3 documentation for options. If you choose, you may want to use one of the projections from the d3-geo-projection package, which will require an additional javascript library file, available here:

```
https://github.com/d3/d3-geo-projection/
```

Place colored circles and text labels on the map in the locations you selected. (20 pts)

Distributions and histograms

2. Create a function `plotHistogram` that creates an SVG histogram. The function should take two arguments: a string representing an element id (eg "#map") and an array of numbers. The body of the function should select the element with that id, create an SVG element inside it, construct a linear scale for the x-axis that is appropriate for the values in the data array, and then construct a histogram from the provided data array, with x- and y-axes. Use any d3 functions that are useful. (20 pts)

3. Normal distribution. Use `d3.random.normal()` to create a function called `normal`, which will return random values drawn from a normal (Gaussian) distribution. Create a function `normal1000` that will generate an array of 1000 samples from your `normal` function. Sample an array from this function and use your `plotHistogram` function to create a density plot of this data. (10 pts)

4. Now create an array of length 100, where each element is the *mean* of an array returned by your `normal1000` function (that is, generate the means of 100 different arrays). The function `d3.mean()` will be useful. Use your `plotHistogram` function to create a density plot of this array of means. Does it have roughly the same shape

as the plot from Problem 3, and does it have the same x-scale? If not, how is it different? (10 pts)

5. Exponential distribution. You can generate a sample from this distribution with this expression:

```
-Math.log(Math.random())
```

Create a function `exponential1000` that will generate an array of 1000 numbers drawn from an exponential distribution. Sample an array from this function and use your `plotHistogram` function to create a density plot of this data. (10 pts)

6. Create an array of length 100, where each element is the *mean* of an array returned by your `exponential1000` function. Use your `plotHistogram` function to create a density plot of these means. Does the histogram of the *distribution* (from the previous problem) look like the histogram of the *mean* of samples from the distribution? If not, how is it different? (10 pts)

7. Cauchy distribution, a badly behaved distribution. You can generate a sample from this distribution with this expression:

```
normal() / normal()
```

where `normal` is the Gaussian random variable generator function you created in Problem 2. In words, the expression samples two independent Gaussian random variables and returns their *ratio*.

Create a function `cauchy1000` that will generate an array of 1000 numbers drawn from a Cauchy distribution. Sample an array from this function and use your `plotHistogram` function to create a density plot of this data. (10 pts)

8. Create an array of length 100, where each element is the *mean* of an array returned by your `cauchy1000` function. Use your `plotHistogram` function to create a density plot of these means. Does the histogram of the means from this distribution look like the histograms of means from Problems 4 and 6? If not, how is it different? (10 pts)