

# MATH 3341 — Spring 2020

## Lab 13: Random Numbers, Histogram & Monte Carlo Integration

Download `Math.3341.Lab.13.zip`, unzip it by following the Windows Instructions on WyoCourses. Change the current working directory of MATLAB to the unzipped folder, and type `edit lab_13_script` in the Command Window.

### 1 RANDOM NUMBERS AND HISTOGRAM

- (a) Create a vector `x_uniform` of length  $N = 10000$  random numbers, which are uniformly distributed on the interval  $[-3.5, 3.5]$ , using `rand`.
- (b) Create a vector `x_normal` of length  $N = 10000$  random numbers, which are normally distributed with zero mean  $\mu = 0$  and unit variance  $\sigma^2 = 1$ , using `randn`.
- (c) Create histograms for `x_uniform` and `x_normal`.

### 2 MONTE CARLO INTEGRATION

- (a) Open `lab_13_example.m` and `monteCarlo.m`. Go through `lab_13_example.m`, see how the script is written to use Monte Carlo Integration to integrate the function  $f(x, y) = 1$  over the disk  $x^2 + y^2 \leq 1$ . Then convert the Monte Carlo Integration part in the script to a function in `monteCarlo.m`.
- (b) Then in `lab_13_script.m`, use `monteCarlo.m` to evaluate the following integral using  $N = 100000$  samples:

$$\int_{-1}^1 \int_{2x^2}^{1+x^2} (x + 2y) dy dx.$$

- (c) Use the built-in function `integral2` to evaluate the above integral, and compare the error between these two integrations.

Finally, call `diary('lab_13_output.txt')`, run the script `lab_13_script.m`, and then call `diary off` to save the output. Upload the script file `lab_13_script.m`, function file `monteCarlo.m`, figure file `lab_13_figure.pdf`, and output file `lab_13_output.txt` to Overleaf. Recompile, and submit the generated .pdf file on WyoCourses.