MATH 3341 — Fall 2021

Lab 13: Random Numbers, Histogram & Monte Carlo Integration

If you haven't downloaded and unzipped `Math.3341.zip`. Download and unzip it under `H:` (H Drive if you are working on the Remote Lab). Change the current working directory by typing `cd H:\Math.3341\Math.3341.Lab.13` in the Command Window, and type `edit lab_13_script` in the Command Window to edit `lab_13_script.m`.

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 historgrams 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.