CSUS College of Engineering and Computer Science
Electrical & Electronic Engineering
ENGR 120 Probability and Random Signals

Computer Assignment 1: The Gaussian Random Variable

Generation of random variables is of paramount importance in simulating communication systems. The objective of this assignment is to visualize and generate a standard normal random variable, and plot its probability density function (PDF) from the generated data. The following tasks will require the use of Matlab to generate a standard Gaussian random variable *X~N(0,1).* Attach all figures with the corresponding MATLAB code.

Task 1: Use Matlab to generate a standard Gaussian random *X,* i.e. a sufficiently large vector of normally distributed random variables. Use the generated data to plot the random variable *X*.

Task 2: Use the generated data in Task 1 to plot the PDF of *X*.
Hint: you may find these Matlab functions helpful for Task 1 and Task 2, randn(.) and histogram(.).

Task 3: Plot the theoretical PDF of this random variable – use suitable values for *x*. Overlap the theoretical plot with the simulated plot generated in Task 2. Recall the PDF of *X* is

$$f_X(x) = \frac{1}{\sqrt{2\,\pi}}\, e^{-\frac{x^2}{2}}$$

Task 4: Use Matlab to calculate the total area under the plotted curve in Task 3. This should represent the total area (or probability) under the PDF. *Hint: you may find this function helpful for this step* trapz(.,.). For this task, simply write down the output of this function.

Task 5 (optional): Use the Matlab function trapz(.,.) along with the theoretical PDF plotted in Task 3 to calculate the probability *P* (*X*>2). Use the Q-function to verify this result. For this task, simply compare the two results. Are they the same?

Use these figures as guide for Tasks 1-3. Your plots should look similar but not necessarily the same.