# ENGINEERING TRIPOS PART II A

**EIETL MODULE EXPERIMENT 3F3 RANDOM VARIABLES and RANDOM NUMBER GENERATION**

**Short Report Template Name:**

**College:**

**Lab Group Number:**

**This is a template suitable for the short report write-up. Simply edit the Latex or Word document to include your calculations/ results/ code.**

1. **Uniform and normal random variables.**

Histogram of Gaussian random numbers overlaid on exact Gaussian curve (scaled):

*Include your graphic here*

Histogram of Uniform random numbers overlaid on exact Uniform curve (scaled):

*Include your graphic here*

Kernel density estimate for Gaussian random numbers overlaid on exact Gaussian curve:

*Include your graphic here*

Kernel density estimate for Uniform random numbers overlaid on exact Gaussian curve:

*Include your graphic here*

Comment on the advantages and disadvantages of the kernel density method compared with the histogram method for estimation of a probability density from random samples:

*Text answer here*

Theoretical mean and standard deviation calculation for uniform density as a function of *N* :

*Text/maths answer here*

Explain behaviour as *N* becomes large:

*Text/maths answer here*

Plot of histograms for *N* = 100, *N* = 1000 and *N* = 10000 with theoretical mean and *±*3 standard deviation lines:

*Include your graphic here*

Are your histogram results consistent with the multinomial distribution theory?

*Text/maths answer here*

1. **Functions of random variables** For normally distributed *N* (*x|*0*,* 1) random variables, take *y* = *f* (*x*) = *ax* + *b*. Calculate *p*(*y*) using the Jacobian formula:

*Text/maths answer here*

Explain how this is linked to the general normal density with non-zero mean and non-unity variance:

*Text/maths answer here*

Verify this formula by transforming a large collection of random samples *x*(*i*) to give *y*(*i*) = *f* (*x*(*i*)), histogramming the resulting *y* samples, and overlaying a plot of your formula calculated using the Jacobian:

*Include your graphic here*

Now take *p*(*x*) = *N* (*x|*0*,* 1) and *f* (*x*) = *x*2. Calculate *p*(*y*) using the Jacobian formula:

*Text/maths answer here*

Verify your result by histogramming of transformed random samples:

*Include your graphic here*

# Inverse CDF method

Calculate the CDF and the inverse CDF for the exponential distribution:

*Text/maths answer here*

Matlab code for inverse CDF method for generating samples from the exponential distribution:

*Matlab code here*

Plot histograms/ kernel density estimates and overlay them on the desired expo- nential density:

*Include your graphic here*

1. Simulation from a `difficult' density.

Matlab code to generate N random numbers drawn from the distribution of X:

Plot some histogram density estimates with alpha= 0, 1.5 and several values of beta :

Hence comment on the interpretation of the parameters alpha and beta: