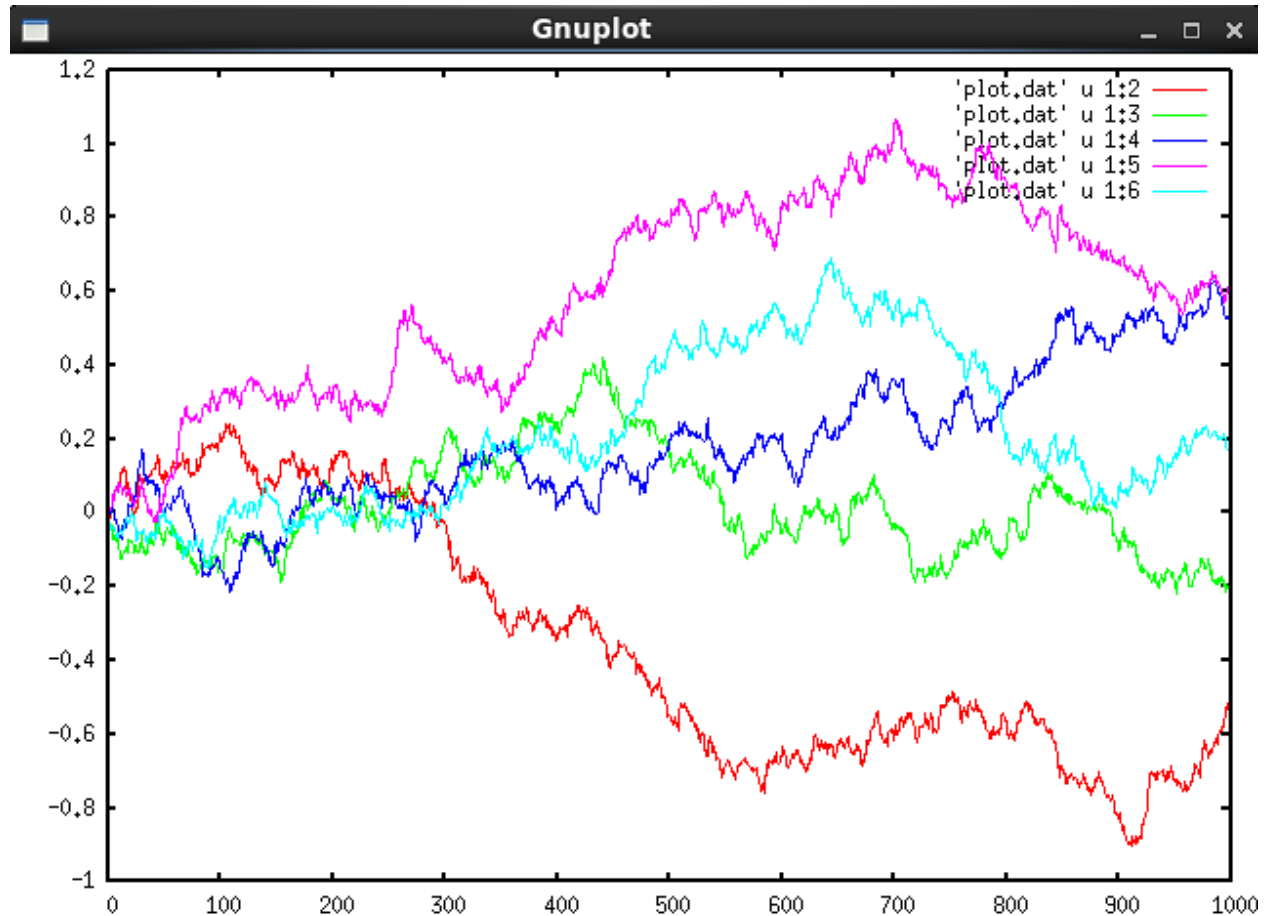


# 5637 Stochastic Differential Equations in Finance Report

## Part 1: Implement random number generator to simulate brownian motion.

Before I wrote my own random number generator to simulate brownian motion, I used the `gnu_ran_gaussian()` from `gsl` library.

The following picture is a sample of 5 brownian motions plotted by gnuplot with data generated from my cpp code:



qs1: generator of gaussian distributed number?

## Part 2: Write software to solve the differential equation.

qs2: runge-kutta

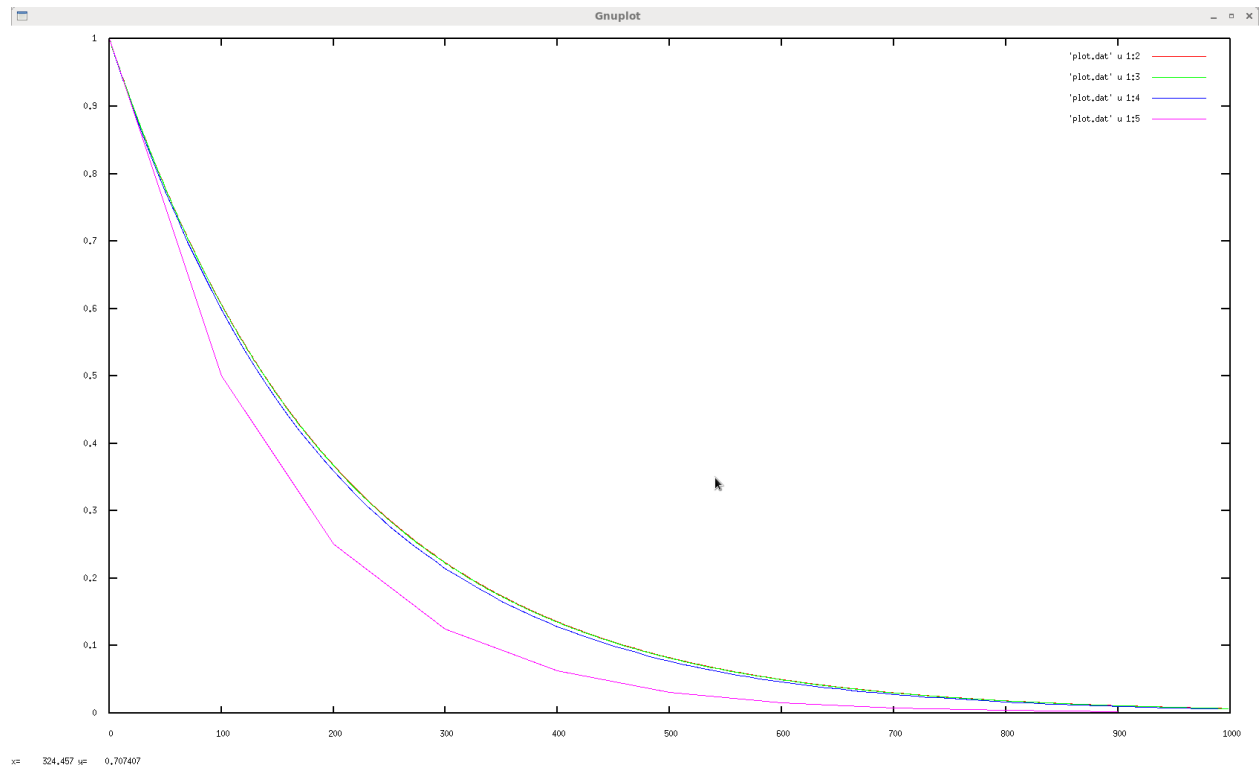
The equation given is:

$$dx = -5x dt, x(0) = 1,$$

Solving this equation step by step I got  $x = e^{-5t}$  and in c/c++ language should be written as  $x = \exp(-5*t)$ .

Solving this equation by euler method, I got  $X_{n+1} = X_n + h * (f(t_n, X_n))$ .

I implemented euler method with 3 different step sizes in  $[0,1]$ : 0.1 is the purple line in the below picture, 0.01 is the blue line and 0.001 is the green line. At the same time the analytic solution is also plotted as the red line with step size 0.001. We can see in the graph red line and green line coincide with each other.



### Part 3: Solution of one dimensional SDEs.

(a):

(b):

### Part 4: Two dimensional SDE.

**Part 5: Heston stochastic volatility model.**

**Part 6: Solve.**

**Part 7:**