Maths 190
Topics be covered for the week of 06 - 10 March 2017

For this week, we aim to cover the following theories/concepts:

1. Three martingales of a Brownian motion (Coverage of Long Exam 2 will include this topic.)

2. **Calculus of Brownian motion (continued)**
   Analysing the qualitative behaviour of W_t, its properties and how it's being employed in financial modelling

3. Stochastic differential equation of the form $dX_t = \mu(X_t, t)dt + \sigma(X_t, t)dW_t$

4. Itô's lemma/Itô's differentiation rule

5. The "multiplication rule"

6. The geometric Brownian motion as a model for price dynamics

7. Some applications and examples

8. Simulation of random walk and its convergence to Brownian motion

9. Basics of Monte-Carlo simulation. Application to valuation of options and implementation in the Excel software will be considered.

10. Partial differential equation (PDE) approach in valuation: The intent here is to derive the PDE, with terminal condition, that satisfies the price of a derivative security. Here, we shall consider a portfolio whose value is Π in which the holder is short one derivative security and long an amount of $\frac{\partial f}{\partial S}$ of shares, where S is the price of the underlying asset and f is the price of a derivative security.

11. The Feynman-Kac's result linking the solution of a PDE to conditional expectation will be presented without proof