Problem Set 1: Path simulation

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1 Exercise 1

Generate 10000 Wiener process paths in the interval $[0, 1]$ with 100 equal simulation steps.

Draw the first 10 paths

2 Exercise 2

Generate 10000 Wiener process paths in the interval $[0, 1]$ with 100 equal simulation steps using the cumsum from the numpy package.

Draw the first 10 paths.

3 Exercise 3

Generate 10000 paths of geometric Brownian motion (Black-Scholes model) on the interval $[0, 3]$ (i.e. up to three years) with 12 simulation steps per year with three methods (accurate discretization, Euler scheme and Milstein scheme) based on the same samples from the normal distribution while considering $r = 0.02$, $\sigma = 0.25$.

Compare the first paths obtained by each method in one drawing.

4 Exercise 4

Generate 10000 CIR process paths in the interval with 252 simulation steps (Euler and Milstein Scheme) based on of the same samples from the normal distribution while considering $\kappa = 10.0$, $\theta = 0.03$, $r_0 = 0.05$, $\sigma = 0.25$.

Compare the first paths obtained by each method in one drawing.

5 Exercise 5

Generate 10000 paths of two correlated Wiener processes on the interval $[0, 2]$ with 252 simulation steps per year and 0.9 correlation.

Draw the first paths of both processes in one drawing.

6 Exercise 6

Generate 100 paths of three correlated Wiener processes on the interval $[0, 1]$ with 252 simulation steps per year and correlations $\rho(W1, W2) = 0.9$, $\rho(W1, W3) = -0.7$, $\rho(W2, W3) = -0.7$.

Draw the first paths of three processes in one drawing.