MATLAB REPORT

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Problem 1: Stochastic BOD model using Euler- Murayama scheme

Theory

The Euler–Maruyama method (also called the Euler method) is a method for the approximate numerical solution of a stochastic differential equation (SDE). It is an extension of the Euler method for ordinary differential equations to stochastic differential equations.

Stochastic BOD model:

$$\frac{dB_t}{dt} = -K_1 B_t + s_1 - B_t \sigma \xi_t, \quad B_{to} = B_o$$

In terms of Weiner process:

$$dB_t = (-K_1 B_t + s_1)dt - B_t \sigma dW_t, \quad B_{to} = B_o$$

Since the white noise process in this stochastic model is a mathematical approximation of a noise process with a relatively short correlation scale, this SDE has to be interpreted in the Stratonovich sense. Since the Euler scheme can only be used for Itô equations, the model above rewritten as an Itô SDE:

$$dB_t = \left(-K_1 B_t + s_1 + \frac{1}{2} B_t \sigma^2\right) dt - B_t \sigma dW_t, \quad B_{to} = B_o$$

The Exact solution is given by the equation:

$$L_t = L_0 \, e^{-kt}$$

RESULT: The figure shows plot between B(t) and Time, red line indicating the exact solution and blue line showing the solution given by Euler Maruyama method, on comparing, we can see that the deviation is much smaller and we can to some extent use Euler Maruyama method for solving complex SDE models.