MTH371 - Stochastic Processes and Applications
Assignment 2 Report

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1 Question 1

In this question, there were two tasks:
Simulate two zero-mean Gaussian processes, with the following covariance matrices:

- $K(i,j) = e^{-16(i-j)^2}$
- $K(i,j) = min(i,j)$

The plots obtained are shown in Figure 1.

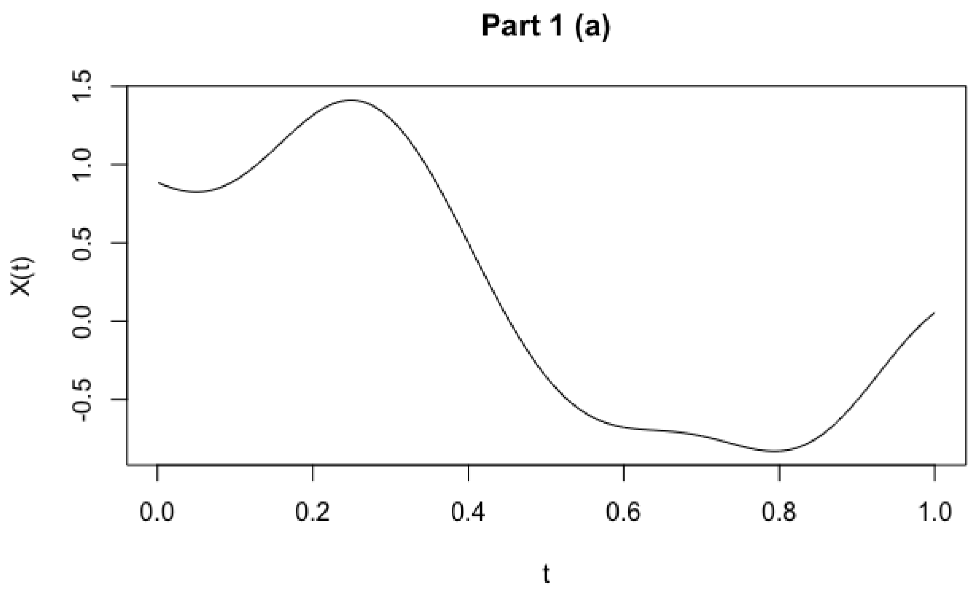
1.1 Task 1

For this task, I performed the following steps:

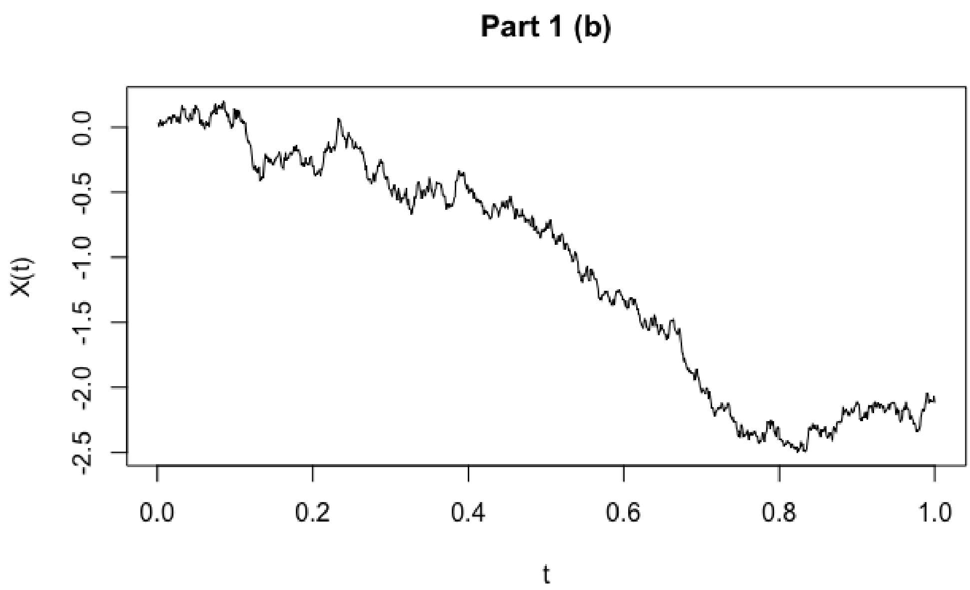
- Generated an array `t` with values from 0 to 1 with a step of 0.001. This would be my time steps.
- Then, initialize a 2-D array for holding the covariance matrix
- Iterate over this array and populate it covariances using the Kernel functions and the values in t.
- Initialize the zero vector for the mean vector.
- Finally use the function `mvrnorm` to get the values of the Gaussian process for the time steps.
- Finally, plot the values of the Gaussian process versus the time steps.

1.2 Task 2

I used the same procedure as Task 1.1. Except, now for the covariance function I used the function, $K(i,j) = min(i,j)$.



(a) Task 1: $K(i,j) = e^{-16(i-j)^2}$



(b) Task 2: $K(i,j) = min(i,j)$

Figure 1: Plots generated for Q1.

2 Question 2

In this question, we had to simulate a symmetric random walk, with the starting point as 10 and absorbing boundaries at 0 and 20. In order to do this, I performed the following steps:

- First I initialized a variable `stake` to store the current value of the stake, which is initially 10.
- I also initialized an array, `record`, with the current value of the stake.
- I then entered an infinite loop, where I sampled a random number. If I got a number less than 0.5, I decresed the `stake` variable by 1, else I increased it by 1. If the `stake` varibale reached 0 or 20, I exited the loop.
- At the end of each iteration I appended the updated value of the `stake` variable to the `record` array.

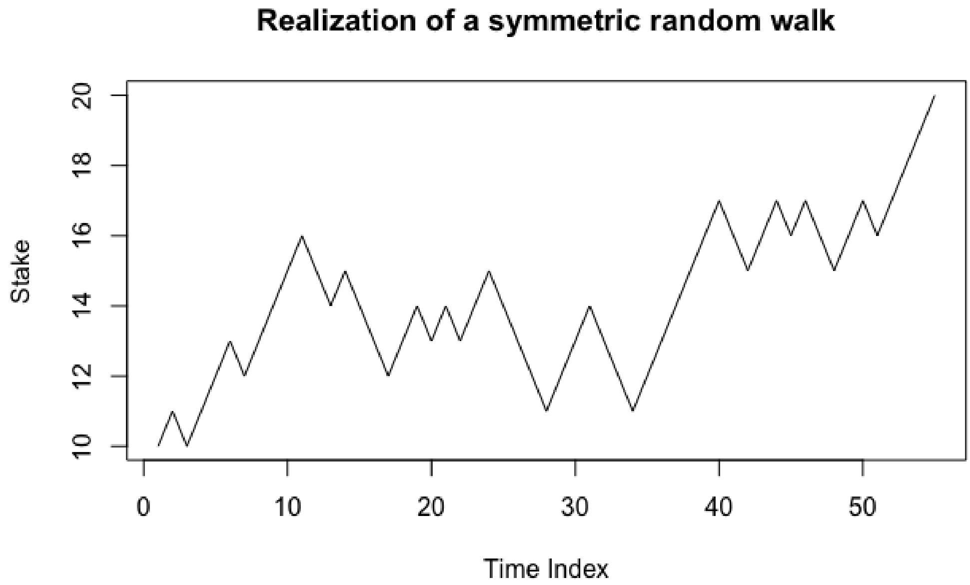


Figure 2: Realization of a symmetric random walk with initial value 10 and absorbing boundaries at 0 and 20.

- After exiting the loop, I plotted the `record` array versus the time index.

The resultant plot is shown in Figure 2.

3 Code Dependencies

The code for Problem 1 requires the `MASS` package in `R` to run.