Report for Point Process Assignment 1

Zhaoyu Li

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1 Introduction

Thinning algorithm is a prominent method for simulating point process. In order to improve the understanding of the thinning algorithm and point process pattern, in this assignment I implement thinning algorithm for multi-dimensional hawkes process simulation.

2 Prerequisites

I implement the assignment using Python API. To run my code, **numpy**, **pickle**, **matplotlib** and **easydict** should be installed. All the parameters are stored in **utils/config.py**. You can use your own parameters by changing **experiment.yaml** if you like. Run **python assignment1.py – cfg experiment.yaml** to simulate 1000 sequences with a maximum length of 200. The generated event sequences are stored in **output/len200_num100** and the results are showed in Section 4.

3 Encountered Problems

At first, I am confused how to use thinning algorithm to generate events in different dimensions. Specifically, I am not very familiar with attribution-rejection test in simulation of multi-dimensional hawkes process. After reviewing the knowledge on the slide as well as asking to TA, it's all clear to me.

4 Results and Analysis

In this assignment, I simulate 1000 multi-dimensinal hawkes sequences with a maximum length of 200. The number of different dimensional events in one of my simulation is showed in Table 1 as below:

Table 1: Number of Different Dimensional Events

Dimension	0	1	2	3	4	5	6	7	8	9
Number	19	30	11	15	26	15	21	17	27	19

I also use **matplotlib** to plot the event sequence and intensity function as well. The result is showed in Figure 1 as below:

From Figure 1, we can see the intensity function increases exponentially. It is mainly because the weight decay $w = 0.01$ is too small, which makes the time interval of two events becomes short

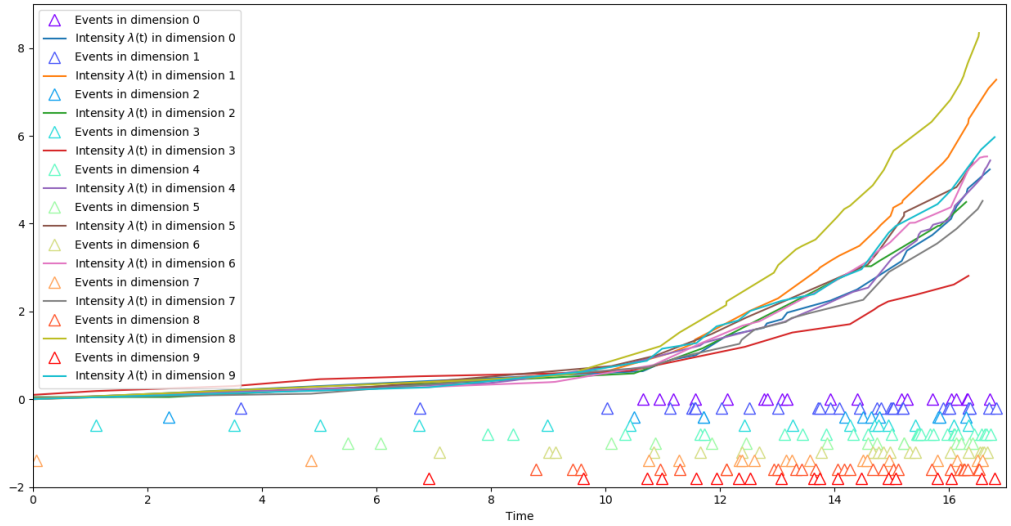

Figure 1: Simulation of Multi-dimensional Hawkes Process.

and the influence of former events exert a tremendous influence on the next event. If we change weight decay $w = 0.5$, the result is showed in Figure 2, which indicates larger w makes the interval of two events longer and reduce the influence of former events. From Table 1, we can know the events in different dimensions are quite equal. However when $w = 0.5$, note that the number of events happen in dimension 3 is far much more than others. It is because the base intensity μ of dimension 3 is the largest and its influence is larger than the former events because of the larger weigh decay w. In general, μ, A and w decide how to generate the next event sequence and how the former events influence other events in different dimensions.

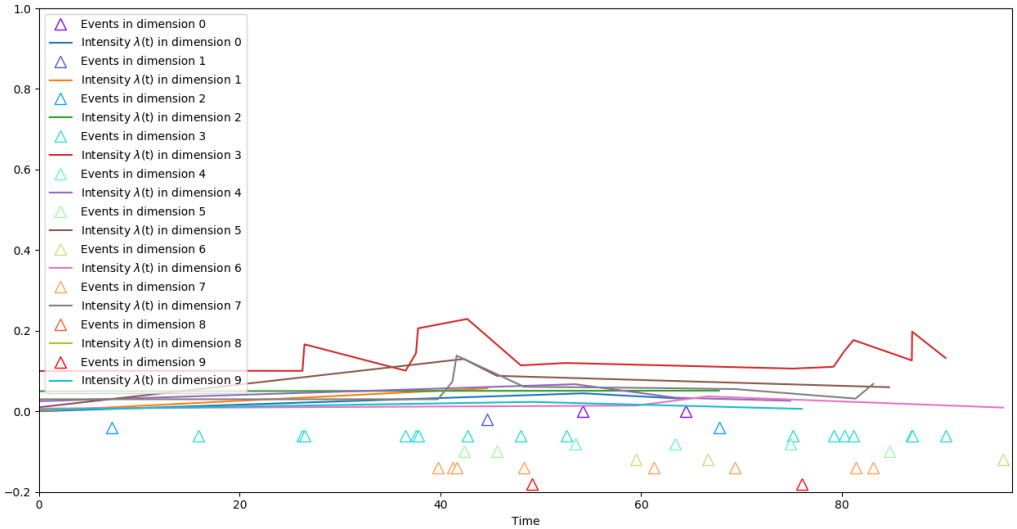

Figure 2: Simulation of Multi-dimensional Hawkes Process with $w = 0.5$.