## STAT 534 - Lecture 24

## Modeling Point Patterns using NHPPs

- Statistical modeling depends on a sampling model for the data and the associated likelihood function.
- Conditional on the number of points, Num(D) = n, the location density can be specified as:
- Then condidering the location and number of points simultaneously, we have

$$f(s_1, \dots, s_n, Num(D) = n) = \prod_i \frac{\lambda(s_i)}{(\lambda(D))^n} \times$$

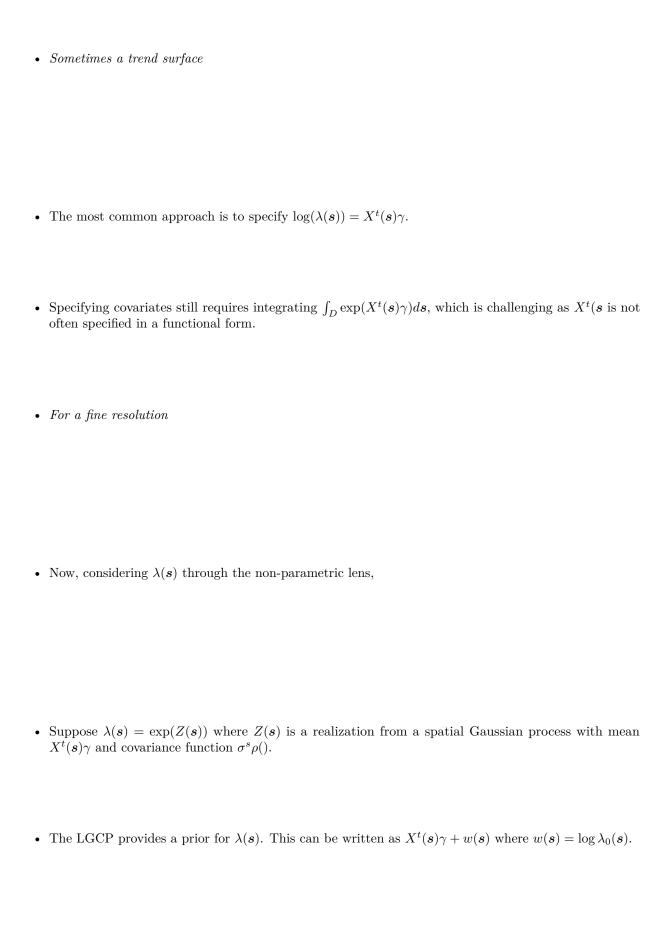
• Finally, the likelihood is

• Alternatively, consider a fine partition for D, then using the Poisson assumption, the likelihood is the product of the counts across the partitions.

$$\prod_{l} \exp(-\lambda(A_{l}))(\lambda(A_{l}))^{Num(A_{l})}$$

As the grid becomes finer,  $Num(A_l) \in \{0, 1\}$ .

•	The likelihood is a function of the entire intensity surface $\lambda(s)$ .
•	<b>Discuss</b> : how could $\lambda(s)$ be obtained?
•	There are two general approaches for modeling $\lambda(s)$ :
•	A simple, but "silly" example of a parametric form would be $\lambda(s) = \sigma \lambda_0(s)$ .
•	Suppose remoted-sensed covariate information is available on a grid. How might this be used for constructing $\lambda(s)$ ?
•	In general a parametric function $\lambda(s;\theta)$ could be specified, but it would required a richly specified class that would need to be non-negative. A common approach for this type of problem is to use a set of basis functions such that $\lambda(s;\theta) = \sum_k a_k g_k(s)$ .
•	Sketch a set of basis functions to create a multimodal curve in 1D.



- **Discuss**: How to fit a model for a LGCP?
- In the parametric setting,

• In the non-parametric setting,

- Thus priors are needed
  - -In general algorithms for this type of data are computationally intensive.
- Due to the challenges in modeling LGCP, the data is sometimes considered on a grid. Then the intensity for grid i could be estimated as:

$$\log \lambda_i = X_i^t \beta + \phi_i.$$

However, the results can be sensitive to the grid specification.