3 Minute Student Talks

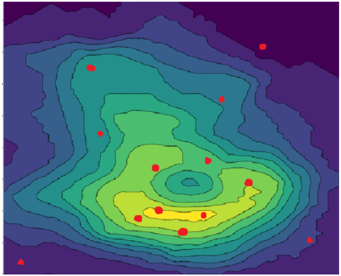
SAMBa

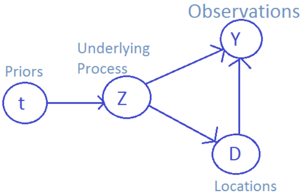
Aoibheann Brady

Attribution of Large Scale Drivers for Environmental Change

Spatial Statistics and Preferential Sampling!

- Stochastic dependence between unknown underlying process and sampling locations.
- Dependent on the *utility* of a design.
- Example: Monitoring pollution levels.





- How do we deal with this?

Matthew Griffith

An Increased Model Height in the Met Office's Unified Model

Log-Gaussian Cox Processes

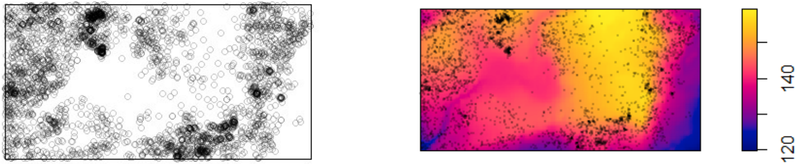


Figure: Locations of 3605 trees in rainforest, bei dataset

Homogeneous Poisson Process	**Inhomogeneous Poisson Process**	**Cox Process**
$N(A) \sim Po(\lambda \lVert A \rVert)$	$N(A) \sim Po(\int_A \lambda(\boldsymbol{x})dx)$	Stochastic intensity function $\Lambda(\boldsymbol{x})$ $\Lambda(\boldsymbol{x}) = \lambda(\boldsymbol{x}) \implies$ Inhom. PP

Understanding Measure-valued Martingales

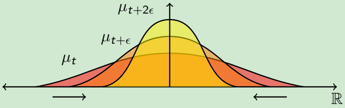
Definition

A stochastic process $(\mu_t)_{t\geq 0}$ is said to be a **measure-valued martingale** (MVM), i.e. $\mu_t \in \mathcal{P}^1(\mathbb{R})$ (integrable) $\forall t \geq 0$, and $\mu_t(A)$ is a martingale $\forall A \in \mathcal{B}(\mathbb{R})$.

Formulation of the Problem

Given that μ_t has a constant "speed" (exact sense to be determined...), what is the MVM that makes $\mathrm{var}(\mu_t) := \int z^2 \mu_t(dz) - \left(\int z \mu_t(dz)\right)^2$ decrease as fast as possible (on average)? What about general functions F of μ_t, not just variance? The aim is to use the JKO scheme by extending its application to measure-valued processes.

Example



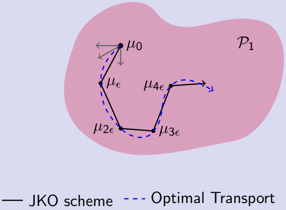
Fact: a measure-valued martingale has shrinking support.

Financial Application

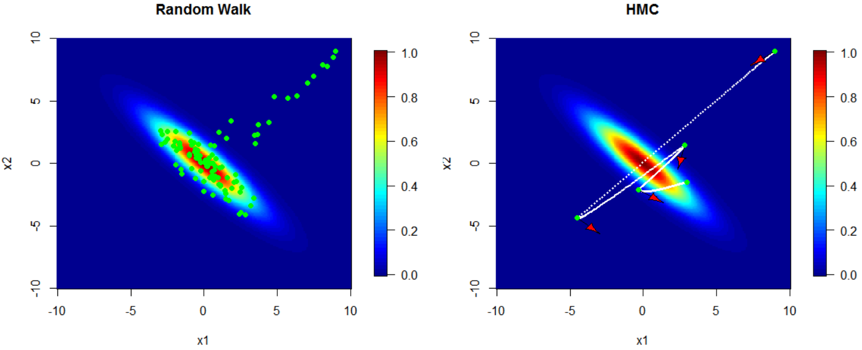
Variance swaps: speculating on or hedging the risks associated with the volatility of the underlying financial product (exchange rates, interest rates, stock index).

Jordan-Kinderlehrer-Otto (JKO) scheme

The JKO scheme is a time discretisation scheme that allows us to find the unique (local) minimising direction (gradient flow) of F at each point in the Wasserstein metric space $\mathcal{P}_1$. Optimal transport theory tells us that if we take the mesh size to zero we get a geodesic.



Large Scale
Differential Geometric MCMC



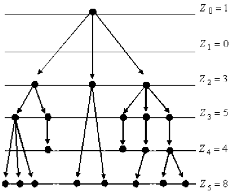
Tom Pennington

Lizzi Pitt

First in Human Trials

Simple Branching

Figure: GW Process



$$Z_{n+1} = \sum_{n=1}^{Z_n} A_j^{(n+1)}$$

$\downarrow$

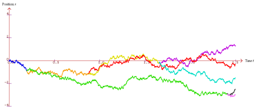
Continuous-time Galton Watson process $\rightarrow$

$\downarrow$

Continuous-time BP

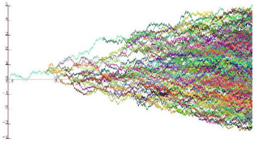
Spatial consideration

Figure: Branching RW



$$X_n(\cdot) = \sum_{n=1}^{Z_n} \delta_{x_i^n}(\cdot)$$

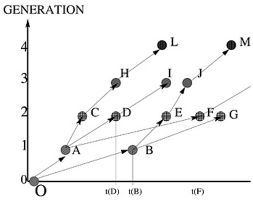
Figure: Branching Brownian Motion



$$X_t(\cdot) = \sum_{n=1}^{Z_t} \delta_{x_i^t}(\cdot)$$

Ex: Spatial Position = Birth time

Figure: CMJ process



(a)

Definition

A *spatial branching process* is branching phenomenon + spatial motion given by a Markov process.