Adaptive Sensor Placement for Continuous Spaces

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PROBLEM

- Placing sensors to detect events of interest,
  - **Maximise number of events detected** minus cost.
- Events arise according to a Non-homogeneous Poisson process.
- We are interested in a sequential version of the problem,
  - **Continuum-Armed Bandit**.

Events generated according to a Poisson process. The green interval is the selected sensing region.
We consider the regret minimisation framework and require an approach which tackles the following challenges:

- **Scalable inference**
  - Dependence on number of observed events important

- **Continuous action space**
  - Determining the best amongst infinitely many actions

- **Appropriate exploration/exploitation**
  - UCB, TS etc. - need to be adapted to point process data.
We propose an approach which meets the challenges by use of

- **Bayesian histogram**
  - Efficient nonparametric estimation, asymptotically optimal error shrinkage
- **Progressive discretisation**
  - Both of histogram and action space.
- **Thompson Sampling**
  - Readily deployable without tuning UCBs

Bayesian histogram confidence intervals, showing progressive discretisation
We have a **bound on the Bayesian Regret** of order $\tilde{O}(T^{2/3})$, and **strong empirical performance**.
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