Comment on “Cosmic structures” and on “Analysis of spatial point patterns

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Cosmic structures

- Initial conditions
- N body simulations
- Map of the universe
Cosmic structures

Initial conditions

N body simulations (some aspects still unclear)

Map of the universe (sampling/data issues)
Cosmic structures

Initial conditions

N body simulations (some aspects still unclear)

Map of the universe (sampling/data issues)

Similar to goodness-of-fit testing in spatial point process model fitting.

model  ───→  simulated realizations  ───→  actual data
• Martínez proposes Minkowski functionals.

• Properties of excursion sets of density fluctuations about the mean at multiple scales.

• galaxy data $\rightarrow$ density $\rightarrow$ wavelets $\rightarrow$ MF’s
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• Properties of excursion sets of density fluctuations about the mean at multiple scales.

• galaxy data \(\rightarrow\) density \(\rightarrow\) wavelets \(\rightarrow\) MF’s

• Why use \(v_3\), number of holes in the excursion set?

• How does one understand/interpret deviations of empirical \(v_3\) from, say, that of the Gaussian?

• Is \(v_3\) affected by the boundaries of the survey?
• Different surveys yield different estimates of correlation length, e.g. 2dF vs SDSS – ascribed to different galaxy content in the 2 surveys.

How to tell if differences in results between surveys are due to actual differences, or just random variation?

• Can we combine information from different surveys?
Analysis of spatial point patterns

• Extended residuals for 1-D pt process to general spatial pt processes, using the Papangelou conditional intensity.

• Having diagnostic plots is useful.

• Possibility of separating clustering from inhomogeneity.
For $u \in B$, $\lambda(u, X)$ is probability of having a point at $u$, given point process $X$. 

$\int_B \lambda(u, X)$ – add up probability for all points in $B$; related to expected number of points in $B$
• Mark plot appears difficult to interpret:
  • residuals correlated;
  • residuals are zero when summed over B;
  • which B?

• Lurking variable plot – pts on line are dependent; difficult to judge in less clear-cut cases?

• Many types of residuals can be defined, using different h’s. Need guidelines for practitioners. How to proceed if different residuals yield different conclusions?
• If clustering and inhomogeneity (spatial trend) are present and incorrectly modelled, would one be masked by the other and not show up in the diagnostic plot?

• Large datasets in 3-D – challenges for visualization and computation.

• Can the method be applied to dynamic models, in terms of initial conditions?
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