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Project 4.42 | Spatial modelling of health services data

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Objectives To develop innovative statistical models for the in-depth analysis of participation in health services, in order to provide meaningful inference to the policy maker. This work forms part of CRCSI Project 4.42 'Spatio-temporal modelling of cancer incidence, mortality and survival', whose key objectives include the development of statistical models for improved estimation of cancer risk and methods for informing health service planning and management.

Outcomes The project has delivered a suite of data-driven tools for informing decisions on resource management, based on current utilisation trends. The key benefits of the methodology developed include the incorporation of multiple sources of spatial information, the flexible prediction of service catchments and the characterisation of spatial trends in latent demand

Introduction

The successful delivery and uptake of public health initiatives has been linked with numerous economic and quality-of-life benefits. Spatial modelling of health services data has the potential to provide substantial insight into various aspects of service provision including underlying trends in regional uptake, service catchment zones and the influence of known drivers of service use

Project Achievements: building on current practice

	Current Methods	Tools Developed	End-user benefits
Catchment prediction	• Based on a fixed distance from service • Common across services	• Probability based • Distance effect inferred from data • Effects allowed to vary by service	• Allows for multiple definitions of service catchments, as a function of "confidence"
Management of model uncertainty	• Deterministic criteria for inputs • Lack of statistical uncertainty in outputs	• Bayesian methods • Faciliate expression of uncertainty in both model inputs and outputs • Spatial smoothing of local neighbourhoods	• Wider range of model-based inferences • More robust estimates given small areas/sparse data
Demand-based decision making	• Population based • Driven by risk factors	• Demand is broken down into measurable and latent factors	• Improved identification of areas for future service promotion

Case Study

- Data on a no-fee mammography service in Brisbane, Queensland.
- Data is available on individual visits from January 2007 – December 2008, indexed spatially by participants' are of residence at time of screening (Statistical Local Area)
- No prior knowledge was available on current service catchments

Results 2: Management of uncertainty

- Catchment decisions can be made by defining areas that exceed a cut-off probability
- Prediction as a function of statistical confidence
- Implications for size of catchment; predictive performance

Results 3: Demand-based decision making

- Quantifying "latent demand" = demand not explained by risk factors (eg. distance to service) + uncertainty
- Improved prediction of small area demand that falls short/exceeds expectations: implications for resource management

Results 1: Catchment prediction

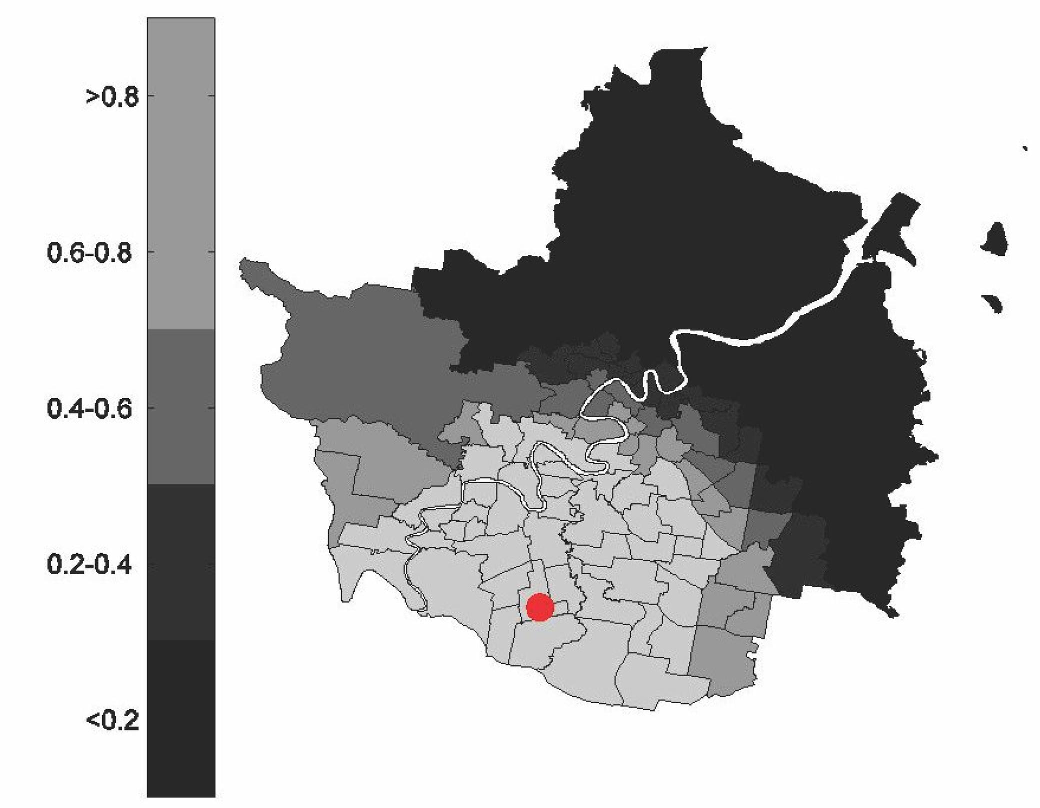

Figure 1: Example catchment for single service. Probability bands reflect probability of SLA accessing service, denoted in red.

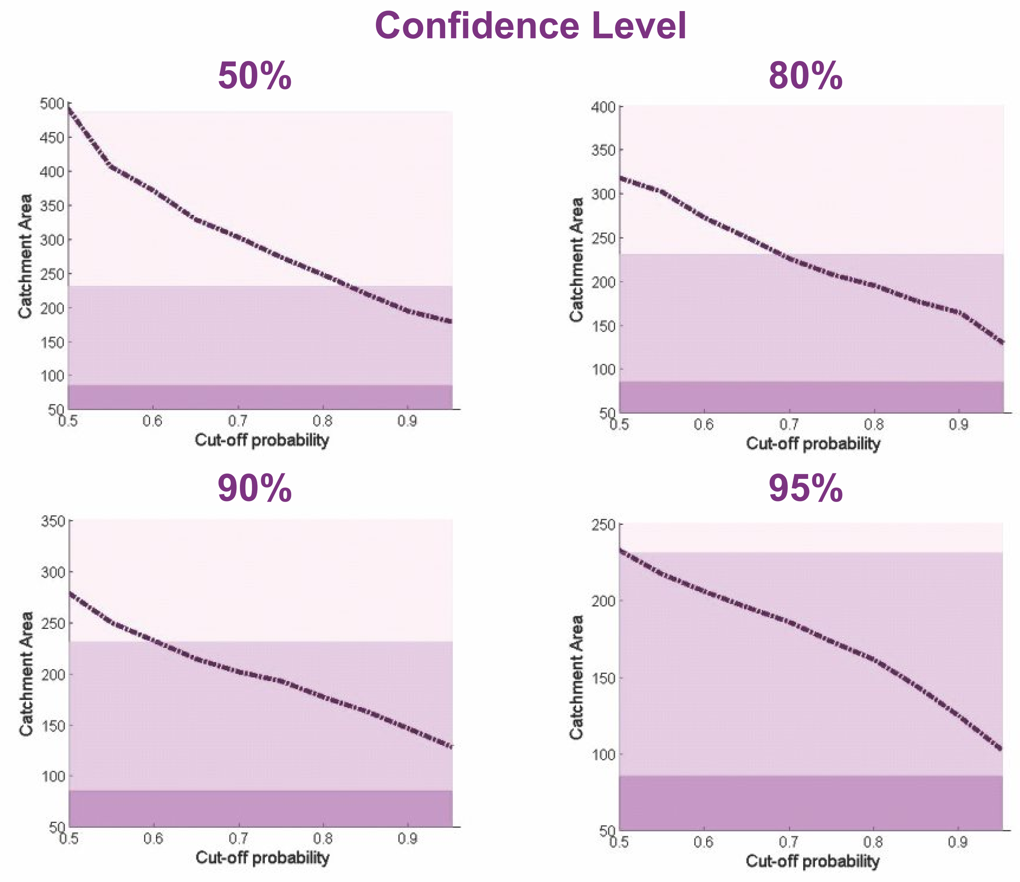

Figure 2: Predicted catchment areas (km2) for select catchment probability cut-offs, as a function of confidence. The shaded sections represent areas from fixed distance cut-offs (5,10,15km)

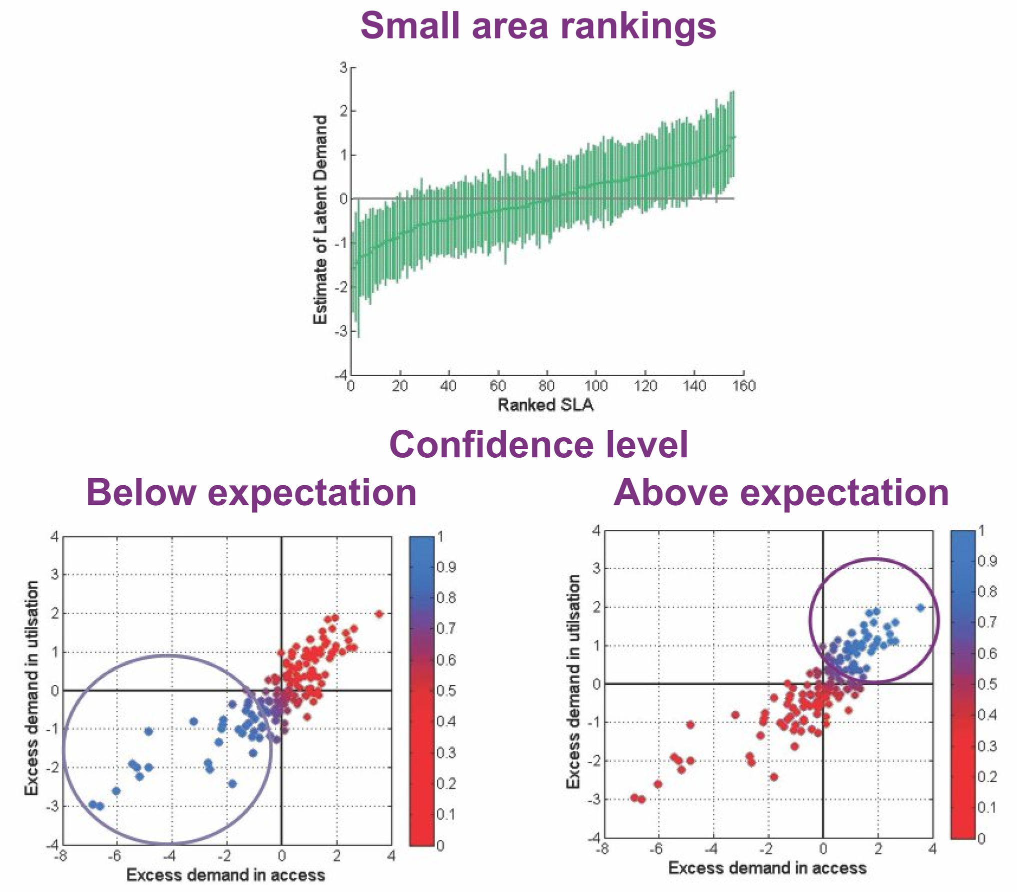

Figure 3: Ranking of SLAs by overall latent demand (top); Identifying regions of under/over latent demand in terms of access and utilisation (both). Circled areas represent small areas with high probabilities of the event

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