

Conditional Phase-type Distributions for Modelling A&E Trolley Waits

Adele H. Marshall¹

¹ Centre for Statistical Science and Operational Research, (CenSSOR), Queen's University of Belfast, Belfast, BT7 1NN, UK

This paper uses a C-Ph model to investigate the duration of trolley waiting times of patients in an A&E department in a Northern Ireland based hospital. The conditional phase-type (C-Ph) distribution consists of a Coxian phase-type distribution conditioned on a Bayesian network (BN) where the phase-type distribution represents a continuous survival variable, the duration of time until a particular event occurs and the BN represents a network of inter-related variables. Previous research has shown how the C-Ph model can adequately represent skewed survival data typical of patient duration of stay in hospital while also facilitating the identification of patient characteristics which collaborate together to influence patient survival. The C-Ph model was initially applied to the healthcare domain to represent the duration of stay of elderly patients in hospital based on patient information known on admission. This provided the potential of using the model as a management tool for identifying potential bed blockers in the healthcare system.

The UK National Health Service (NHS) has received a large amount of media attention concerning their provision of care to the general public. Under particular scrutiny are the queues in which patients are waiting at Accident and Emergency (A&E) departments and the resulting trolley waits they accrue. Upon receipt of their treatment, A&E patients either leave hospital and return home or they become an emergency admission requiring further medical care or attention during a stay in hospital. The *trolley waits* are the times that the emergency admission patients spend waiting in a hospital trolley, from the clinician's decision to admit (DTA) until they are allocated a hospital bed. The UK Government have now placed targets on these trolley waiting times in order to monitor the efficiency of hospitals with the view of motivating healthcare managers to improve the service of healthcare to the patient.

The research reported in this paper focuses on the application of the C-Ph model to represent the distribution of trolley waiting times based on patient admission details. Such a model would facilitate the monitoring of *trolley waits* and thus assist hospital managers in assessing the targets placed upon them by the UK Government to improve hospital efficiency and quality of service.