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SEASONAL DEMAND FOR EMERGENCY DEPARTMENT SERVICES

A thesis presented in partial fulfillment of the
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In

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DIRK ANNANDALE COUTTS

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ABSTRACT

Hospital Emergency Departments (ED) often face wide fluctuations in demand for their services, which sometimes result in operational difficulties due to excessive demand. A better understanding of the patterns and the drivers of this demand would facilitate improved planning of facilities and staffing levels and a better quality of service.

This study uses statistical analysis derived from OLAP Cubes and Data Mining (DM) to investigate data about ED presentations at two hospitals in the Bay of Plenty District Health Board (BOPDHB) region over a period of three years, comprising a total of about 165,000 presentations. The study found variations in demand for each hospital on seasonal and monthly basis and also by day of week and time of day.

The characteristics of patients and the seriousness of their problems was also investigated which revealed differences in patterns of usage of the two hospitals. Cluster analysis revealed that patients under 50 years of age utilize ED facilities more frequently than those above, with teens and young adults being the most frequent patients at both EDs.

It is hoped that this detailed analysis of demand for ED services presented in this thesis will facilitate the planning of services to better meet future demand.

PREFACE

The Researcher's *interest in Data Mining* predates his interest in Health Informatics by a couple of years. The idea all along was that when an opportune time presented itself to indulge in further postgraduate study that the incorporation of some Data Mining functionality would hopefully be both justified and logical – and very importantly: that *the topic to be researched would directly relate to the Researcher's occupation and position* at the time. A third (and last) objective was that *the research should have some practical application value*. Fortunately that is the way it all turned out.

Derek Coutts – Tauranga - NZ - May 2008

DEDICATION

This Thesis is dedicated to **"BJ" (J C V DEVENTER)**

Guardian, Confidante, Mentor, Comrade and Loyal Friend

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Who / Which deserve special mention:

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(Formal authorization and some related correspondence can be found in **Chapter 13.4 APPENDIX D1** at the back of the thesis)

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Priscilla BORGES – CTL (Clerical Team Leader) - Tauranga Hospital ED

Derek Coutts – Tauranga - NZ - May 2008

SEASONAL DEMAND FOR ED SERVICES

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SOME KEY TERMINOLOGY

Information and Communication Technology (**ICT**)

Information Systems (**IS**)

Data Base (**DB**)

Business Intelligence (**BI**)

Decision Support Systems (**DSS**)

Data Warehousing (**DW**)

Online Analytical Processing (**OLAP**)

OLAP Cubes

Data Mining (**DM**)

Statistical Analysis Software (**SAS**)

SAS Enterprise Miner (**SAS EM**)

Clustering

K-Means Clustering

Self-Organizing Maps (**SOM**)

SOM Kohonen Clustering

Microsoft (**MS**)

MS Word / Excel / EndNote

Emergency Department (**ED**)

Bay Of Plenty (**BOP**)

District Health Board (**DHB**)

Bay of Plenty District Health Board (**BOPDHB**)

TAKE NOTE

INTERPRETATIONS AND OPINIONS

EXPRESSED THOUGHOUT THE THESIS ARE

THE AUTHOR'S SOLELY

AND DOES NOT NECESSARILY REFLECT THOSE

OFFICIALLY SUPPORTED BY

THE BOPDHB

OR THAT OF BOPDHB EMPLOYEES

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THE THESIS

1. INTRODUCTION

INTRODUCTION

1. INTRODUCTION

1.1 PROBLEM DESCRIPTION

There may be various explanations for what appears to be temporary breakdowns in the operations of Emergency Departments. One obviously can not anticipate natural disasters – what is also referred to as acts of God, but what of other situations which may develop ever so often?

This begs several questions, including:

- Are there "seasonal" factors at play which influence the influx of ED attendances?
- And if that is the case - are there "seasonality"-related problems with the management of such surges in demand for ED services?

In fact, when questions to this effect were first raised with some in ED Management in the "District" (managed by the District Health Board) the existence of "seasonality" was acknowledged, as was its potential for causing operational difficulties. In other words, there is an acknowledgement that there are "ebbs and flows" in demand for Emergency Services, and that while such can not always be anticipated absolutely, an attempt must none the less be made to pre-empt its fluctuations more accurately, and thus the following rephrased problem description "derived" from the foregoing questions:
There seems to be some seasonality in the demand for ED services and it is causing operational difficulties.

For the purpose of brevity the following succinct Problem Description will be used liberally throughout the remainder of this Research Project / Thesis, namely that this is an attempt at determining **Seasonal Demand for ED Services.**

This compacted rework of the original questions and discussion therefore represent mentioned questions and discussion. Whenever used in the remainder of this Research Project it implies that which precedes it in **Chapter 1.1**.

For the time being that will suffice, but the author will define "season" and "seasonality" more specifically later in the Thesis, in view of some of the earlier "weather" / "season"-related studies mentioned in the Literature Review / References (Section **2.4.2** of **Chapter 2**).

1.2 PROBLEM JUSTIFICATION

The Weekend Herald, Saturday, April 21st, 2007 featured an article about preventable deaths in NZ Hospitals. It included the following comment relating to a particular Emergency Department, namely that "...unacceptable time delays between admission and treatment..." contributed towards a couple of preventable deaths.

"Any preventable error in a hospital is unacceptable and regrettable" according to Patrick Snedden, Chair of the Quality Improvement Committee (a ministerial advisory body) as the government released the first ever consolidated report on serious and sentinel events across the 21 District Health Boards in NZ [Dominion Post, 20 Feb 2008] – viz. partway through the writing of the current thesis. This ministry report was compiled in response to Information Act requests to various health boards [The Press, 16 Feb 2008]. The statistics supplied are those for the 2006-2007 "year", i.e. for Financial Year = 2007 (Viz. July 1st 2006 – June 30th 2007), and found that there were 182 sentinel events (viz. actual or potentially preventable clinical incidents that resulted, or could have resulted in serious harm or death) of which 40 did result in death [Dominion Post, 20 Feb 2008].

Take Note: this report is not ED-specific, rather hospitals as a whole and nationwide-specific - and as such ED-inclusive. Furthermore, the idea was not to name and shame but rather to encourage health boards to lift their game, according to Health and Disability Commissioner Ron Paterson [The Press, 16 Feb 2008]. Professor Mike Ardagh concurs by saying that he would be reluctant for DHBs to release detailed information on adverse or sentinel events [The Press, 16 Feb 2008].

Another bottom-line statistic to emanate from the above ministerial report is that for every 10,000 patients treated in NZ hospitals 2.2 will be involved in sentinel events, and that New Zealand "...compared well with wealthier countries from the OECD...", according to Director-General of Health Stephen McKernon on a range of indicators [Dominion Post, 20 Feb 2008] .

There are "extenuating circumstances", of course. One of these circumstances, and arguably the most critical of circumstances, is the overcrowding of ED services. Ardagh and Richardson [2004] for example quote a statement in the British Medical Journal that "... overcrowding is the most serious issue confronting emergency departments in the developed world ..." They also refer to "... our overwhelmed ..." ED's.

Current staffing practices in EDs at the DHB in question may (or may not) adequately service fluctuating demand for ED services. By "fluctuating demand" is meant time of year, day of week and even time of day within day of week. Certain ED "shifts" may be extra-ordinarily stressful on a fairly regular basis. On duty Staffing and Roster practices may be in need of minor adjustment. This may (or may not) be possible for reasons of critical staffing levels – and Health funding – which may "impede" good intentions.

Incidentally, problems of local concern for an organization or a certain area are perfectly acceptable and appropriate as a research topic, according to Descombe [2002, p. 47]. The ED data used in the present research does indeed pertain to "... a certain area ..." in one somewhat out of the way, albeit rapidly growing (in population), corner of New Zealand.

Seasonal Demand for ED Services also begs a question within a question in that **Demand for ED Services** in a sense precedes "seasonal demand". This thesis often ventures into the area of "demand" more so than "seasonal demand" – for one can not address or understand the one without the other.

1.3 AUDIENCE

- The principal audience of the eventual outcomes of this Research Project is ED Management at the hospitals concerned. Cf. for example **Chapter 3.2.2** concerning the Data of multiple hospitals to be used in this project.
- A secondary audience would be ED Management at other hospitals across New Zealand.
- Health Care professionals in general may also find it informative.
- University Students doing papers in Health Care or Health Informatics – and University Lecturers teaching such courses in tertiary institutions across New Zealand.