



DEMAND FORECASTING OF PATIENT ACTIVITY BASED FUNDING MEASURES

ABF CONFERENCE 2014

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AGENDA

Initial Problem

Aim

Methodology

Results

Key problems faced

Outcomes



Gold Coast University Hospital is seeking to optimise use of resources in meeting future demand.

- September 2013 - Gold Coast University Hospital (GCUH) came online to replace decommissioned Southport hospital.
- GCUH has a stated aspiration to become a world-class provider of healthcare services within the next five years. The strategic plan outlines a number of objectives that includes optimising the utilisation of resources.
- Past discrepancy between available capacity and demands on its services has resulted in inefficiency in some areas – either in underutilised resources or unmet demand.
- In preparation of funding discussions, GCUH were actively seeking to enhance their understanding of expected future demand and to develop insight into opportunities to better allocate resources.
- GCUH engaged Biarri to complete this work based on our ability to provide quantitative analysis and optimisation in easy-to-use web based tools.



The aim of the Demand Forecast was to generate a projection on the number of admissions and WAUs for 2015 and 2016 Financial Years.

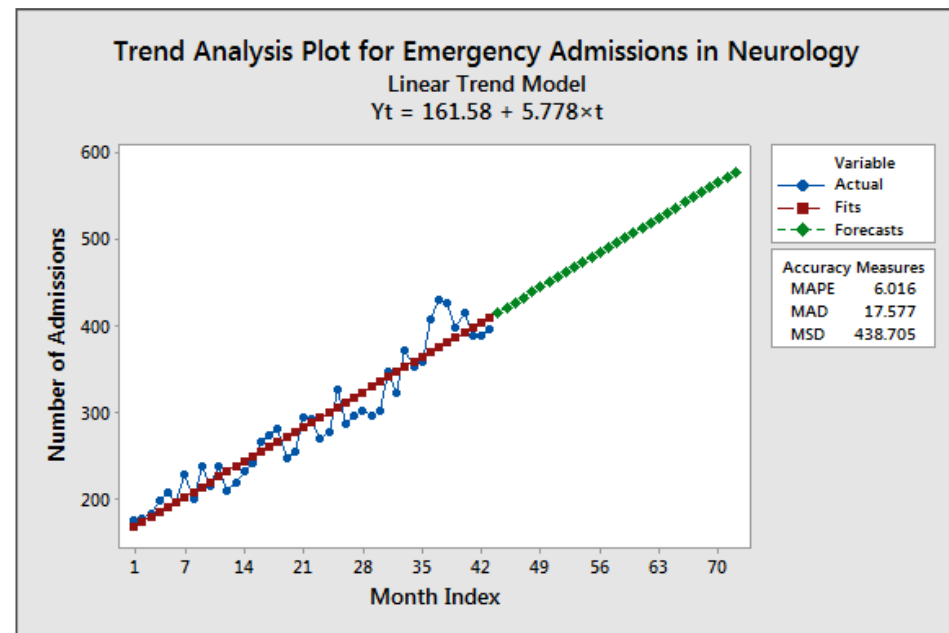
- Forecasts based on historical admissions from 2010 onwards, across:
 - Surgical-Related-Groups (SRGs)
 - High Volume Diagnosis-Related-Groups (DRGs)
 - Surgical Specialities and Urgency Categories (for Elective surgeries).
- The forecasts produced were:
 - Emergency Admissions across SRGs
 - Emergency QWAUs across SRGs
 - Emergency Admissions across High Volume DRGs
 - Emergency QWAUs across High Volume DRGs
 - Elective additions to waiting lists across Surgical Specialities and Urgency Categories

Time Series Forecasting techniques were used to generate monthly forecasts for 2015 and 2016 FYs

- Initially, exploratory data analysis undertaken to visualise historical demand over time across categories (i.e. SRGs and High Volume DRGs for Emergency, and Surgical Specialities and Urgency categories for Elective).
- Several forecasting methods then applied across all groups. These forecasting methods included:
 - Linear Trend (LT)
 - Exponential Smoothing (ES)
 - Trend-Adjusted Exponential Smoothing (TAES)
 - Holt-Winters Method (HW)
- The benefits of these forecasting methods are that they weigh recent data points far more heavily than older data points. This allows jumps in data (i.e. from GCUH opening in September 2013) to be modelled accurately.

Linear Trend forecasts were used for categories with large numbers of admissions/WAUs following a reasonably linear growth rate over time.

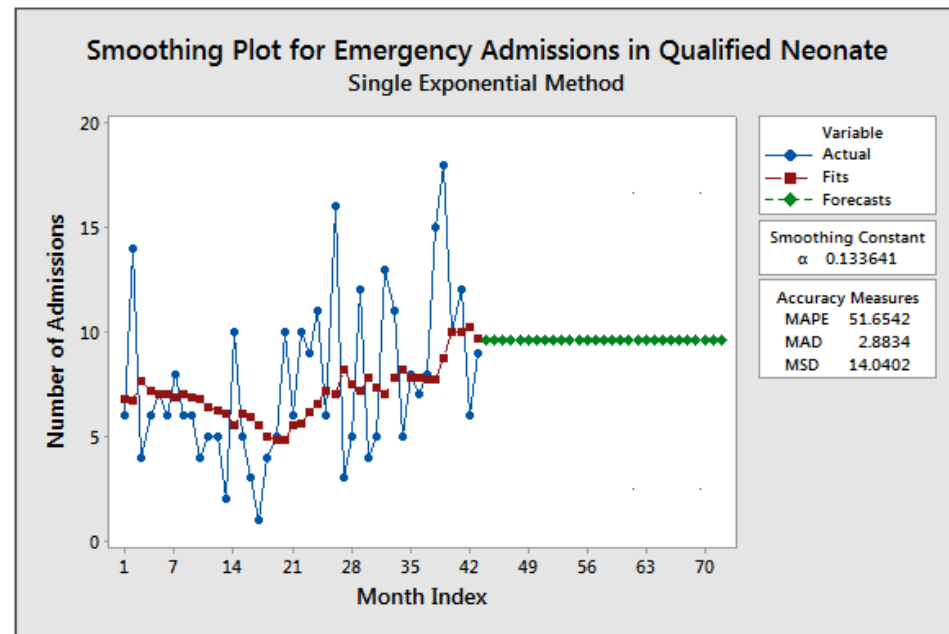
- For SRGs/High Volume DRGs/Surgical Specialities with reasonably linear trends, few outliers, large numbers of records and no seasonality, a simple Line Trend had the best fit of data.
- Although we may logically expect growth to follow exponential growth, it appears that, over a short period of time (e.g. 5 years), a linear rate fit data better than an exponential rate.
- E.g. Emergency Admissions in Neurology



Exponential Smoothing forecasts were made for categories with fewer data points or more relative variability, where little growth pattern is discernible.

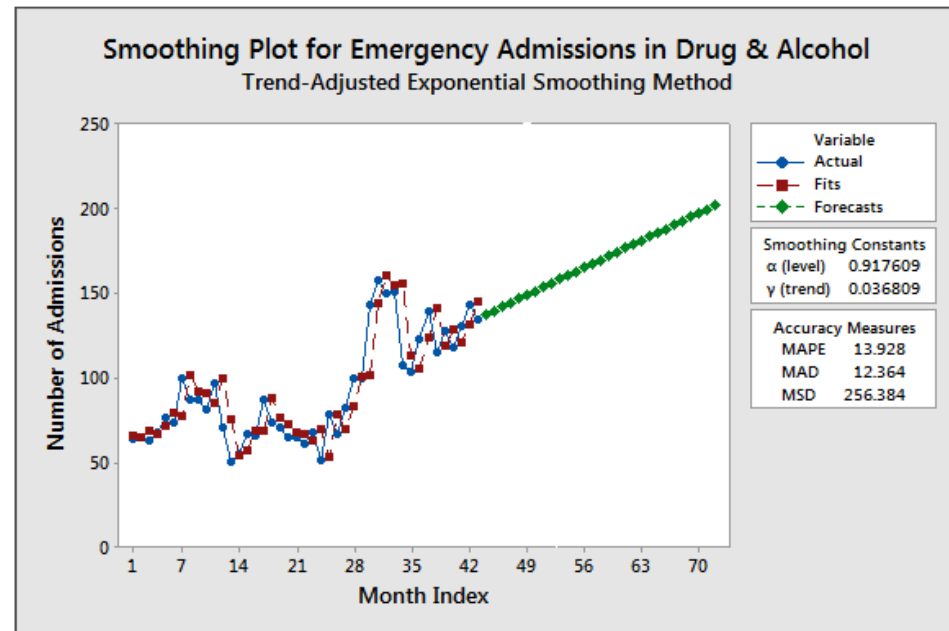
- For SRGs/High Volume DRGs/Surgical Specialties with fewer data points, more outliers, and more inherent relative variability, Exponential Smoothing was required to be used.
- Exponential Smoothing is the least desirable forecasting method as it generates a weighted average value as a forecast, where more recent entries have a higher weighting.
- E.g. Emergency Admissions in Qualified

Neonate



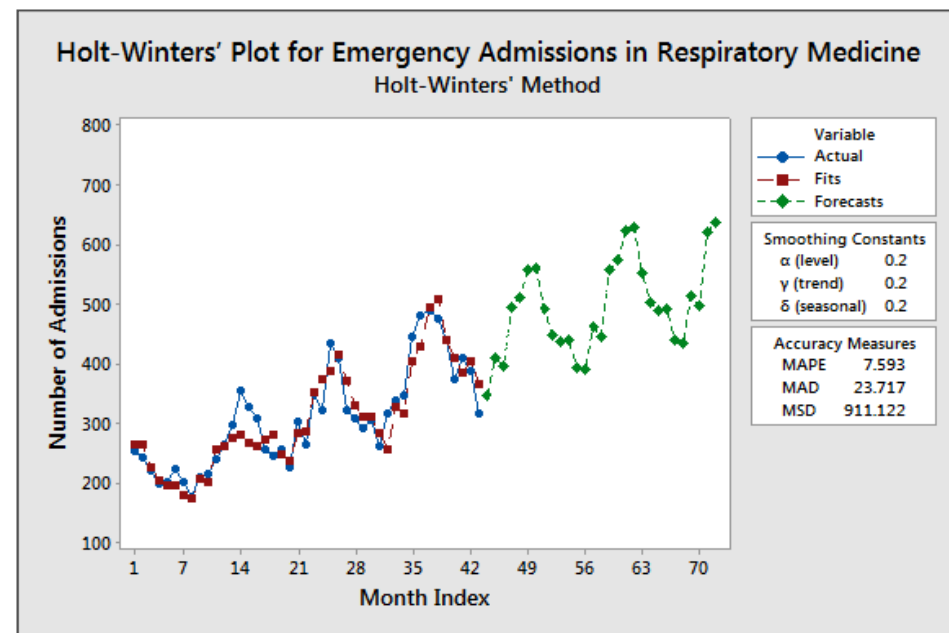
Trend-Adjusted Exponential Smoothing forecasting method was used when a trend was present, but skewed due to outliers/ large peaks of surgeries.

- For SRGs/High Volume DRGs/Surgical Specialities that show distinct linear growth rate, but is affected by outliers/large peaks of surgeries, Trend-Adjusted Exponential Smoothing forecasts were used.
- Trend-adjusted forecasts produce a linear growth rate, but the impact of values far outside of this growth rate are reduced. This removes the bias of outliers and large peaks of surgeries on the forecast. The main benefit of TAES is that it allows constant-gradient linear trends, even with marked jumps in the data (i.e. from GCUH coming online in September 2013)
- E.g. Emergency Admissions in Drug and Alcohol



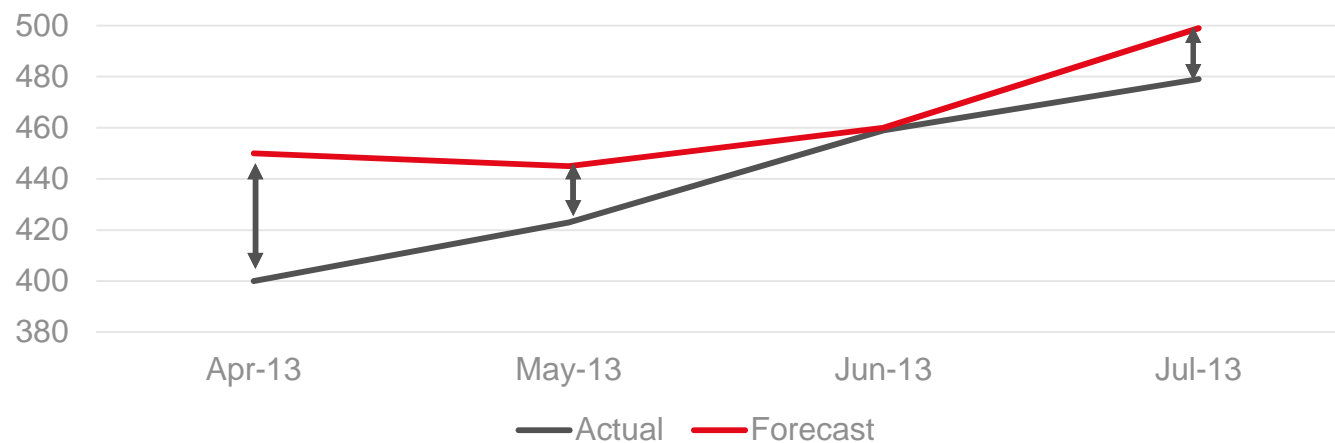
Holt-Winters' forecasts was used on admissions/WAUs for a category where seasonal behaviour was present.

- In Holt-Winters' forecasts, the time periods are grouped into seasonal periods of a single year, and forecasts generated based on the behaviour within and between seasonal periods.
- E.g. Emergency Admissions in Respiratory Medicine



Mean Absolute Percentage Errors (MAPEs) were used to measure how well forecasts fit against the actual numbers.

- Measures of fit:
 - Mean Absolute Percentage Error (MAPE)
 - Mean Absolute Deviation (MAD)
 - Mean Squared Deviation (MSD)
- MAPE is the mean relative difference between actuals and forecasts.
- Under visual observation, MAPEs >40/50% seem to be poorly fitted forecasts.



Forecasts across Emergency admissions closely fit historical admissions, whereas Elective waiting list additions fit poorly. WAU forecasts shows similar trends, but with more noise.

- Emergency Admissions:
 - Data is fine grained, showed consistent trends for most SRGs/High Volume DRGs
 - Mostly low MAPEs (<25%)
 - Assuming admission behaviour is consistent with historical behaviour, forecasts are reliable.
- Emergency QWAUs:
 - Data showed similar trends with Admissions forecasts for SRGs/High Volume DRGs
 - QWAU forecasts showed more inherent noise and variability (i.e. same visual trend, with higher MAPEs)
 - Assuming admission behaviour is consistent with historical behaviour, forecasts are reliable.
- Elective Waiting List Additions:
 - Data was sparse, with only month level granularity from 2012 onwards.
 - Produced variable results, with extremely high MAPEs across Urgency Categories and Surgical Specialities.
 - Forecasts considered unreliable, therefore must be used with caution.

Several issues were faced in determining forecasts.

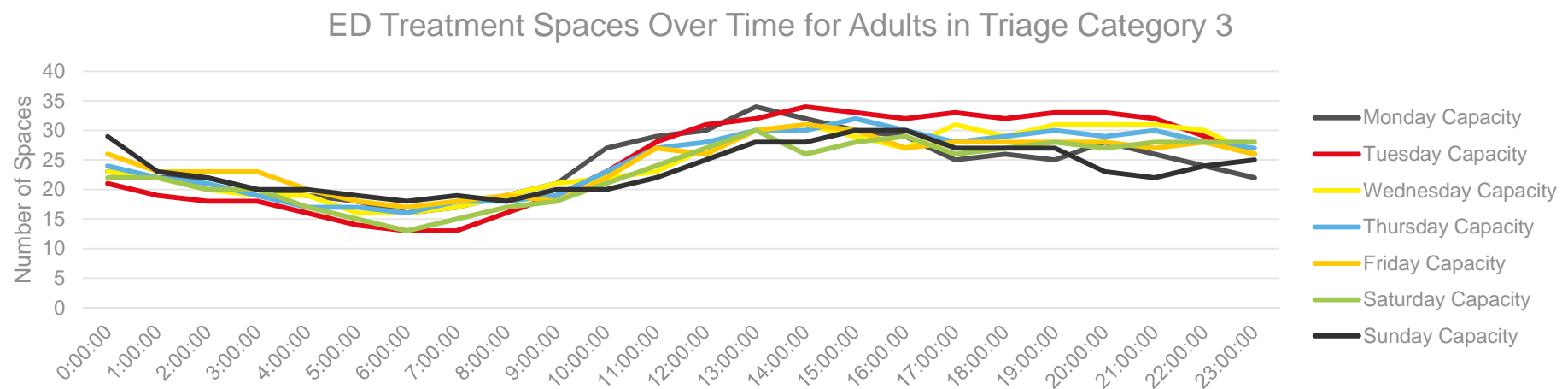
- For Inpatients, higher volume surgeries showed far better fits of forecasts against actuals for both admission numbers and QWAUs. On the other hand, Outpatients did not seem to show better fits for higher patient volumes. This was due to a concerted effort by GCUH to treat their Outpatient backlog in recent months, skewing all forecasts.
- GCUH only opened in September 2013, and therefore historical data from the decommissioned Southport hospital used to proxy historical data for GCUH. Is this a valid assumption to make? Modelling methods were chosen to minimise this impact.
- Required all historical data to be mapped to the same WAU phase. Phase 15 QWAUs were used, simply because they were readily made available. Similarly, DRGs and SRGs needed to be mapped to one consistent set.
- Elective wait list data very sparse and inconsistent/noisy, and only recorded for 2012 onwards. Far fewer data points resulted in far more worse fits of forecasts vs actuals.

With knowledge of forecasted demands for next Financial Year, GCUH are undertaking informed Capacity Planning.

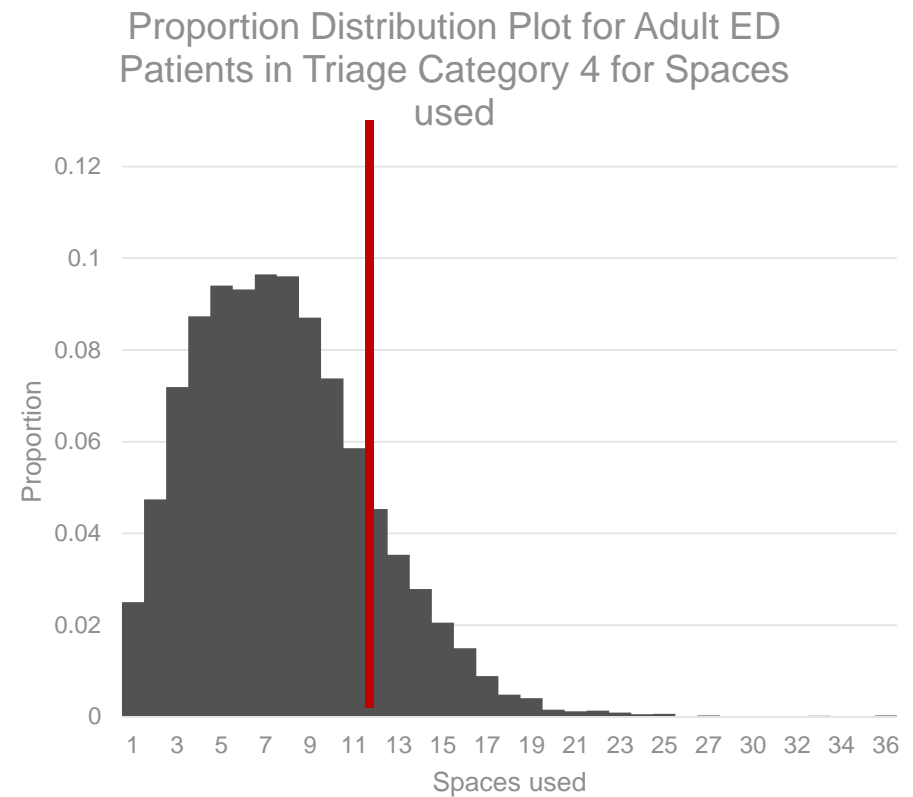
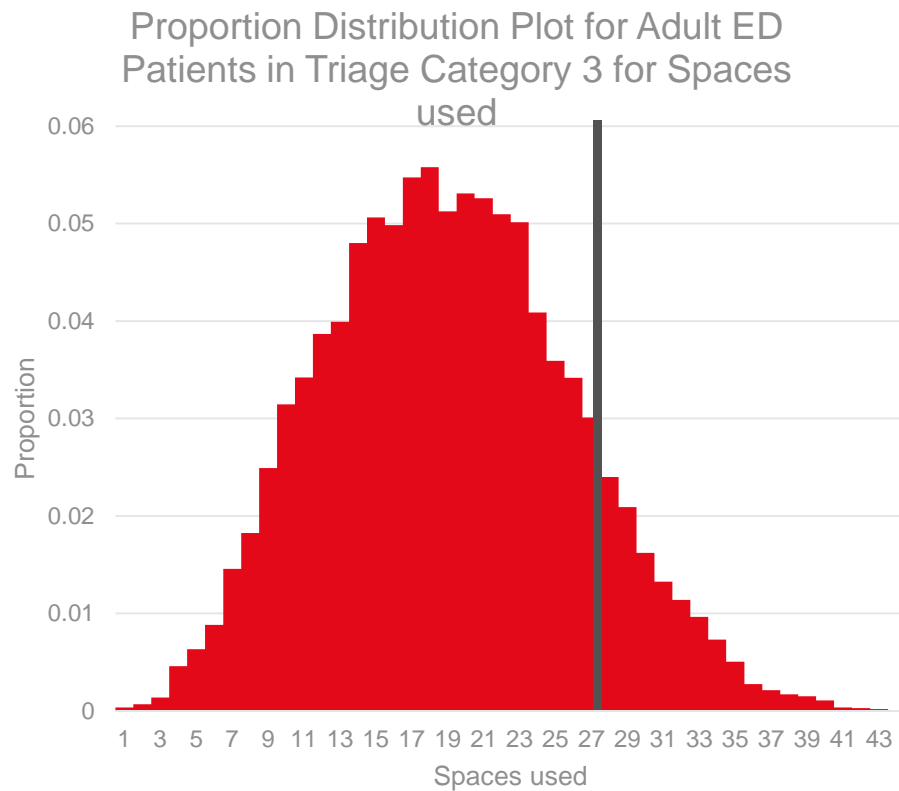
- With knowledge of forecasted demands for next Financial Year, GCUH can now plan capacity requirements for physical resources and staffing resources/workforce optimisation.
- Biarri and GCUH are currently undertaking capacity planning for treatment spaces, clinic spaces, beds and theatres across:
 - Inpatient/Outpatients
 - Scheduled/Unscheduled
 - SRG
 - Care Type
 - Children (0-14)/Adults
 - Time of Day/ Day of week

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- Using historical space usage and growth rates, we can determine future capacity requirements that will satisfy requirements for a specified percentage of times.
- Biarri has created a bespoke web tool that can be used by GCUH to solve future capacity planning instances. The operational use of this tool outside of planning is to run scenarios on how different growth in admissions affects capacity requirements.



With knowledge of forecasted demands for next Financial Year, GCUH are undertaking informed Capacity Planning.



Biarri and GCUH have demonstrated the value of quantitative analysis in forecasting patient admissions and QWAUs and using this to provide more efficient capacity and resource planning.



Biarri has offices in Brisbane and Melbourne, with support staff in Sydney and Perth.

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