Change Detection in Pharmaceutical Demand Forecasting

Executive summary
This project developed time series monitors to detect changes in sub-national demand of SPIRIVA, a prescription medicine produced by Boehringer-Ingelheim. The in-time and accurate change-detection can provide an early warning indication for BI to adjust local stock allocation and response to market competitions.

Challenge overview
Boehringer Ingelheim (BI) is one of the world’s 20 leading pharmaceutical companies, providing high-valued products for human and veterinary medicine. SPIRIVA is a major product developed by BI in treating COPD disease and was successfully launched in the UK in 2002. SPIRIVA has made great contributions to the revenue of BI and has never met strong competitors in the market since 2002. However, new competitors would enter the UK market in September 2012 and BI would like to identify the competition at local areas as soon as it appears. The main challenge of the project is to identify what deviation from the forecasted level can be interpreted as an early indication of a real drop in demand pattern. Due to the randomness of time series and forecast errors, it is difficult to be reasonable sure that the difference between forecast and actual values is caused by demand changes. In forecasting practice, the lower aggregation levels, the higher forecasting errors. Thus, it is also difficult to identify the sub-national levels of demand tracking. It is essential to identify a geography that is small enough to be tactically relevant but large enough so that the change in sales pattern is easy to distinguish from the statistical ‘noise’.

The problem
The project objective is to develop a demand tracking monitor to identity local areas with large changes in demand patterns and make sure in what extent that the difference between forecast and actual sales is due to a large change in the demand pattern of SPIRIVA. In order to track the time series, forecasting models are built to generate forecast SPIRIVA sales units at different sub-national levels and then detected the deviation between actual and forecast values to check if there is an actual dropping demand. To find a proper forecasting model, candidate ES, ARIMA and Regression models have been built and the ES model was chosen with lowest forecasting error. To detect the deviation between actual and forecast values, three alternative test monitors have been developed and ‘Forecast Bias’ monitor worked best among three test monitors with highest accuracy rate. The ‘Forecast Bias’ would generate a warning signal when there is an actual demand below the prediction level and have 59% accuracy rate in detecting changes.

Results and achievements
Results were presented to the clients in the UK headquarter. Key outcomes include:

- Exponential smoothing is the simplest and most accurate model to generate demand forecast outcomes for SPIRIVA.
- ‘Forecast bias’ monitor can detect various sales drop scenarios at an average accuracy rate of 59%.
- Three weekly consecutive warning signals are more reliable than one warning signal because one warning signal may be due to forecasting error.
- Both weekly and monthly time series monitors are suitable for higher sub-national levels (i.e. BU/Region/Territory).
- Monthly time series monitor can be used to detect changes at Primary Care Organisation (PCO) level.