

Combined Models Improve Tourism Demand Forecasting

The combination of forecasting models leads to more accurate tourism demand forecasts show a group of SHTM researchers in a recently published article. Professor Haiyan Song, Professor Stephen Witt, Dr Kevin Wong and Ms Doris Wu compare combinations of models with the single-model forecasting of demand for tourism in Hong Kong from 10 major source markets. Although yet to establish the optimum number of models to combine, the researchers note that the benefit of combined forecasts is particularly evident over the longer term.

Tourism Demand Forecasting

With the rapid growth of the tourism industry around the world, tourism demand forecasting is receiving increased attention. Accurate forecasts are important to the industry in terms of business planning and investment, and to governments in terms of tourism policy development and implementation. The researchers point to the use of time series analysis, econometric models and nonlinear modelling as forecasting techniques over the last 30 years.

Econometric models, in particular, have been used to forecast tourism demand in both Asia and Europe, but can be influenced by the ways in which seasonal data are specified. Another concern about forecast accuracy lies in determining the optimal length of the forecasting horizon, or how far ahead the model should be used to predict demand.

Yet little attention has been paid to the potential for accuracy gains when single models are combined in the same tourism demand forecast. There is, write the researchers, evidence that forecast accuracy can be improved by both the simple averaging of multiple forecasting models and more complex combinations involving weights given to the forecasts produced by

individual methods. With a view to testing combinations of models in a multiple market scenario, the researchers turn to Hong Kong.

Focus on Hong Kong Inbound Tourism

To determine the conditions under which a combination of models would produce more accurate forecasts than a single model, the researchers draw on monthly tourist arrival data from the Hong Kong Tourism Board and the United Nations World Tourism Organisation, and data on explanatory variables from the International Monetary Fund. The source markets covered are those with the ten highest levels of demand for tourism in Hong Kong: mainland China, Taiwan, Japan, the United States, Macau, South Korea, Singapore, the United Kingdom, Australia and the Philippines.

The factors that influence tourism demand are identified as the price of tourism in Hong Kong, represented by the level of the consumer price index in Hong Kong relative to that of the source market, tourism prices in substitute destinations and the income level in the source markets as measured by GDP at constant prices.

The researchers use data from the first quarter of 1984 to the first quarter of 2003 to estimate the models, removing from consideration the unusual circumstances of the SARS outbreak during the second quarter of 2003, which “enormously influenced Hong Kong inbound tourism”. The ex post forecasts can then be compared to actual demand to measure the accuracy of the combination methods used.

Combining Forecast Methods

The researchers use four models in three types of combinations to compare the accuracy of combined forecasts and single forecasts. The models include the seasonal ARIMA method of time series analysis, the

autoregressive distributed lag model in which a final model is obtained through the simplification of a general model, a two-stage error correction model in which the movement of the variables in any period is related to the previous period's deviation from the long-run equilibrium, and a vector autoregression model, which captures the evolution and interdependence of multiple time series.

Simple averaging of the results from multiple models is the most obvious way of producing a combined forecast, but the researchers also consider variance-covariance combination, in which unequal weights are assigned to each single-model forecast based on the performance of each model, and discounted mean-squared forecast error combination, in which more weight is given to the more recent forecasts.

The researchers generate a series of forecasts with single and two, three or four combined methods looking one, two, four and eight quarters ahead. None of the combination methods produce consistently more accurate forecasts than the others across all time horizons and source markets.

Combined Forecast Performance

An initial finding that might not seem too encouraging is that the combined forecasts do not always outperform single-model forecasts over the short, medium and long term. Yet combined forecasts are superior in around 50% of all cases, and in the eight-quarter-ahead forecasts, combined forecasting clearly outperforms single-model forecasting. In other words, the researchers find that combined forecasts are most suitable over the long term, largely because single models that are initially misspecified compound their errors over longer time horizons.

The researchers write that the combined forecasts are not more accurate than the best single forecasts, but they do significantly outperform the worst single forecasts. In practical terms, individual firms and government bodies concerned with the whole tourism industry are likely to obtain much worse forecasts if they use single methods. Forecast combination, note the researchers, is a simple matter of risk reduction.

Putting Combined Methods to Use

Of the combined methods, the discounted mean-squared forecast error combination performed the best overall, suggesting that it should be used most often in forecasting tourism demand. However, the simple averaging method could also be used because it performs reasonably well, "is easy to implement and requires fewer observations".

The researchers note that accuracy increases gradually as more models are combined, but do not specify an optimal number of models to use. Rather, they offer the recommendation that tourism practitioners should actually make the effort to combine forecasting methods, especially when the magnitude of potential forecasting errors is a concern.

The accuracy of combined methods, conclude the researchers, will be particularly important when demand forecasts are used to "assess the feasibility of long-term investment in tourism-related infrastructure".

Points to Note

- The importance of tourism demand forecasting is increasing as the industry grows.
- Accurate forecasts are crucial to both industry and government planning.
- Accuracy increases gradually with the combination of single forecasting models.
- Discounted mean-squared forecast error combination is the most accurate, but the simple averaging method is a practical alternative.

Song, Haiyan, Witt, Stephen F., Wong, Kevin F. and Wu, Doris C. (2008). An empirical study of forecast combination in tourism. *Journal of Hospitality and Tourism Research*, Vol. 33, No. 1, pp. 3-29.