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Combination of long term and short term forecasts, with application to tourism demand forecasting

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Abstract

Forecast combination is a well-established and well-tested approach for improving the forecasting accuracy. One beneficial strategy is to use constituent forecasts that have diverse information. In this paper we consider the idea of diversity being accomplished by using different time aggregations. For example, we could create a yearly time series from a monthly time series and produce forecasts for both, then combine the forecasts. These forecasts would each be tracking the dynamics of different time scales, and would therefore add diverse types of information. A comparison of several forecast combination methods, performed in the context of this setup, shows that this is indeed a beneficial strategy and generally provides a forecasting performance that is better than the performances of the individual forecasts that are combined.

As a case study, we consider the problem of forecasting monthly tourism numbers for inbound tourism to Egypt. Specifically, we consider 33 individual source countries, as well as the aggregate. The novel combination strategy also produces a generally improved forecasting accuracy.

Keywords: Time series forecasting; Tourism forecasting; Tourism demand; Forecasting tourism in Egypt; Forecast combination; Exponential smoothing; Holt's model; Bayesian forecasting

1. Introduction

It is well-documented that forecast combinations are often superior to their constituent forecasts. Typically, time-varying conditions among time series, such as regime switching or simply parameter drifts, make identifying the best model among various competitors almost like a moving target. The problem is also aggravated by parameter estimation errors and model misspecification. Forecast combination reduces these unfavorable effects. In several studies (such as those of Clemen, 1989; Makridakis & Hibon, 2000; Stock & Watson, 2004), combined forecasts have

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generally been shown to outperform the forecasts from the single best model.

One favorable feature to have in a forecast combination system is diversity in the underlying forecasting models, as a safeguard against focusing over much on a narrow specification (see Armstrong, 2001). Diversity is typically achieved by using different forecasting models, different explanatory variables, or possibly non-overlapping estimation periods. However, most methods for combining forecasts consider time series with identical timings. It is possible, however, that different time frames will introduce additional complementary information that will only help to improve the forecasting performance. In this paper we investigate the benefits of combining forecasts obtained using different time aggregations. For example, we could have a monthly time series where we need a long horizon forecast, such as 12 or 24 months ahead. We aggregate the time series (timewise) to obtain a yearly series. By forecasting both the monthly and time-aggregated yearly series, and combining their forecasts, we make use of both the short-term dynamics (exemplified by the monthly series) and the long-term dynamics (exemplified by the yearly series). Moreover, the short-term forecast should have a greater influence on the time period a short time ahead. Conversely, the long-term forecast will probably be more influential in the later months of the horizon. These aspects can be tuned by variable weighting according to the number of steps ahead being forecasted.

The other topic that we consider is tourism demand forecasting. Tourism is a major sector in the economies of many countries. In fact, tourism is one of the fastest growing sectors in the world economy. Tourist arrivals grew by 6% during 2007, reaching 900 million worldwide, and producing over 600 billion dollars in revenue.[1] It is therefore very important for decision makers to have accurate forecasts of tourism numbers. We apply the developed long-term/short-term combination methodology to the problem of forecasting the inbound tourism demand for Egypt. Specifically, the goal is to forecast tourist arrivals from 33 major source countries, as well as total tourist arrivals.

[1] World Tourism Organization (http://www.unwto.org/aboutwto/why/en/why.php?op=1).

Forecast combination in the context of tourism forecasting has not been considered until recently. In fact, we have been able to identify only a few such studies, despite the importance of the topic and its potential impact on forecasting accuracy. A recent major survey article by Song and Li (2008) recommends that the research community conduct more studies on forecast combination in the context of tourism forecasting. Specifically, they say:

"more efforts are needed to look at the forecasting accuracy improvement through forecast combinations. For example, more complex combination techniques, additional advanced individual forecasting methods and multiple forecasting horizons should all be considered in future studies".

We hope that this study will be one more step toward exploring such an aspect. In summary, the contributions of this work are:

- We make the point that combining short-term and long-term forecasts is likely to lead to a forecast performance which is better than that of either one on its own. This is confirmed by conducting tests on two large business time series benchmarks. As such, this strategy could be a serious contender for forecasting problems involving monthly time series (with long enough forecast horizons).
- We compare 15 major forecast combination methods, to determine which methods are best suited to this different time aggregation combination framework.
- Some of the forecast combination methods considered are novel, and thus this study is also a contribution to the general topic of forecast combination. Examples of such methods are the combination method based on testing performance differences, and the hierarchical forecast combination (i.e., a combination of several linearly and nonlinearly combined forecasts).
- We apply the proposed short-term/long-term combination approach to the tourism forecasting problem. Thereby, we make use of the lessons learned from the experiments above to determine a methodology for applying the combination framework to the problem of tourism forecasting. This tourism application also confirms the superiority of the proposed approach.