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Towards a framework for statistical evaluation of forecast performance under serial dependence

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The performance of forecasting systems needs to be evaluated in an objective manner, either with regard to certain specific applications or in a general sense. The quality of forecasting systems is of interest to end users, and forecast performance can serve as an indicator for the quality of the components of a forecasting system. Forecast evaluation can only be performed in a statistical sense, and in this contribution, we focus on the evaluation of forecasting systems through performance indices or *scores* averaged over time, where the scores compare each individual forecast with the corresponding verification. As many authors have noted, the fact that the statistical properties of the average score might be very complicated presents a serious difficulty. In order to apply a Law of Large Numbers or a Central Limit Theorem, for instance, the assumption often made (explicitly or implicitly) is that the verification–forecast pairs (or at least their scores) are independent. But this is not even approximately true even in very simple and idealised situations, and this assumption can lead to a serious underestimation of the variance and thus an overly optimistic performance assessment. On the other hand, the forecast available at any time k provides information about future verifications, and this information can in some cases be harnessed to provide (at least partly) the probabilistic structure of the score time series, as we will show. Several forecast evaluation strategies will be investigated in this light. Further, it is shown how the nominal behaviour of the forecasts can completely determine the correlation structure of the score time series to a point where the Law of Large Numbers and the Central Limit Theorem apply rigorously.