

Chapter 8

Forecasting Conflict in the Balkans using Hidden Markov Models¹

Philip A. Schrodtt

University of Kansas, Lawrence, Kansas, U.S.A.

This study uses hidden Markov models (HMM) to forecast conflict in the former Yugoslavia for the period January 1991 through January 1999. The political and military events reported in the lead sentences of Reuters news service stories were coded into the World Events Interaction Survey (WEIS) event data scheme. The forecasting scheme involved randomly selecting eight 100-event “templates” taken at a 1-, 3- or 6-month forecasting lag for high-conflict and low-conflict weeks. A separate HMM is developed for the high-conflict-week sequences and the low-conflict-week sequences. Forecasting is done by determining whether a sequence of observed events fit the high-conflict or low-conflict model with higher probability.

Models were selected to maximize the difference between correct and incorrect predictions, evaluated by week. Three weighting schemes were used: unweighted (U), penalize false positives (P) and penalize false negatives (N). There is a relatively high level of convergence in the estimates—the best and worst models of a given type vary in accuracy by only about 15 % to 20 %. In full-sample tests, the U and P models produce an overall accuracy of around 80 %. However, these models correctly forecast only about 25 % of the high-conflict weeks, although about 60 % of the cases where a high-conflict week has been forecast turn out to have high conflict. In contrast, the N model has an overall accuracy of only about 50% in full-sample tests, but it correctly forecasts high-conflict weeks with 88% accuracy in the 3- and 6-month horizon and 92 % accuracy in the 1-month horizon. The models are remarkably insensitive to the length of the forecasting horizon—the drop-off in accuracy at longer forecasting horizons is very small, typically around 2 % to 4 %. Some experiments with simplified models indicate that it is possible to use models with substantially fewer parameters without markedly decreas-

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ing the accuracy of the predictions; in fact predictions of the high conflict periods actually increase in accuracy quite substantially.

1 THE SEQUENCE RECOGNITION APPROACH TO POLITICAL FORECASTING

Event sequences are a key element in human reasoning about international events. Human analysts “understand” an international situation when they recognize sequences of political activity corresponding to those observed in the past. Empirical and anecdotal evidence point to the likelihood that humans have available in long-term associative memory a set of “templates” for common sequences of actions that can occur in the international system (and in social situations generally). When part of a sequence is matched, the analyst predicts that the remainder of the sequence will be carried out *ceteris paribus*. Sequences can be successfully matched by human analysts in the presence of noise and incomplete information, and can also be used to infer events that are not directly observed but which are necessary prerequisites for events that have been observed.

The use of analogy or “precedent-based reasoning” has been advocated as a key cognitive mechanism in the analysis of international politics by Alker (1987), Mefford (1985) and others, and is substantially different from the statistical, dynamic and rational choice paradigms that characterize most contemporary quantitative models of international behavior. Khong (1992) and Vertzberger (1990) review the general arguments in the cognitive psychology literature on use of analogy in political reasoning; May (1973) and Neustadt and May (1986) discuss it from a more pragmatic and policy-oriented perspective. As Khong observes:

Simply stated, ... analogies are cognitive devices that “help” policymakers perform six diagnostic tasks central to political decision-making. Analogies (1) help define the nature of the situation confronting the policymaker; (2) help assess the stakes, and (3) provide prescriptions. They help evaluate alternative options by (4) predicting their chances of success, (5) evaluating their moral rightness and (6) warning about the dangers associated with options. (Khong, 1992: 10)

Analogical reasoning is an easy task for the human brain, one that is substantially easier than sequential or deductive reasoning. Most experimental evidence suggests that human memory is organized so that when one item is recalled, this naturally activates links to other items that have features in common, and these are more likely to be recalled as well (Anderson, 1983; Kohonen, 1984).