Probabilistic prediction without probabilities

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The confidence with which quantitative representations of uncertainty can be employed in decision making differs in the cases of (i) repeated, arguably "identical" trials (rolling a die), (ii) repeated, arguably similar trials (next Saturday's high temperature) and (iii) effectively unique events (the high temperature in Oxford during August 2084). It is argued that model-based probability distributions are fundamentally incomplete representations of uncertainty; two alternatives for the quantification and communication of decision-relevant probabilistic forecasts are presented. P D Thompson argued for quantifying the growth of forecast "error" given the current state of the atmosphere thirty years before H Tennekes famously noted that no forecast was complete without an estimate of forecast error. I J Good came closer to an explicit call for probability forecasts in 1952, suggesting that Met Office personnel receive a bonus based on their improvement of a proper, local probability score. With no suggestion of returning to definitive forecasts of the future, the common notion of providing model-based probably forecasts, to be used as probabilities in decision making, is challenged. More generally, the utility of stand-alone probability forecasts is questioned for cases where the decision maker does not have complete and absolute trust in the algorithm by which the probability forecast is constructed. This suggests more than a probability is required to complete the forecast. It is argued that no model-based probability forecast is complete without an explicit estimate of its likely irrelevance regarding the future. The core issue here is that, inasmuch as one accepts that all models are but models, the core probabilities that are estimated relate only to the probability of the model runs, not events in the world. How might known model inadequacies be quantified and communicated? Two approaches are considered. The first aims to quantify second-order uncertainty in model-based probabilities directly, by elicitation of the probability of a "big surprise". The second is to replace the notion of probability-based fair odds with that of "sustainable odds". Sustainable odds aim for a rational expectation of breaking even (making neither a profit nor a loss), while accepting that the model(s) upon which probability forecasts are based are imperfect. It is argued that if fair odds correspond to probability forecasts then they are not sustainable in this case. Arguably, this result is neither surprising nor novel, nevertheless it impacts how probabilistic forecasts are communicated, evaluated and used. It distinguishes clearly the aims and nature of quantitative decision support situations where verification data are available, as in games and weather forecasting, from those where it is not, as in climate forecasting.