Multinomial Processing Trees and Response Time Distributions

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Response time is perhaps the most important dependent measure used to investigate hypotheses about mental processes in experimental psychology. Another widely applicable tool for the study of mental processes has been provided by multinomial processing tree (MPT) models. I present a method to bring together response-time distributions and MPT models. In its simplest form, the method assumes binary processing trees in which each path to an observable outcome represents a succession of processing stages for which processing times add. Processing time is assumed to be exponentially distributed with a different rate parameter for each of the two outcomes of each process. Response time also includes an additive component summarizing encoding and motor times that is assumed to follow a truncated Gaussian distribution. The model is hierarchical so that different parameters are estimated for each process and participant to accommodate the substantial heterogeneity between participants in response time distributions and at the same time reap the benefits of data aggregation accrue in applications with relatively sparse data. The model permits parameters (process probabilities and exponential rates for process times) to correlate across participants and provides a complete description of the observed response frequencies and the observed response-time distribution for each response category and participant. Alternative distributional assumptions and applications to substantive questions of psychological interest are sketched.