Proper scoring rules for point processes

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Probabilistic predictions of the occurrence of events in space or space-time take the form of point processes. Examples include the prediction of earthquakes, crimes or distribution of species. While there is a wide variety of diagnostic tools available to assess the fit of point process models to observed data, it can be very challenging to rank competing point process models according to their predictive performance. The main reason for this is that many point process models are defined iteratively and their density is only known up to a constant, obstructing the use of the log-likelihood score. We present a class of proper scoring rules that overcomes this issue and can be evaluated from simulated draws of a point process model. The class of scores we consider is flexible and can target different properties of the prediction, such as homogeneity or point interaction. The principle we use for constructing these scores is not restricted to point processes and is useful for constructing scoring rules whenever the observation space is involved.