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Title: Common probability patterns arise from simple invariances

Abstract: A few common probability patterns dominate observations. Why are those few patterns so common? Historically, the methods and perspectives of statistical physics set the approach. Start with a basic description of the system, such as an idea gas composed of identical particles. Then analyze how the microscopic processes generate a macroscopic probability pattern. Most fields continue to emphasize the primacy of mechanistic generative explanations. The problem is that fields as different as economics, biology, and physics share the same common probability patterns yet have very different mechanistic processes. If a common mechanistic basis does not exist, then what alternative lead to the common nature of pattern? I show that observed patterns are consistent with a few simple invariances. In particular, simple notions of shift, stretch and rotational invariance are sufficient to explain the common families of continuous probability distributions and their relations to each other. Because much of science comes down to interpreting observed probability patterns with respect to underlying process, we must consider two key questions. How can we understand the information content in observed probability patterns (the Jaynesian question)? How can we reconcile mechanistic and invariance-based explanations for the commonly observed forms of probability patterns?