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Exploring Student Difficulties with Multiplicity and Probability in Statistical Physics[1] DONALD MOUNTCASTLE, JOHN THOMPSON, TREVOR SMITH, University of Maine — We continue our research program on the teaching and learning of concepts in upper-division thermal physics at the University of Maine. Typical statistical physics textbooks introduce entropy (S) and multiplicity (w) [S = k ln(w)] with binary events such as flipping coins N times. Inherent confusion with probability and statistics, macrostates and microstates, and their varying dependence on N leads to student conceptual difficulties that persist after textbook-centered activities. We developed and implemented a guided-inquiry tutorial on the binomial distribution with student use of computational software to produce calculations of multiplicities, outcome probabilities, and graphs of their distributions as functions of N. This allows convenient exploration of statistics over more than seven orders of magnitude in N. Comparing student answers to pre- and post-tutorial questions, we find some, but not all of the intended learning results are achieved.

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