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Rolling the Dice on Complex Calculations

An interview with **Jeffrey Rosenthal**, Statistician
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Probability theory is the mathematical approach to randomness and uncertainty. We try to study how things that are random proceed, often proceeding in time, and how randomness gets more and more random over time. So a good thing to think about might be if you're gambling at a casino, let's say, and you have a certain probability of winning each bet. But then if you bet over and over again, then you can say, well what's the probability that you're going to end up winning more times than you lose, and so on. And so we can say a lot of things about what happens to those probabilities in the long run, and in particular that's why casinos always make money, because the odds are a little bit against you, and over the long run that becomes more and more important.

What is the focus of your research?

The main thing that I study is what are called Monte Carlo computer algorithms, and those are computer algorithms which use randomness as an essential step. It's a little bit like when you take a public opinion poll and you can't ask everybody questions, so you choose a random sample and phone a random sample of people. Computers do things like that but on a more complicated scale, but they involve actual randomness as the computer program runs to try to learn things. It turns out there's lots of things that we want to compute but they're too hard to compute exactly, just like you can't phone everybody in the country and ask them what their opinion is, you can't run computers long enough and fast enough and strong enough to be able to compute all the complicated statistical models that come up in everything from medical studies, and the finance world, and populations, and all sort of

things. So you say, well, maybe we can use randomness to estimate these quantities and it turns out to be a very important thing, these Monte Carlo algorithms.

Why is your work important at this moment?

There's more and more data that's coming to us, and there's bigger and bigger computational problems, and computers are getting faster, which is good, but that only takes you so far. Computers also have to get smarter, which means we need better computer algorithms.