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STAT778

3/30/2024

Estimating NFL Play Success with Adaptive Metropolis-Hastings

Summary:

I’d like to base my final project on the paper Arman presented and which I took notes for, “Adaptive Independent Metropolis-Hastings”. At this point in the course, I feel most comfortable with rejection sampling algorithms and specifically Metropolis-Hastings. Thus, I’d like to replicate their implementation, do a basic simulated experiment, and then test the implementation on real-world NFL data. The first two parts are fairly self-explanatory, so I’ll explain the NFL scenario a little more.

I’m a huge American football fan. Currently, analytics are a very popular talking point in and around the sport. Specifically, coaches are often criticized based on their degree of adherence to “the analytics”, which typically refers to some play outcome statistic like expected points added (EPA). Thus, these statistics—particularly EPA—have become exceedingly important to understand. For this reason I’d like to use Adaptive Metropolis-Hastings to sample from EPA’s distribution, conditioned on variables that the coach can control (how far the team is from a first down, what formation the offensive team is in, whether the play is meant to be a run or pass, etc.). This in a way is using Adaptive Metropolis-Hastings as a machine learning technique, but it’s also creating a probabilistic way to assess coaches’ play-calling abilities. I’ll use data from NFLFastr, a very popular package that tracks play-by-play data for over 20 seasons of NFL football.

Timeline:

1. Review HW#5 results, correct any mistakes made with my Metropolis-Hastings algorithm from question 1c.
2. Extend the Metropolis-Hastings sampler to include adaptive sampling.
3. Test the Adaptive Metropolis-Hastings algorithm with a small, simulated experiment.
   1. X is a simple 2 or 3 dimensional vector of numerics, Y is a single dimension of numerics.
4. Test the Adaptive Metropolis-Hastings algorithm on real-world data by sampling play results (expected points added, EPA) given pre-snap data (formation, down and distance, run or pass, etc.).