CS269I: Exercise Set #5

Due by 11:59 PM on Wednesday, October 31, 2018

Instructions:

(1) You can work individually or in a pair. If you work in a pair, the two of you should submit a single write-up.

(2) Submission instructions: We are using Gradescope for the homework submissions. Go to www.gradescope.com to either login or create a new account. Use the course code MZZ2BV to register for CS269I. Only one person needs to submit the assignment. When submitting, please remember to add your partner's name (if any) in Gradescope.

(3) Please type your solutions if possible. We encourage you to use the LaTeX template provided on the course home page.

(4) Write convincingly but not excessively. You should be able to fit all of your solutions into two pages, if not less.

(5) Except where otherwise noted, you may refer to the course lecture notes and the specific supplementary readings listed on the course Web page *only*.

(6) You can discuss the exercises verbally at a high level with other groups. And of course, you are encouraged to contact the course staff (via Piazza or office hours) for additional help.

(7) If you discuss solution approaches with anyone outside of your group, you must list their names on the front page of your write-up.

(8) No late assignments will be accepted, but we will drop your lowest exercise set score.

Lecture 9 Exercises

Exercise 19

Prove that the linear scoring rule $S(\mathbf{p}, i) = p_i$ is not even weakly proper. (Here i is an outcome in the set X, $\mathbf{p}$ is a probability distribution over X, and p_i denotes the amount of probability that $\mathbf{p}$ assigns to i.)

Exercise 20

The *spherical scoring rule* is defined as

$$S(\mathbf{p}, i) = \frac{p_i}{\|p\|},$$

where $\|p\| = \sqrt{\sum_{i \in X} p_i^2}$ is the Euclidean norm of $\mathbf{p}$. Prove that when X consists of two outcomes, this scoring rule is strictly proper.[1]

[1] It is strictly proper for any number of outcomes, but you don't have to prove this.

Lecture 10 Exercises

Exercise 21

We saw in lecture that the worst-case loss of an automated market maker based on the logarithmic scoring rule is $\ln |X|$, where X is the outcome set, assuming that the initial probability distribution is the uniform distribution. What is the worst-case loss of a market based on the quadratic scoring rule (again, initialized with the uniform distribution)?