Dynamic Pricing Competition
Scenario descriptions

Scenario 1: Duopoly with inventory constraints

In this scenario, each pair of submitted algorithms (called 'players') will compete against each other in an iterated duopoly with finite inventories. For each pair of players (henceforth called player 1 and player 2), we will run a large number of S simulations. Each simulation consists of $T = 10000$ discrete time periods, indexed by $t = 1, \ldots, T$. The time horizon is divided into 100 consecutive non-overlapping selling seasons, each consisting of 100 time periods. Thus, the j-th selling seasons consists of time periods $100(j-1) + 1, \ldots, 100j$, for $j = 1, \ldots, 100$. The inventory of player $i \in \{1, 2\}$ at the beginning of period $t \in \{1, \ldots, T\}$ is denoted by $c_{i,t}$. At the beginning of a selling season, the inventory of both players is set to $C = 80$; we thus have $c_{i,100(j-1)+1} = C$ for all $i = 1, 2$ and $j = 1, \ldots, 100$. In each time period $t \in \{1, \ldots, T\}$, both players $i = 1, 2$ set a price $p_{i,t} \in \{0.00, 0.01, \ldots\}$, after which sales $s_{1,t} \in \{0, 1, \ldots, c_{1,t}\}$ for player 1 and sales $s_{2,t} \in \{0, 1, \ldots, c_{2,t}\}$ is realized according to an undisclosed sales-generating mechanism that may be different in each simulation (but, conditionally on selling prices and the number of sellers having inventory available, statistically identical in different selling seasons within the same simulation). Each player can observe its own prices, its own sales, the competitor's prices, and whether or not the competitor is out-of-stock (but not the precise sales data of the competitor). After sales has realized, player 1 earns revenue $p_{1,t}s_{1,t}$ and player 2 earns revenue $p_{2,t}s_{2,t}$, and one proceeds to the next time period. Unsold inventory at the end of a selling season perishes and has no salvage value. The objective is to maximize expected revenue earned over the whole time horizon $t = 1, \ldots, T$, averaged over all S simulations, and over all plays against different competitors. The following domain knowledge is available: (i) within a selling season, demand is weakly increasing over time, and (ii) prices larger than 100 will generate a negligible amount of sales, regardless the competitor's price.