Econ 272 / GSB 607 **Department of Economics**

Spring 2025 **Stanford University**

Problem Set III

Due: Sunday April 20th, 2025,11pm.

1. Here we will do some simulations to assess how much more effective running an adaptive (bandit) experiment is compared to an experiment with fixed assignment probabilities. We focus on a case with six treatment arms, and a binary outcome. The true success probabilities for the six arms are $p_1 = 0.2$, $p_2 = 0.5$, $p_3 = 0.45$, $p_4 = 0.3$, $p_5 = 0.1$, and $p_6 = 0.45$. We use flat (uniform) priors on the six probabilities in our Thompson sampling algorithm.

   (a) Run a single experiment with 6,000 units, 1,000 assigned to each of the six arms. At the end of the experiment report the posterior mean and standard deviation for the six success probabilities.

   (b) For the experiment in (a), report the posterior probability for each arm that it is the best arm. You can do this by drawing from the posterior distribution of the six success probabilities.

   (c) Now re-run the experiment a single time using Thompson sampling, still with 6,000 units. You can do it either in batches of 100, or updating the assignment probabilities every time a new unit comes in. Report the posterior mean and standard deviation for the six success probabilities, the posterior probability for each arm that it is the best arm, and the fraction each arm was drawn in the 6,000 draws. Discuss the differences relative to the results in (a) and (b).

   (d) Now repeat the simulations in (a) and (c) 100 times. Each time record which treatment arm has the highest posterior probability of success. Report a table with for each treatment arm the true success probability, and the fraction of times it had the highest posterior mean according to the two algorithms.

   (e) Also report the regret for the two algorithms; the average difference between the

optimal success probability (0.5, for arm 2) and the success probability of the chosen arm at the end of the experiment.