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BUS 37904
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# Advanced Quantitative Marketing: Switching Cost Assignment

In this assignment you will solve a model of purchasing in the presence of a loyalty or reward program. The model follows Hartmann and Viard (2008). In each period $t = 0, 1, \dots$ a consumer decides whether to buy a product or service. Purchase is denoted by $a_t = 1$, and $a_t = 0$ indicates the choice of the outside option. We assume that purchase coincides with consumption and that the payoff from purchase is $\delta + \epsilon_{1t}$, where $\epsilon_{1t}$ is a latent utility draw. The purchase price is constant, and hence one can think of $\delta$ as the product valuation net of price, $\delta = \tilde{\delta} - p$. The payoff when not making a purchase is $\epsilon_{0t}$. All $\epsilon_{jt}$ draws are independent and Type I Extreme Value distributed.

The consumer accumulates reward points (credits) when making a purchase. $x_t$ denotes the number of reward points that a consumer holds at the beginning of period $t$. If the consumer has accumulated $x_t = N$ rewards in the past and she makes another purchase then she receives a reward with value $r$. Hence, if she decides to purchase when $x_t = N$ her payoff is $\delta + r + \epsilon_{1t}$. Upon making a purchase the consumer receives one credit, and $x_{t+1} = x_t + 1$ if $x_t < N$. However, if the consumer receives a reward the balance of credits resets to zero ($x_{t+1} = 0$ if $x_t = N$ and $a_t = 1$).

Consumers are forward looking and maximize the expected present discounted value of payoffs. $\beta < 1$ is the discount factor.

Your task is to numerically solve and analyze this dynamic purchase decision problem.

1. Verify that this problem is a special case of a dynamic discrete choice problem as defined in class. Correspondingly state the specific form of the utility function $u_j(x)$ and the transition probability $f(x'|x, a)$.

2. Numerically solve for the choices-specific value functions on the state space $\mathbb{X}$. Your code should allow for a solution based on arbitrary parameter values $\beta, \delta, r, N$.

3. Following Hartmann and Viard (2008) define the switching cost

$$c(x) \equiv (v_1(x) - v_0(x)) - (v_1(0) - v_0(0)).$$

   Explain this definition, and in particular why $v_1(x) - v_0(x)$ would not be a suitable measure of switching costs.

4. Define the *type* of a consumer as $\delta$. Correspondingly, high types are consumers with large product valuations, and low types are consumers who value the product less. A central claim in Hartmann and Viard (2008) is that high types generally face lower switching costs than low types. Re-examine this claim based on the numerical model solution and an examination of the switching cost function $c(x)$ (plotting $c(x)$ helps!). Can you find

violations of the claim for specific parameter values? How is the answer to this question affected by the value of the discount factor $\beta$?

5. Let $\sigma_j(x)$ be the conditional choice probability (CCP) of action $j$ given state $x$. Exploiting the form of the implied CCP's by the Type I Extreme Value assumption on $\epsilon_{jt}$ show that

$$\log(\sigma_1(x)) - \log(\sigma_0(x)) = v_1(x) - v_0(x).$$

   Correspondingly, re-express the switching cost as $\exp(c(x))$ and discuss the interpretation of this measure.

6. Instead of analyzing type-specific switching costs based on the whole schedule of switching costs $c(x)$ try to summarize $c(x)$ across states for different types. Think of the best way to quantify the average switching cost faced by a specific consumer, and again re-examine if higher types generally face lower switching costs than lower types based on this average. Instead of characterizing consumers by their type $\delta$ one can also characterize them by their average (in a well-defined sense) CCP $\sigma_1(x)$ or by the ratio $\sigma_1(x)/\sigma_0(x)$. Repeat your analysis of average switching costs for different consumers types, where consumer type is now measured using the CCPs.

7. Summarize your conclusions from questions 1-6 in a write-up. Show supporting figures and/or tables. Be brief and concise.

## References

Hartmann, W. R. and V. B. Viard (2008): "Do frequency reward programs create switching costs? A dynamic structural analysis of demand in a reward program," *Quantitative Marketing and Economics*, 6, 109–137.