Consumer Utility

Our model assumes that consumers have some general amount of utility by which they favor mom-and-pop stores, although moment-to-moment changes in preferences might override this. To account for both this preference and variability, for the k^{th} consumer, the utility gained from shopping at a mom-and-pop is a positive constant plus some random factor:

$U_k = (p_M + r_{kM}[0,1])$[1]

Consumers gain utility from shopping at the big-box store as well. Thus, the consumer's overall utility gain is:

$U_k = \max\{(p_{kM} + r_{kM}[0,1]), r_{kB}[0,1]\}$

The overall utility in the market is expressed as the sum of these utilities over the population:

$\Sigma_k U_k$

To rephrase our assumptions: consumers gain the most utility when both mom-and-pops and big-boxes are around, they do second best when they have available only mom-and-pops, and worst when they have only big-boxes. But it turns out that even in cases of high preference for mom-and-pop store, the consumers' least preferred outcome can arise.

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[1] The variables p_M and $r_M[0,1]$ are between 0 and 1 inclusive. p_M is consumer preference for mom-and-pops, and r_X is a random number. We abbreviate "mom-and-pop" by *M* and "big-box" by *B*. The subscript indicates the variable belongs to the type of retailer.

Mathematical Analysis

We give the expected utility in the three periods of our model.

(1) When there are only mom-and-pops, $E(\Sigma_i U_i) = E (\Sigma_i (p_M + r_{iM}[0,1])) = (\Sigma_i (E p_M + E r_{iM}[0,1])) = (\Sigma_i (p_M + 0.5)) = N(p_M + 0.5)$ by linearity.

(2) When there are big-boxes as well as mom-and-pops, $E((\Sigma_i U_i)) = E (\Sigma_i (\max \{ p_M + r_{iM}[0,1], r_{iB}[0,1] \})) = \Sigma_i E \max \{ p_M + r_{iM}[0,1], r_{iB}[0,1] \} = N((2/3) + (1/2)p_M+(1/2)p_M\text{^}2-(1/6)p_M\text{^}3)$.

(3) When there are only big-boxes, $E (\Sigma_i U_i) = E (\Sigma_i r_{iB}[0,1]) = (\Sigma_i E r_{iB}[0,1]) = N(0.5)$

We note that for preferences in [0,1], the expected value in (2) is greater than that of (1) which in turn is greater than that of (3).

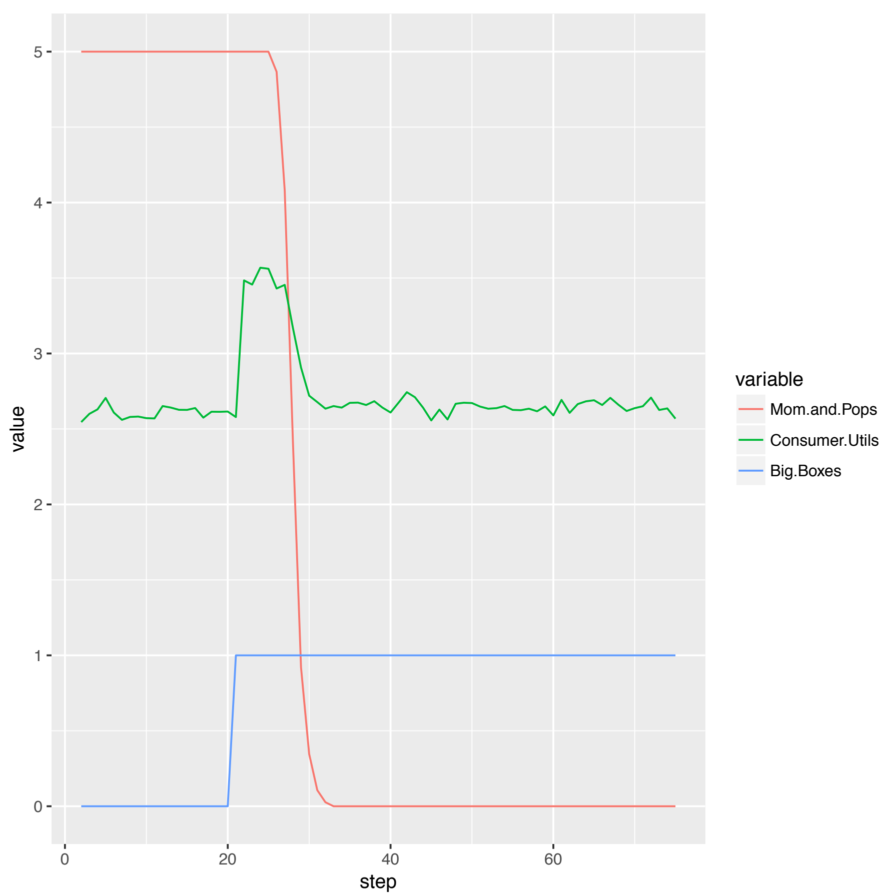
Big-box Statistics

Runs

The following graphs represent the average run time of models where consumer "added" preference for mom-and-pops is 0.0, 0.2, 0.4, 0.6, and 0.8 respectively. All other variables beside preference are held constant.[2] For each preference level, we ran seventy-five runs of seventy-five periods each. Note that in all experiments the big-box store appears in period 20.

In each experiment we give the expected utilities for (1) having only mom-and-pops, (2) having both kinds of store, and (3) having only big-box stores. We divided the utility by 5 in both the calculation and the model for sake of the data's presentation.

In the experiments where the preference for mom-and-pops is 0.0, 0.2, 0.4, and 0.6, mom-and-pops tend to vanish leaving the result where consumers end up with the situation of least utility.



Pref. p_M = 0.0

(1) 2.6

(2) 3.5

(3) 2.6

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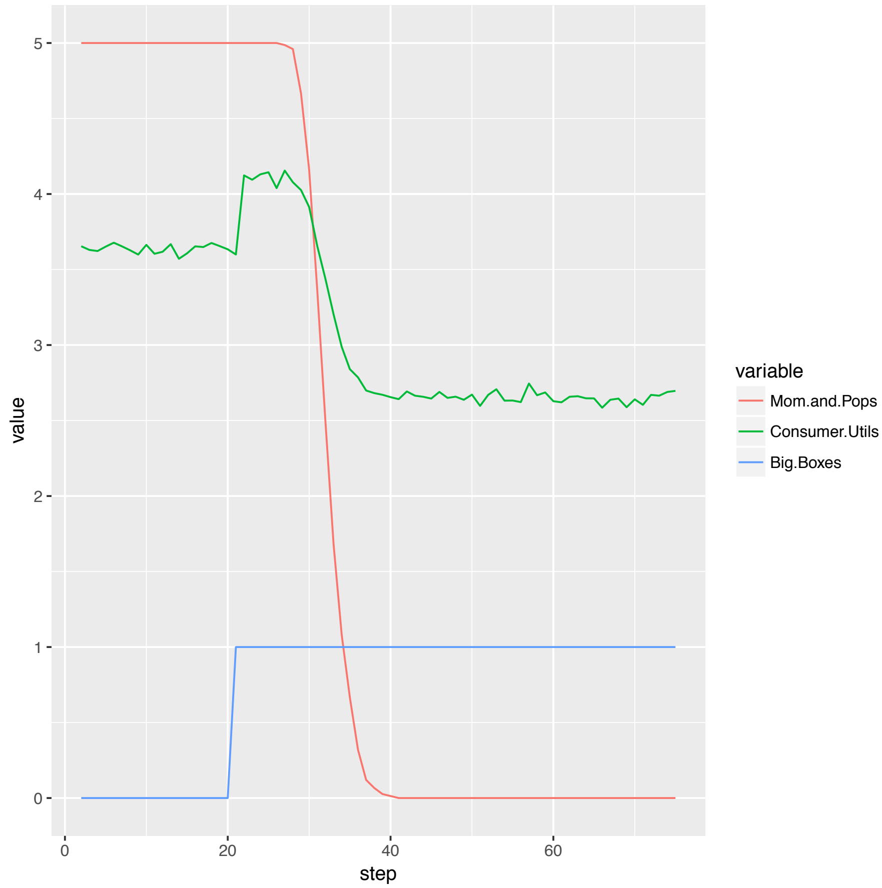
[2] There are 26 consumers, 5 mom-and-pop stores, each of which have an initial endowment of $30, gain $2 per purchase, and loose $10 per step. The big-box appears on period 20. It has an initial endowment 1000 times that of the big-box-store, and it pays five times the rent.

Pref. $p_M = 0.2$

(1) 3.6

(2) 4.1

(3) 2.6

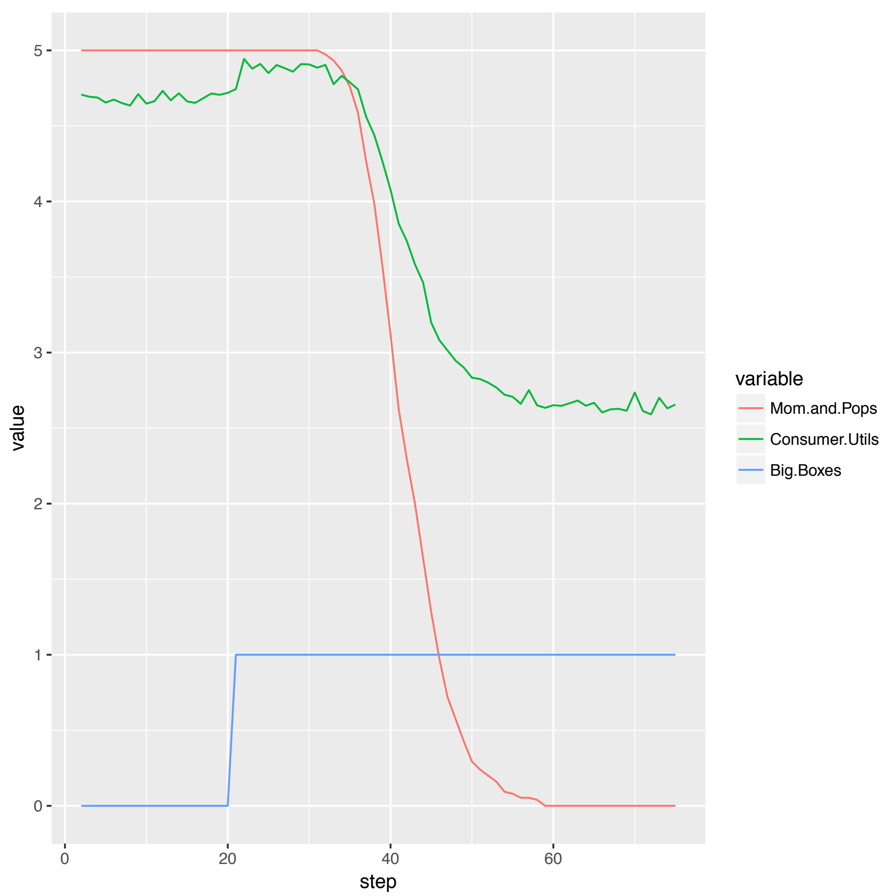


Pref. $p_M = 0.4$

(1) 4.6

(2) 4.8

(3) 2.6

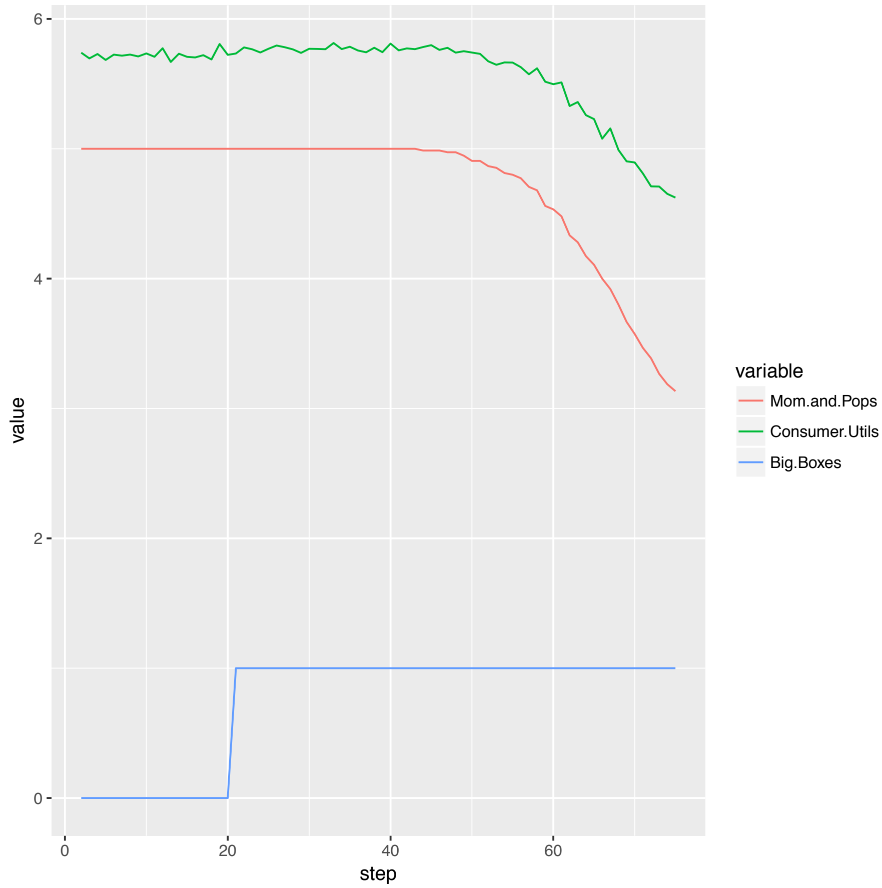


Pref. $p_M = 0.6$

(1) 5.7

(2) 5.8

(3) 2.6



Pref. $p_M = 0.8$

(1) 6.8

(2) 6.8

(3) 2.6