high valuation and low valuation customers. So, RM product design can be thought of as an optimal segmentation problem—taking a set of underlying segments (defined only by variations in their valuations and disutilities) and their purchase preferences (ideal points) and creating K segments (and, of course, the consequent operational problem of allocating capacity to the K resulting products). For the moment, assume that valuations are deterministic and there is a single segment. The description that follows generalizes to multiple segments in a transparent way.

Let n_j be the number of customers whose ideal point is product j. The firm's decision problem is to come up with prices p_j and allocations u_j, subject to $p_j \geq 0$ and $\sum u_j \leq C$.

$u_j = 0$ is taken to imply product j is not offered, so designing K RM products amounts to the restriction that at most K of the u_j's have non-negative values.

The firm's objective function then is given by

$$\max \quad \sum_j p_j x_j \tag{11.2}$$

$$\text{s.t.} \quad \sum_j u_j \leq C, \tag{11.3}$$

$$0 \leq x_j \leq u_j, j \in \mathcal{K}. \tag{11.4}$$

x_j represents the actual demand observed by the firm. We discuss how this is formed shortly. The restriction on number of products are captured by adding the following integer programming constraints to (11.2). Let y_j be a binary decision variable such that

$$y_j = 1 \ \text{ if } \ u_j > 0.$$

Then, these restrictions are modeled by

$$y_j \geq \frac{u_j}{C}, \quad \sum_j y_j \leq K, \quad y_j \in \{0, 1\}.$$

Customers are utility maximizers in the sense that they will purchase the product (among the available products) that gives them the maximum positive net utility. The consumer's decision is of course influenced by the prices p_j and allocations u_j set by the firm.

Let x_{ijk} be a binary variable equal to 1 if a customer i with ideal point j purchases k and 0 otherwise ($\sum_k x_{ijk} \leq 1$). Let B be a sufficiently

distributions of valuations. The notion of "distinct" is necessarily vague. The definition is akin to cluster analysis, where we want to define distinct clusters that are similar within the cluster and as dissimilar as possible across the clusters.