large number (say $> vN$). The customer decision making is modeled as follows. Let $v_{jk} = v - w_{jk} - p_k$ be the net utility of a customer with ideal point j purchasing product k at price p_k. A customer with ideal point j ranks $v_{jk}, k \in \mathcal{K}$ and chooses the highest available one, provided his net utility is nonnegative. This is the equivalent to saying if $v_{jk} \geq v_{jl}$ then $x_{ijk} \geq x_{ijl}$.

Notice not all customers are assured of being able to buy the product (even if they have some product with positive net utility) because of rationing. We capture the utility maximization of customers by the following set of linear integer programming constraints added to (11.2).

$$\sum_k x_{ijk} \leq 1 \tag{11.5a}$$

$$1 + \frac{v_{jk}}{B} \geq x_{ijk} \tag{11.5b}$$

$$x_k = \sum_{i,j} x_{ijk} \tag{11.5c}$$

$$\sum_{i,k} x_{ijk} \leq n_j. \tag{11.5d}$$

$$1 + z_{il} + \frac{v_{jk} - v_{jl}}{B} \geq x_{ijk} - x_{ijl} \tag{11.5e}$$

$$1 - \frac{u_l - \sum_{m(m \neq i),j} x_{mjl}}{B} \geq z_{il} \tag{11.5f}$$

The set of constraints (11.5a–11.5f) model demand as follows: (11.5a) says that customer i buys at most one product; (11.5b) that if net utility for customer i (with ideal point j) to purchase k is less than zero, then he does not purchase k; (11.5c) gives the total demand for product k as sum of all the customers who choose k; (11.5d) sets the number of customers with ideal point j as n_j. Finally, (11.5e) and (11.5f) impose the utility-maximizing condition that for customer i if $v_{jk} < v_{jl}$ then $x_{ijk} < x_{ijl}$, unless there is no remaining capacity for l. z_{il} is a binary variable, equal to 1 if product l is not available for customer i (it had been sold out to other customers) and 0 if there is available capacity for product l. (11.5f) sets the values for z_{il}.

The above linear integer program captures many important elements of RM such as utility-maximizing customers, customer preferences, prices and restrictions (even if it is rather hopeless to solve—at least in its entirety—in practice). Note that customers are not strategic as in Section 5.5.2—they do not change their purchase behavior anticipating the firm's or other customers' actions. As with any posted price mechanism, the sequence of arrivals of the customers makes a difference (high valuation before low, etc.). The integer programming formulation here