Conjoint studies are numerous in the CPG and automobile industries, and applications of conjoint analysis to design travel and hospitality industry facilities, products and amenities have been reported in [570, 102, 573, 574, 532, 216], but we know of no applications of conjoint analysis for quantity-based RM product "restriction" design as such. A second caveat is that current market environment often guides product design: what products the competition is providing and what prices they are charging. This presents an especially vexing problem for RM because (available) products and prices can change rapidly, making comparisons difficult. Barring these two caveats, the methodology has the potential to be useful in making rational product-design decisions.

The customer-behavior model of conjoint analysis is similar to the discrete-choice models discussed in Section 7.2.2, both having roots in microeconomic theories of preferences. There are M possible attributes of a product, and the firm can choose the *level* of attribute j in designing its product. Table 11.4 gives an example of the attributes and their levels for a hotel product. The choice of attributes and their levels is usually a result of management judgment or analysis of a survey among customers. It is advisable to be parsimonious and list only the most important attributes and the most reasonable range of their values.

A *profile* is a particular combination of the M attribute levels that can make up a potential product, $\mathbf{x} = (x_1, x_2, \ldots, x_M)$. Customers form a utility for a product that has the combination of attribute levels $\mathbf{x}$. The most common model[3] used for this utility formation is an additive composition of the *part-worths*, $u_j(\cdot)$ of attribute j:

$$U(x_1, x_2, \ldots, x_M) = \sum_{j=1}^{M} w_j u_j(x_j).$$

One can simplify this further and assume linear part-worth functions and a finite set of profiles. So if attribute k is assumed to have one of M_k levels, the utility of a customer i for a profile p is hypothesized to be

$$U_{ip} = \sum_{j=1}^{M} \sum_{k=1}^{M_k} u_{ijk} d_{jk}^{p}. \tag{11.1}$$

d_{jk}^{p} is an indicator variable equal to 1 if attribute j is at level k in the profile p and 0 otherwise, and u_{ijk} is the part-worth for customer i for the attribute j at level k. We would like to estimate these part-worth

[3]Other, more complicated, utility functions have been proposed, but we stick to this popular one for ease of exposition.