3.36B rolls up into bargain and deluxe products. Not only are the numbers different, the number of numbers is different. Price and customer are two equally valid ways of grouping individual products. For most multidimensional products, the two rollups would be treated as separate hierarchies within the same dimension.4

In this sense, a dimension may be thought of as a collection of leaf members and the set of hierarchy or group members created from that collection. In other words, all the members of a dimension—leaf members, intermediate level members, and root members—form a single collection of members of the same type, which, as a whole, constitutes one factor/dimension in a multifactor/dimensional situation. Keep in mind that all members of a dimension, from leaf to root, can vary from analysis to analysis.

Looking again at Figure 3.34, if a dimension has multiple hierarchies, when traversing up the hierarchy from any node (child) that has two or more parents, it is necessary to specify the parent or root toward which you are navigating. For example, if from the member fax machines, you wanted to navigate up to office equipment, it would be necessary to indicate that you wanted to move in the direction of allproduct rather than in the direction of deluxe products.

Summary of Hierarchies
Hierarchies are the foundation for aggregating data and for navigating between levels of detail within a hypercube. Relative referencing within a hierarchical environment is more complicated than within a row and column environment as the former is direction-specific. Although hierarchies are not a necessary part of any dimension, all real-world applications of moderate or greater complexity involve some hierarchical dimensions such as time, geography, product, customer, or market.

Multilevel Hypercubes
The combination of multiple dimensions and multiple levels per dimension constitutes the essence of a multidimensional cube or hypercube. A cell in a hypercube is defined by the intersection of one member from each dimension. The more dimensions and hierarchies are in the cube, the more complex is the neighborhood surrounding any cell, and the more directions along which you can go browsing. In an N-dimensional hypercube (with one hierarchy level per dimension), each cell has 2N immediate neighbors or browsing directions (an immediate neighbor to a cell differs from that cell by one unit of one dimension). A cell in a two-dimensional spreadsheet, for example, has four immediate neighbors; a cell in a three-dimensional cube has six.
Calculating the Number of Cell Neighbors

When you add hierarchies to the situation the number of browsing directions gets even larger. Figure 3.37 shows how to calculate, for any given cell, the total number of neighboring cells. (The total number of neighboring cells includes all cells other than itself that are zero or one unit away in any combination of dimensions.)

In general:

\[
\text{# of immediate neighbor cells} = \left[ \text{total product of } \left( \# \text{ of immediate neighbors in each dimension} + 1 \right) \right] - 1
\]

Figure 3.37 Calculating the number of neighboring cells.

Navigating in a direction is one way to browse a hypercube (or any structure, for that matter). Every time you use your cursor key or scroll bar, you are directionally navigating. Another way to move is by explicit statement of where you want to go. I call this an endpoint navigation. Stating that you want to see data for New York, or see last month's total sales, or see projections for next year's labor force are examples of navigating to a particular endpoint or view as opposed to navigating in a particular direction.

The term "drill down" refers to the process of navigating either directionally or by endpoints toward greater detail. That greater detail can come from moving down along any dimension. In other words, if you were looking at the screen shown in Figure 3.38A, you could drill down in any of the model's dimensions for which greater levels of detail existed. Figure 3.38B shows the
3.38 Drilling down.

result of drilling down in the products dimension. Figure 3.38C shows the result of drilling down in the geography dimension. The term “drill up” is simply the reverse of drill down.5

References


3. The number of distinct hierarchies in a multidimensional structure is equal to the product of the number of hierarchies in each dimension. Thus, if there were 3 in time (calendar, fiscal and project), 3 in store (regions, types