Introduction

Increase in competition is witnessing the twin trends of product price erosion and product proliferation. Retailers cater to the price sensitive customer by providing standard low-priced products. They also cater to the customer segments that are willing to pay a premium for customisation by offering customised extensions of the standard product. While the profit margin for a standard product is generally low and the profit depends on volumes, its customised extensions carry higher profit margins. However, the standard product typically has longer shelf life while its customised extensions are promoted as flavours of the season and have short shelf lives. Examples of this are (i) breakfast cereal (standard product) with flavours for different climatic seasons, (ii) chocolate (standard product) with extensions for different occasions like vacation and festivals and (iii) sportswear (standard product) with flavours for different game seasons/occasions like basketball season, cricket World-Cup and Olympic Games. Increase in customised extensions results in increase in demand uncertainty and higher inaccuracy in forecasting demand for individual stock-keeping units (SKUs). This in turn implies higher possibility of stock-outs or oversupply.

Retailers of products with limited shelf life are faced with the dilemma of stocking the right mix of standard product and its customised extensions or SKUs. On the one hand, stocking only a standard product ensures logistics that can be managed easily and efficiently, lower manufacturing cost, and stable demand with minimal stock-out or oversupply. The profit is volume driven and there are lesser losses owing to stock-out or oversupply. On the other hand, stocking only customised products implies higher margins, higher logistics complexity owing to high...
variety, higher manufacturing costs and higher losses owing to stock-out and oversupply. In this paper, we attempt to derive the optimal allocation of a standard product and its customised SKUs that would maximise the retailer’s profit.

The above problem belongs to a class of problems known as newsboy problem or single period inventory model. Over the last decade, several researchers have worked on multiple-product single inventory problem. Refer to Khouja (1999) for an excellent survey on capacitated multiple-product single inventory problem. We build our model as an extension of the work done by Khouja, Mehrez and Rabinowitz (1996). The problems are modelled in §2. The proposed solution methodologies with numeric examples for both problems are also described in this section. Discussions and conclusions are in §3.

The problems and solution methodologies

In the newsboy problem, an optimal stock of product is built in the beginning of the period from which the demand for that period is met. However, the newsboy cannot replenish the stock during the period in case the demand is more than the opening stock. Hence, the demand that is excess of the opening stock is lost sales for the newsboy. Also, the newsboy has to clear the stock left at the end of the period, owing to demand being less than the opening stock, at a salvage or clearance price.

Notations

Subscripts, parameters and variables:

\[ I = \{i | i = 1, \ldots, p\} \]

= set of customised extensions of standard product

\[ c \]

unit cost of procuring and retailing a standard product

\[ r \]

unit retail (un-discounted) price of standard product

\[ m \]

unit clearance price of standard product, \( m \leq c \)

\[ c_i \]

unit cost of procuring and retailing a customised product \( i, c_i \geq c \forall i \)

We assume that the retailer can predict aggregate demand accurately, though, it is not the case with the customised products.

\[ r_i \]

unit retail (un-discounted) price of customised product \( i, r_i \geq r \forall i \) and \( r_i - c_i \geq r - c \forall i \)

\[ F_i \]

fixed cost per period for retailing customised product \( i \)

\[ m_i \]

unit clearance price of customised product \( i, m_i \leq c_i \)

\[ M \]

a very large number