Consider a seller who is endowed with a fixed number of units of a product that he/she can sell to a price-sensitive and stochastically arriving stream of consumers during a given selling season. The seller’s problem is to dynamically adjust the product’s price to maximize the revenues he/she can collect if no replenishment is possible during the sales horizon. This setting is quite typical of many industries including among others, airlines (selling seats on a specific flight), hotels (booking rooms on a particular night), and retailers (selling seasonal merchandise). Often, these problems are labeled as revenue management problems since operational decisions are driven solely by revenues; inventory and capacity costs are sunk and incurred independently of changes in prices and/or number of units sold. The assumption of a fixed capacity is by no means critical if we consider that in most of these industries capacity is flexible only in the long run. Moreover, capacity decisions and price decisions take place on different timescales. Issues regarding the type of airplanes to schedule on a particular route, or the number of rooms to build in a given hotel, or the amount of seasonal merchandise to purchase from an overseas supplier are decided long before demand is realized and price policies are implemented.

In this article, we discuss, specifically, the revenue management problem alluded to in the previous paragraph using a stylized mathematical formulation. We focus on the research that considers the case in which the seller has incomplete demand information. That is, there are some characteristics of the demand process (e.g., the arrival rate or the price elasticity) that the seller does not know with certainty. Through this discussion we aim at summarizing some of the fundamental theoretical results of the existing literature. The model is simplistic but, we believe that the methods used and the insights drawn are quite representative of more general models and various other settings related to revenue management and, more broadly, to inventory management. Our exposition is by no means exhaustive and we refer the reader to Refs 1 and 2 for a comprehensive review of the literature on dynamic pricing and revenue management, and to Ref. 3 for a detailed exposition on point processes and their optimal intensity control. We start reviewing the basic mathematical model under complete demand information.

DYNAMIC PRICING WITH COMPLETE DEMAND INFORMATION

Consider a stream of potential customers arriving according to a time-homogeneous and price-independent Poisson process with rate \( \Lambda \). We refer to \( \Lambda \) as the market size. Upon arrival, a consumer buys the product with probability \( F(p) \), where \( p \) is the price of the product listed at this time. We can interpret \( F(p) \) as follows. We associate with each consumer a reservation price (that is, a maximum willingness to pay), which is distributed according to \( F(\cdot) \) among the population of consumers (see Ref. 4 for more details), so that \( F(p) = 1 - F(p) \). We will assume that \( F \) admits a density \( f \). The effective demand process or the sales process that results from