

A Revenue Management Approach for Attended Home Delivery

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Keywords: Revenue Management, Two-phase stochastic programming.

Attended home delivery is a last-mile delivery service, where the customer must be present for the delivery. The classical delivery model utilizes couriers who serve customer requests through bicycles, motorcycles, cars and vans and that communicate via mobile phone. Most of the vehicles perform short-duration delivery routes with respect to the planning horizon due to the characteristics of the package, the delivery service, and the vehicle capacity. Each customer request consists of a pair of pickup and delivery locations (o-d pairs) associated with a tight delivery time window on which the delivery company and the customer agree. These requests are usually done with little or no notice and their frequency depend on several factors as the day of the week and the hour of the day.

One major concern for last-mile delivery service companies is to deal with high variability in the demand as well with high concentration of the demands in some time slots. In this presentation, we present a revenue management approach in order to favor demand shifting from peak slots to off-peak slots and thus smooth out the parcel delivery demand curves. Indeed increasing capacity (by requiring the services of external couriers) is highly expensive. Nevertheless it is possible for the service provider to decrease his capacity cost by increasing some peak period prices and/or reducing off-peak period prices, and hence convince some customer to shift their demand to more available periods.

Revenue management is the name given to “a series of techniques which are directed towards enhancing the firm’s revenues”. The objective of these techniques is not necessarily to stimulate product demand directly, but rather to better convert existing demand into higher revenues. The development of RM has been initially stimulated by the deregulation of the airline traffic in the United States in the late 1970s. As the impact of RM on the airline business has been dramatic, RM has now emerged as a best business practice in many industries. After the airlines, RM quickly spread to rental cars, hotels, and vacations...

The last mile delivery service problem satisfies the assumptions to apply RM approaches. The products, i.e. the number of deliveries per time slot and per courier, are perishable and can be booked in advance. The capacity is limited and cannot be increased easily. The demand is composed of heterogeneous customers with a certain price sensitivity allowing customers segmentation. Finally the demand varies sharply with the time of the day and is mainly unknown a long time in advance.

The proposed approach is divided into two phases each one corresponding to a different planning level: tactical and operational. The tactical planning aims to determine the available

delivery capacity per time slot whereas the operational planning integrates RM techniques to smooth out the demand.

The tactical planning is an integrated shift scheduling and load assignment optimization problem for attended home delivery under demand uncertainty. This problem is modeled as a two-stage stochastic programming model. This model integrates two types of decisions. First-stage decisions are related to the design of a schedule that includes the periods of the day in which each courier must work and the o-d pairs to visit at each time period. Second-stage decisions (recourse actions) consist of the allocation of a number of packages to be delivered at each time period, for each o-d pair, by each courier, such that the demand (number of packages to deliver) for each scenario is satisfied. Recourse is the ability to take corrective actions after a random event has taken place. The objective is to minimize the sum of the daily staffing cost (fixed cost) plus the expected daily recourse cost (variable cost). To solve this problem, we propose and implement a multi-cut integer L-shaped algorithm, where the second stage decomposes by time periods and by demand scenarios. To strengthen the first stage model, some valid inequalities are added, and some of the existing constraints are lifted.

In the operational planning, tariff classes are defined to favor booking anticipation and demand shifting. The tariffs for joint time slot and O-D pair combinations are set according to delivery costs, the customer segmentation. Indeed the peak periods sharply depend on the pick-up and delivery zones of the parcels. The capacity of each tariff class is pre-defined according the tactical problem solution. Unequal tariffs for the same joint time slot and O-D pair combination come from the service through an external courier or the relocation of a courier pre-assigned to a different O-D pair in the tactical phase. The operational problem consists in, successively, closing tariff classes during the booking period according to the known demand and allocating delivery orders to couriers in real-time. The first step is based on a Bid price approach. The second step is based on the generation of delivery routes designed according the o-d pairs assigned in the tactical planning phase. Routes are assigned to couriers in such a way that every customer request is covered, and the total transportation cost is minimized.

Results on real-world based instances from a delivery company demonstrate that our approach provides robust tactical solutions that easily accommodate to fluctuations in customer orders, preventing additional costs related to the underutilization of couriers and the use of external couriers to satisfy all delivery requests.