A dynamic routing problem for perishable items in a natural disaster relief

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Abstract:
Natural disasters such as earthquake are complicated, in which it is so difficult to predict the time and location of the earthquakes, in spite of using the net of thousand seismographs and continual analysis of data, using powerful computers, all around the world. Accidental and unpredictable nature of Natural disasters leads to existence of comprehensive plans in order to reduce the danger of the probable events. In such a situation, shortage of commodity, resources, and transportation systems limit the optimum usage of available facilities. Thus, in spite of limited resources, implementation of proper plan to reach the maximum efficiency is essential.

The objective of this project is to provide a comprehensive study, and develop analytical models to address challenges in the Inventory Routing Problem under dynamic and uncertain environments (stochastic demand and events, last information about opened or closed roads, etc.) where expiration date of perishables items and time windows have to be also taken into account. In this study, we focus on highly perishable items as blood or derivate product of blood, and some pharmaceutical products.

Keywords: Supply chain management, Natural disasters, Inventory and Routing Problem, stochastic events, perishables items, Dynamic Simulation

Context and objectives:
Natural disasters such as earthquake are complicated, in which it is so difficult to predict the time and location of the earthquakes, in spite of using the net of thousand seismographs and continual analysis of data, using powerful computers, all around the world. Accidental and unpredictable nature of Natural disasters leads to existence of comprehensive plans in order to reduce the danger of the probable events.

According to the previous experiences, although logistical actions and evacuation operations are important procedures in order to reduce the fatality during an earthquake, the determination of good logistical plan remain difficult. In this situation, it is obvious that the people’s requirements have to be met by stored commodity or related suppliers. Moreover, some commodities have a limited life time in order to transfer them to their destination which we should take this into consideration.
Nowadays designing inventory systems for perishable items became more and more important. Many authors had investigated designing inventory systems for perishable items such as blood, pharmaceutical products, food, chemicals, etc. In a natural disaster situation, transportation of perishable items will become vital [1, 2, 3].

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Although shortage in mentioned resources is less destructive in minor incidents; the crises managements become very important in a severe catastrophe. In this situation, crisis management can't deal as an individual problem. Consequently, the existence of a decision aid tool can allow identify quickly the best solution and use efficiency several resources by considering last information about the state of roads as well as the constraints linked to capacity and request of several service points.

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Meanwhile, according to the fact that the main objective in this situation is minimizing the time to cover all users by providing them the needed items, in mathematical model, actual and logical conditions are considered to minimize the time needed to transfer perishable goods to corresponding users and to satisfy their demands.

Same study can be carried out for patients after disaster events in order to find the best service point (hospital or urgent service) considering the ability, capacity and availability of each service. In this way, it's also necessary to take into account the type of vehicle (ambulance or classic vehicle), capacity of each vehicle, possibility of transshipment between several service points, road condition, etc.

Finally, it's interesting to study the combine transportation of patients and goods in disaster situations. The developed mode must allow taking into account this possibility. Transportation network, which is the income of the model, can be generated by network designing algorithm. [5]

The question that we want to answer by doing this project is 'how to design a logistics model for distributing perishable items in a disaster situation?
Background required from the applicant:
Operation management, Mathematical modeling, Operation research, Stochastic programing, Industrial engineering, Optimization and engineering software, Simulation (CPLEX, Matlab, GAMS, simulation tools...)

References


