A Survey on the Stochastic Vehicle Routing Problem and Solution Method for Car Pooling Application

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Abstract— **Car pooling is a transportation alternative to address congestion i.e., sharing a vehicle toward a common destination, based on a priori agreements. Carpooling is one method that can be used to resolve a variety of problem that continue to be affect urban areas, ranging from energy demands and traffic congestion to environmental pollution. Most of the existing method used stochastic other disturbance arising from variations in vehicle travel times for carpooling. In this paper multiple stochastic factors (particularly other regular incidents such as stochastic variations in the amount of demand) to form a more complicated stochastic model. To perform this Chance constrained formulation Programming (CCP) approach is proposed for the problem with stochastic demand and travels time parameter, under mild assumptions on the distributions of stochastic parameter.**

Keywords— **CCP, Car pooling, CMG.**

I. INTRODUCTION

In recent years in the problems of global warming and the energy crisis have aroused widespread public concern. One recommended solution for reducing the harmful factors leading to such problems is car pooling. This type of transportation service could make a big difference if organized on a large scale by government or big companies, particularly large corporations with many branches or sub companies. Car pooling schemes are designed to encourage commuters to share travel expenses and resources with colleagues. There are two main types of carpooling operations: 1) the daily car pooling problem and 2) the long-term car pooling problem.

Some carpooling organizations have been set up in Taiwan, and some of these have set up websites for consulting or exchanging information about participants' travel routes, departure arrival times, departure arrival locations, or requests. The problem is that users can only find matches by exchanging data or by the application of a simple logic program. Consequently, the matching results obtained are not only ineffective but also possibly inferior. There have been a few studies regarding the carpool optimization problem. Recently, Chen and Yan [4] have employed a time space network flow techniques to develop a models for the many-to-many carpooling problem with multiple vehicle type and person types. The model is formulated as an integer multiple commodity network flow problem. Chen and Yan [5] observed that if prematching information is not considered in daily carpooling, then there may be a significant difference between the planned results and prematching information requirements, which forces carpool members to frequently adapt to different carpool partners or drivers to adapt themselves to new routes. Therefore, they developed a carpooling model with prematching information. Dealing with the long-term carpooling problem, Yan et al. [6] considered that some drivers with longer origins and destinations could pay higher costs, which might thus decrease their willingness to join the carpool plan. Therefore, they developed a model to resolve long-term many-to-many carpooling problems in relation to the fairness considerations.

In actual operations, stochastic vehicle travel times often occur, hampering the performance of the already planned vehicle routes and schedules. Vehicle travel times tend to fluctuate due to congestion, which is an ever-present problem on Taiwan roads. A projected (or average) vehicle travel time, as adopted in current practice, may not comply with the actual Vehicle travel time. Therefore, to design a good matching route and schedule, stochastic vehicle travel times have to be taken into account.

In this paper work I consider multiple stochastic factors (particularly other regular incidents such as stochastic variations in the amount of demand) to form a more complicated stochastic model. To perform this Chance constrained formulation/Programming (CCP) approach is proposed for the problem with stochastic demand and travel time parameters, under mild assumptions on the distribution of stochastic parameters.

To construct a stochastic carpooling model those consider only the influences of stochastic travel time. I propose Chance constrained formulation/Programming (CCP) approach of the problem with stochastic demand and travel times parameter, under the assumptions on the distributions of stochastic parameters and relates it with a robust optimization approach. Since real problem sizes can be large, it could be difficult to find optimal solutions within a reasonable period of time. Therefore solution algorithm using tabu heuristic solution approach is

developed to solve the model. A tabuheuristic is proposed to solve the model and simulation is conduct to evaluate the quality of routes to be generated from chance constrained formulations. This work is experimentally observed that chance constrained routes can reduces to the unmet demand for moderately tight deadlines the and total supply constraints are shows that proposed models and solution algorithms are good and could be useful for the carpooling practices.

II. SCPM

This paper is aimed at developing a carpooling model with stochastic vehicle travel times and a solution algorithm for practical applications. To simultaneously and optimally determine every participant's role (driver or passenger), driver schedules, and passenger deliveries, as well as to match several participants in a car, is a very complex task. This involves complicated movements of drivers (or vehicles) and passengers in terms of time and space. The objective is to minimize the expected system costs and the penalty for unserved carpool members while satisfying the participant-related constraints. To simplify the description of this complicated problem, we first define the terminologies used.

1) CMG is an abbreviation of "carpool member group." ACMG contains a number of members that can carpool together. A carpool member can request to share the same trip with his/her friends, in which case they are treated as a CMG. Each CMG is associated with a data set. The number of persons in a CMG can be greater than one but cannot exceed the vehicle capacity (or a planning capacity less than the true vehicle capacity, which can be set by the authorities based on operational considerations). CMG scan be further divided into CMGVs and CMGNVs, which are explained below.
2) CMGV is a CMG with a vehicle. In other words, it is with a vehicle paired with a driver who is a member of the CMGV.
3) CMGVP is a CMG with a vehicle but assigned to passengers without using the vehicle (similar to a CMGNV) via the optimization process described later.
4) CMGNV is a CMG that cannot provide a vehicle. A CMGNV will be determined to be/not to be served via the optimization process.

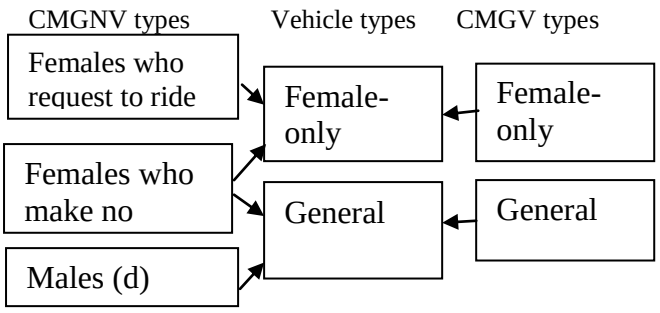

Fig. 1.Relations between the CMGNV, CMGV, and vehicle types.

There are three types of CMGNV: 1) female CMGNVs who request to ride in female-only vehicles; 2) female CMGNVs who make no specific gender requests; and 3) male CMGN Vs. Each CMGNV has to be one of these three types. If there are males and females together in a group, then this group automatically belongs to the male type of CMGNV. If a CMGV is designated a CMGVP, it has to be carried by the vehicle type it provides. Thus, the two CMGV types are the same as the two vehicle types, i.e., female-only and general. As shown in Fig. 1, the female-only vehicles can carry only female CMGs with/without gender requests and female-only CMGVs. The general vehicles can carry female CMGNVs who make no gender requests, male CMGNVs, and general CMGVs.

In this paper, the data set provided for each CMG must be known beforehand.

1) The CMG's origin and destination.
2) The CMG's earliest departure time and latest allowable arrival time: These become the starting and ending times of the time window for the CMG. The length of the time window indicates the longest travel time that can be tolerated by the CMG, which can affect the matching success and efficiency.
3) The number of people: The number of members requesting the same trip in the CMG.
4) Vehicle or no vehicle: If a vehicle capacity and type can be also provided, then it will be labeled as a CMGV; otherwise, it will be labeled as a CMGNV.
5) CMGNV type.
In conclusion, the carpooling problem involves selecting the CMGVs to drive and to be carried (i.e., as CMGVPs), matching all CMGNVs and CMGVs and simultaneously identifying the routes of all CMGVs and CMGNVs. The goal is to minimize the system costs, subject to the CMG (whether CMGNV or CMGV) time window, CMGNV type, vehicle type, CMGVP selection, and vehicle capacity constraints. A
Time–space network technique is applied to construct a carpooling model, which demands the optimal management of CMGV and CMGNV movements/matching within the network.

III.CHANCE CONSTRAINED PROGRAMMING

Three branches of the chance constrained programming (chance, constrained programming stochastic programming is the expected value model, chance-constrained programming and related opportunities for planning. Which chance-constrained programming the investigation nasdaq (a.charnes, and cooper (whooper 1959, is achieve the optimal theoretical probability sense it is a stochastic programming method with random variables for the constraints, and must make decisions before the realization

of the observed random variables. Chance constrained programming takes into account the to make decisions in adverse situations may satisfy the constraint conditions, while the use of a principle: that allows the decision-making to some extent, satisfy the constraint conditions that have been made, but the decision established the probability of constraint is smaller than some small enough confidence level. some special cases, the chance constrained programming problem can be transformed into the equivalent deterministic mathematical programming problem, but for more complex chance-constrained programming problem, they have to use stochastic simulation-based genetic algorithm for solving general chance constrained programming problems and chance-constrained multi-objective planning and chance-constrained goal programming problem. chance constrained programming constraints contain random parameters, its general form as follows: Ai = (aij) sm, bi s-dimensional vector, and Ai and bi some or all of the random variable, c ∈ Rm is the coefficient of x ∈ Rm is the decision vector, 0.

There are basically two kinds of chance-constrained programming solution. First, the chance constrained programming for deterministic planning, and then use the theory of deterministic planning, and the other constraints by stochastic simulation technology opportunities, and use of genetic algorithms survival of the fittest, the optimal value of the objective function and decision variables of the chance-constrained programming optimal solution set of random coefficients in the optimal solution set with the model of the optimal value of chance-constrained programming objective function and decision variables, and thus the randomness. statistics from the mathematical point of view, the random objective function optimal value and optimal solution set of decision variables can make a certain level of confidence interval estimation to measure an important indicator of the interval estimation accuracy is estimated the length of the interval, The estimated length the smaller the range, it is estimated that the greater the accuracy, on the contrary, it is estimated that the greater the interval length, the smaller the estimation accuracy.

IV. TABU SEARCH HEURISTIC

Tabu search is a met heuristic search method employing search methods used for mathematical optimization.
The word tabu (or taboo) comes from Tongan, a language of Polynesia, where it was used by the aborigines of Tonga Island to indicate things that cannot be touched because they are sacred. According to Webster's Dictionary, the word now Also means "a prohibition imposed by social custom as a protective measure" or of something "banned as constituting a risk."The tabu search is a meta-heuristic superimposed on another heuristic. The approach is to avoid entrainment in cycles by forbidding or penalizing moves which take the solution, in the next iteration, to points in the solution space Human behavior appears to operate with a random element that leads to inconsistent behavior. The resulting tendency might be regretted as a source of errors but can also prove to be source of gain to deviate from a charted course. The tabu method operates with the exception that new courses are not chosen randomly.

The regions of problem solutions space is investigated with the goal of avoiding local minima and ultimately finding the desired solutions.
The local minima's are used in tabu search. The steps used to avoid the methods used to retract records use one or more tabu lists. The originals intent of the list was not to prevent a previous move from being repeated, but rather to insure it was not reversed. The tabu search memory consists of a list which are historical in nature. At initialization the goal is make a coarse examination of the solution space, known as diversification, but as candidate locations are identified the search is more focused to produce local optimal solutions in a process of the "intensification". The differences between the various implementations of the tab method have to do with the size, variability, and adaptability of the tabu memory.
In combinatorial optimization problems the tabu search is used more. The tabu search is applied directly to continuous functions by choosing a discrete encoding of the problem. Many applications involve integer programming problems, scheduling, routing, traveling salesman and related problems.

V. SCOPE OF THE SURVEY

The scope of the survey is to present an application which provides a communication platform between car owners and passengers in a Stochastic Vehicle Travel Times. Car owners will be able to post a notice announcing that she has been travelling between some particular locations regularly or just once, to search a travel-mate in order to reduce the ride costs.

The problem involved in this is locating users at their origin locations who needed to reach the same destination point given temporal and topographical constraints. **C**arpooling involves two or more users, heading in the same direction, who travel together by means of a private vehicle along a semi common route. Carpooling as a transportation service organized by a large company that encouraged its employees to pick up colleagues while driving to/from work to minimize the number of private cars travelling to/from the company site.

VI. RELATED WORKS

Shangyao Yanin the year 2011 proposed network flow technique to systematically develop a long-term many-to-many car pooling model [2]. Remy Chevrierin the year 2012 proposed Demand responsive transport (DRT) to improve the performance of transport services[3]. Astrid S. Kenyon in the year 2003 discovered Stochastic Vehicle

Routing with Random Travel Times for optimal and better routing [4].

Nianbo Liu in the year 2013 proposed the idea of Mobility Crowd sourcing (MobiCrowd) to accurately position the vehicle and to improve performance [5]. George Dimitrakopoulos proposed the framework of Information and communication technology (ICT) to improve the Reliability of the knowledge-based selection decisions is higher [6].

VII. CONCLUSION

The project is to present the applications which are provides a communication platform between car owners and passengers in a Stochastic Vehicle Travel Times. Car owners will be able to post a notice announcing that (s) he has been travelling between some particular locations regularly or just once, to search a travel-mate in order to reduce the ride costs. The problem involved in this is locating users at their origin location who needed to reach the same destination point given temporal and topographical constraints. **C**arpooling involves two or more users, heading in the SAME direction, who travel together by means of a private vehicle along a semi common route. The work is extended to consider multiple stochastic factors (particularly other regular incidents such as stochastic variations in the amount of demand) to form a more complicated stochastic model. To perform this Chance constrained formulation/Programming (CCP) approach is proposed for the problem with stochastic demand and travel time parameters, under mild assumptions on the distribution of stochastic parameters.

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