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Dynamic Processes and Equilibrium in Transportation Networks: Towards a Unifying Theory

Traditionally, traffic assignment to transportation networks has been approached through *equilibrium* models, which provide consistent link flows and costs. Equilibrium analysis is based on the implicit assumptions that such a state exists, is unique and stable, and is enough close to the state actually occupied by the system. This paper describes a more general modeling approach based on deterministic and/or stochastic dynamic processes. The described framework is used to investigate coincidence of fixed-point attractors of a determistic process model and equilibrium states, existence and uniqueness of fixed-point attractors, stability of both fixed-points and equilibrium. Conditions for stochastic process regularity are proposed ensuring, among other things, existence and uniqueness of a stationary probability distribution of system states. Day-to-day dynamic analysis allows to single out and numerically check the effects of a number of factors, such as congestion levels, quality of information, users' propensity to change.

The Intermodal Trailer Assignment Problem

One of the key points in the operation of an intermodal rail terminal is the loading of trailers onto outbound railcars. A compromise between minimization of operating costs and meeting service commitments must be established. Most of the costs are a function of the number of railcars used, thus the problem of efficiently assigning trailers to railcar hitches is relevant. This paper offers a novel modeling approach to this intermodal trailer assignment problem. The problem is cast in the form of a set covering problem with side constraints. Two methods of resolving the resulting formulation are studied. One is a traditional branch and bound procedure, and the second is a heuristic method observed to perform very well in practice. This work has motivated the development of a system that is now in use in many intermodal rail yards across the United States.

Computational Approaches to Stochastic Vehicle Routing

The paper by BERTSIMAS, CHERVI and PETERSON is a computational study of several well-known "graphical" heuristics for the probabilistic traveling salesman problem (PTSP) and the probabilistic vehicle routing problem (PVRP). These problems are of wide interest in logistical and transportation planning because they explicitly treat the uncertainty in the collection demands.

In some cases, a company facing a PTSP/PVRP may be able to redesign its collection routes daily to adjust to changes in demand. However, in many cases, such a strategy may be highly impractical. For example, the company may wish to have a driver follow the same route each day in order to gain familiarity with a particular set of customers. In such cases, the company would benefit instead from a single routing strategy, designed in advance of specific demand information but incorporating knowledge of the underlying uncertainty. Such situations ideally call for simple heuristics with good average cost performance over the range of demand realizations.

The strategies discussed in this study fit this description, and as the authors' results show, they perform well over a range of demand distributions. For the practitioner, the paper suggests that relatively simple procedures will give quite adequate results. The methods can be implemented easily in numerous types of delivery systems, are robust with respect to the underlying distributions, and allow the user to avoid the inconvenience sometimes associated with redesigning tours to accommodate day-to-day changes in demand.

Linearly-Constrained Entropy Maximization Problem with Quadratic Cost and Its Applications to Transportation Planning Problems

Many transportation problems have been formulated as a linearly-constrained convex programming problem whose objective function consists of entropy functions and other terms reflecting linear cost like travel time. There have been concerns about the adequacy of linear cost in such formulations. For example, J. A. Tomlin pointed out, back in the early 70's that the linear cost per unit flow from an origin to a destination in a trip distribution problem is an oversimplification. However, there has been very little systematic treatment in the literature.

This paper intends to address such concerns by proposing a model of linearly-constrained entropy maximization with *quadratic* cost. The related du-

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ality theory has been studied. It leads to the development of a *globally* convergent algorithm with a *quadratic* rate of convergence. The efficiency and the robustness of this approach are confirmed by the computational experience.

The unconstrained dual approach also unifies many theories and algorithms previously proposed for solving various linearly-constrained entropy optimization problem with only linear cost, e.g., the conventional trip distribution problem with linear cost, the entropy-based modal split model, and the decomposed problems of the combined problem of trip distribution and assignment.

The Effect of Spatial Structure on *p*-Median Results

This paper discusses the influence of the shape of the transportation network on location-allocation results by analyzing the results of the p-median problem solved on 17 systematically generated networks. Networks are generated from a 18×18 lattice of points in which each point has the same spatial environment as every other point but are linked in different ways. They basically represent two spatial configurations: regular and radial. A 9-median problem is solved for each network. The impact of the shape of the network on the efficiency and the equity in the supply is then discussed based on six different measures: the average distance, the maximum distance, the total allocation, the location of optimal supply sites, the shape of the market areas and the distribution of the distance frequencies. Finally, changes in the number of sites p is considered in order to investigate the sensitivity of the regularities discussed on the range of p. Several regularities are put forward: existence of relationship between the shape of the network and the optimal location, importance of location of peripheral link to the efficiency of solutions on radial networks, and high sensitivity of market zones to the shape of the market.

These simulations lead to interesting conclusions in the domain of regional economics and land planning and to striking illustrations of already discussed theoretical problems. It hopefully opens up a broad avenue for further investigations.