Decision-making Framework for Effective Trip Planning Based on Travel Time Reliability

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Abstract

Decision making is a key element in trip planning. As the vehicle volumes on road networks increases, the uncertainty of traffic and roadside situations grows resulting in unreliable travel times. Hence, planning a trip becomes a challenging task, especially in situations where there are alternate routes and no reliable data (i.e.: travel times, real-time traffic levels) to make sound decisions. Since a trip possesses a monetary value that can be measured in terms of time and/or cost, trip planning and related decision-making have become key aspects of contemporary transportation. Traffic data collection had been a conventional practice until the recent advances in research work introduced many technology-based automated solutions. These inventions facilitated real-time large-scale data collection and provided access to such data revolutionizing the field of transportation. The analyses conducted on travel conditions generate useful information that aids the trip planning and decision-making process. The objective of this study is to aid the users of transport systems with the trip planning process through a systematic decision-making process. The methodology of the research involves developing a data-driven decision-making framework to fulfil the said purpose. Travel time reliability which is defined as the dependability of travel times is the key parameter incorporated in the proposed framework and it is measured using indicators: the cumulative probability of arriving at the destination at the desired arrival time (primary measure), and coefficient of variation of the travel time distribution of the selected route (as a secondary measure if needed). The basis of the decision is â€˜the risk of experiencing an unpunctual arrival' which is measured in terms of cumulative probability as stated before. The risk can be a late arrival as well as an early arrival. The outputs are generated based on the user requirements namely departure time, arrival time, and route choice. Hence, this is a user-specific (or scenario-specific) decision-making tool that produces solutions for an exact trip-making instance. In other words, this framework does not produce general solutions. This paper presents the final framework developed in this research for the decision-making process. It requires historic travel time data of road segments to determine the cumulative probability for reliability measurement. Provided that such information is available, this framework can be effectively utilized to assist the users in the decision-making process of trip planning. The latter part of the study demonstrates the applications of the proposed decision-making framework using several scenarios that represent different expected departure and arrival time conditions. For situations such as selection of the most suitable route for a trip from the available alternatives and determination of the most probable arrival time for a trip, this method can be applied. The outputs can assist the user to make choices rationally thereby avoiding unnecessary delays and/or losses. The outputs generated based on the proposed methodology are simple and straightforward; thus, this method can be directly adopted in the trip planning process. Even for the users with less technical knowledge and analytical skills, this framework can provide guidance to methodically arrive at a decision (e.g.: distinguishing the most suitable route and the optimum departure time for the trip, the decision on the optimum departure time based on a fixed arrival time or when there are limitations on the latest arrival time, determination

of a desirable arrival time based on a set departure time or when there are limitations on the earliest departure time) regarding the trip. The access to more accurate data will further improve in the future and the technological breakthroughs will pave the way for the development of a user application for day-to-day trip planning needs. The transport planners, authorities, and regulators can also benefit from this framework as it allows them to establish traffic management decisions (e.g.: identification of reliability-related high-priority links on the road network and implementing suitable traffic plans) based on the generated outputs.

Keywords: *data-driven decision-making, decision-making framework, travel time reliability, trip planning*

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