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Mathematical Model to Determine Average Travel Distance of Shared Taxi

Yuichi Kozakai, Yoichi Shimakawa
Department of Computer Science and Technology
Salesian Polytechnic
Tokyo 194-0215, Japan
s20512@salesio-sp.ac.jp, simakawa@salesio-sp.ac.jp

Hiroyuki Goto
Department of Industrial and Systems Engineering
Hosei University
Tokyo 184 8584, Japan
goto-h@hosei.ac.jp

Abstract

Shared taxis are ubiquitous throughout Southeast Asia. Unlike buses, this mode of transportation does not have fixed routes or schedules. Its distinctive feature is the transport of multiple passengers with different origins and destinations in one trip. Thus, shared taxis can be regarded as a public transportation service that is an intermediate between taxis and shared buses. More specifically, passengers inform the driver of their destinations, as in regular taxi services, with the driver picking up other passengers heading in the same direction along the way. If there are drop-off points for other passengers before they reach their destination, the driver makes a slight detour to drop them off first. Thus, travel distance can increase depending on the number of additional passengers along the path. Although the taxi visits the drop-off points of passengers in order of proximity, the drop-off points of any new passengers picked up during a trip are continuously added to the route. Consequently, passengers might not necessarily travel the shortest route to their destinations. In this study, we modeled a formula to determine the average travel distance of a shared taxi using Crofton's differential equations. We assumed that passengers appear randomly within a circular urban area and travel along a straight line between their origin and destination points. In our validation experiment, the average distance estimated by the model was compared with that obtained via computer simulation.

Keywords
Shared taxis, Average travel distance, mathematical model, Computer simulations, and Crofton's differential equation.

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Biographies
Yuichi Kozakai is a student of the Department of Computer Science and Technology at Salesian Polytechnic, Japan. His research interests include operations, mathematical models, and algorithms.

Yoichi Shimakawa is a Professor of the Department of Computer Science and Technology and the Director of the Advanced Course in Production Systems Engineering, at Salesian Polytechnic Japan. He received his B.S. and M. S.

degrees. from Chuo University in 1990 and 1996, respectively. In 1998, he joined the staff as a research assistant on the "Integrated Geographic Information Systems" research project at the Chuo University in China, where he received his D.E. degree. He also received a Paper Award from the Operations Research Society of Japan (ORSJ), of which he is a member, in 2002.

Hiroyuki Goto is a professor at the Department of Industrial and Systems Engineering, at Hosei University, Japan. He received his B.S. and M.S. degrees from The University of Tokyo in 1995 and 1997, respectively, and his D.E. from the Tokyo Metropolitan Institute of Technology in 2004. His research interests include operations, geographical information science, and high-performance computing.