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Designing a Multimodal Transportation Network under Biomass Supply Uncertainty

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Abstract

Climate change and the uncertainty in weather makes the yield and availability of biomass uncertain which affects the supply chain decision of biomass. Supply chain decisions should be able to address those uncertainties and consider the error on the prediction of availability. This study presents a two-stage stochastic programming model that dynamically assigns multi-modal facilities to design a biomass supply chain network under feedstock supply uncertainty. The first stage of the model decides upon the usage of multi-modal facilities whereas the second stage decides the number of container, biomass transportation, production and inventory once after the uncertainty is revealed. We develop a hybrid algorithm combining sample average algorithm, progressive hedging algorithm, and rolling horizon algorithm to solve this challenging NP-hard problem and consider the state of Mississippi and Alabama as a testing ground to validate this approach. Computational results show that the proposed hybrid algorithm is capable of producing high quality solution in solving large scale biomass supply chain problem in a reasonable amount of time.

Keywords
Bio-fuel supply chain network, multi-modal facility location, stochastic programming, supply uncertainty.

Biography

Sushil Raj Poudel currently is a Ph.D. student in the Department of Industrial and System Engineering at Mississippi State University. He is majoring in Industrial Engineering with concentration on operation research. He received his Bachelors degree (in 2013) in Industrial and System Engineering from Mississippi State University. Sushil's research interests are in Bio-fuel Supply Chain and Transportation Network, Multi-modal Transportation Network and Disruption Management.

Dr. Mohammad Marufuzzaman received his Ph.D. in Industrial & Systems Engineering from Mississippi State University in 2014. He received his MASc degree in Industrial Systems Engineering from University of Regina, Canada in 2010 and B.Sc degree in Industrial & Production Engineering from Shah Jalal University of Science & Technology, Bangladesh in 2006. He joined Industrial & Systems Engineering department as an Assistant Professor in August 2015. His main areas of interest are in supply chain optimization with applications in renewable energy, stochastic programming, decomposition methods, solving large scale supply chain network problems and supply chain risk management. Dr. Maruf's publications have appeared in journals such as Transportation Science, Computers & Operations Research, Transportation Research Part E, International Journal of Production Economics, Canadian Journal of Chemical Engineering and several conference proceedings. He is a member of INFORMS and IIE.

Dr. Linkan Bian is an assistant professor in Industrial and Systems Engineering Department at MSU. He received his Ph.D. in Industrial and Systems Engineering from Georgia Institute of Technology in 2013. He also holds a dual M.S. degree in Statistics and Mathematics from Michigan State University, and a B.S. degree in Applied Mathematics from Beijing University. Dr. Bian research interests focus on the combination of advanced statistics and stochastic methods for system modeling, diagnosis, and prognosis. Applications of his research include advanced manufacturing systems and supply chains. He is currently participating in a DoD project focusing on uncertainty quantification and process optimization in Additive Manufacturing processes. His research is also funded by FedEx Express. Dr. Bian's publications have appeared in journals such as Institute of Industrial Engineers (IIE) Transactions, Statistical Analysis and Data Mining, Naval Research Logistics, and several conference proceedings. He is a member of INFORMS and IIE.

Dr. Hugh Richard Medal holds a Ph.D. (University of Arkansas, 2012), M.S. (University of Arkansas, 2008), and B.S. (North Dakota State University, 2006) in industrial engineering. He joined the Industrial and Systems Engineering Department at Mississippi State University as an assistant professor in 2012. Hugh is interested in the following applied optimization research topics: transportation logistics; supply chain design and management; and network optimization. In particular, he examines how to optimally design and protect networks that are vulnerable to disruptions (e.g., supply chains and transportation systems) and how to optimally interdict networks that are a threat to society (e.g., infectious disease contact networks). Hugh's teaching interests include transportation and logistics, supply chain management, and stochastic optimization. He has also taught engineering economy, engineering statistics, and work methods.