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Stochastic selfish routing.

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Summary: We embark on an agenda to investigate how stochastic delays and risk aversion transform traditional models of routing games and the corresponding equilibrium concepts. Moving from deterministic to stochastic delays with risk-averse players introduces nonconvexities that make the network game more difficult to analyze even if one assumes that the variability of delays is exogenous. (For example, even computing players' best responses has an unknown complexity.) This paper focuses on equilibrium existence and characterization in the different settings of atomic vs. nonatomic players and exogenous vs. endogenous factors causing the variability of edge delays. We also show that succinct representations of equilibria always exist even though the game is non-additive, i.e., the cost along a path is not a sum of costs over edges of the path as is typically assumed in selfish routing problems. Finally, we investigate the inefficiencies resulting from the stochastic nature of delays. We prove that under exogenous stochastic delays, the price of anarchy is exactly the same as in the corresponding game with deterministic delays. This implies that the stochastic delays and players' risk aversion do not further degrade a system in the worst-case more than the selfishness of players.

Keywords: non-additive nonatomic congestion game; stochastic Nash equilibrium; stochastic Wardrop equilibrium; risk aversion
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