

Sensitivity of Electric Vehicle Charging Facility Occupancy to Users' Impatience

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Abstract: In this paper, we consider an electric vehicle charging facility that offers various levels of service, i.e., charging rates, for varying prices such that rational users choose a level of service based on their value of time, also called impatience. In particular, we characterize the sensitivity of the expected number of users, i.e., occupancy, at the facility to the probability distribution of users' impatience. We first provide an upper bound for the difference between the expected occupancy under any two different distributions on users' impatience. Next, we consider the case when the users' impatience are discrete random variables, and we study the sensitivity of the expected occupancy to the probability masses and attained values of the random variables. We show that the expected occupancy varies linearly with respect to the probability masses and is piecewise constant with respect to the attained values. These results suggest how the facility operator might design prices such that the expected occupancy does not vary much under small changes in the distribution of users' impatience, which is generally difficult to characterize accurately from data. We demonstrate this idea via examples.