The data-driven (s, S) policy:
why you can have confidence in censored demand data

Speaker:
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Abstract:
We revisit the classical dynamic inventory management problem of Scarf (1959b) from the perspective of a decision-maker who has $n$ historical selling seasons of data and must make sensible ordering decisions for the upcoming season. We first prescribe a nonparametric estimation procedure for the $(s;S)$ policy that is asymptotically optimal. We then characterize the finite-sample performance of the estimated $(s;S)$ levels by deriving their asymptotic confidence intervals using the Central Limit Theorem. We further consider having at least some of the past selling seasons of data censored from the absence of backlogging. We show that the intuitive and widely-used procedure of correcting for censoring in the demand data directly yields an inconsistent estimate. We then show how to correctly use the censored data to obtain consistent decisions and derive asymptotic confidence intervals for this policy using Stein’s method to handle the serial correlation that arises due to the correctioning. Surprisingly, censored data can be beneficial under some conditions; that is, estimated decisions with censored data may have smaller variance and mean squared error (MSE) than those with fully uncensored data. We thus arrive at the remarkable result that a decision maker with fully uncensored data can add artificial censored data to optimally estimate the $(s;S)$ policy. We provide a prescription for the optimal level and amount of artificial demand data to add. Our results also apply to the repeated newsvendor problem and the base-stock policy problem by appropriate parameter choices.

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