

## **Production and Leftovers Usage Policies to Minimize Food Waste under Uncertain and Correlated Demand**

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**Abstract :** One of the common problems in food service industry is demand uncertainty. This research presents a multi-criteria optimization approach to identify the efficient frontier of points lying between the minimum-waste and minimum-shortfall solutions within uncertain demand environment. It also addresses correlation across demands for items (e.g., hamburgers are often demanded with french fries). Reducing overproduction food waste (and its corresponding environmental impacts) and an aversion to shortfalls (leave some customer hungry) need to consider as two contradictory objectives in an all-you-care-to-eat environment food service operation. We identify optimal production adjustments relative to demand forecasts, demand thresholds for utilization of leftovers, and percentages of demand to be satisfied by leftovers, considering two alternative metrics for overproduction waste: mass; and greenhouse gas emissions. Demand uncertainty and demand correlations are addressed using a kernel density estimation approach. A statistical analysis of the changes in decision variable values across each of the efficient frontiers can then be performed to identify the key variables that could be modified to reduce the amount of wasted food at minimal increase in shortfalls. We illustrate our approach with an application to empirical data from Campus Dining Services operations at the University of Missouri.

**Keywords :** environmental studies, food waste, production planning, uncertain and correlated demand

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