Using Mathematical Modeling to Study Refund Policies in Airline Pricing

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Airlines have increasingly adopted flexible refund policies that allow passengers to cancel tickets in exchange for time-limited travel credits. While these policies reduce customer risk, they introduce uncertainty because cancellations and future credit usage make demand and revenue stochastic. This project analyzes how flexible refund policies affect customer demand, optimal pricing, and airline revenue under limited seat capacity. I developed both a theoretical and numerical framework to analyze airline pricing and revenue under flexible and non-refundable policies. I modeled customer demand and utility mathematically to capture purchasing behavior and derive demand functions. I formulated the airline pricing strategy as a dynamic optimization problem using a Bellman equation and solved it with dynamic programming and backward induction. I also implemented Monte Carlo simulation to evaluate airline ticket policies under stochastic customer purchasing behavior, cancellations, and credit redemption. In addition, I examined how airline revenue changes with key policy parameters such as credit expiration length. The results show that flexible refund policies increase average ticket prices and airline revenue compared to non-refundable policies, while also increasing demand. Shorter credit expiration periods further increase profit by reducing future credit redemption. This work extends existing research by incorporating refundability into a dynamic pricing framework and providing analytical results that describe its effects on demand and pricing. The model also offers practical applications, enabling airlines to optimize pricing strategies and evaluate refund policy parameters to improve revenue outcomes under uncertainty.

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