Airliner Boarding and Deplaning Strategy

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Summary

To reduce airliner boarding and deplaning time, we partition passengers into groups that board in an arranged sequence. We assume that first-class and business-class passengers board first; our model treats only economy class. Since deplaning is the converse process of boarding, a strategy for boarding gives a strategy for deplaning.

We develop a model of interferences among passengers, which determine boarding time. We try to find a strategy with the least interferences. By running Lingo, we tackle the resulting nonlinear integer programming problem and obtain near-optimal strategies for fixed numbers of groups. This model supports the outside-in and reverse-pyramid strategies.

We develop another model to give a global lower bound for interferences. We also prove that individual boarding sequence, which boards passengers one by one in a particular order, attains that lower bound.

We develop code in C++ to simulate boarding strategies and test various strategies for three airliners: Canadair CRJ-200 (small), Airbus A320 (midsize) and Airbus A380 (large). Individual boarding sequence, reverse-pyramid, and outside-in are the best three strategies in terms of both average boarding time and its standard deviation.

We test strategies under various luggage loads and levels of occupancy, with and without late passengers and those with special needs. Outside-in and reverse-pyramid are stable under variation of parameters, whereas individual boarding sequence is extremely sensitive, though not to luggage.

Our conclusions discredit traditional back-to-front strategies and support individual boarding sequence, reverse-pyramid, and outside-in. The more groups, the worse the situation with back-to-front. Taking cost into consideration, random sequencing should also be recommended.

Finally, we analyze deplaning and see how its time can be minimized.

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