

# Best Boarding uses Buffers

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## Summary

By constructing a mathematical model of human behavior, we find:

- **Back-to-front block loading is the least efficient boarding method.** As passengers enter the aircraft in groups, aisle congestion becomes greatest at the front of the plane, consequently increasing the time required for the next group to enter and take their seats. Aisle congestion in this case is primarily attributed to the time for a passenger to navigate the aisle and reach the assigned seat if obstructed by another passenger sitting in the same row.
- **Small planes and large planes exhibit minimal turnaround times.** Small planes have a single aisle but few passengers, hence little congestion. In large planes, multiple aisles and decks offset the congestion found in single-aisle midsize planes; a large plane can be modeled as several small planes.
- **Boarding strategies are optimized when 10% of the passengers are late.** Fewer passengers enter initially, so there is less congestion. When passengers enter late, congestion that would otherwise have occurred is averted.

Our first observation concurs with researchers who suggest abandoning back-to-front boarding in favor of more-elaborate schemes [Finney 2006; van den Briel et al. 2004; Ferrari and Nagel 2005]; however, these new models make erroneous assumptions about human behavior. A comprehensive scheme must include the time to navigate a congested aisle, stow luggage, and maneuver through a filled row if necessary. We recommend the following:

- **Abandon back-to-front block boarding and consider alternatives.** We suggest a hybrid group-boarding method utilizing a rotating seating arrangement that incorporates back-to-front and window-to-aisle seating.
- **Incorporate a second aisle into midsize aircraft.**
- **Reduce carry-on luggage.**
- **Queue passengers into lines prior to gangway entry.**

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