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Revenue Management Forecasting in Times of Change

Lessons Learned from a Year into the Pandemic

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AGIFORS RM Study Group
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Speaker Biographies

Thomas Fiig – Chief Scientist, Amadeus

- Ph.D., Theoretical Physics & Mathematics, University of Copenhagen
- 20+ years of airline revenue management experience
- Papers in forecasting, offer optimization, reinforcement learning etc.
- 10+ AGIFORS Best Presentation Awards

Mike Wittman – Expert, RM Science and Research, Amadeus

- Ph.D., Air Transportation Systems, MIT
- 8+ years of experience in airline industry research
- Author of 13 peer-reviewed academic articles
- 2016 AGIFORS Anna Valicek Award Finalist

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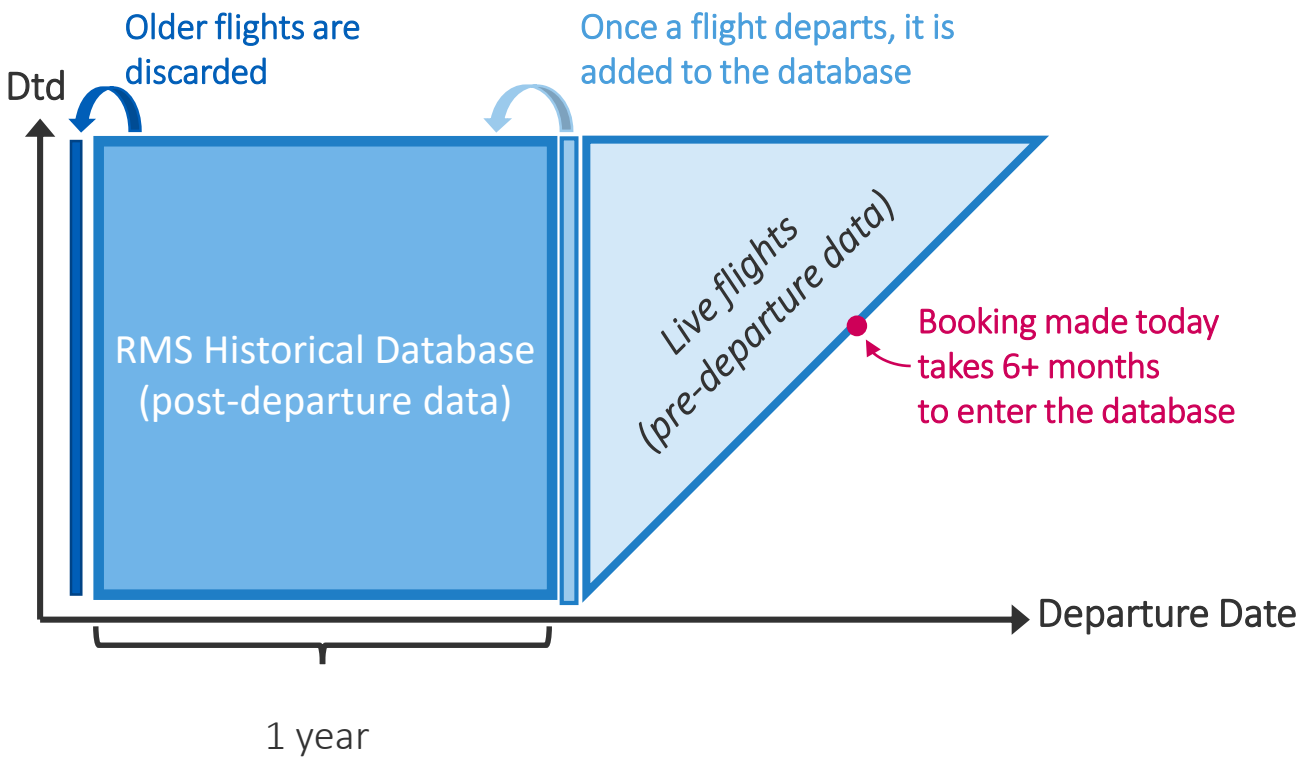
A Healthy RMS Forecast Model



- Forecast parameters estimated from one year of historical data
- Changes in customer behavior (slowly) influence the historical database
- Designed for stability and predictability
- Users responsible for adapting to shocks

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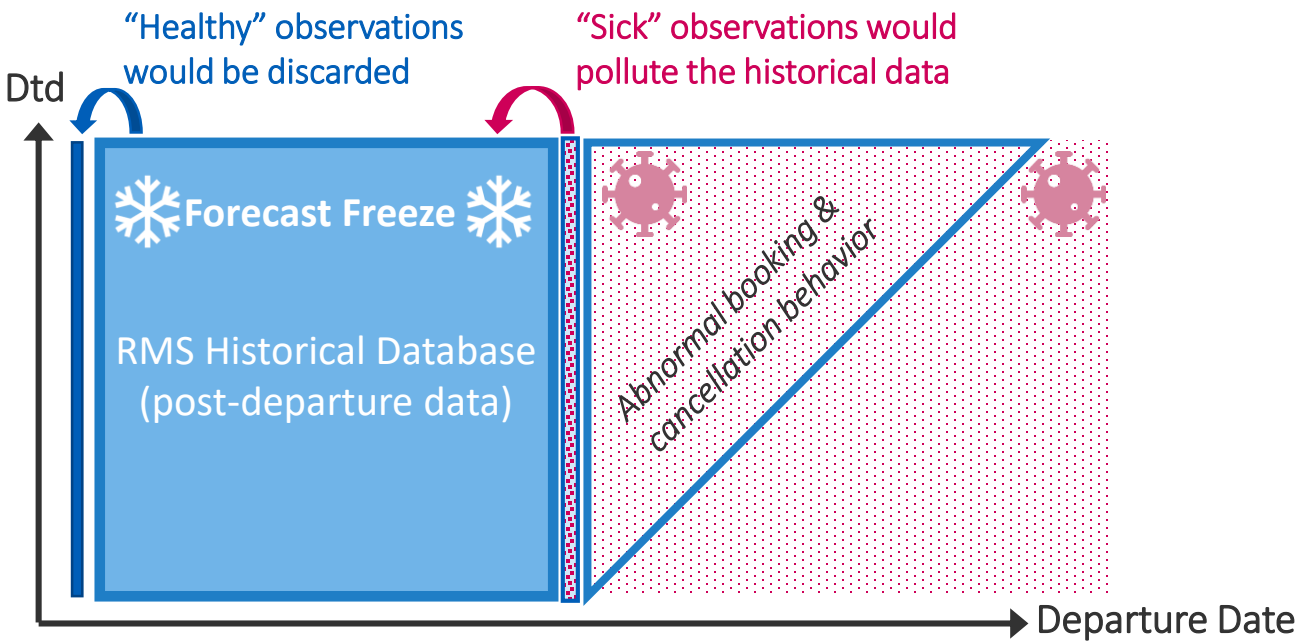
Imposing a COVID Lockdown to Prevent Infection



- Historical data frozen to prevent infection from "sick" observations
- Forecasts static – up to users to control
- Users were flying blind – how to respond?
- Needed automated approach that focused on adaptivity

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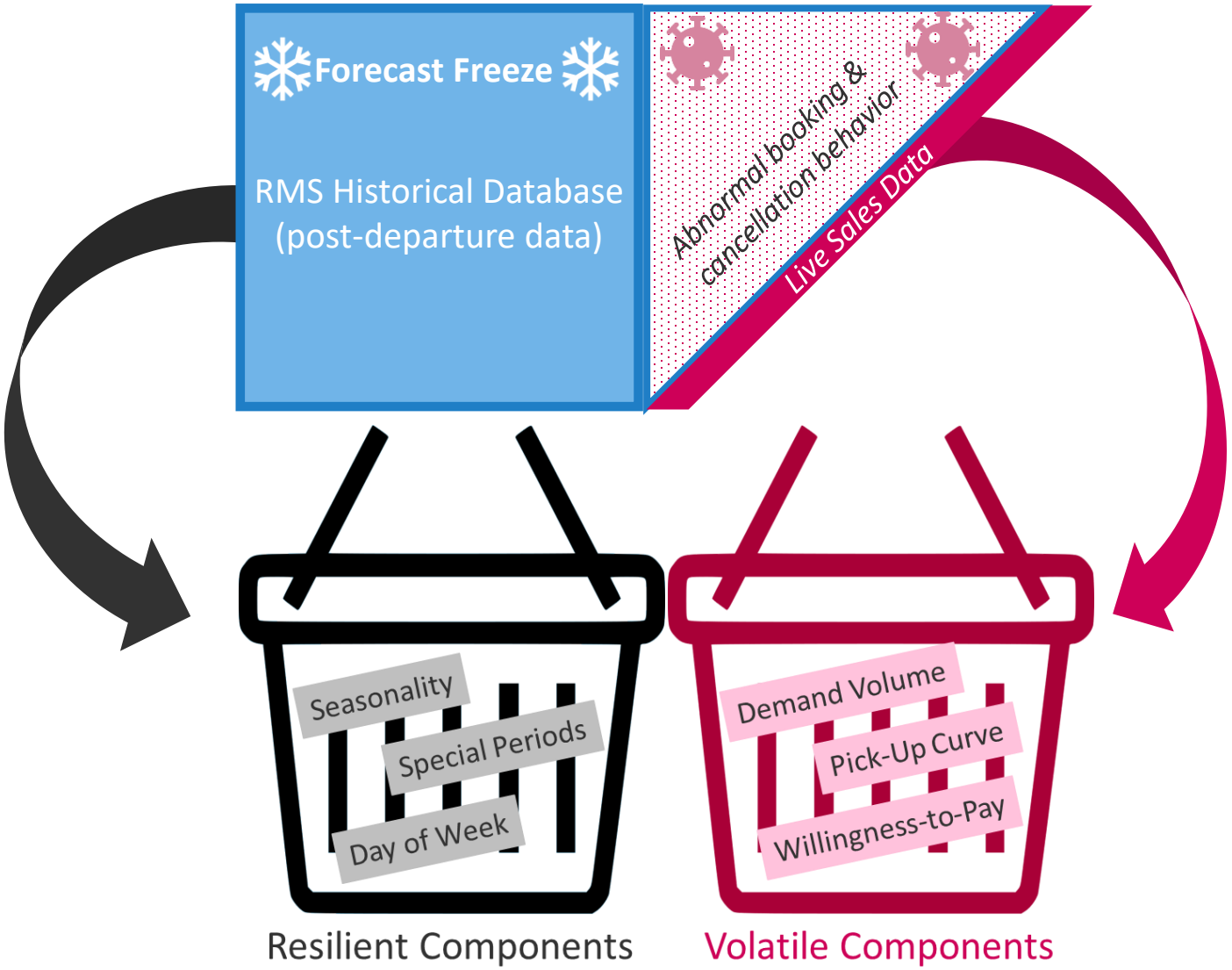
Injecting an Additional Data Source

Use live sales data to automatically adjust volatile forecast components



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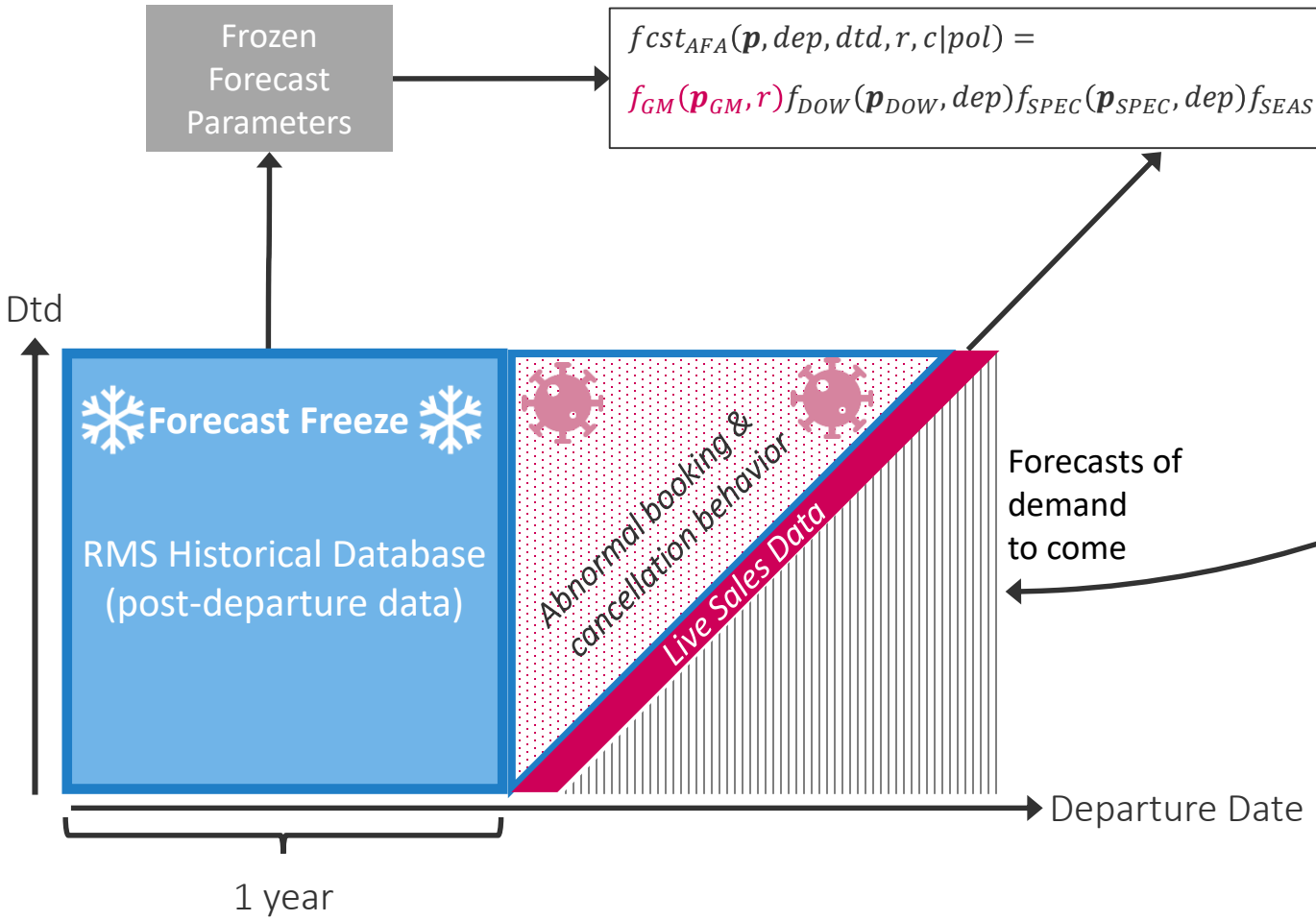
Active Forecast Adjustment (AFA)

Parametric Forecast Model with Active Forecast Adjustment

$$fcst_{AFA}(\boldsymbol{p}, dep, dtd, r, c|pol) =$$
$$f_{GM}(\boldsymbol{p}_{GM}, r) f_{DOW}(\boldsymbol{p}_{DOW}, dep) f_{SPEC}(\boldsymbol{p}_{SPEC}, dep) f_{SEAS}(\boldsymbol{p}_{SEAS}, dep) f_{DBU}(\boldsymbol{p}_{DBU}, dtd) f_{CCM}(\boldsymbol{p}_{CCM}, c|pol)$$



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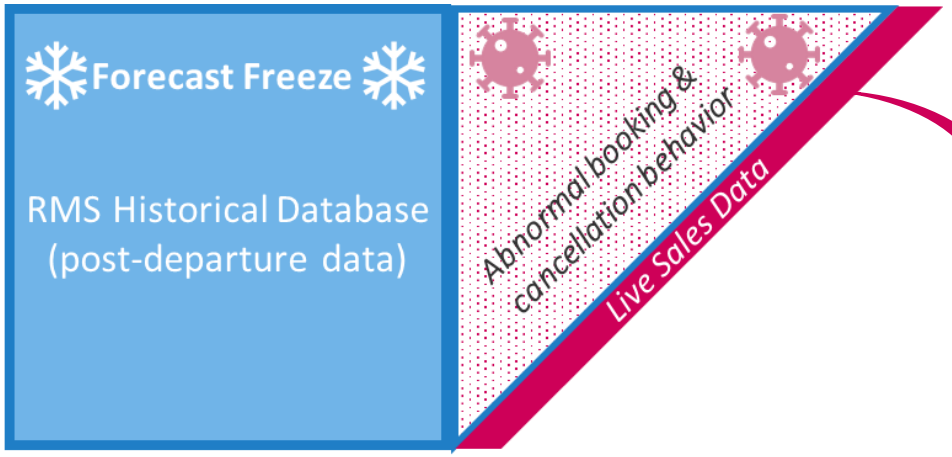
Computation of AFA Modifiers for Volume and Pick-Up Curve

_**Goal:** Minimize the error between AFA forecast and the bookings in the parallelogram:



$$\min \sum_{\text{dep,dtd}} (\text{AFA_Demand}(\text{dep,dtd}|\text{pol}) - \text{bookings}(\text{dep,dtd}|\text{pol}))^2$$

$$\gamma_{AFA}^{Volume}, \ \gamma_{AFA}^{PUC}$$

_Minimize the forecast error by computing two "AFA modifiers":

- **Volume modifier** – Scale demand volume up or down
- **Pick-Up Curve (PUC) factor** – Move demand closer to or further from departure

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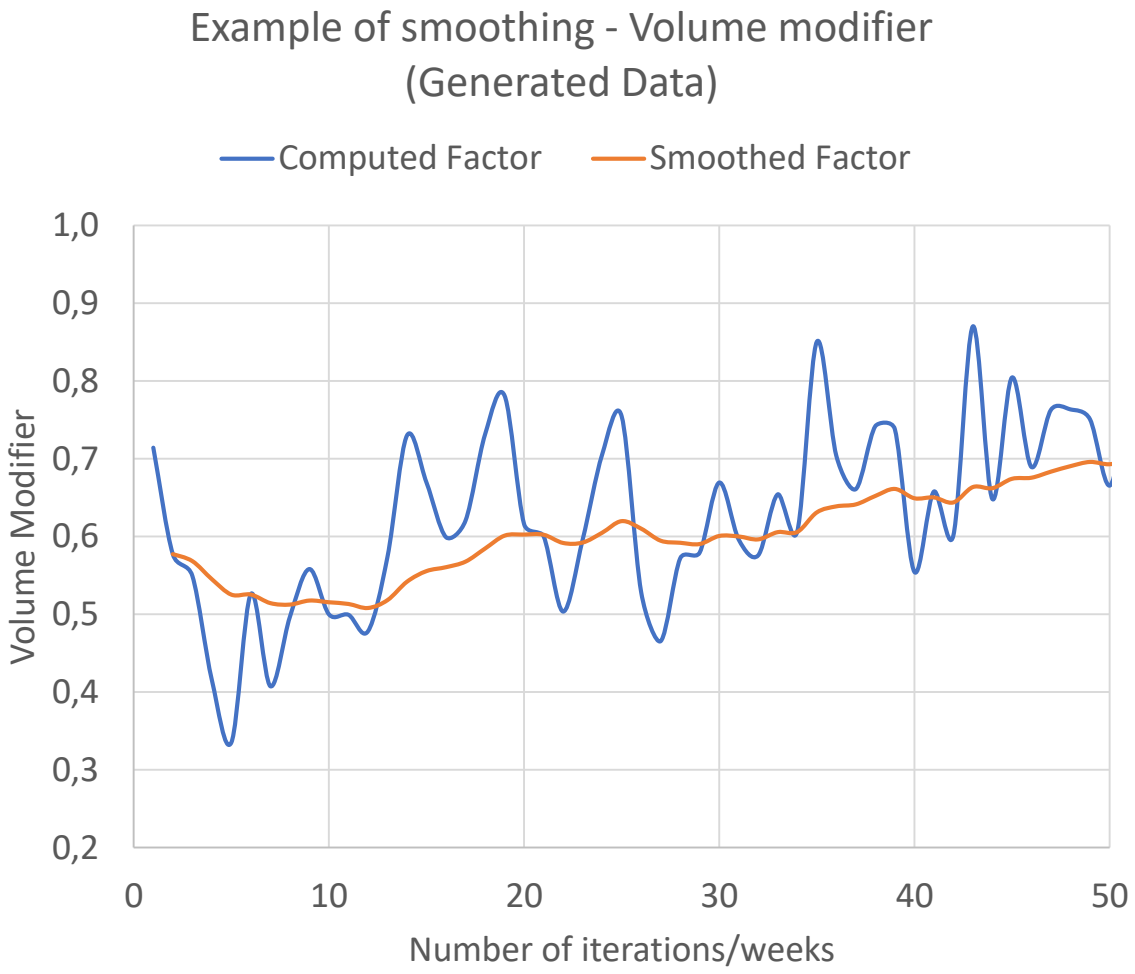
Smoothing and Capping AFA Modifiers

_ AFA Modifiers are **smoothed** between parallelograms

- Smoothing helps to filter out the data noise and capture the underlying trends
- Adaptive to new terms, versatile enough to withstand outliers, yet easy to control
- Based on Exponential Smoothing

_ AFA Modifiers can also be **capped**

_ AFA is only applied if enough data exists within the parallelogram to capture demand trends



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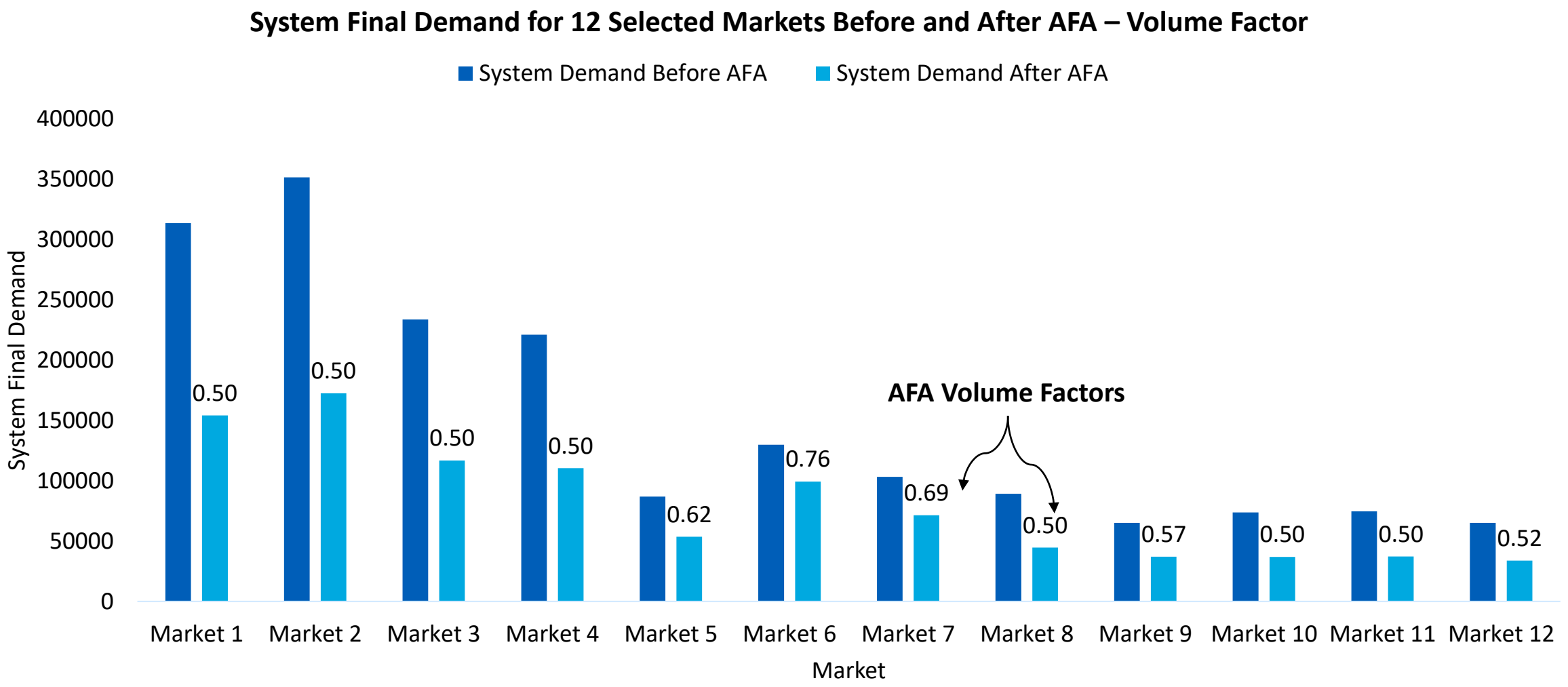
AFA Results in Production – Volume Adjustment



Note: Airline elected to set AFA volume capping at 0.50

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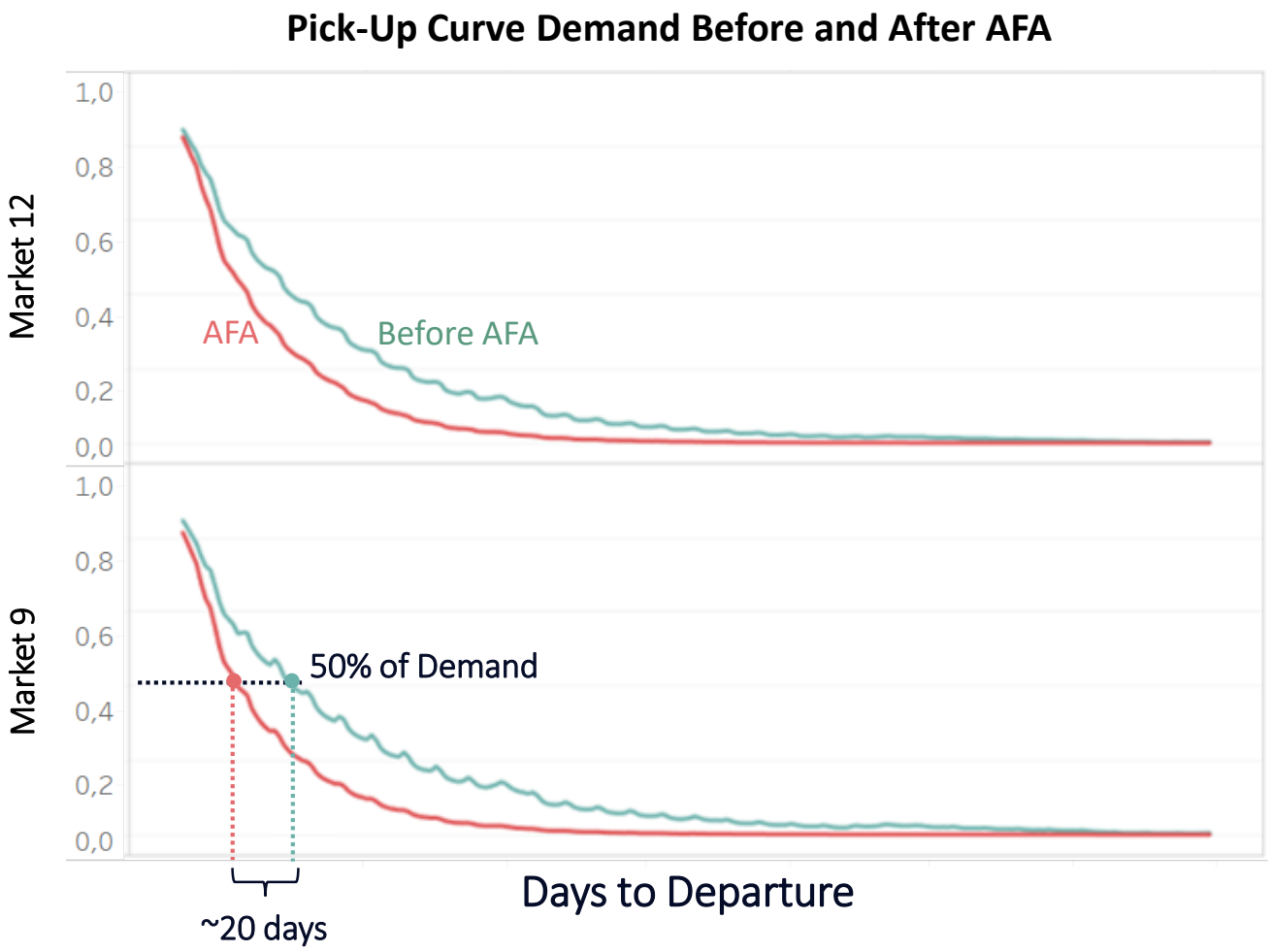
AFA Results in Production – Pick-Up Curve Adjustment



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Lessons Learned from a Year of Forecasting in a Pandemic

What Happens When the Live Booking Data is Fully Vaccinated?

- Feedback from airlines: AFA reduces user workload and forecast adjustments align with expectations
- AFA represents a change from current practices – needed to work with airlines to readjust processes and interventions
- Keeping airlines in control was still important – validation of adjustments before application, which markets to activate, etc.
- Next steps: How will AFA evolve during recovery and when the historical database is unfrozen?

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