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Presentation for AGIFORS

Agent Based Modeling for Airline Pricing Strategies

May 9th, 2019

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Agenda

- Response times in the Airline Industry
- Agent Base Modeling
- The Model
- The Results

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Response times in the airline industry

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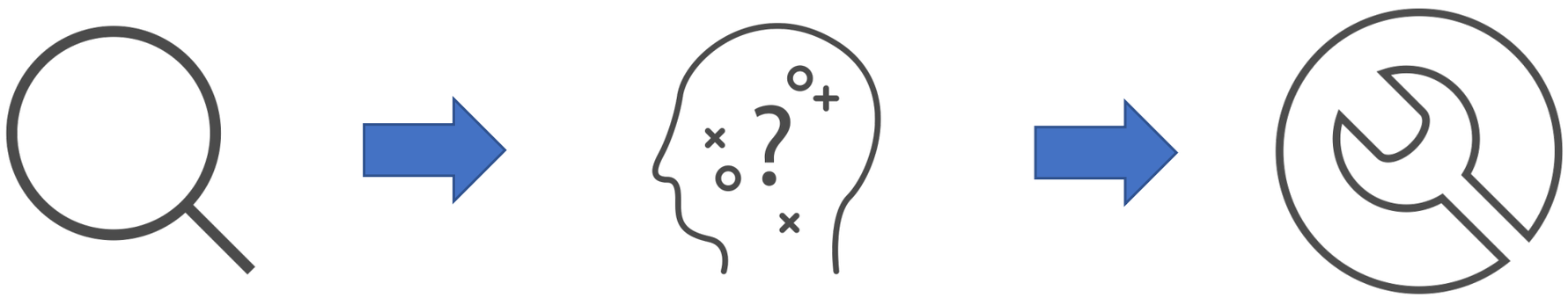
What is time to market



t1

Information Build-up

Time to collect data and produce relevant competitive and market information

t2

Response Design

Time to design the price adjustment and react to the changes in the market

t3

Approval & Publishing

Time to approve, upload and publish the new prices and rules of the fares

t1+t2+t3 = Time to Market

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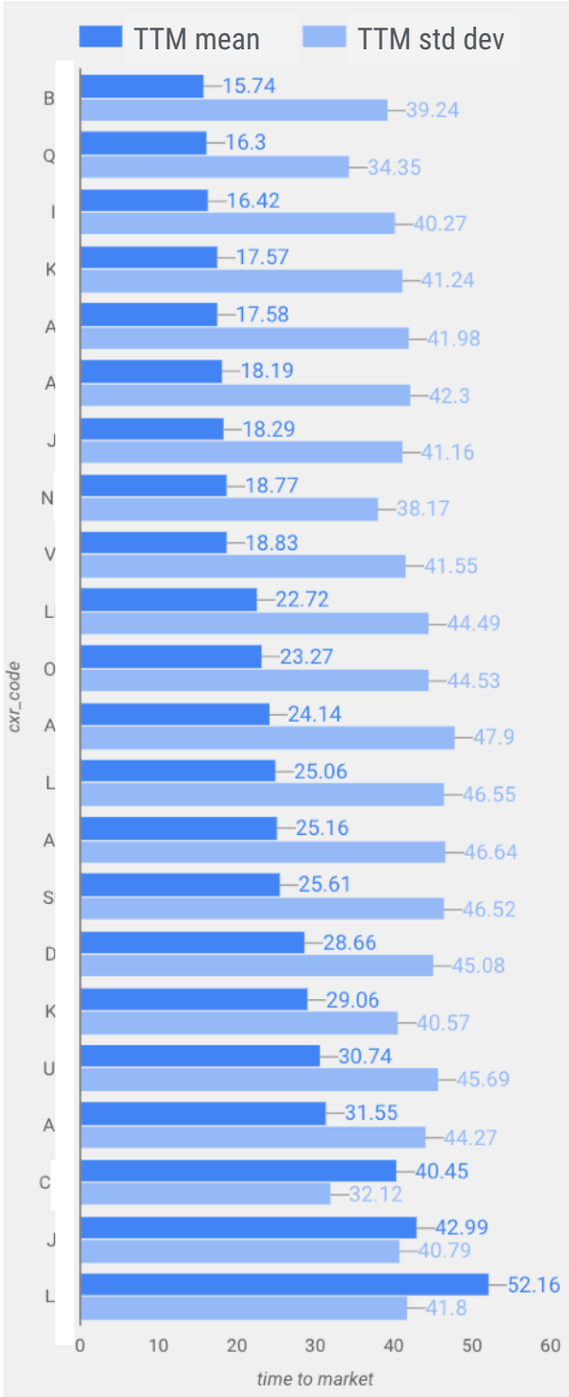
Time to market data



- In this sample, the average time to market is 26.1 [hrs] with a standard deviation of 40[hrs].
- These differences can be caused at any of the steps in the pricing processes
- Improvements in time to market reduce exposure to losses in market share and dilution

does it?

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How can we estimate the impact?

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Agent Base Modeling

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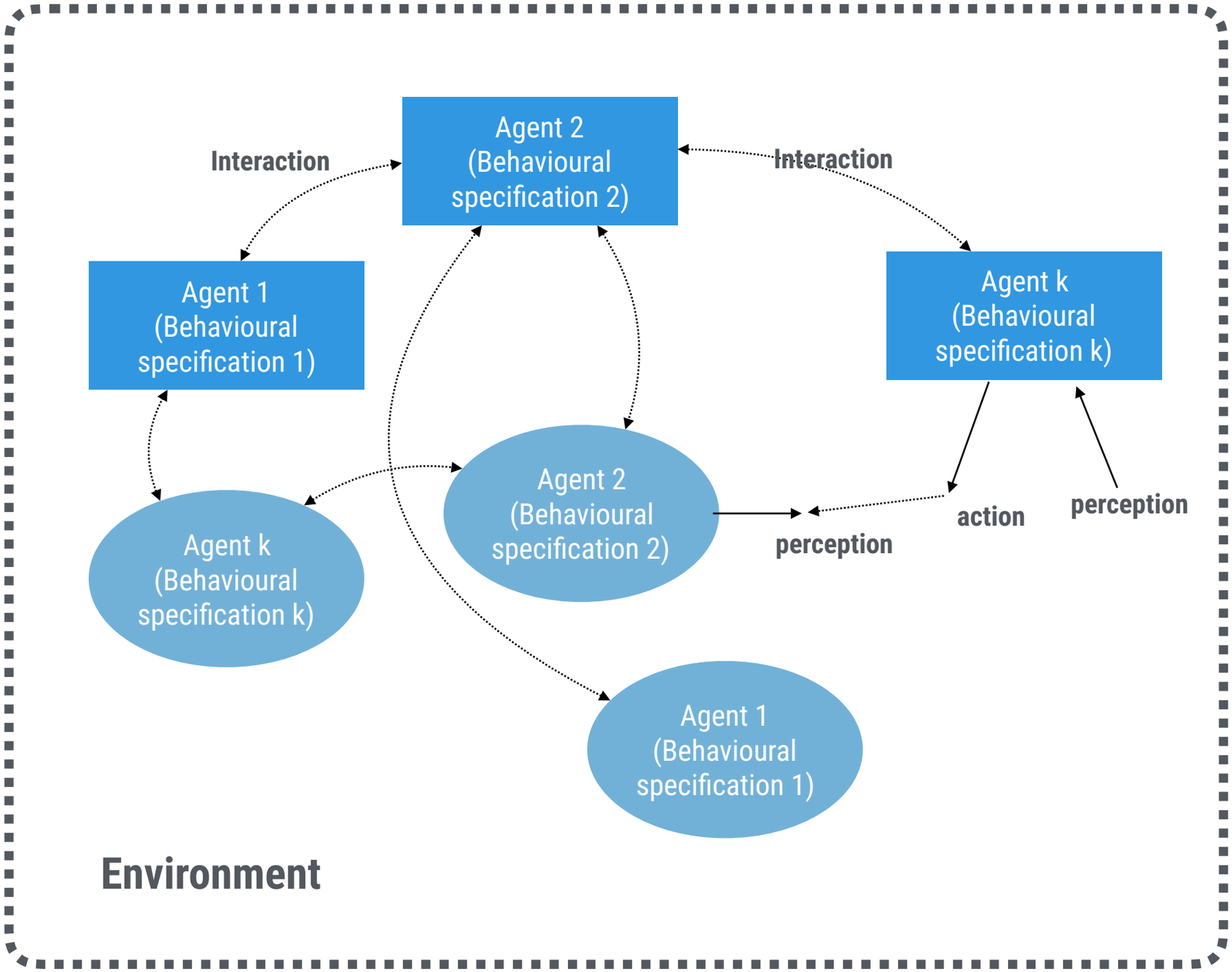
What is Agent Based Modeling?



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What is Agent Based Modeling?

Agent-based models are computer simulations used to study the interactions between people, things, places, and time.

- They are stochastic models **built from the bottom up** meaning individual agents are assigned certain attributes.
- The agents are **programmed to behave and interact** with other agents and the environment in certain ways.
- These interactions produce **emergent effects** that may differ from effects of individual agents.
- Agent-based modeling differs from traditional, regression-based methods in that, like systems dynamics modeling, **it allows for the exploration of complex systems that display non-independence of individuals and feedback loops in causal mechanisms**

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The Model

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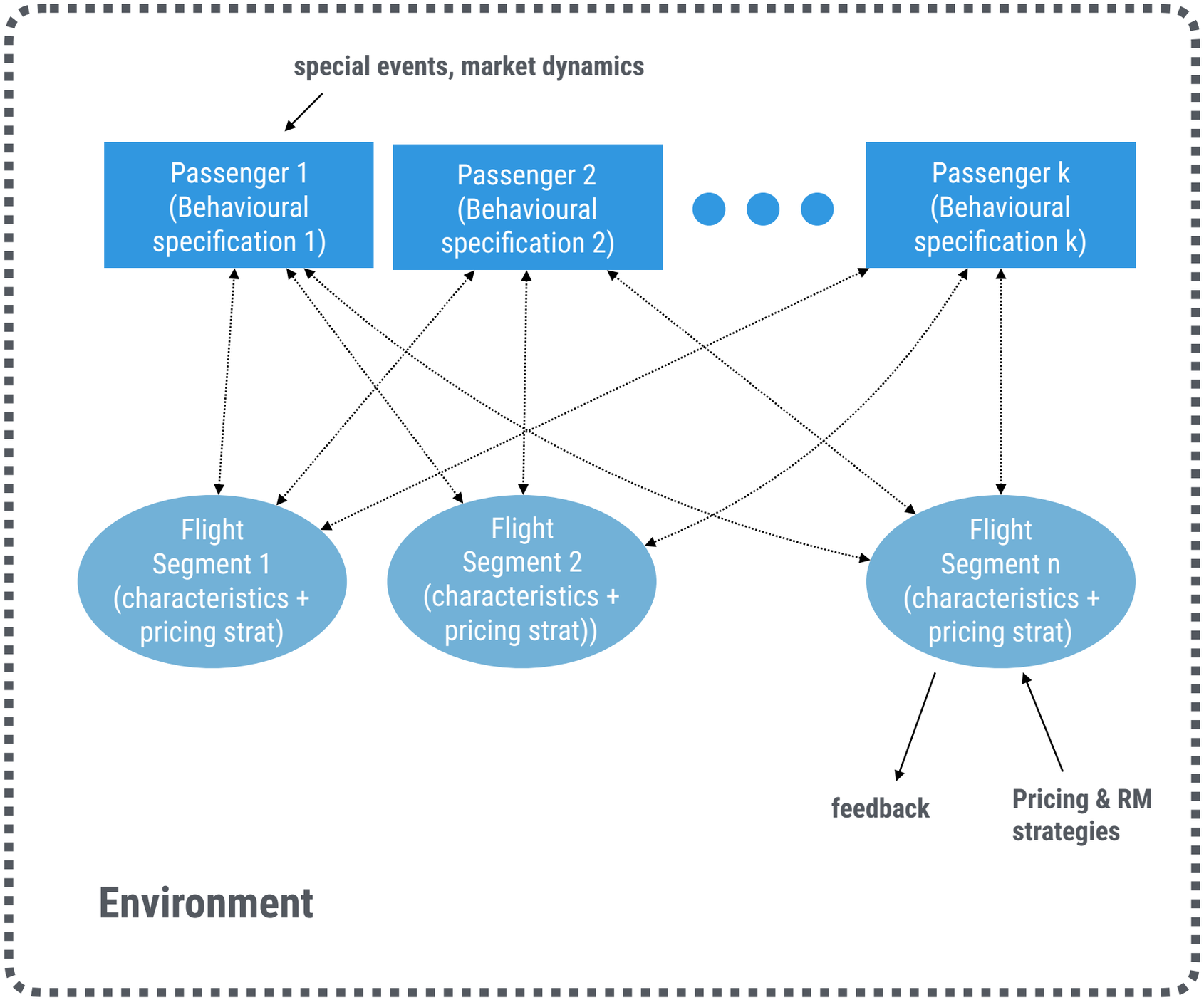
Model Diagram



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Model Diagram

- Two Carriers : Carrier A and Carrier B
- Same Fare Structure and Fare restrictions
- Both use EMSR
- Simulation is done in one flight segment
- Both have one daily flight with the same capacity (100 seats)
- One publishes a promotion (with no marketing) for 30 days
- The promotion is for both directions and for the flights departing in March

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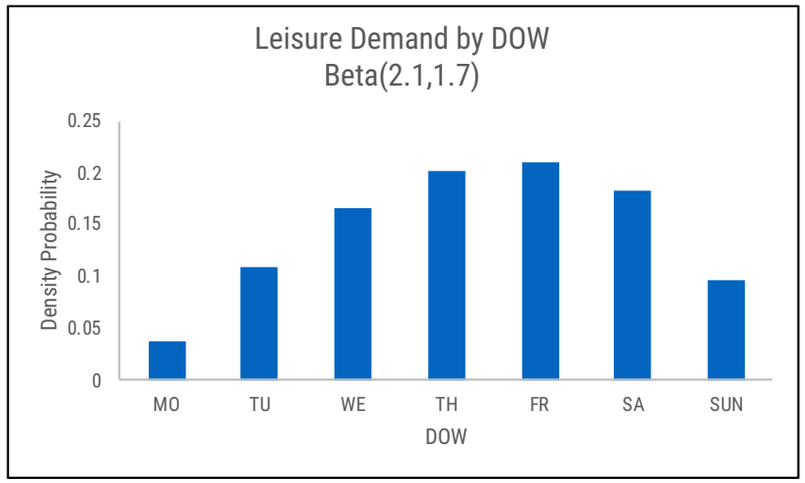
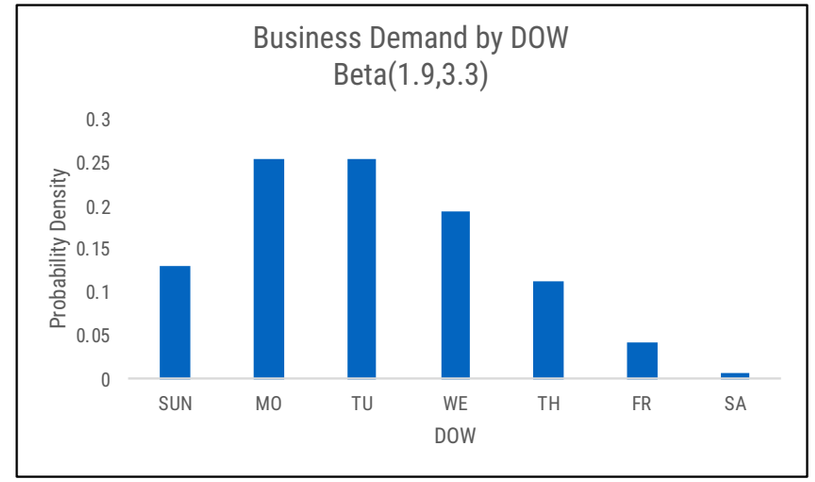
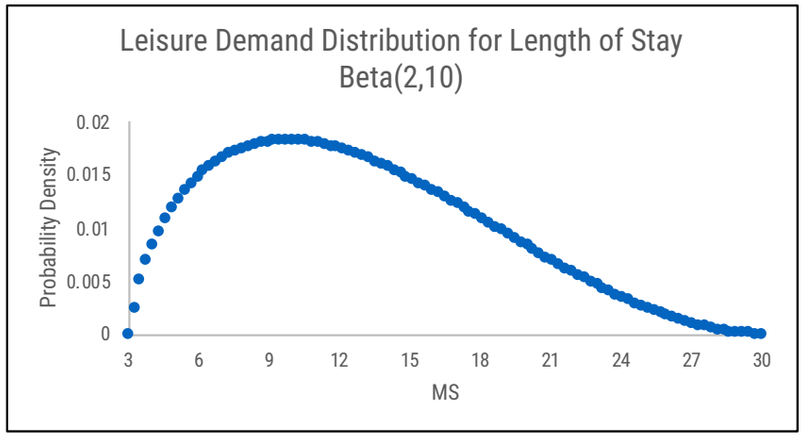
Model Diagram



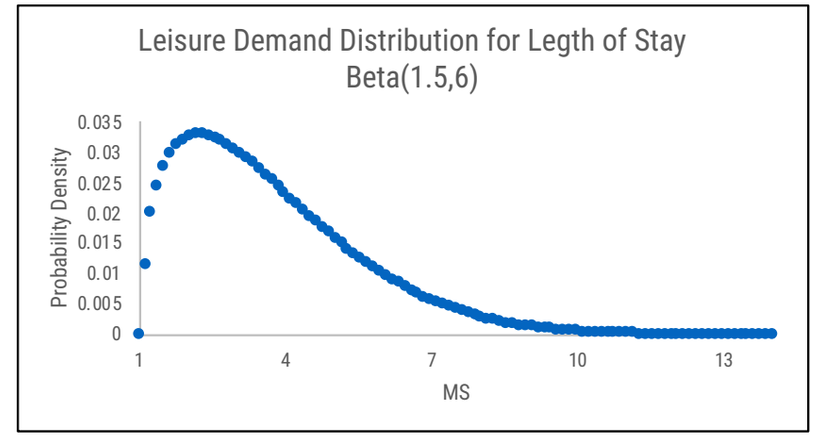
- We expect that the most important departures are made at the end of the work week, that is, between Thursday and Friday.



- In this case expect that the most important departures are made between Monday and Tuesday



- We consider a Length of Stay concentrated between 1 and 2 weeks.
- This combined with the distribution by dow ensures an important role of the Saturday night



- We consider a Length of Stay concentrated between 1 and 4 days.
- In this case the Saturday night is less expected.

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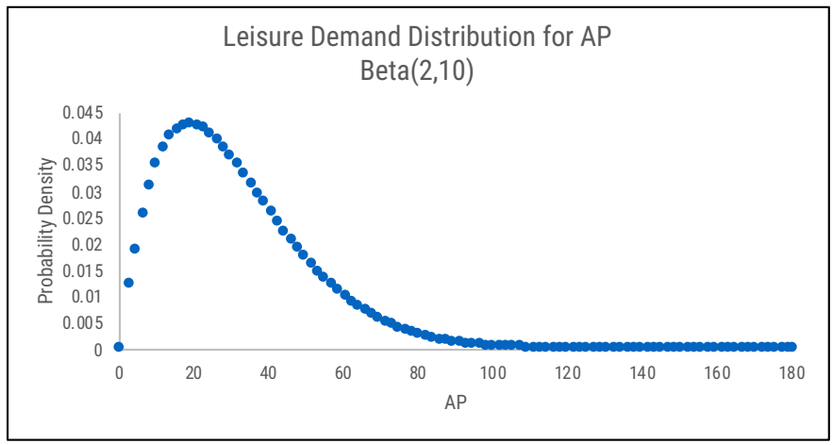
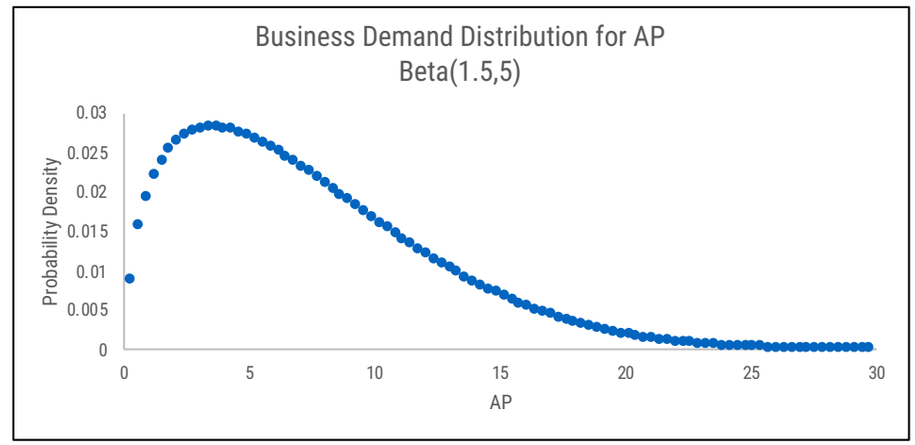
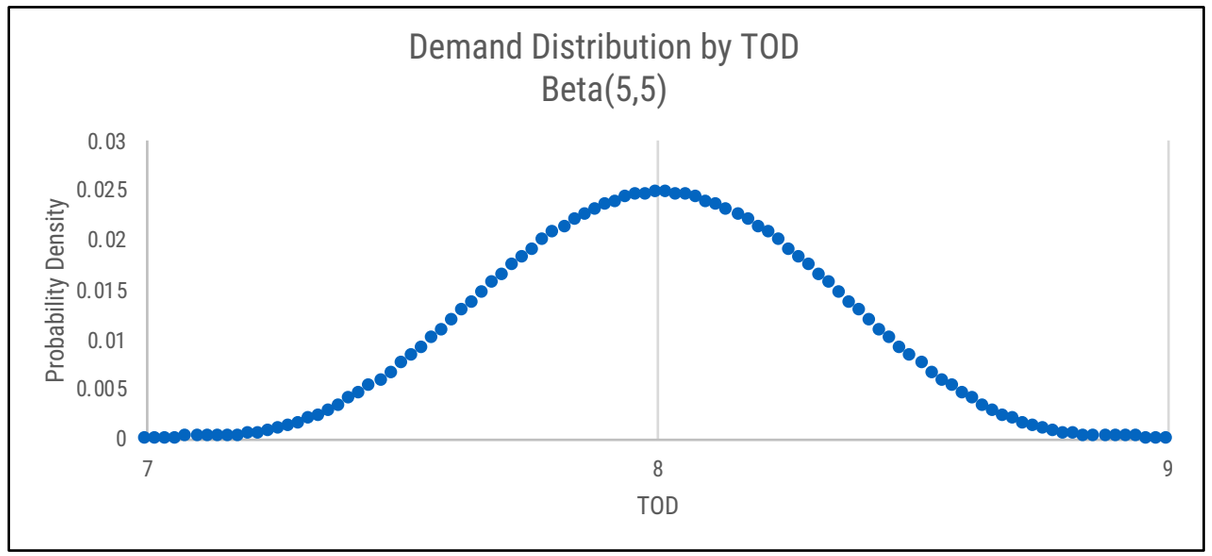
Model Diagram



- We consider that the 80% of the passengers books between 45 and 1 days before the departure date, and its peak its around 20 days before dep date.



- We consider that the 80% of the passengers books between 11 and 1 days before the departure date.



- Corporate segment disutility paremeter: 10 USD per hour
- Leisure segment disutility parameter: 0.05 USD per hour

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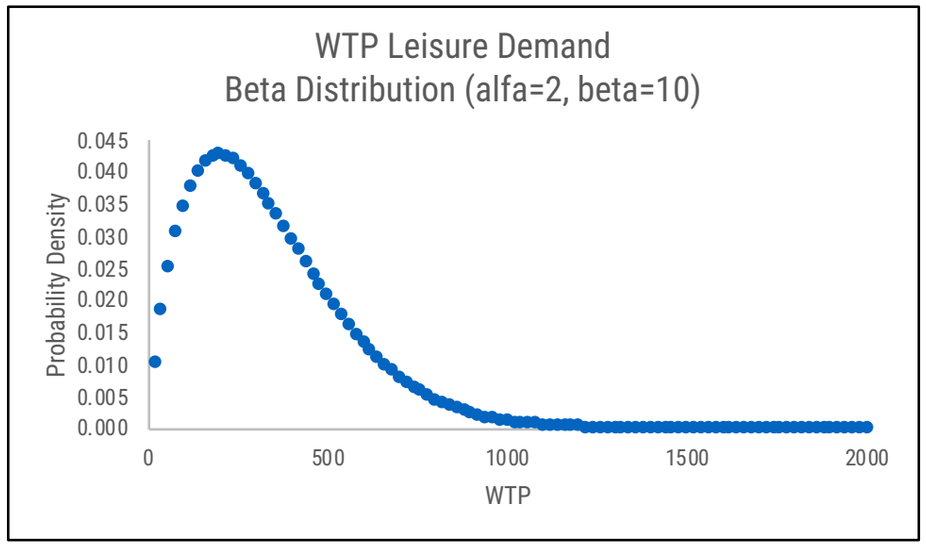
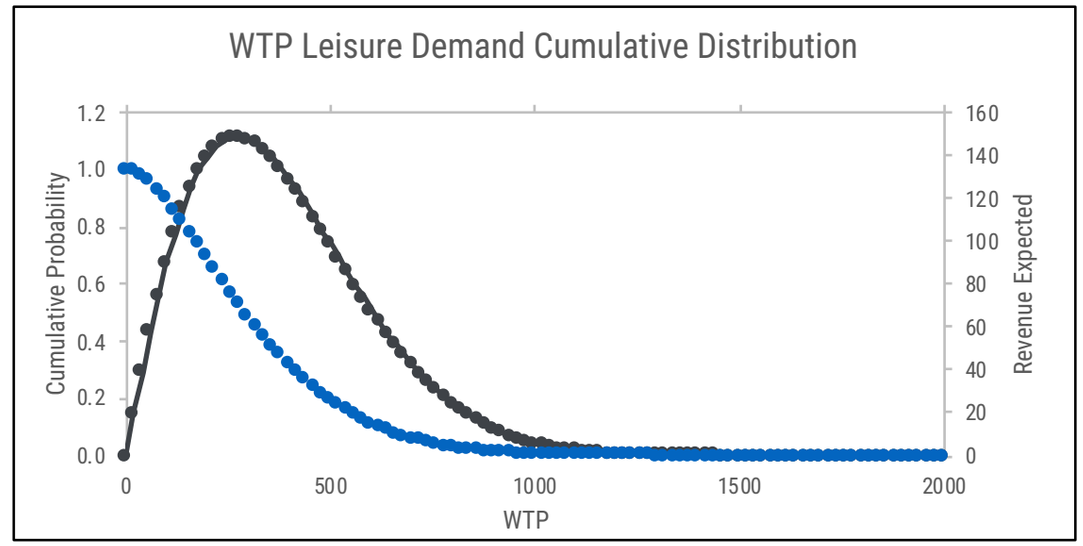
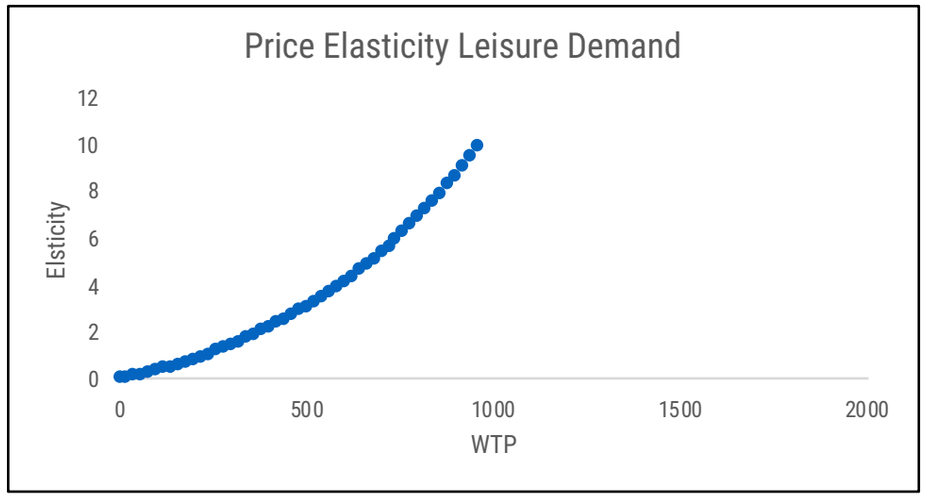
Model Diagram: Elasticity

Leisure Demand







- We consider a distribution with a WTP concentrated in the lower range.
- We draw the curve of revenue expected at each WTP

  *Revenue Expected= cumulative Prob *WTP*
- The revenue peak match an elasticity **1** arround a WTP=240
- We set our lower fare class arround close to this peak

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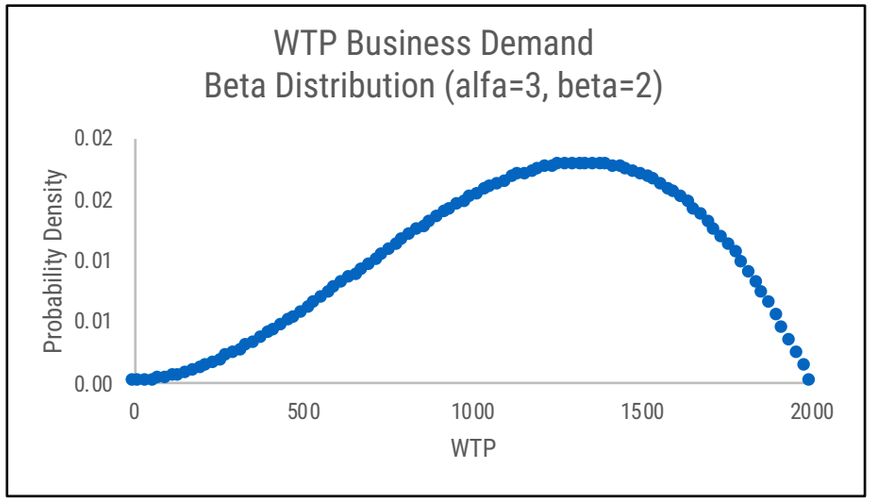
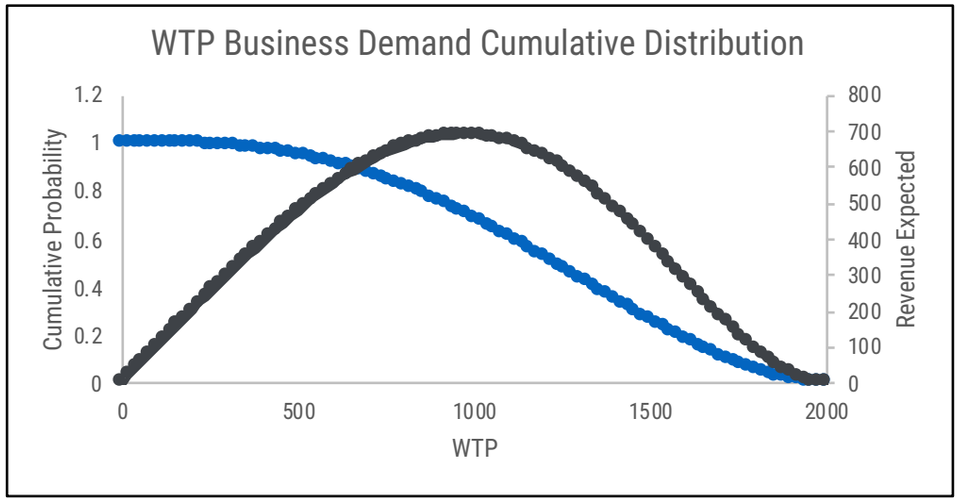
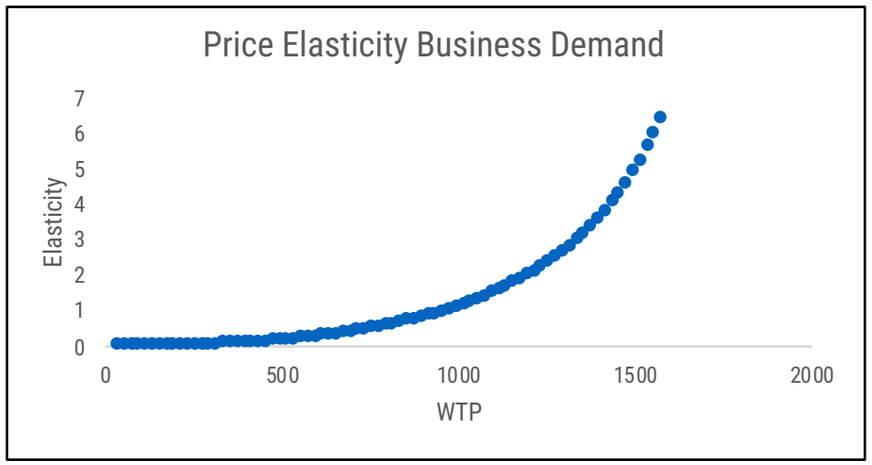
Model Diagram: Elasticity

Business Demand







- We consider a distribution with a WTP concentrated in the higher range.
- The revenue peak match an elasticity **1** arround a WTP=980
- This causes the peak of the Leisure revenue curve to be placed a quarter of the peak of the revenue curve of the business curve
- We set our high fare close to the business revenue peak

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Model Diagram: Fare Structure

- Carrier A

Class	Fare	Sat night	Min Stay	AP
Y	514	N	-	-
B	411	N	-	-
H	329	Y	2	-
K	263	Y	2	3
M	210	Y	3	5
L	175	Y	3	7
V	146	Y	5	10
S	127	Y	5	14
N	110	Y	7	21
Q	100	Y	7	30

- Carrier B

Class	Fare	Sat night	Min Stay	AP
Y	514	N	-	-
B	411	N	-	-
H	329	Y	2	-
K	263	Y	2	3
M	210	Y	3	5
L	175	Y	3	7
V	146	Y	5	10
S	127	Y	5	14
N	110	Y	7	21
Q	100	Y	7	30

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The Results

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Simulation parameters

Low Demand

- Leisure demand: 20,000
- Leisure demand prob to flight: 6/365
- Corporate demand: 200
- Corporate demand prob to flight: 20/365

Medium Demand

- Leisure demand: 30,000
- Leisure demand prob to flight: 6/365
- Corporate demand: 300
- Corporate demand prob to flight: 20/365

Medium Demand

- Leisure demand: 40,000
- Leisure demand prob to flight: 6/365
- Corporate demand: 400
- Corporate demand prob to flight: 20/365

General parameter

- Promotion start day: Day 150
- Promotion end day: Day 180
- Promotion discount: 20 USD

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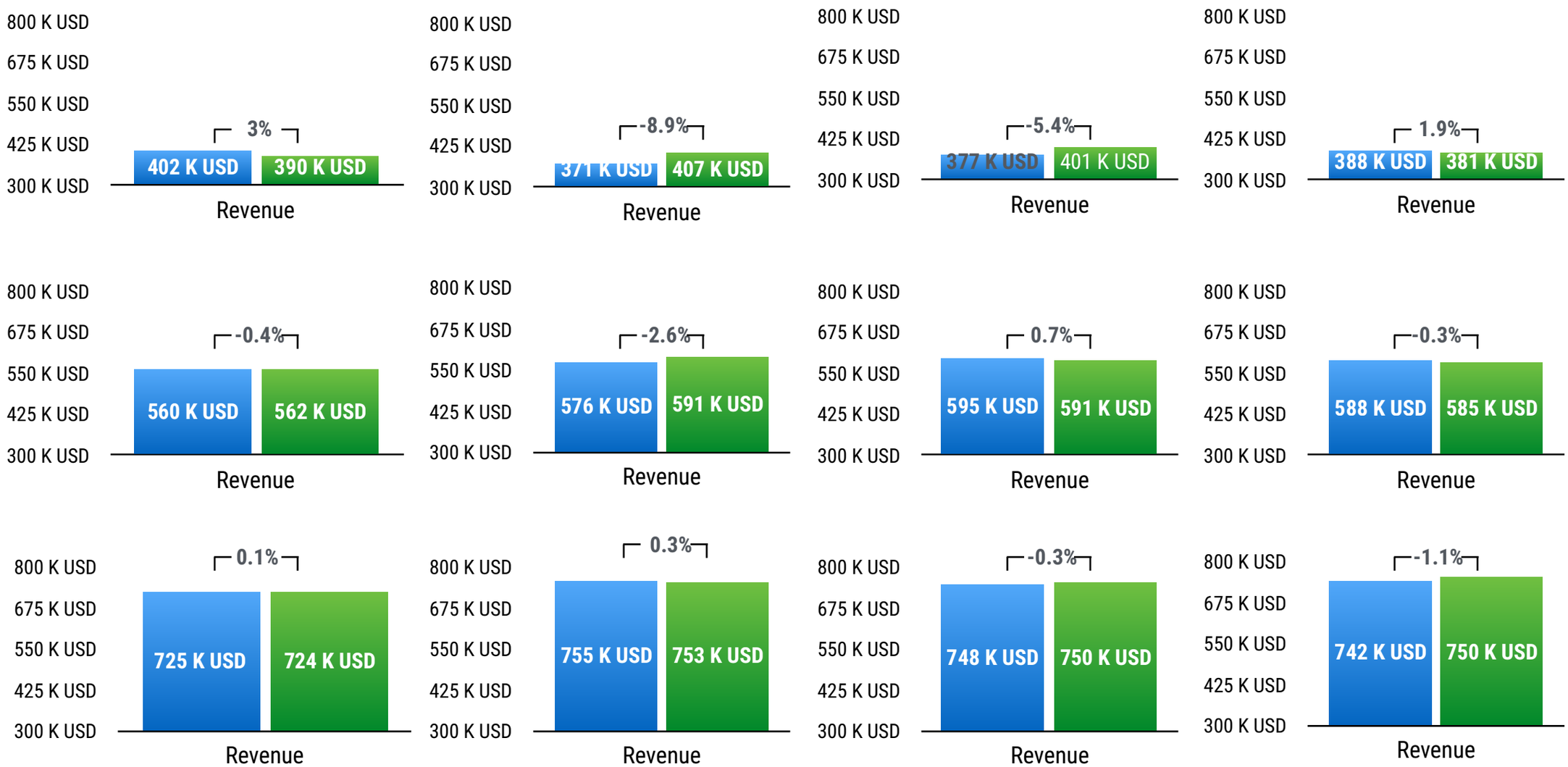
Results: Promotion

	TTM: base case	TTM: 10 days	TTM: 3 days	TTM: 1 day
Low Demand (~60% LF)	402 K USD / 390 K USD, 3%	371 K USD / 407 K USD, -8.9%	377 K USD / 401 K USD, -5.4%	388 K USD / 381 K USD, 1.9%
Medium Demand (~80% LF)	560 K USD / 562 K USD, -0.4%	576 K USD / 591 K USD, -2.6%	595 K USD / 591 K USD, 0.7%	588 K USD / 585 K USD, -0.3%
High Demand (~90% LF)	725 K USD / 724 K USD, 0.1%	755 K USD / 753 K USD, 0.3%	748 K USD / 750 K USD, -0.3%	742 K USD / 750 K USD, -1.1%



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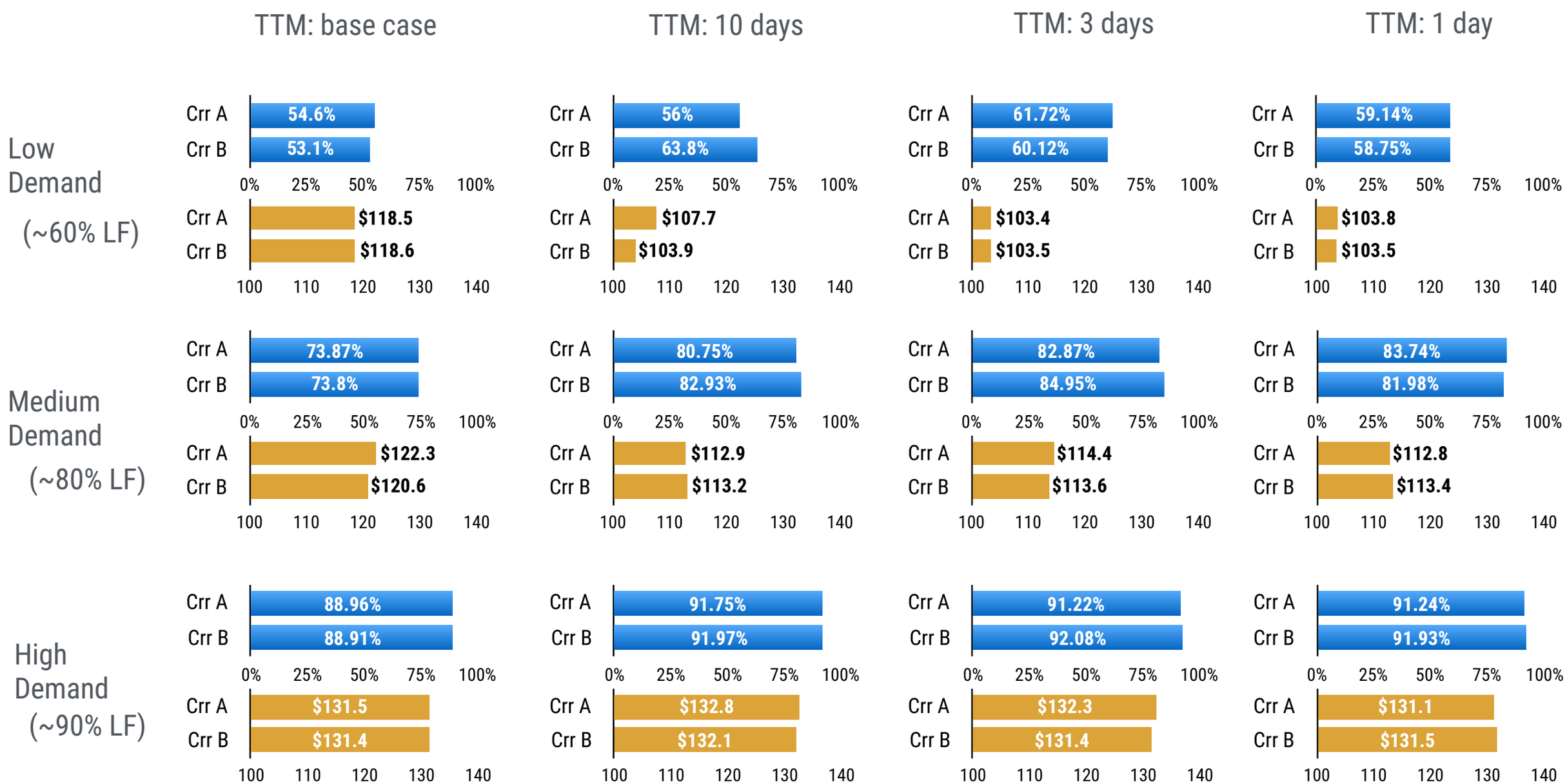
Results: Promotion



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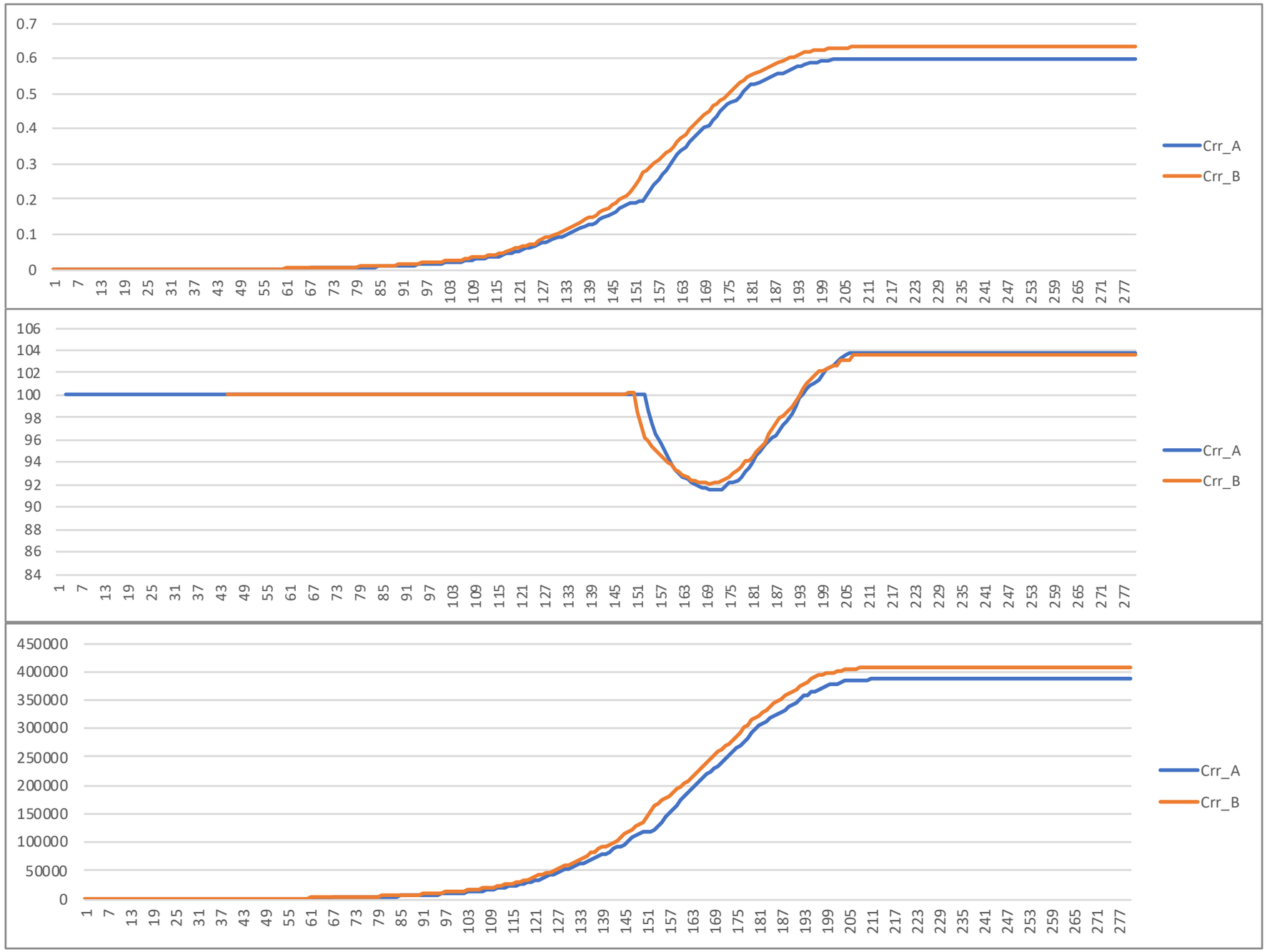
Results: Low Demand, 3 days delay



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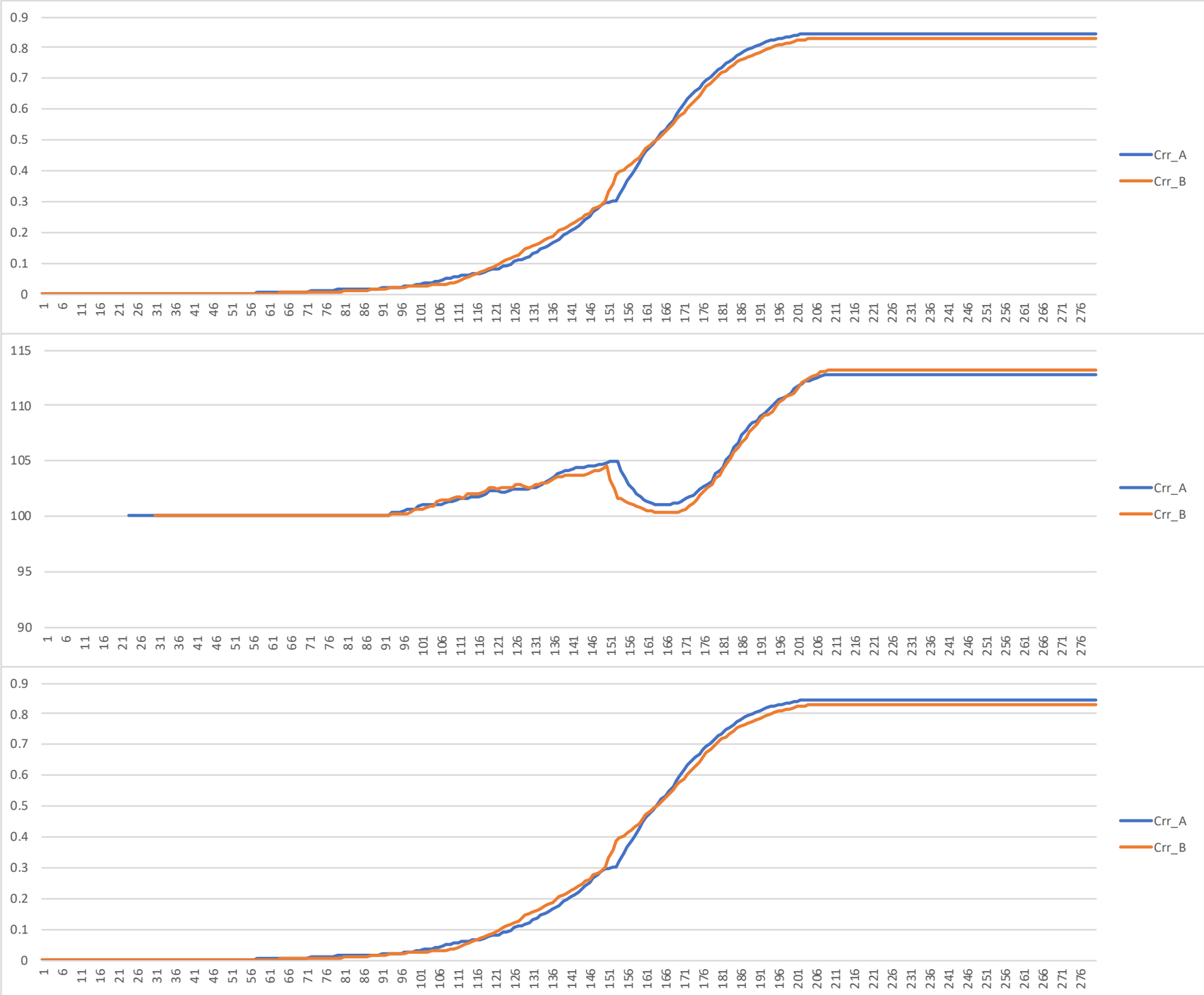
Results: Medium Demand, 3 days delay



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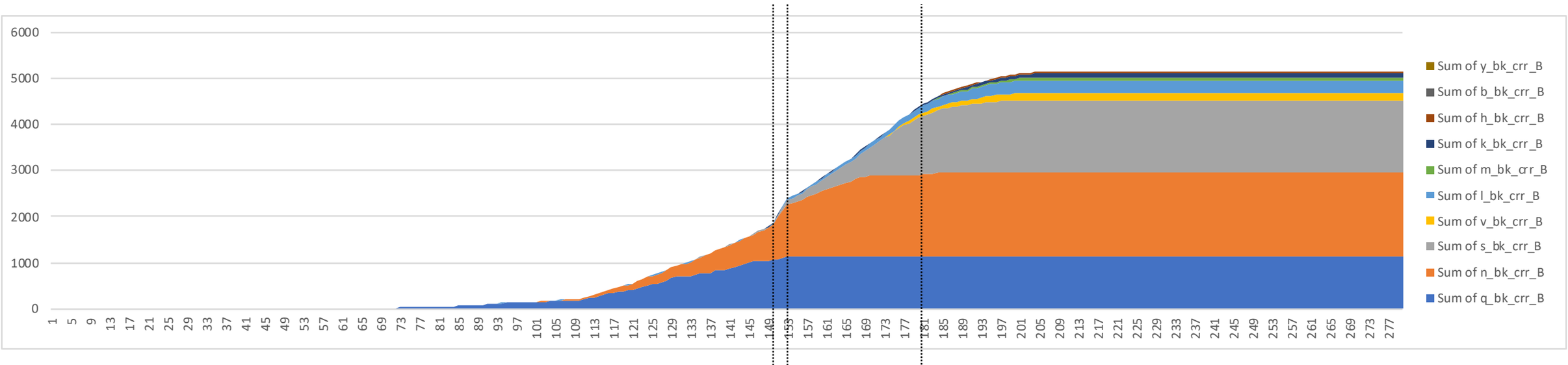
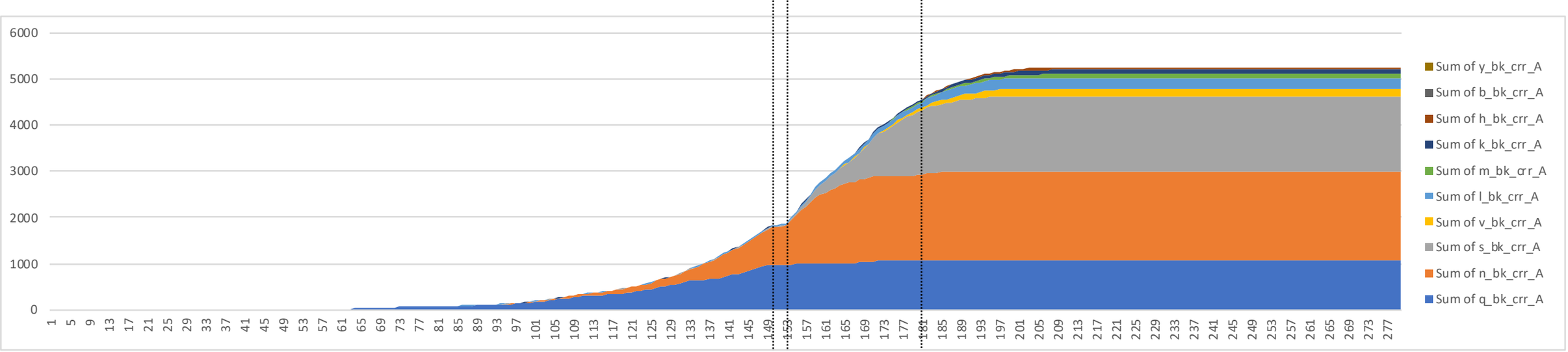
Results: Medium Demand, 3 days delay

crr B



crr A



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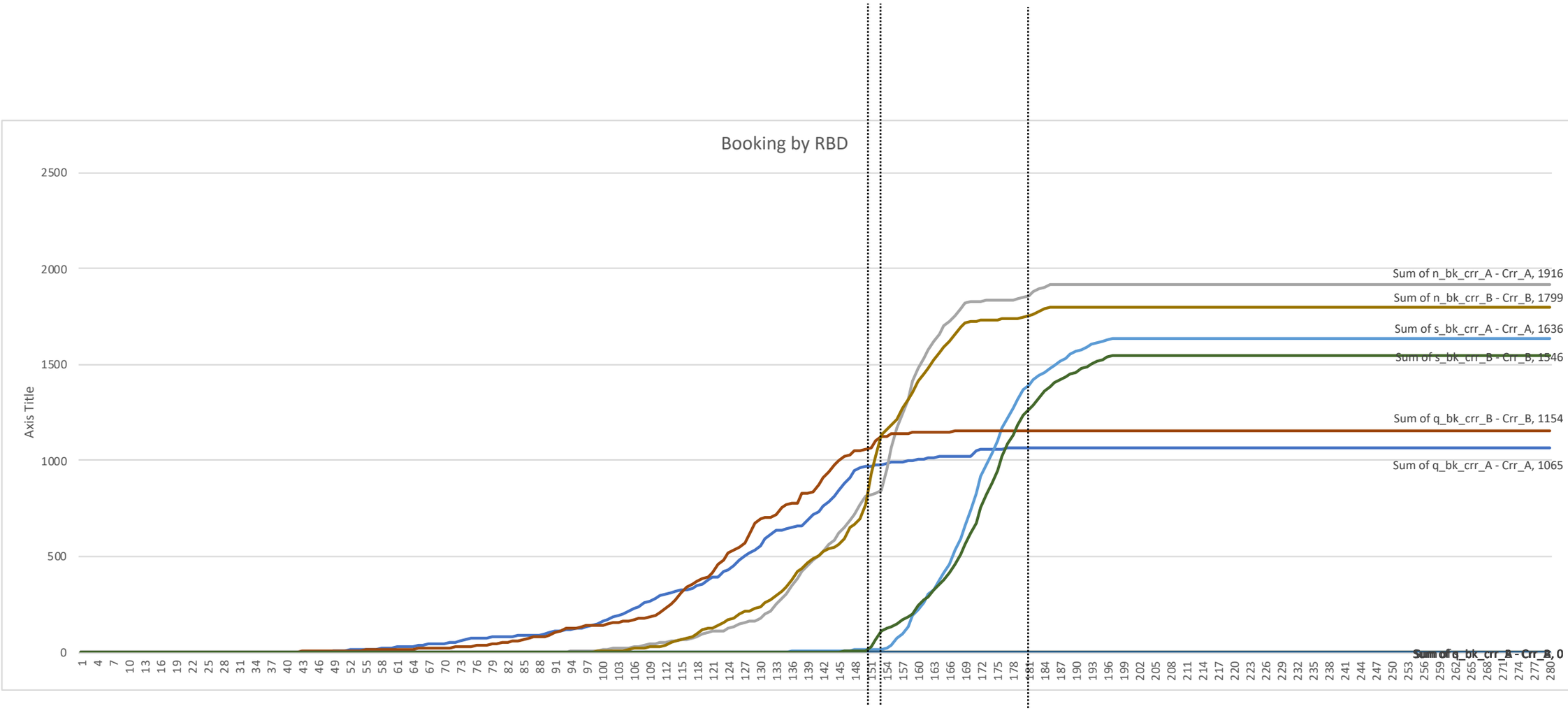
Results: Medium Demand, 3 days delay



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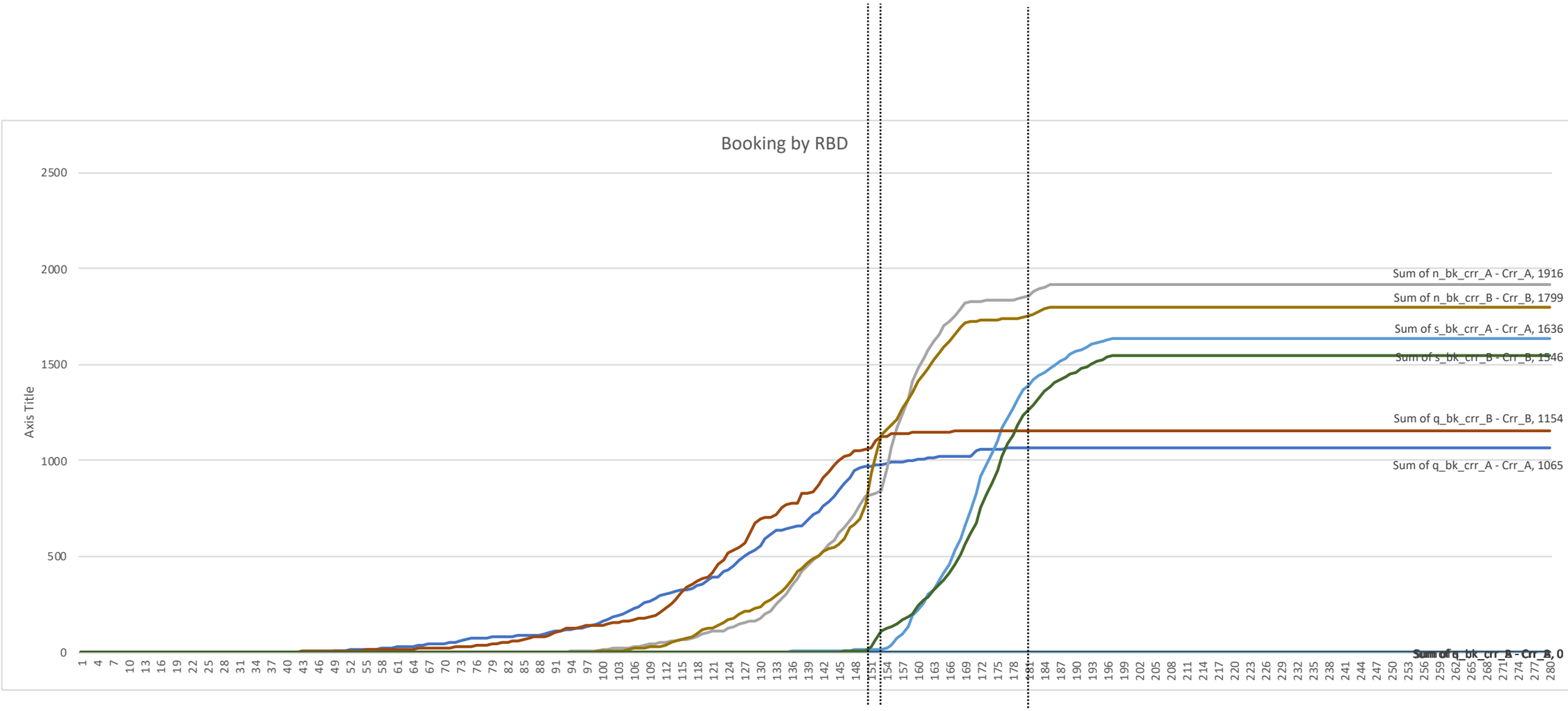
Results: Medium Demand, 3 days delay



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Results: Medium Demand, 3 days delay

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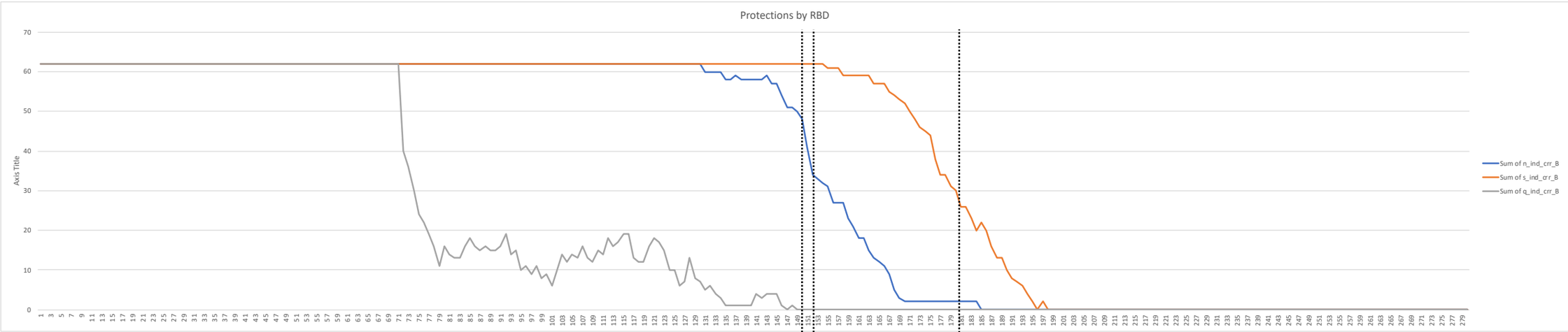

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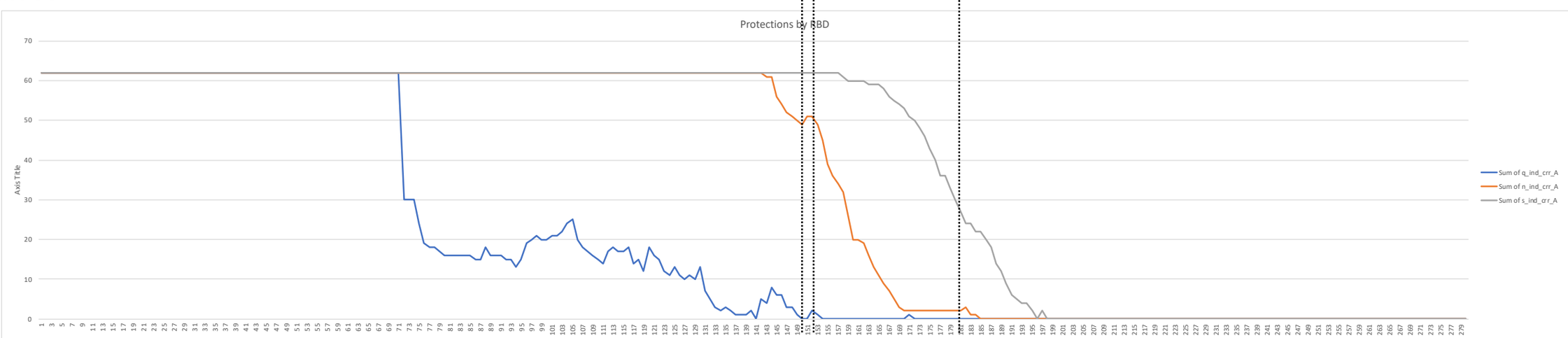

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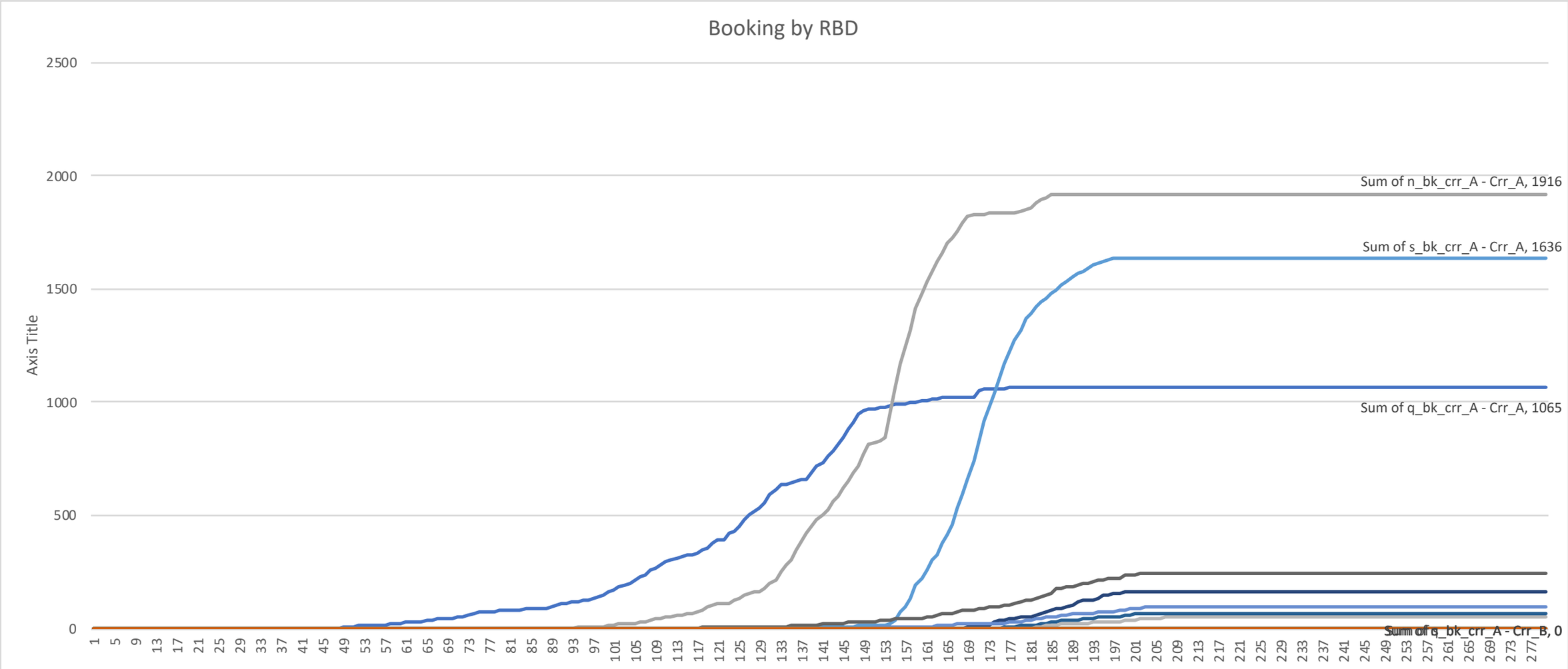
Results: Medium Demand, 3 days delay



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Results: High Demand, 10 days delay

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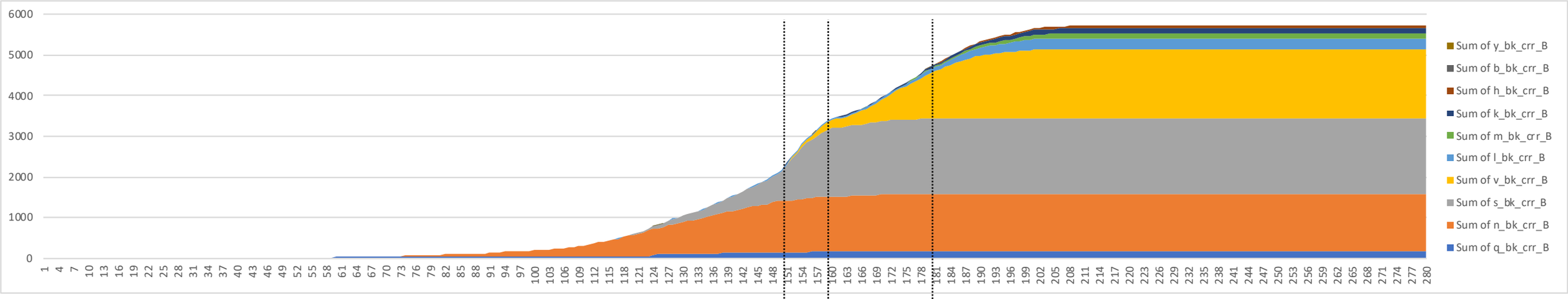

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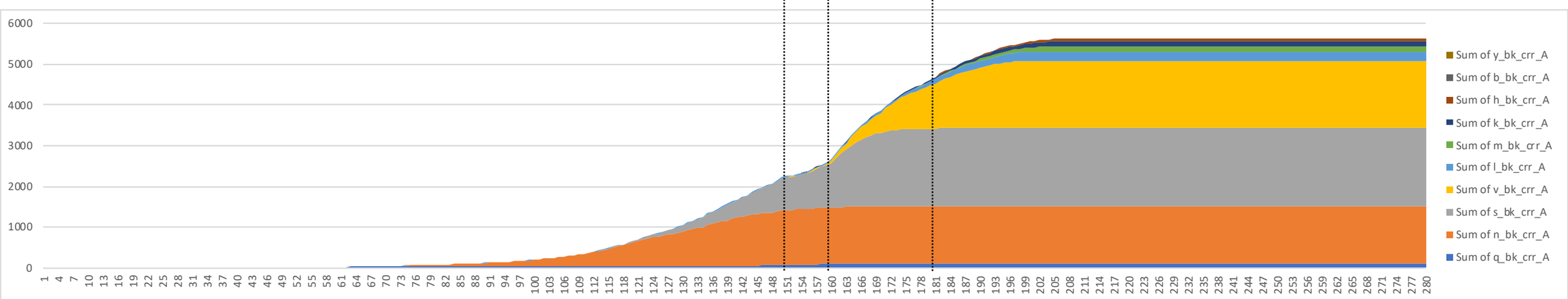

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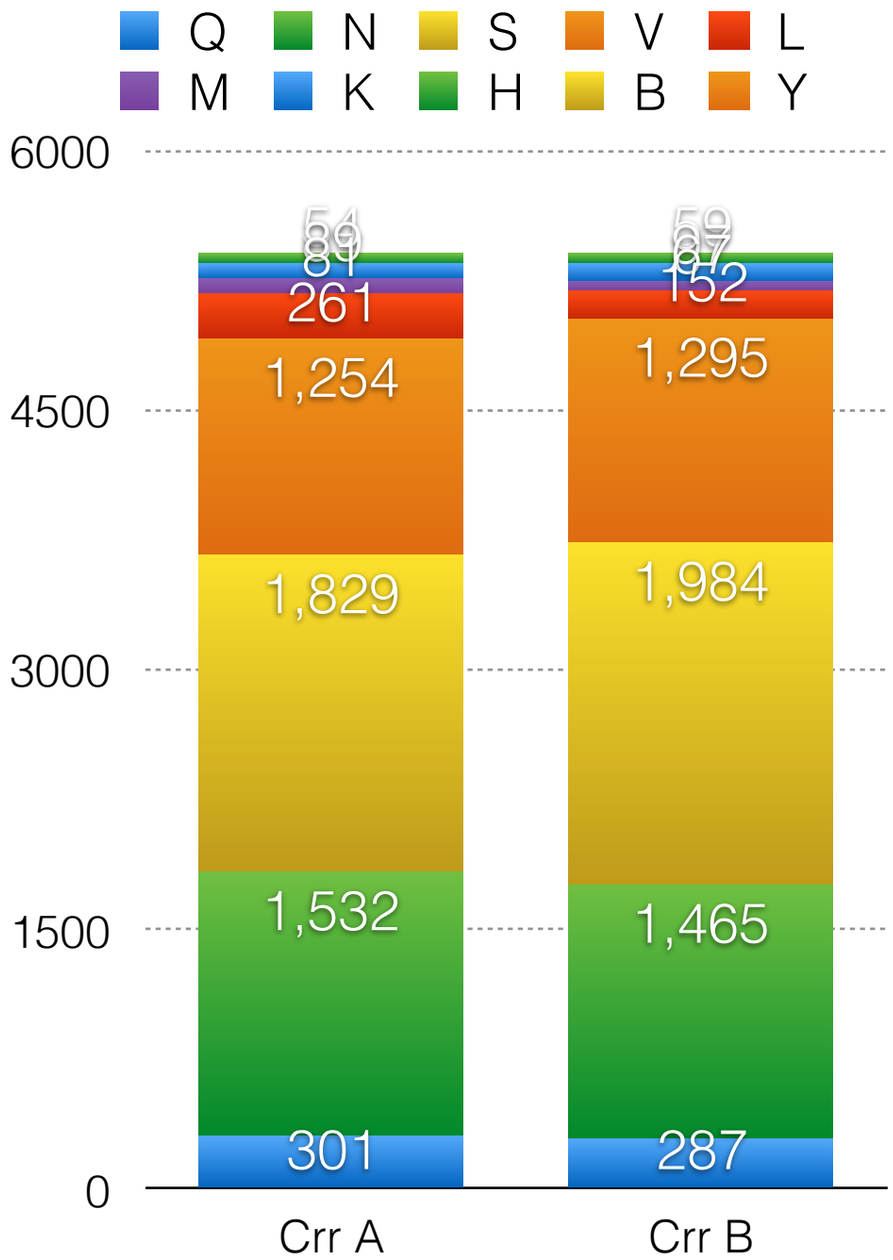
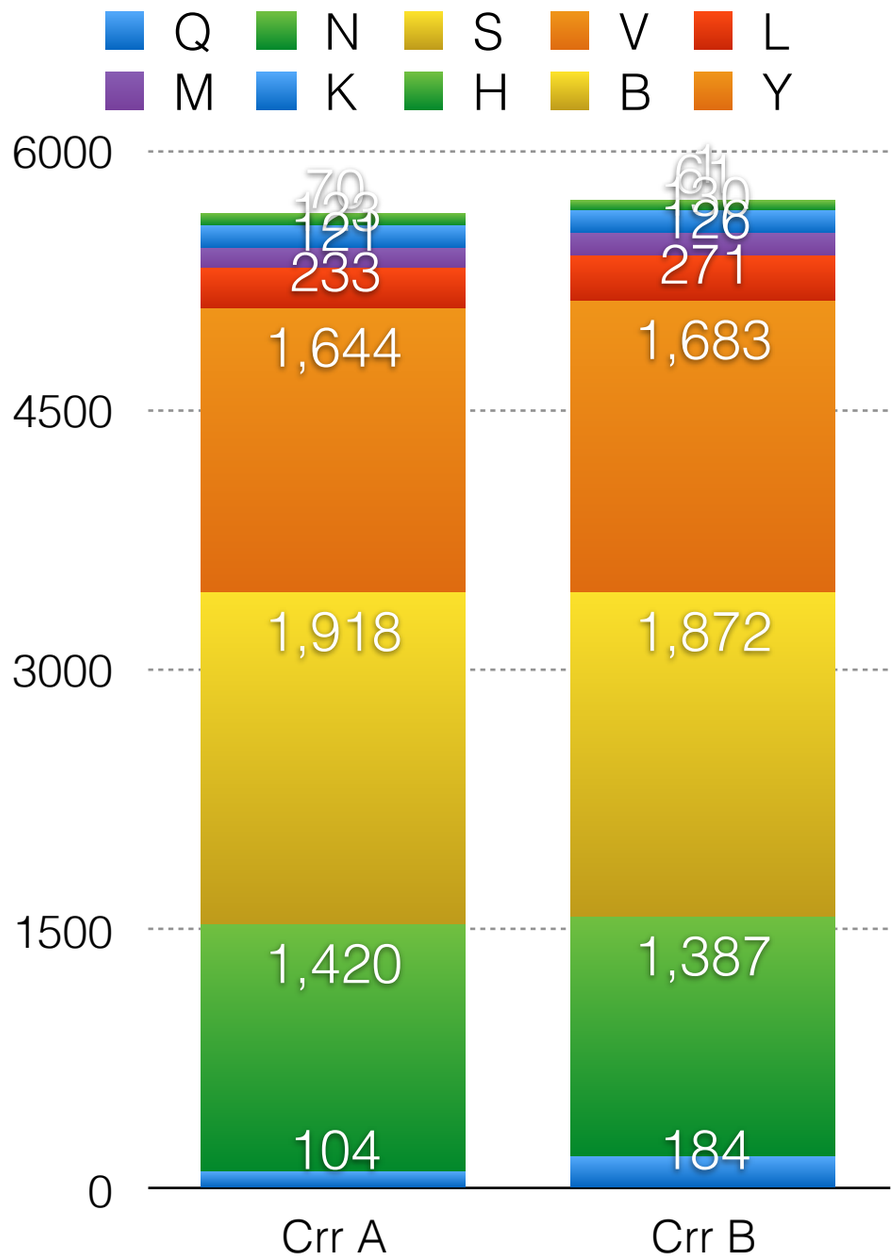
Results: High Demand, 10 days delay





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Conclusions

- We see a clear advantage between having a bad Time to Market (10 days) and having a good time to market (1 day) for scenarios with low and medium demand
- For scenarios with very high demand, it's better to wait more time to follow the competitor (maybe even not following)
- We see a particular behavior in the scenarios with medium demand, in which, apparently it's better to wait a couple of days to react than react in just one day. One reason could be that in this scenarios, Load Factor are still quite high and we don't have a high-yield low AP tourist demand that could fill RBD's in the mid level of the fare structure
- More scenarios with more diverse demand segments will be necessary to have more conclusive results
- More simulations per scenario are necessary to have "cleaner" results

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Next Steps

- Calibrate demand agents with real data
- Try simulations in scenarios with more types of demand and load factors between 70% and 80%
- Add 3 types of leisure demand and 3 types of corporate demand
- Add OnD logic
- Implement “Marketing” effect
- Try multiple fare movements on the same simulation
- Simulate continuous pricing concepts

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