Congestion in a competitive world: A study of the impact of competition on airline operations

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Outline

- European vs US airline industry
- Airline Scheduling in the US
- Issues in the current situation
- Case study: why airlines won't reduce frequency using PODS (revenue management simulator)

Actual State

	EUROPE	USA
Planning	Slot Owning	Free Scheduling*
On the day	Global Traffic Control	Global Traffic Control

* except JFK, EWR, LGA, ORD and DCA

Some Numbers for the US

- Total profit in 2007 $5.6 Billion (< 2%)
- Total delay in 2008 4.3 Mio hours
- Delay costs in 2008 $41 Billion
  - $19 Billion additional operating costs
  - $12 Billion passengers' value of time
  - $10 Billion spill out to other industries
- Additional tons of carbon dioxide 7.1 Mio

  (0.12% of total US emission)

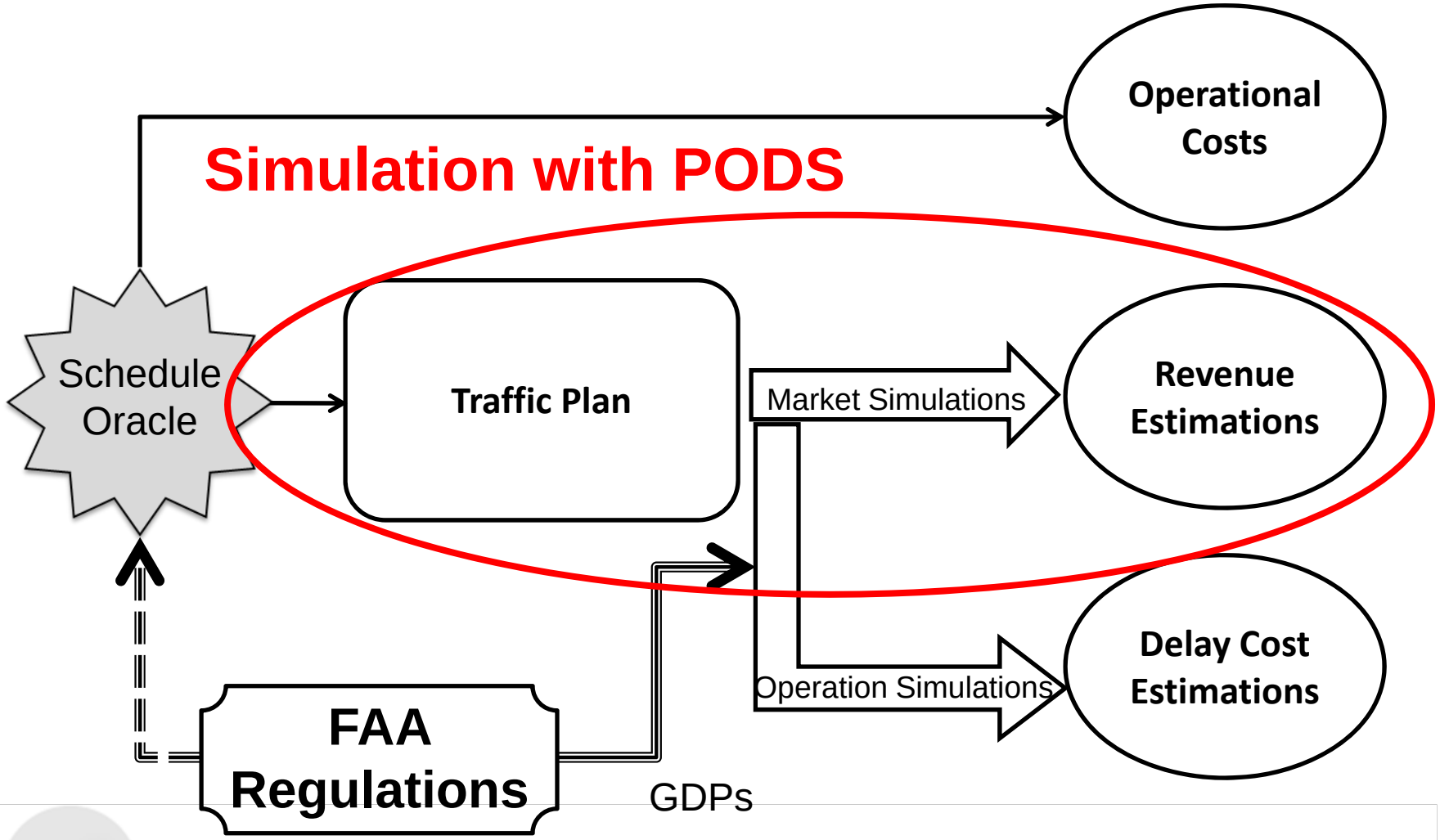
Situation is getting worse

- Yearly increase of 2.5% flights/year until 2025
- Each 1% additional flights generates 5% additional delays

Issues and open questions

- Will airlines reduce frequency by their own?
- Are external regulations required?
  - What should the regulations be?
  - How to get airlines involved?
  - How to guarantee fairness?
- Are regulations applicable, at what cost?

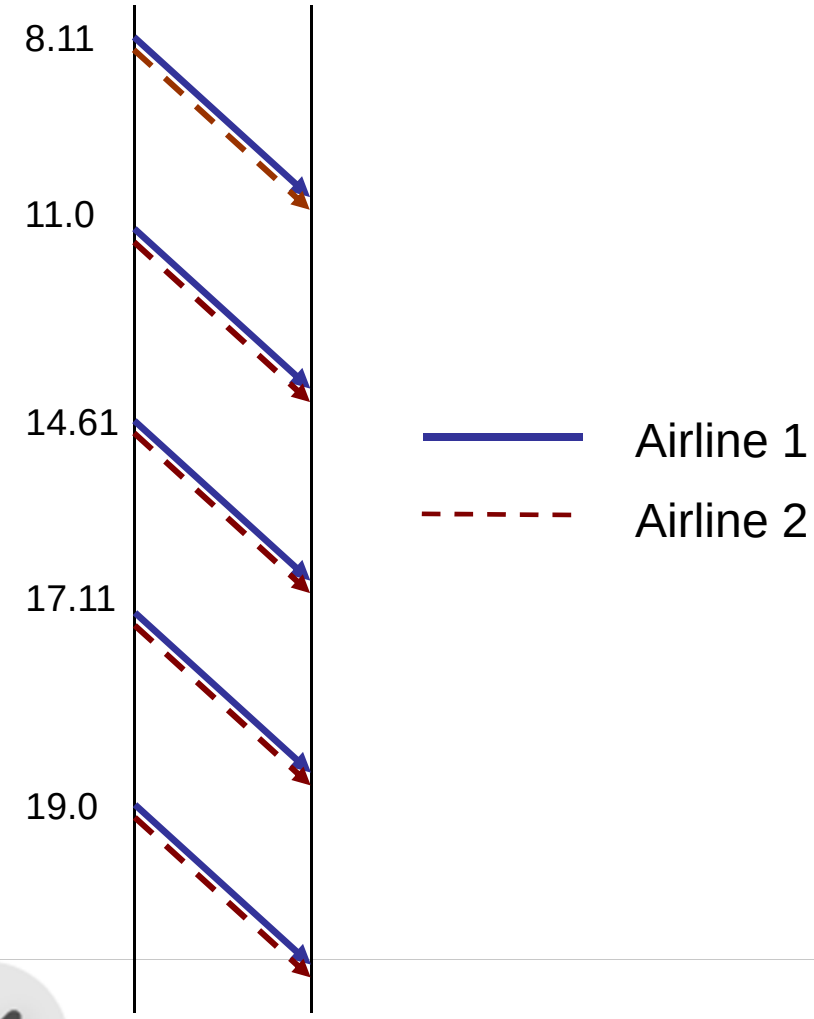
US Airline Scheduling Process



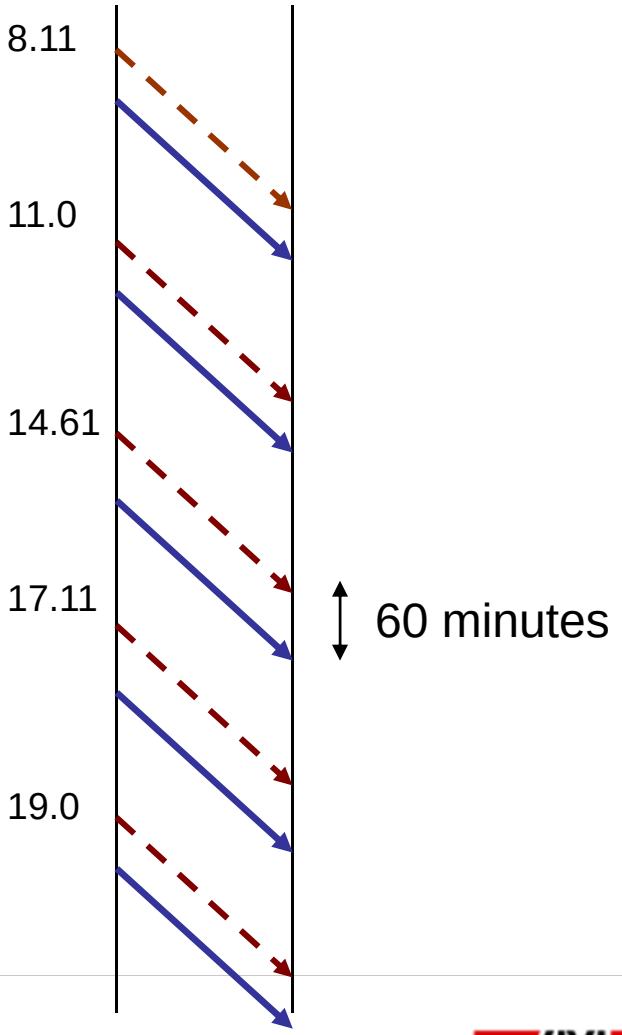
Case Study

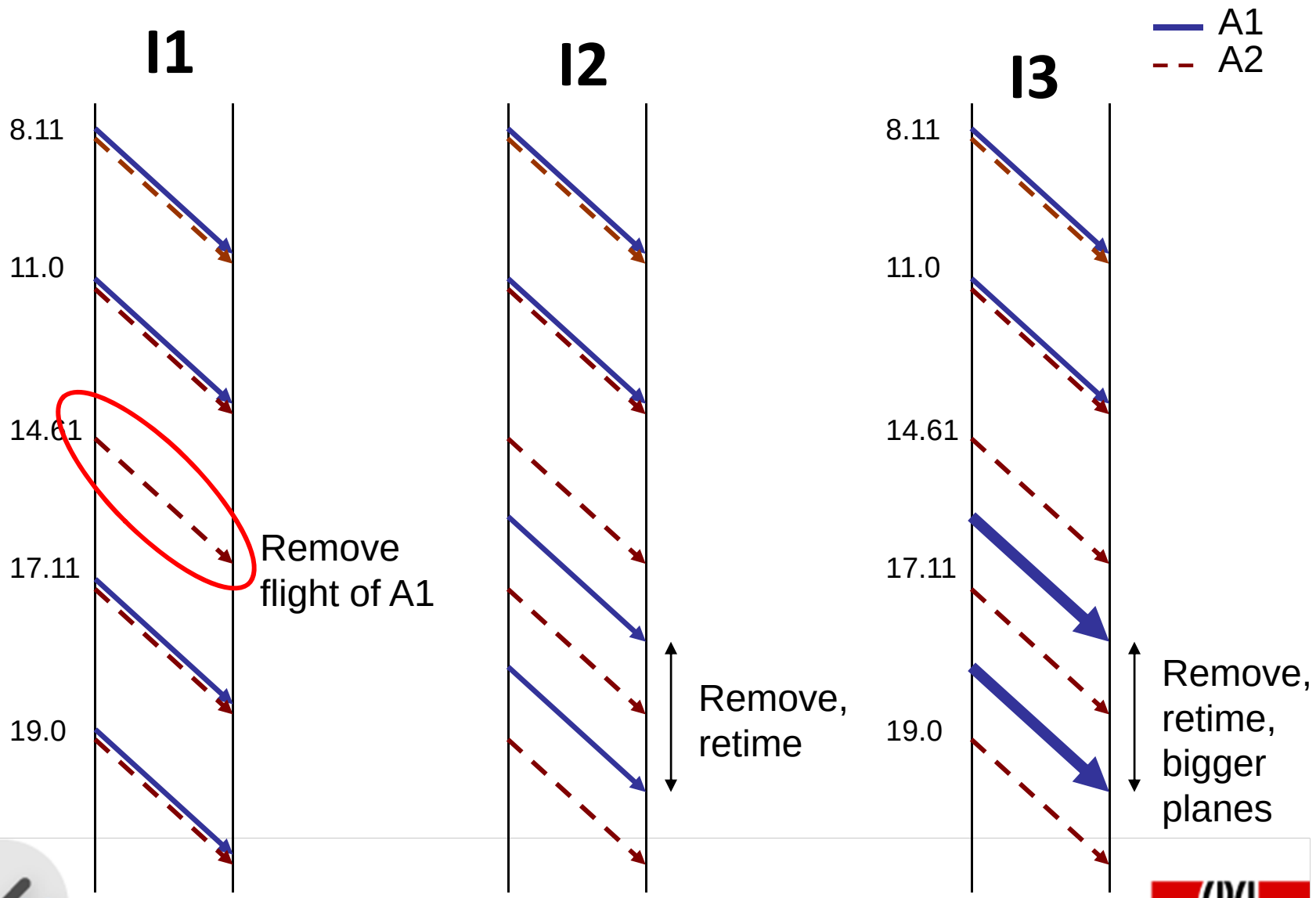
- Single OD market
  - 1440 miles
  - 3.39 hours block time
  - 6 fare classes
- 2 Competing airlines (A1 and A2)
  - 5 flights per day
  - 100 seats per flight

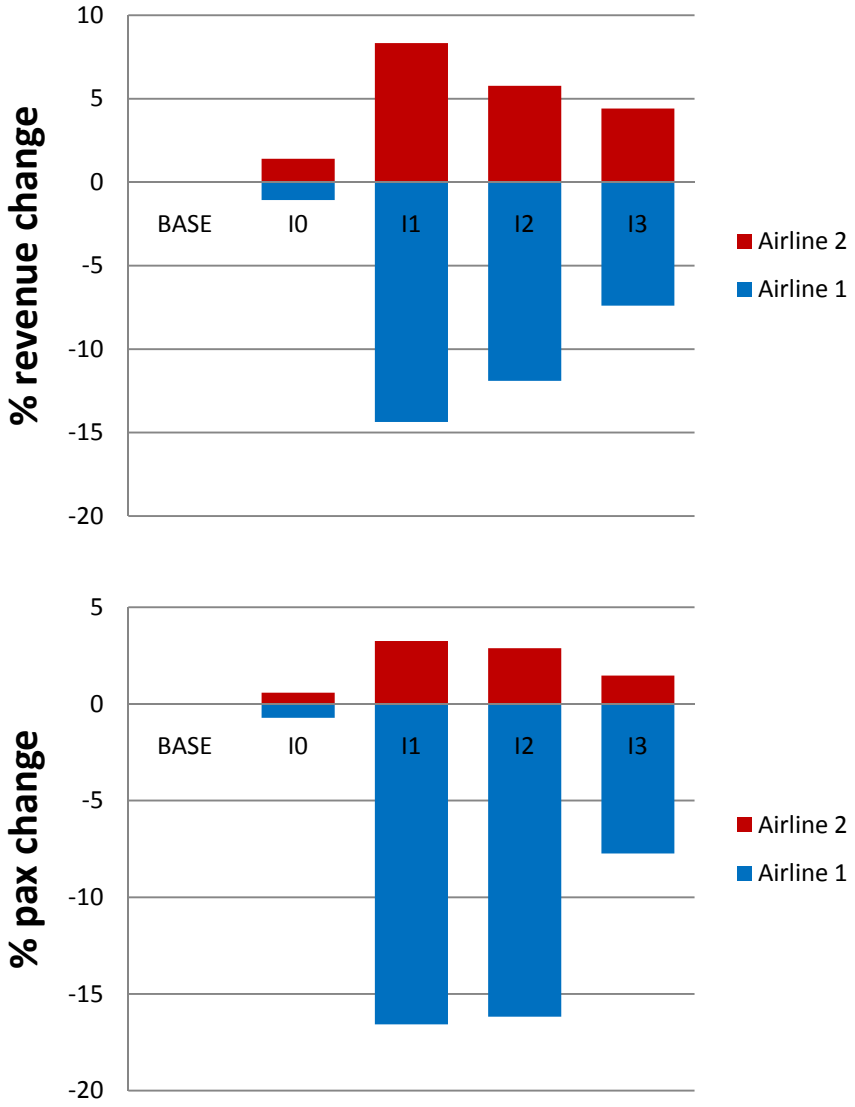
BASE (Original)



I0



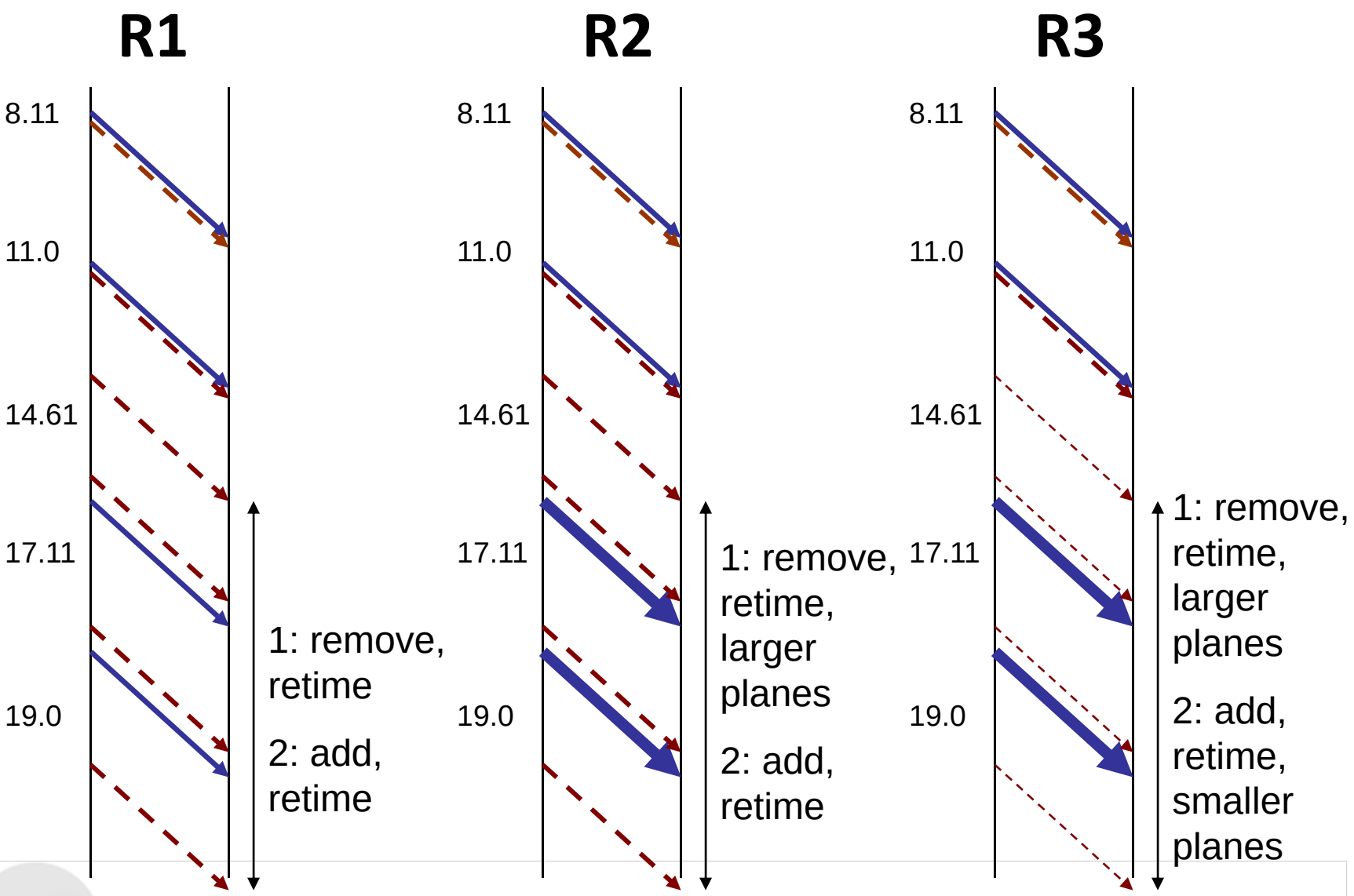

I1
I2
I3
A1
A2
8.11
11.0
14.61
17.11
19.0
Remove flight of A1
Remove, retime
Remove, retime, bigger planes



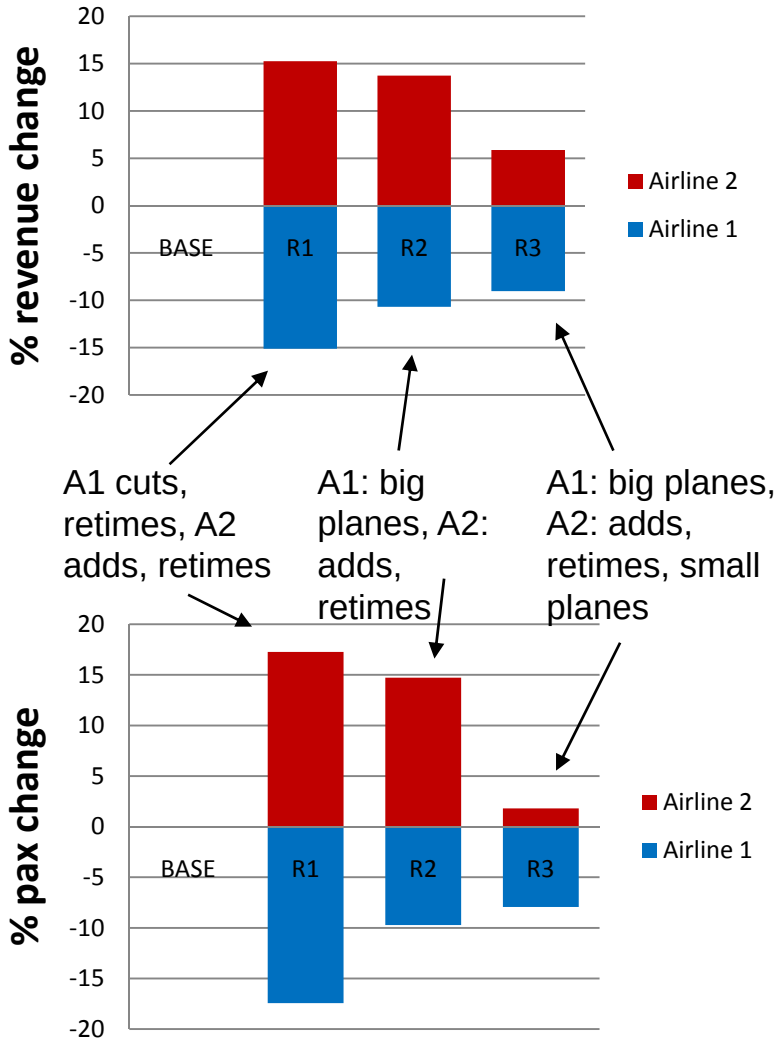
- A1 reduces frequency (and total capacity) by 20%
- A2 inherits some additional revenue for free, but not all what A1 loses
- A2 cannot inherit all passengers left over by A1 with no response
- A1's loss mitigated by re-timing increase of total capacity
- Marginal revenue for passengers is increased for both airlines (consequence of revenue management)

No Competitive Response (I0-I3)

- Retiming only (I0)
  - retiming only affects revenue
  - not sensitive to small retiming gaps
  - Poor retiming decision: direct revenue transfert of ~2.5%
- Frequency reduction (I1-I3)
  - Frequency reduction of A1 higher than revenue loss
  - A2 gains less than A1 loses
  - A1 recaptures loss by retiming (I2) and increasing capacity (I3)


R1
R2
R3
8.11
11.0
14.61
17.11
19.0
1: remove, retime
2: add, retime
1: remove, retime, larger planes
2: add, retime
1: remove, retime, larger planes
2: add, retime, smaller planes

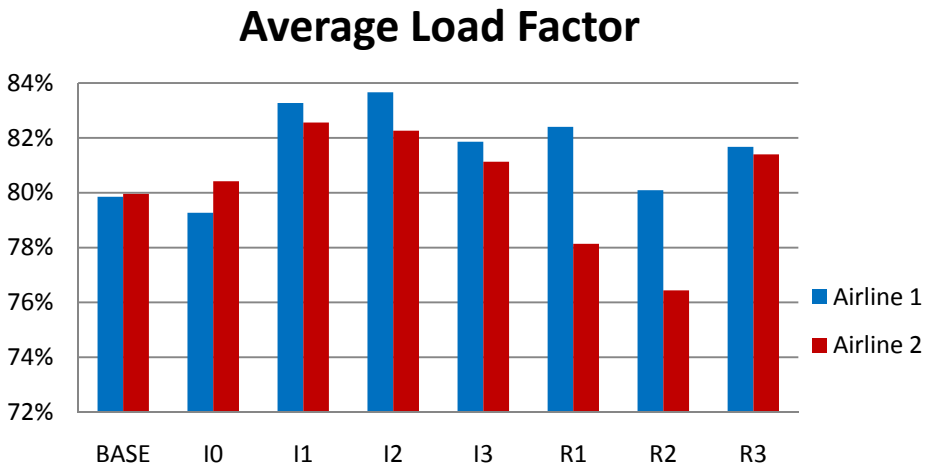
Competitive Response by A2



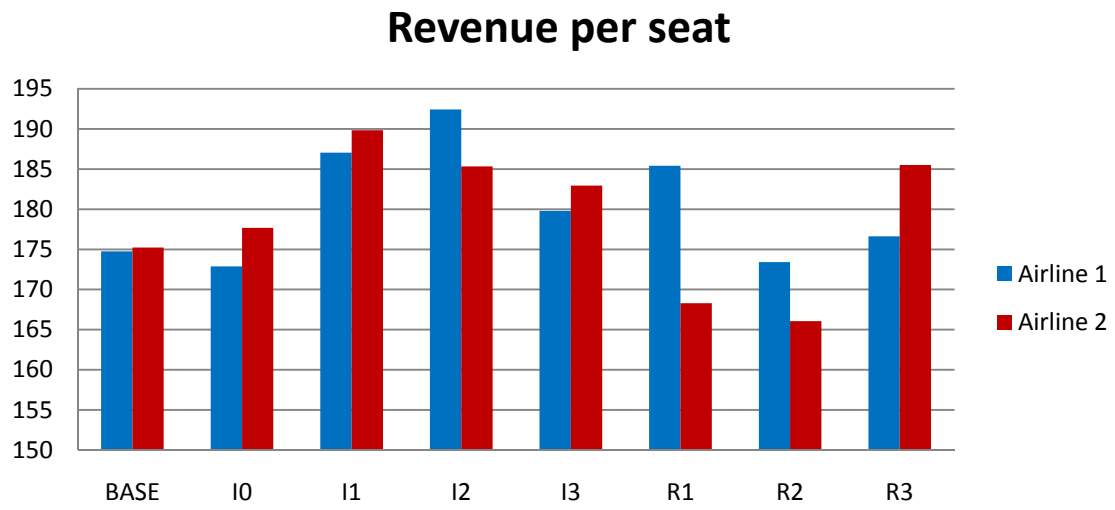
- A2's 20% capacity increase is equivalent to 15.2% revenue increase in R1
- R3: Global number of pax is increased by 2.5% when total capacity is increased by 5%
- R3: A2 with a 0% capacity increase and 20% frequency increase gets 6% more revenue
- R3: Global revenue decreases by 1.6%, total capacity by 5%
- High-frequency-low-capacity has better yield than low-frequency-high-capacity

Competitive Response (R1-R3)

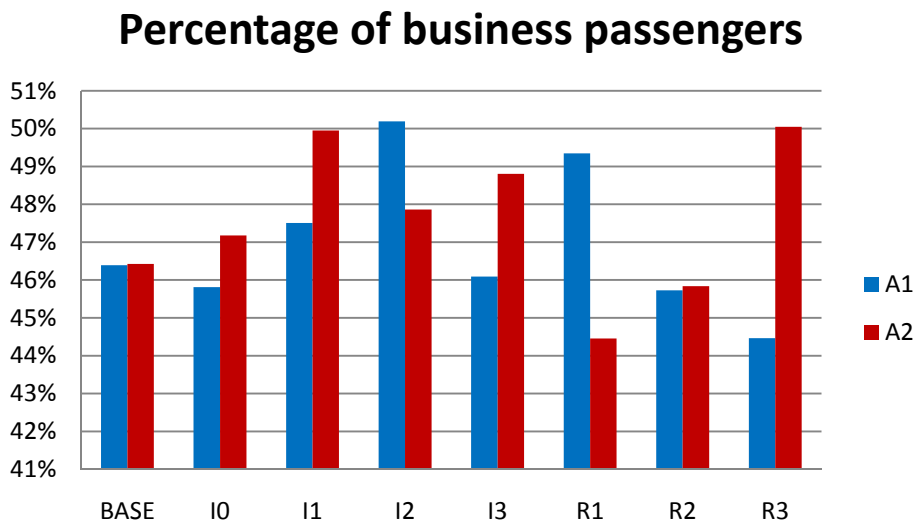
- Competitive response to cut only (R1)
  - A2 gets a high profit, A1 loses a lot of market share
- A1 increases capacity by 12.5% (R2)
  - A1 recaptures 44% of the pax lost in R1
  - A1 could only recapture 29% of the lost revenue in R1
  - A2 loses market share w.r.t. R1
- A2 with high-frequency-low-capacity (R3)
  - A2 gains only few passengers but increases revenue to a greater extent
  - A1 cannot compete: they lose more revenue (9%) than passengers (8%)

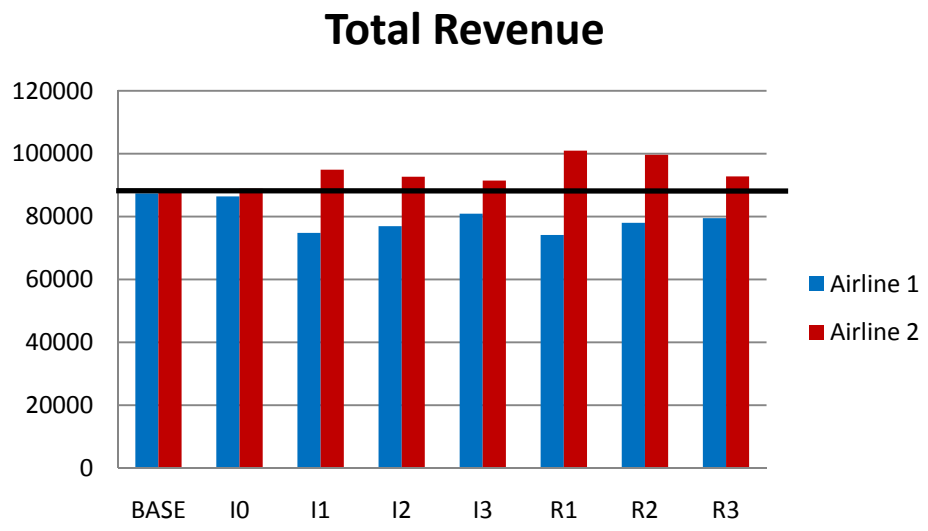


- A1 always has higher load factor, except when retiming only (I1) due to:
  - Lower capacity (all scenarios)
  - Recapturing more lower fare class passengers left over by A2, which focuses on higher fares
- A1 reduces load factor by 2.8% when increasing capacity by 12.5% in R2
- A2's load factor increases by 6.5% when reducing capacity by 17% from R2 to R3

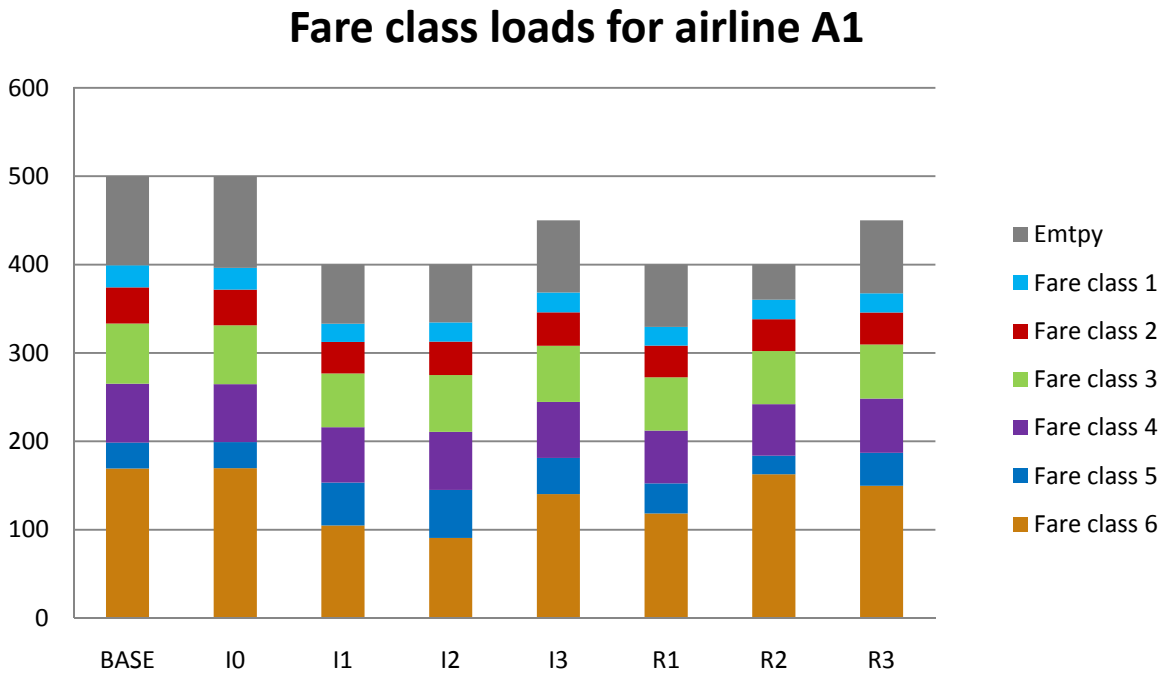


- Revenue per seat decreases significantly when A2 increases capacity (R1,R2) (A2 has over-capacity)
- Highest revenue per seat is achieved by A1 when cutting one flight and retiming only (I2)
- R3: revenue per seat is clearly better for A2 than A1

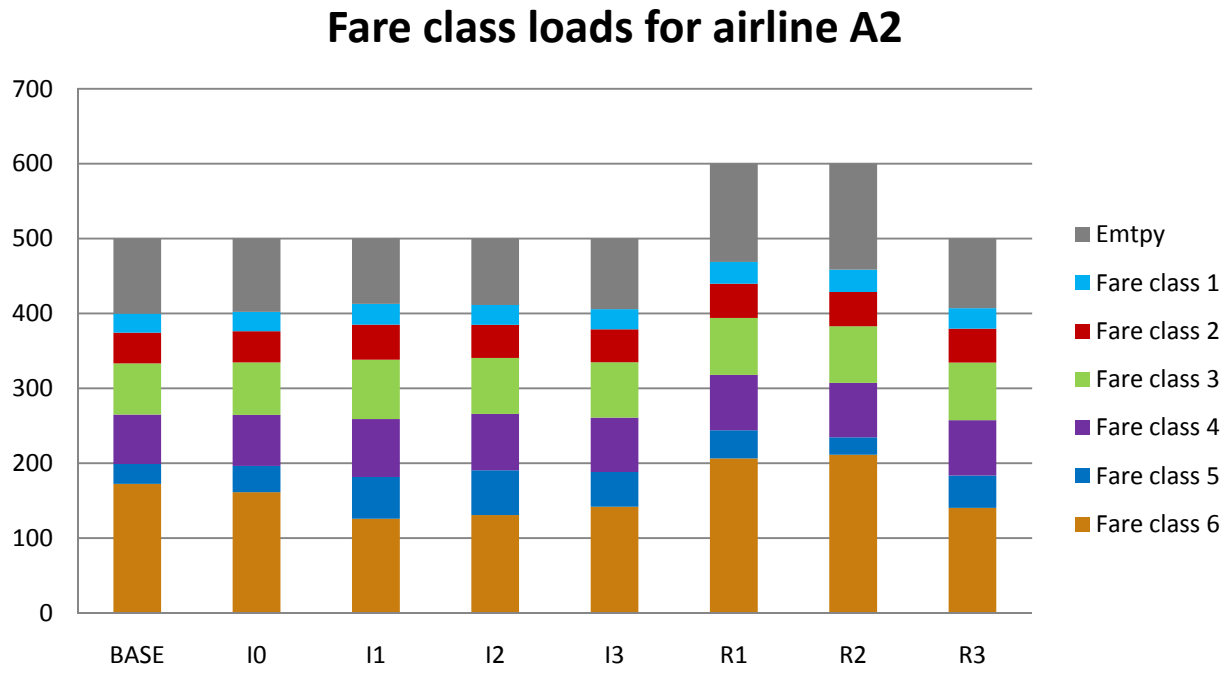




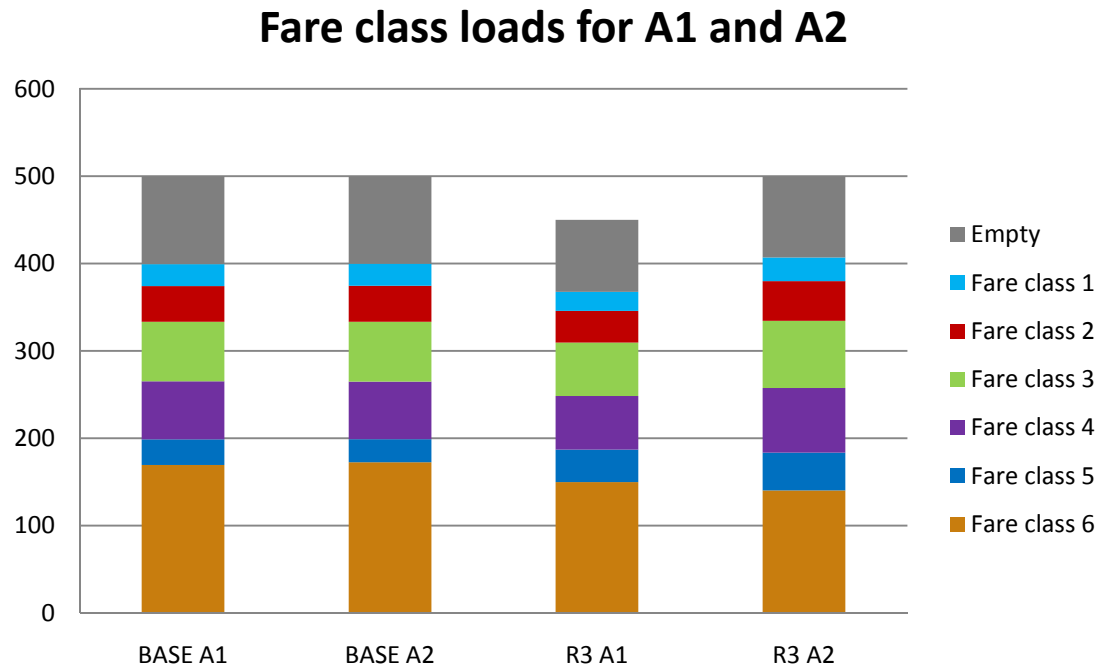
- With lower-capacity-higher frequency, A2 has 9.7% more business passengers (R3 compared to R2)
- In R3, A2 transports 10.7% more passengers than A1
- A1 loses 11.8% of business passengers in R3
- In R3, A1 transports 7.9% less passengers in total, A2 only 1.8% more
- Revenue is made by pax type, not pax number



- When lower capacity, get more pax in fare classes 4 and 5 for less in class 6 (lowest fare class)
- When lower capacity, empty seats decreases both absolutely and relatively
- Fare classes 1 and 2 are have lower variability than other classes



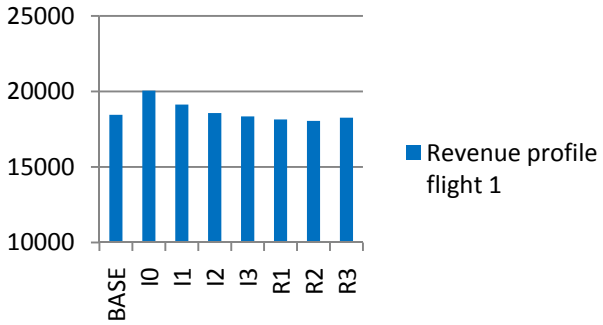
- When larger capacity, get less pax in fare classes 4 and 5 for more in class 6 (lowest fare class)
- I1 and I2: gain made by higher fare classes, not total number of pax
- R1-R3: High fare classes (1 and 2) have larger number of pax when higher frequency



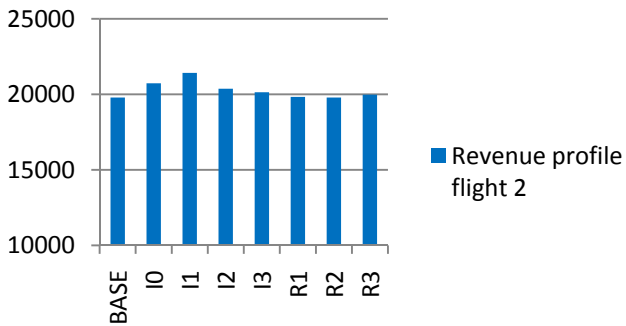
- In R3, A2 gets more high fare class pax than A1
- Low fare class pax are decrease for both A1 and A2
- Global revenue decreased by 1.5%, total capacity decreased by 5%

Individual Flights A1

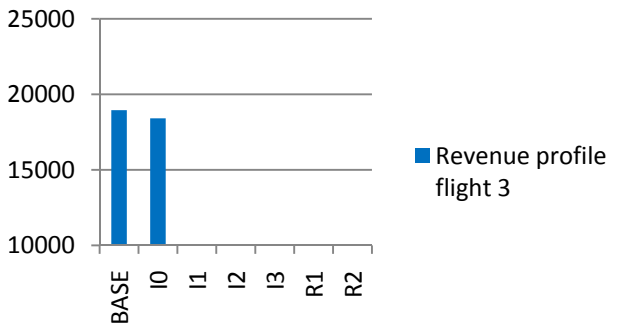
Flight 1 (8.11)



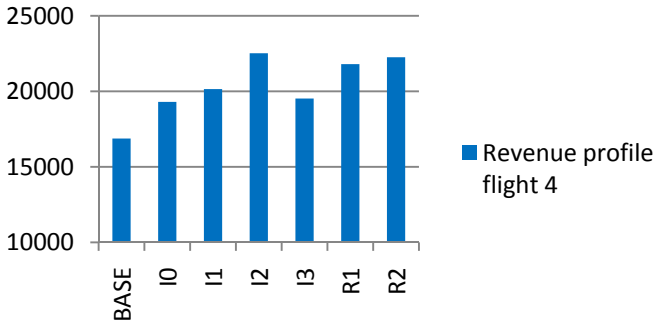
Flight 2 (11.00)



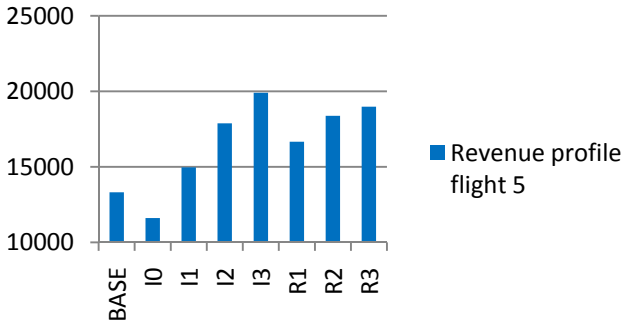
Flight 3 (14.61)



Flight 4 (17.11)

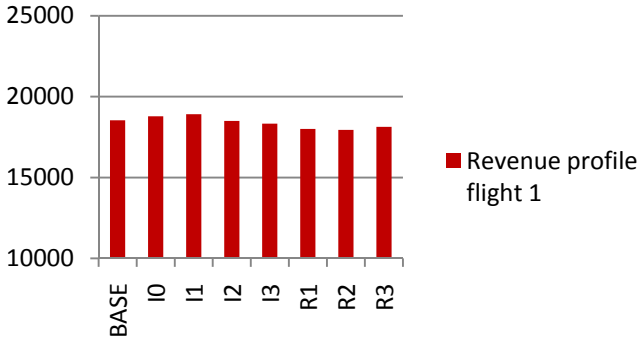


Flight 5 (19.00)

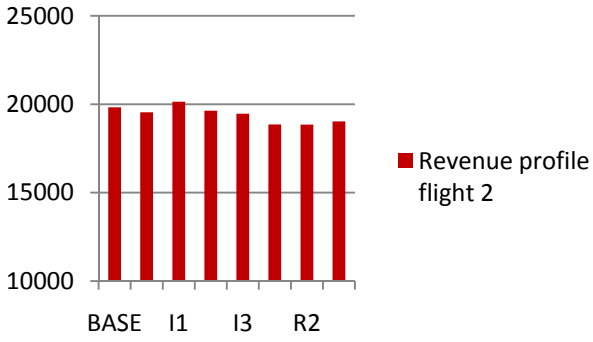


Individual Flights A2

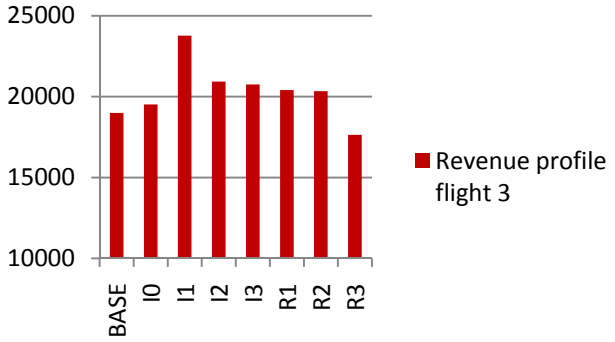
Flight 1 (8.11)



Flight 2 (11.00)



Flight 3 (14.61)



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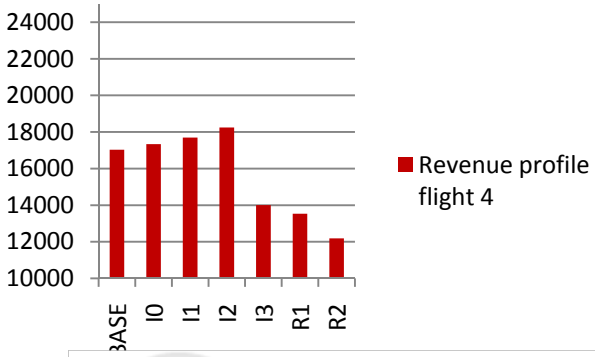
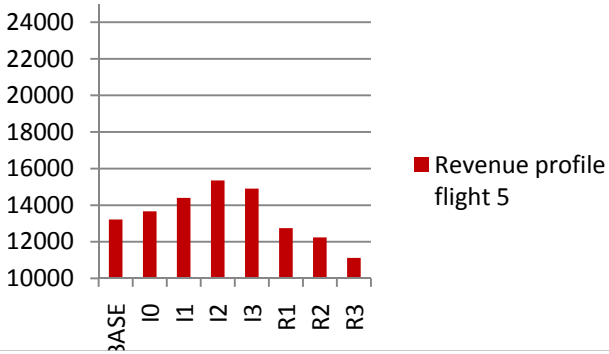
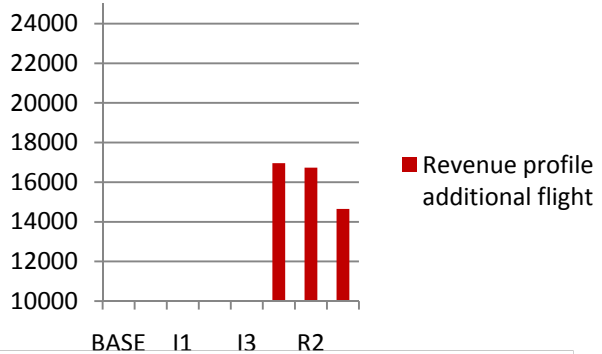


Flight 5 (19.00)



New Flight (16.50)

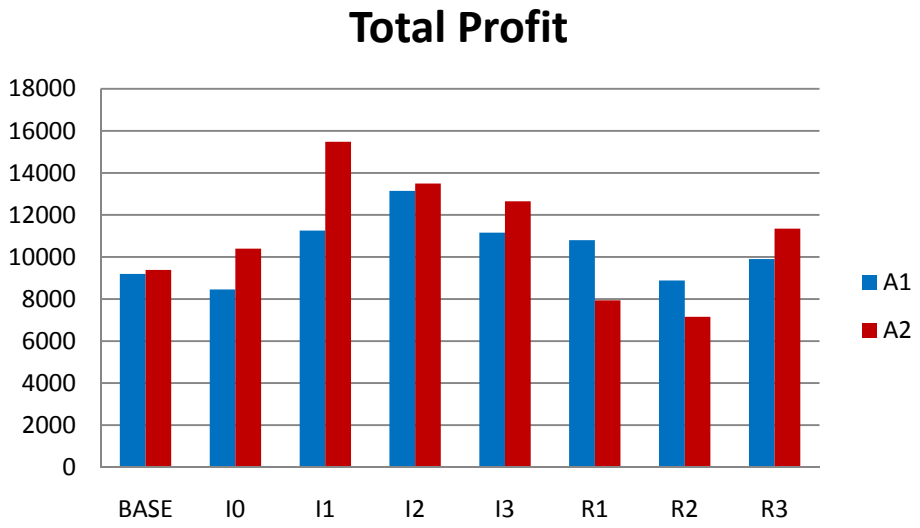


Considering operating costs

# Seats	Block-hour cost	Cost / departure	Cost / pax	Overhead	Distribution
75	2000	700	37	15%	9%
100	2500	800	37	15%	9%
125	3000	900	37	15%	9%

- Economies of scales for block-hour costs with respect to number of seats
- Larger planes have higher departure costs
- Cost per passenger is constant

Considering operating costs(2)



- A1 makes more profit when A2 adds a flight with 100 seats (R1-R2)
- Added flight by A2 always has negative profit (1% to 10% loss)
- R3: A2 increases profit by using smaller planes by 59%
- I1: highest profits for A2 when A1 cuts 1 flight only
- When cutting 1 flight, all flights of A1 have positive profit

Big picture

- A2 gains from A1's frequency reduction even without response
- A1 does not lose as much as it cuts frequency
- Revenue management can mitigate losses
- Higher frequency allows for better match of high-fare demand profiles
- Add capacity is increasing revenue, but not necessarily increasing profit

Conclusions

- Airline congestion in the US is a major issue
- Airlines benefit from increased frequency
- Airlines have no interest in reducing voluntarily their frequency
- Need external regulation to ensure quality of service

Thank you!