Airport economic value – informing business models

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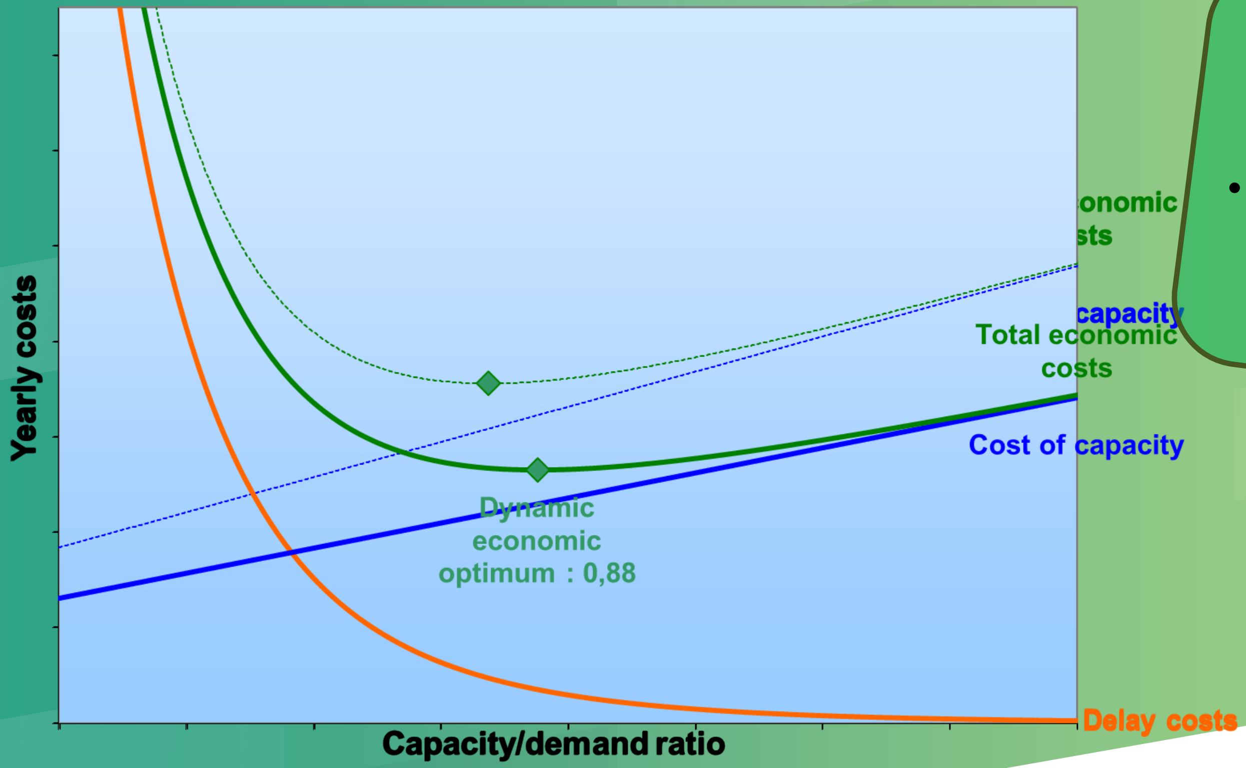
1. Goals and background

Objectives

- Contribute to SESAR Operational Focus Area 05.01.01 (Airport Operations Management)
- Assess the economic value of extra capacity at an airport
- Better understand interdependencies of various KPIs
- Assess existence and behaviour of an airport economic optimum, in a similar way to the early 2000s when estimating the economic en-route capacity optimum
- Build a simple model but highly data-driven

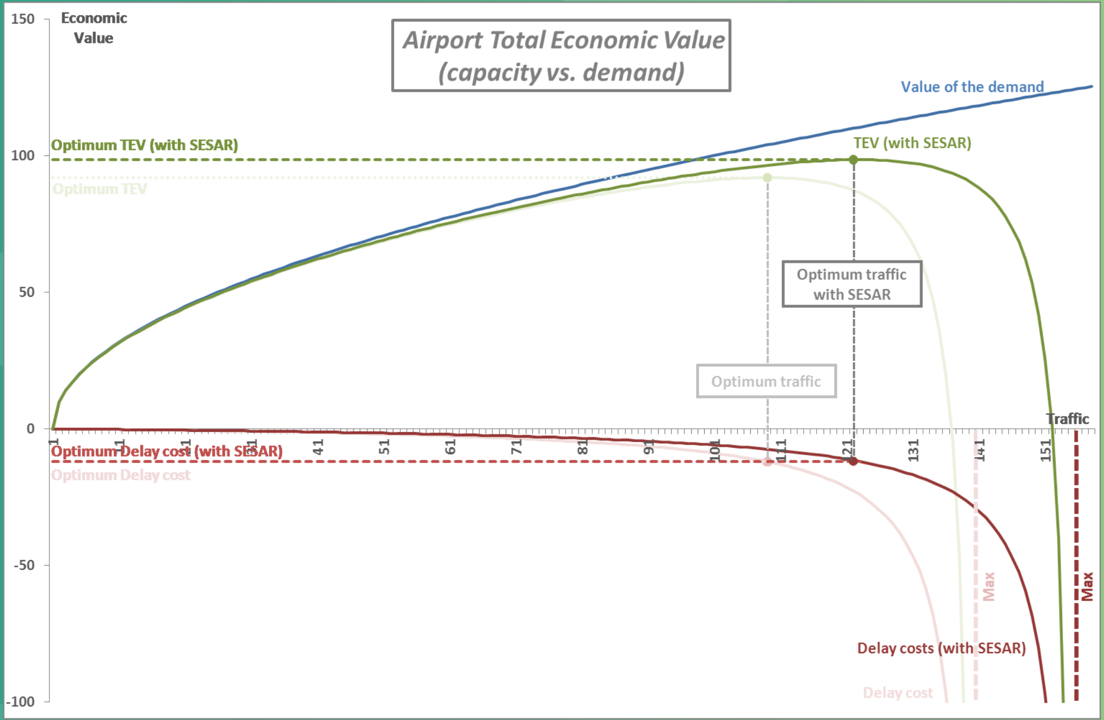
En-route capacity economic optimum



- Methodology developed in Bretigny (FAP project).
- Now in use by the Network Manager for en-route capacity planning.

Basic idea: capacity is costly, but delays too.
Economic optimum requires a minimum of delays.

Airport Economic value (1/2)



Objective: Is it possible to compute an airport economic value as well as its optimum depending of various parameters?

Airport Economic value (2/2)

- Gather various types of airport-related data:
  - Operational.
  - Economic & Financial.
  - Quality of service (satisfaction).
  - ...
- Develop a simple generic model based on real data.
- Analyse behaviour of this model as well as its optimum.

2.
Data analysis

Data sources

- Large variety of data sources
- Alignment is difficult!

Source	Typical Content	Use	Transfer
FlightGlobal	Number of flights, number of passengers, share of European flights	Cluster analysis, calibration	Transferred
EUROCONTROL CODA	Delay per airport & per type	Comparison with DDR delays	NA
EUROCONTROL DDR	Full trajectories of aircraft for one month of data	Delay distribution, capacity fitting, share of different types of companies	NA
ACI	Number of passengers (domestic, international, etc.)	Calibration purposes	Transferred
ACI	Ownership airport	Not used in final analyses	Transferred
Private communication, EUROCONTROL (2016)	Coordination of airport	Not used in final analyses	NA
Skytrax, etc.	Passenger satisfaction	Cluster analysis	Transferred
ATRS	Financial data	Cluster analysis, calibration	Transferred for 2013 and 2014
ATRS	Airport charges	Comparison with aeronautical revenues per aircraft	Transferred
Private communication, EUROCONTROL (2016)	Maximum Take-Off Weight	Cost of delay calibration	NA
University of Westminster	Cost of delay	Cost of delay calibration	Public report

Clustering

- Clustering produced to categorise airport based on data only
- Found 3 clusters (modularity-based method)
- Based on variables inferred from a principal component analysis

Cluster Id	ICAO Code	Airport Name
2	EBBR	Brussels
	EDDL	Dusseldorf
	EGCC	Manchester
	EIDW	Dublin
	EKCH	Copenhagen Kastrup
	ENGM	Oslo Gardermoen
	ESSA	Stockholm Arlanda
	LOWW	Vienna
	LPPT	Lisbon
1	EDDF	Frankfurt
	EDDM	Munich
	EGKK	London Gatwick
	EGLL	London Heathrow
	EHAM	Amsterdam Schiphol
	LEBL	Barcelona-El Prat
	LEMD	Madrid Barajas
	LFPG	Paris Charles de Gaulle
	LIRF	Rome Fiumicino
	LSZH	Zurich
	LTBA	Istanbul Ataturk
0	EDDH	Hamburg
	EDDK	Cologne Bonn
	EFHK	Helsinki
	EGBB	Birmingham
	EGSS	London Stansted
	ELLX	Luxembourg
	EPWA	Warsaw Chopin
	LFMN	Nice Cote d'Azur
	LGAV	Athens
	LHBP	Budapest
	LKPR	Prague
	LPPR	Porto

3.
Model development

Model overview

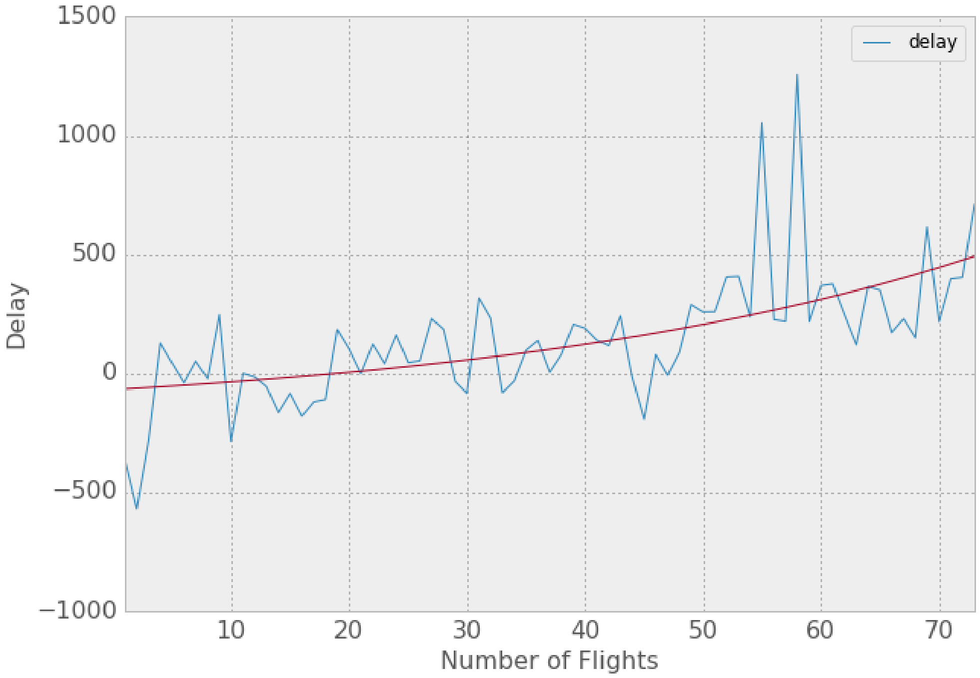
- Single airport modelling (calibrated on a big hub in Europe)
- Equilibrium between supply (airport capacity) and demand (traffic from airlines)
- Includes relationship between capacity and delay
- Includes loss of revenues for airline due to delays
- Includes traffic variation based on airline revenues
- Includes operational cost of airport, direct and indirect revenues

Model flow

- Airport chooses capacity based on cost and revenues
- Capacity sets level of delay
- Delay impacts airline revenue
- Airline revenue changes probability of operating flights
- Probability of operating flight changes airport revenue

Traffic vs. delay

- Exponential fit
- Linear fit works well too



Cost vs. delay

$$c_d = -7.0\,\delta t - 0.18\,\delta t^2 + (6.0\,\delta t + 0.092\,\delta t^2)\sqrt{MTOW}$$

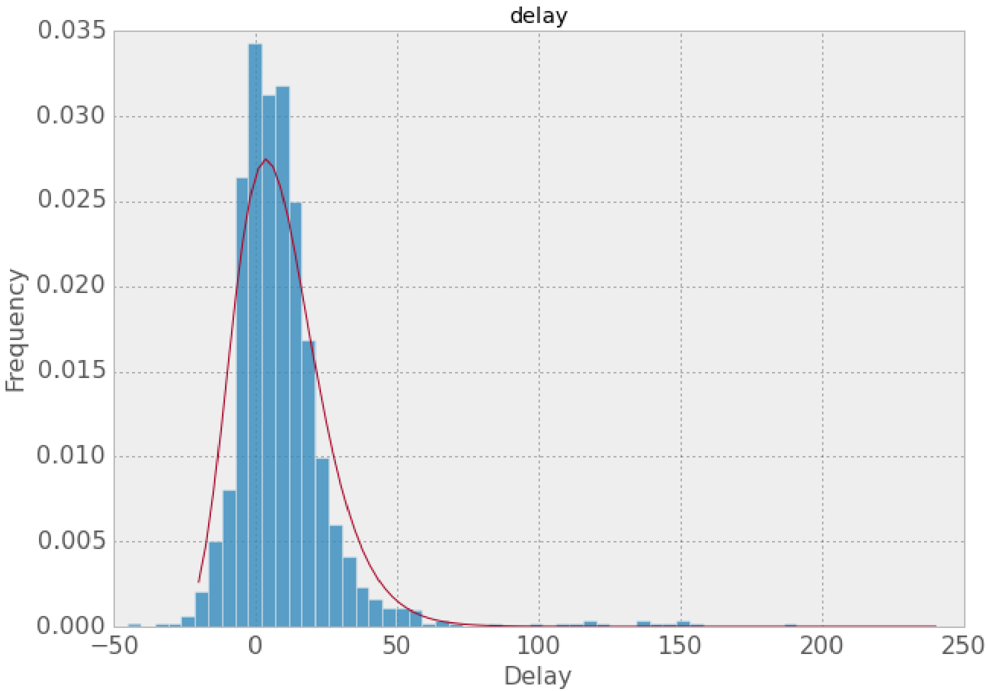
- Sourced from Uni. of Westminster standard reference values
- For the airport calibrated, mix of type of aircraft and airlines taken into account

Problem: **cost of average** is not **average cost of delay** because:

- Cost is not linear with delay,
- In particular, airlines do not make money from negative delays (anticipated flights with respect to their schedule)

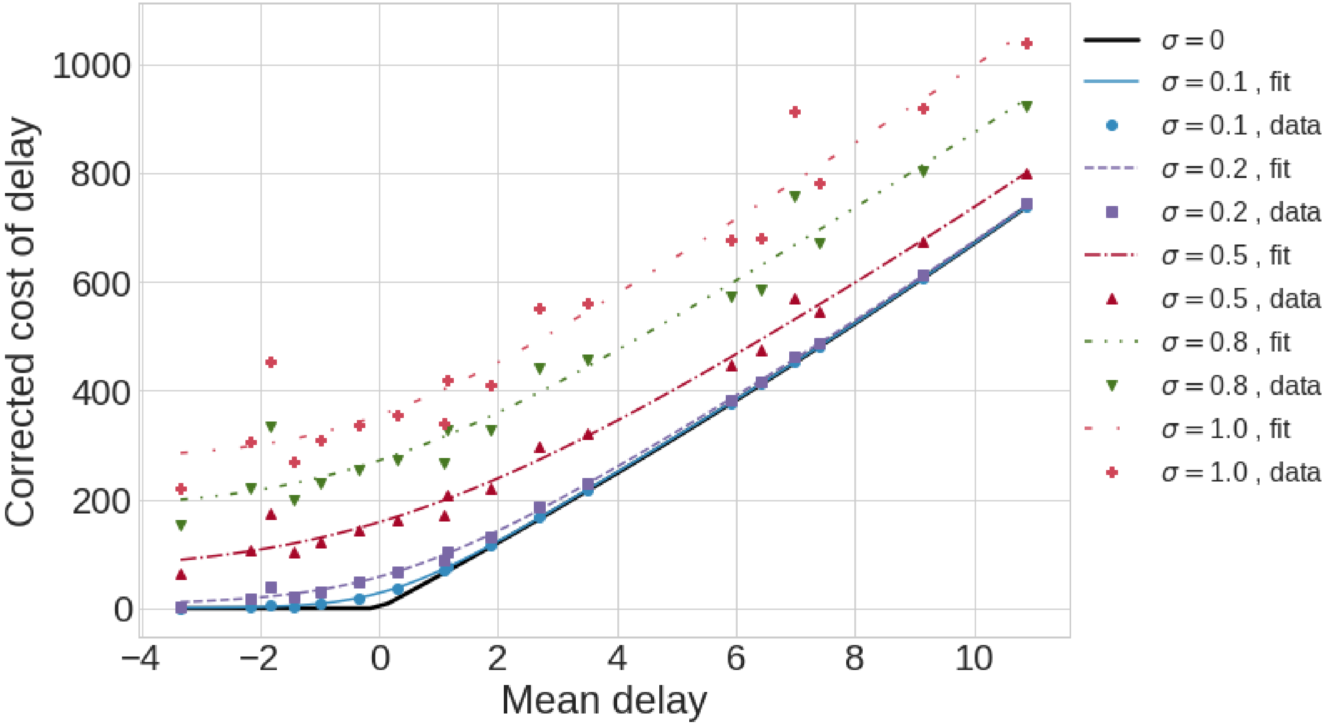
Distribution of delays

- Lots of negative delays
- Some very high positive delays

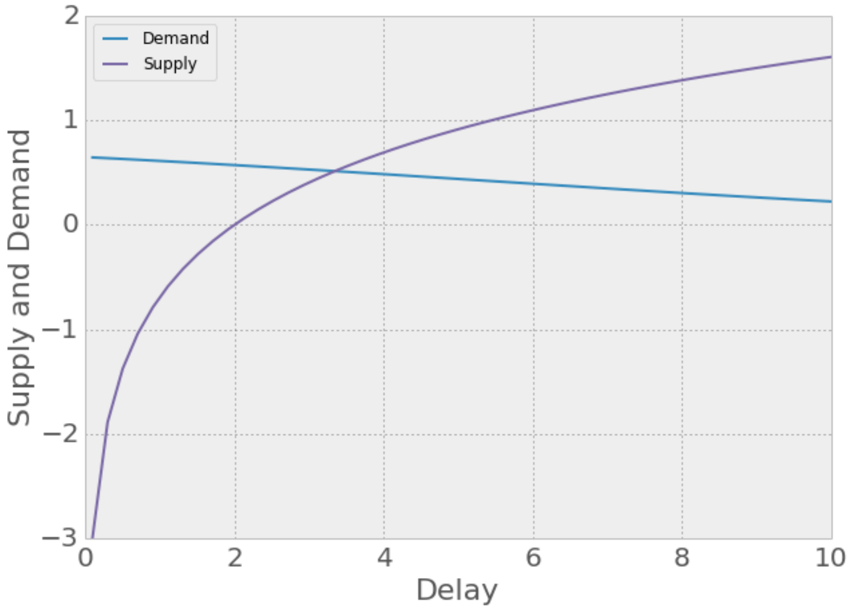


Cost of uncertainty

- Cost of 'uncertainty' can be bigger than cost of average delay



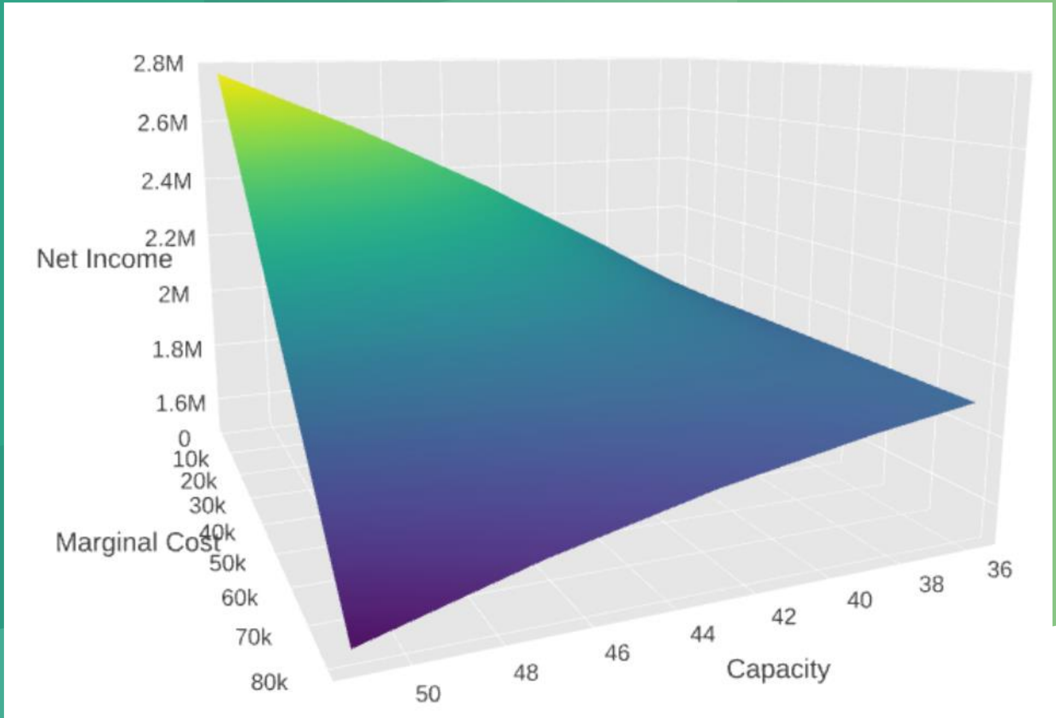
Equilibrium



- Delay depends on traffic;
- traffic depends on probability of operating the flight;
- probability depends on the cost of delay;
- cost of delay depends on delay.
- ➔Implicit equation.

4.
Results

Airport income



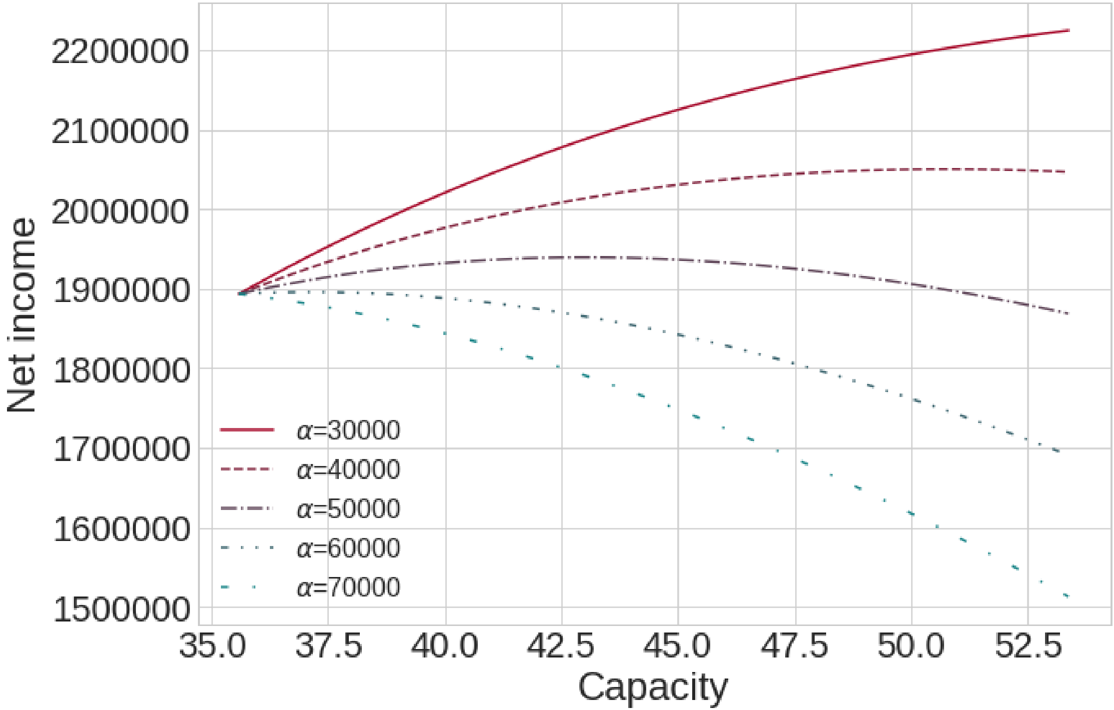
Marginal cost of capacity

is hard to calibrate

➔ used as a variable.

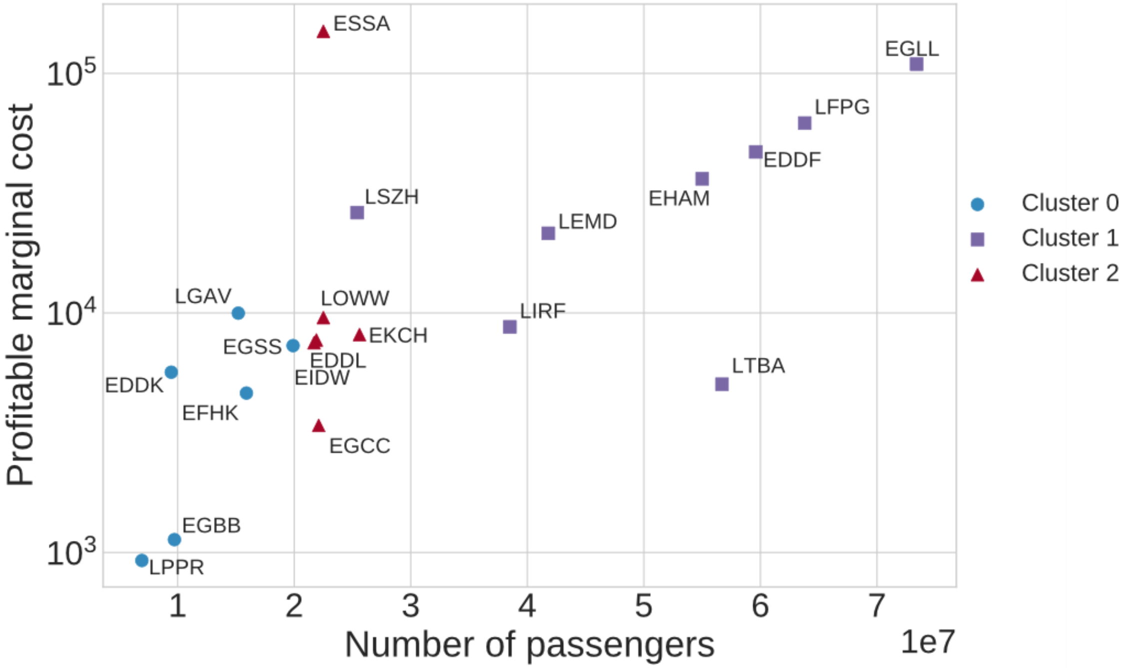
Optimal capacity

- Optimal point in capacity
- Point depends on several factors, including marginal operational cost



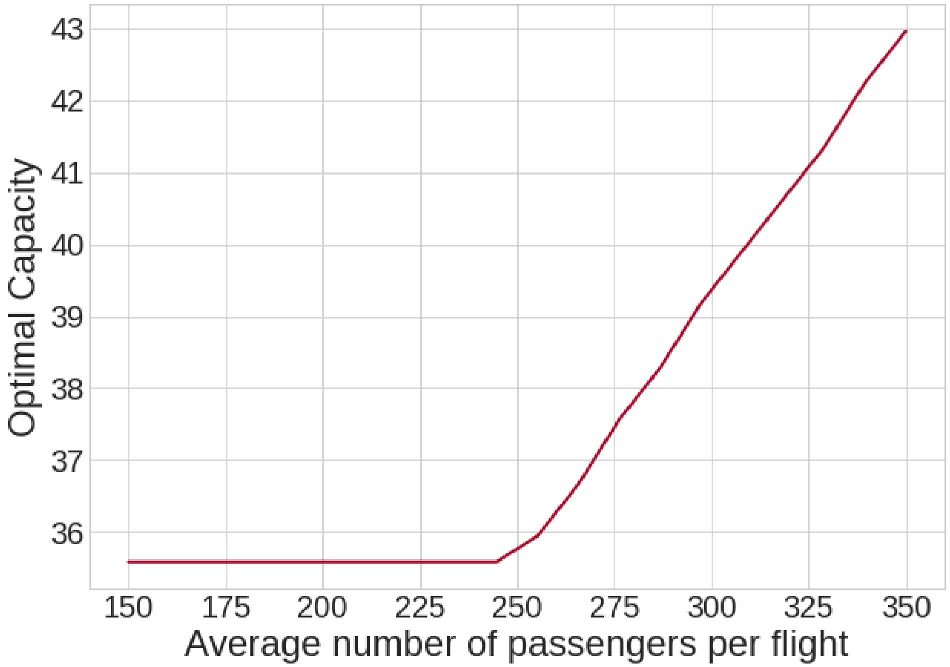
Airport comparison

- Airports have different profitable marginal costs
- Profitable marginal cost depends on the size of the airport



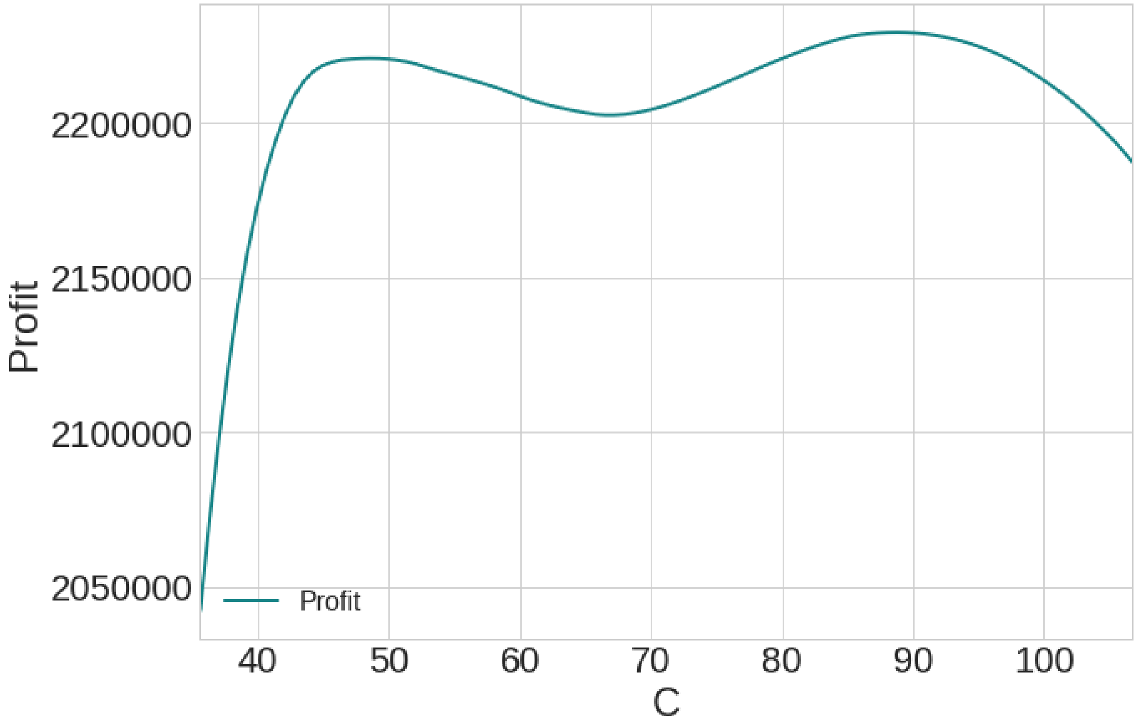
Pax per flight

- Increasing the number of pax per flight helps additional capacity units to be more profitable.



Passenger effects

- Up to a point, pax spend more when they spend more time at airport ('golden hour')
- Pax are less satisfied when waiting more
- →More optimal points



Conclusions

- Study compiles lot of different sources of data.
- Only scratched the surface!
- Can be focused on specific airports in the future

- Model based on:
  - Delay vs traffic
  - Cost vs delay
  - Traffic vs revenues
- Full cost of delay, including uncertainty, is taken into account

- Single optimal capacity point in general
- Depends on marginal costs of capacity
- Can be used to benchmark airports
- Pax-related effects could be enhanced, e.g. access and dwell time models

Thanks!

Questions?

EUROCONTROL

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