ANALYSING THE DECISION-RULES FOR A GROUND DELAY PROGRAM: MEXICAN AIRPORT NETWORK

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OUTLINE

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- Methods
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- Conclusions
MEXICAN AIRPORT NETWORK

76 Airports
58 International
18 National

No Open Skies

In 2016 an agreement between US and Mexico
DEMAND GROWTH

Flag Carrier
Aeromexico

LCCs: Interjet, Volaris, VivaAerobus
Air passenger traffic by main airports in Mexico, Jan-May 2017

(a) Domestic
- Mexico City: 34%
- Guadalajara: 7%
- Monterrey: 6%
- Cancun: 5%
- Tijuana: 4%
- Merida: 2%
- Culiacan: 2%
- Hermosillo: 2%
- Puerto Vallarta: 2%
- San Jose Del Cabo: 2%
- Others: 9%

(b) International
- Cancun: 36%
- Mexico City: 30%
- Guadalajara: 8%
- San Jose Del Cabo: 8%
- Monterrey: 7%
- Bajio: 7%
- Cozumel: 6%
- Morelia: 5%
- Querétaro: 4%
- Others: 2%
CURRENT SITUATION OF MEX

• MEX international airport has limited capacity for growth
  • 2016: almost 450,000 ATM
  • 89% passenger flights

• A new airport is being developed (2020?)

• Traffic flow management initiatives: ground delay programs

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CURRENT GDP SITUATION

• 40 Arr/hr Hard limitation, 61 ATM/Hr declared capacity
• A GDP is applied when expected 40 Arr/hr.
• A delay of 15 mins is imposed on the Mexican carriers only
• International flights have priority
AIM OF THE STUDY

- Simulation-based for assessing the current ground delay program (GDP) in Mexico City.
  - Alternatives for the GDP
  - Better management of the Airport
METHODS: MODELING SYSTEM

• GIS & Simulation of Mexican Network
• Stochastic Modelling
METHODS: MODELING SYSTEM

• MEX: Capacity of 96 Positions, micro ops neglected
• INPUT: Flight Schedule (OAG), origin, flight operator, A/C Type, arrival time, and flight duration
MODEL SET-UP

- Simulation of DEMAND
- Simulation Time: one week of Data, 4000 Flights
MODEL SET-UP

- A/C flights between airports in a network of nodes and edges. Length proportional to the flight’s travelling time (stochastic)
- Destination: MEX
- Origin airports: all direct flights to MEX included
- 98 departure airports, 26 carriers, 22 equipment codes, 96 contact positions
- Flight data: OAG (2013) adjusted to 2017 values, public flight information
- Statistical data: Mexican authorities (AICM, SENEAM, SCT), BTS
- Variability: Flight time, TAT, Delays, GDP
6221 flights operated between May 23 and June 10, 2017 were analyzed (FLIGHT RADAR 24)
ANALYSIS OF PUBLIC DATA

- BY AIRLINE (AEROMEXICO, INTERJET, VOLARIS)
- BY AIRCRAFT TYPE
- BY DESTINATION, BY AIRPORT TYPE, ...

Generic airline, medium aircraft
(0.5 – 2.5 h) - Loglogistic distribution

Aeromexico, heavy aircraft
(2.8 – 5.3 h) - Weibull distribution
SCENARIOS

- GDP 1: FLIGHTS DEPARTING FROM MEXICAN AIRPORTS, OPERATED BY MEXICAN AIRLINES (MEX)
- GDP 2: FLIGHTS DEPARTING FROM INTERNATIONAL AIRPORTS, OPERATED BY INTERNATIONAL AIRLINES (INT)
- GDP 3: FLIGHTS WITH AN EXPECTED FLIGHT TIME LESS THAN 2 HOURS (<2H)
- GDP 4: FLIGHTS WITH AN EXPECTED FLIGHT TIME EQUAL OR HIGHER THAN 2 HOURS (>2H)
Dependency on Limit, RT and Dt:

Domain of ARR/Hr : [25, 30, 35]
Revision of ARR/Hr Rt: [15,30,45,60]
Ground Delay imposed Dt:[5,10,15,20,25,30,35,40,45,50,55,60]

Experiments with 100 replications each.
Warmup period of 8 hrs

RESPONSES:
• AVG Delayed Time for Flight
• AVG GDP actions
• Avg number of A/C delayed
GDP ACTIONS DEPENDING ON THE LIMIT

Behavior of GDP actions vs Limit of Arrivals
AVG DELAYED TIME

Dependency of Delayed Time/AC VS RT and DT
GDP INSTANCES DEPENDING ON RT AND DT

Dependency on GDP action VS Rt and DT
Number of aircraft affected by the GDP as a function of limiting arrival capacity.
CONCLUSIONS

• We used a stochastic model-based approach for analysing the GDP of Mexico
• We identified that under a restricted scenario, it is better to be more reactive than follow a fixed rule
• The system is more sensitive to the revision frequency than to the amount of delay applied (amount of A/C)
• The GDP action is sensitive to the delay imposed under a fixed revisión time (more work for ATC)
LESSONS LEARNED

• The applied rule is not the most efficient one
• Under adverse conditions, it is better to reduce the revision time than increasing the delay time (more work for ATC) but better service to Airlines
• Under a less restricted scenario, it might be better to reduce the frequency (less work for ATC). The AVG A/C affected does not change in AVG.
• A flexible GDP is preferable than the current one
ANALYSING THE DECISION-RULES FOR A GROUND DELAY PROGRAM: MEXICAN AIRPORT NETWORK

THANK YOU!

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