Airline Passenger Transportation System: Structure and Dynamics

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A flight from DFW to ABQ has an on-time performance of 70%. For delayed flights the average delay is 30 minutes.

The flight is cancelled 1% of the time. For passengers on cancelled flights the average delay is 10 hours.

The typical flight has 100 passengers.

The Total Passenger Trip Delay expected is:

a) $(0.7 \times 100 \times 30) = 2100$ mins
b) $(0.3 \times 100 \times 30) = 900$ mins
c) $(0.3 \times 100 \times 30) + (0.1 \times 100 \times 10) = 1000$ mins
d) $(0.3 \times 100 \times 30) + (0.1 \times 100 \times 600) = 6900$ mins
Organization

1. Passenger Transportation System
2. Itinerary Performance
3. Network System Performance
Passenger Trip

• Direct Itinerary:
  – Origin
  – Destination
  – Scheduled Departure Time Origin (as ticketed)
  – Scheduled Arrival Time Destination (as ticketed)
  – Flight Number
  – Flight Seat Capacity
  – Type: Direct

• Connecting Itinerary
  – Origin
  – Hub
  – Destination
  – Origin-Hub
    • Scheduled Departure Time – origin (as ticketed)
    • Scheduled Arrival Time - Hub (as ticketed)
    • Flight Number
    • Flight Seat Capacity
  – Hub-Destination
    • Scheduled Departure Time – origin (as ticketed)
    • Scheduled Arrival Time - Hub (as ticketed)
    • Flight Number
    • Flight Seat Capacity
  – Type: Direct
Itinerary Performance
Itinerary Performance

• Passenger Trip Delay = Actual Passenger Arrival Time – Scheduled (i.e. Ticketed) Arrival Time

• Disruptions resulting in Passenger Trip Delays
  1. Delayed flights
  2. Cancelled flights
  3. Diverted flights
  4. Denied Boarding
  5. Missed Connections
Passenger Trip Delays – Direct Itin

Delayed Flight

• Pax Trip Delay
  – Ticketed Arrival Time – Actual Arrival Time – 15 min
  – $D_{DelayedFlight}$

• Probability of Pax Trip Delay
  – Probability Flight Delay > 15 minutes
  – $P_{DelayedFlight}$
Passenger Trip Delays – Direct Itin

Cancelled Flight

• Pax Trip Delay
  – Ticketed Arrival Time – Actual Arrival Time
  – $D_{\text{CancelledFlight}} = f(\text{Frequency of Service O-D})$

• Probability of Pax Trip Delay
  – Probability Flight Cancelled
  – $P_{\text{CancelledFlight}}()$
Passenger Trip Delays – Connected Itin

Delayed Flight

- Pax Trip Delay
  - Ticketed Arrival Time – Actual Arrival Time – 15 min
  - \( D_{\text{DelayedFlight H-D}} = f \) (Frequency of Service O-D)
- Probability of Pax Trip Delay
  - Probability H-D Flight Delay > 15 minutes
  - \( P_{\text{DelayedFlight H-D}} \)
Passenger Trip Delays – Connected Itin

Cancelled Flight (O-H)

• Pax Trip Delay
  – Ticketed Arrival Time – Actual Arrival Time – 15 min
  – \( D_{\text{Cancelled Flight with Connection}} = f \)
    (Frequency of Service O-H, H-D)

• Probability of Pax Trip Delay
  – Probability O-H Cancelled
  – \( P_{\text{Cancelled Flight O-H}} \)
Passenger Trip Delays – Connected Itin

Cancelled Flight (H-D)

• Pax Trip Delay
  – Ticketed Arrival Time – Actual Arrival Time – 15 min
  – $D_{\text{CancelledFlight}} = f(\text{Frequency of Service H-D})$

• Probability of Pax Trip Delay
  – Probability H-D Cancelled
  – $P_{\text{cancelledFlightO-H}}$
Passenger Trip Delays – Connected Itin

Missed Connection Flight

- Pax Trip Delay
  - Ticketed Arrival Time – Actual Arrival Time – 15 min
  - $D_{\text{MissedConnectionFlight}} = f$ (Frequency of Service O-D)

- Probability of Pax Trip Delay
  - Probability O-H Flight Delay > 15 minutes AND Probability Pax Misses Connection
  - $P_{\text{DelayedFlightO-H}} \times P_{\text{MissedConnection}}$

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The Passenger Trip “Game Wheel”

- **Passengers On-Time** - < 15 Minutes Delay (74%)
- **Passengers on Delayed Flights** (23.9%, Avg 57 minutes)
- **Passengers on Cancelled Flights** (1.8%, Avg 11 hours)
- **Passengers on Diverted Flights** (0.2%, Avg 3.5 hours)
- **Passengers Denied Boarding on Over-sold Flights** (<0.001%)

Not drawn to scale
For Each Passenger Itinerary

Direct or Connecting O to H

Cancelled

Rebook Pax O to D and Compute Pax Delays
Rebook Pax H to D and Compute Pax Delay

Compute Pax Delay for Diverted Pax
Compute Flight Delay for Diverted Flight

Missed Connection

H to D Diverted

Compute Flight Delay for Diverted Flight

O to H Diverted

Compute Pax Delay for Diverted Pax

Delayed

H to D Diverted

Missed Connection

H to D Delayed

H to D Diverted

O to H Delayed

H to D Delayed

O to D Diverted

Compute Pax Delay for Diverted Pax
Compute Pax Delay For Delayed Flight

O to D Cancelled

Cancel

O to H Cancelled

H to D Cancelled

* Denied Boarding Not Shown, same as cancelled

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## Calculating Passenger Trip Delay

<table>
<thead>
<tr>
<th>Scheduled Departure Time</th>
<th>Scheduled Arrival Time</th>
<th>Seats</th>
<th># Pax</th>
<th>Flight Status</th>
<th>Delay</th>
<th>Pax Trip Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>O-D</td>
<td>06:00</td>
<td>08:00</td>
<td>100</td>
<td>100</td>
<td>Delayed</td>
<td>20 mins</td>
</tr>
<tr>
<td>O-D</td>
<td>06:10</td>
<td>08:20</td>
<td>120</td>
<td>100</td>
<td>Cancelled</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$(20 \times 130)$</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>$+(50 \times (210+40))$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$+(30 \times 460)$</td>
</tr>
<tr>
<td>O-H1-D</td>
<td>06:30</td>
<td>10:30</td>
<td>120</td>
<td>100</td>
<td>On-Time</td>
<td></td>
</tr>
<tr>
<td>O-D</td>
<td>09:30</td>
<td>11:50</td>
<td>150</td>
<td>100</td>
<td>Delayed</td>
<td>40 mins</td>
</tr>
<tr>
<td>O-H2-D</td>
<td>13:00</td>
<td>15:00</td>
<td>120</td>
<td>70</td>
<td>On-Time</td>
<td></td>
</tr>
</tbody>
</table>
Passenger Trip Delays

• Passengers on Direct Itinerary:

\[
\text{Expected Pax Trip Delay} = (P_{\text{DelayedFlight}} \times D_{\text{DelayedFlight}}) + (P_{\text{CancelledFlight}} \times D_{\text{CancelledFlight}} \times f(\text{Frequency of Service O-D}))
\]

\[
\text{Probability of Disrupted Trip} = (P_{\text{DelayedFlight}} + (P_{\text{CancelledFlight}}))
\]
Passenger Trip Delay

• Passenger on Connecting Itinerary:

   Expected Pax Trip Delay =
   \[
   ( P_{\text{DelayedFlight}}(H-D) \times D_{\text{DelayedFlight}} ) + \\
   ( P_{\text{DelayedFlight}}(O-H) \times P_{\text{MissedConnection}}() \times D_{\text{DelayedFlight}} ) + \\
   ( P_{\text{CancelledFlight}}(O-H) \times D_{\text{CancelledFlight}} \times f(\text{Frequency of Service O-D}) ) + \\
   ( P_{\text{CancelledFlight}}(H-D) \times D_{\text{CancelledFlight}} \times f(\text{Frequency of Service O-D}) )
   \]

   Probability of Disrupted Trip =
   \[
   ( P_{\text{DelayedFlight}}(H-D) ) + \\
   ( P_{\text{DelayedFlight}}(O-H) \times P_{\text{MissedConnection}}() ) + \\
   ( P_{\text{CancelledFlight}}(O-H) ) + \\
   ( P_{\text{CancelledFlight}}(H-D) )
   \]

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Itinerary Performance

Expected Pax Trip Delay

\[
\begin{align*}
&= \left( P_{\text{Delayed Flight}}(\text{H-D}) \cdot D_{\text{Delayed Flight}} \right) + \\
&+ \left( P_{\text{Missed Connection}}(\text{O-H}) \cdot D_{\text{Missed Connection}} \cdot D_{\text{Delayed Flight}} \right) + \\
&+ \left( P_{\text{Cancelled Flight}}(\text{O-H}) \cdot D_{\text{Cancelled Flight}} \cdot f(\text{Frequency of Service O-D}) \right) + \\
&+ \left( P_{\text{Cancelled Flight}}(\text{H-D}) \cdot D_{\text{Cancelled Flight}} \cdot f(\text{Frequency of Service O-D}) \right)
\end{align*}
\]

Direct Itin (70% Direct) 30% Connecting Itin/ Connecting Itin

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Network Performance
Passenger Trip Delays in a Transportation System

• Markets
  – Five
  – Located in same Time Zone
  – Equal distance apart

• Transportation Service at each Market
  – Each market has own airport
  – Travel time = 1 Unit Time between airports
  – (e.g. Travel Time 1 to 4 = 4)
Transportation Demand

- Transportation demand
  - 100 trips to each Destination Market
  - 100 trips from each Origin Market
  - 25 trips from each Origin market to each Destination Market
  - 500 trips total
  - Passengers are required to be at Destination for start of day
  - Demand for travel at each Origin to arrive at Destination at start of day (shown on right)
    - 100 pax leave each market
    - 100 pax arrive at each market
Direct Flight Network

- Total Passengers = 500
- Total Itineraries = 20
- # Flights = 4 * 5 = 20
- Aircraft Size 25 seats
- Distance Traveled = 10 + 10 + 7 + 7 + 6 = 40
- Total Trip Time = 40
- Total Arrival Displacement Time = 0 (all pax arrive at required time)
- Average Trip Time = 10/4 + 10/4 + 7/4 + 7/4 + 6/4
- Max Simultaneous Arrivals at each airport = 4 (at each airport)
- Max Simultaneous use of airspace = 5 (at each TRACON)

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# Direct Flight Network

<table>
<thead>
<tr>
<th>Origin</th>
<th>Originating Pax</th>
<th>Destination</th>
<th>Itinerary = Flights</th>
<th>Pax per Itinerary = Flight</th>
<th>Trip Time</th>
<th>Arrival Displacement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>2</td>
<td>1-2, 1-3, 1-4, 1-5</td>
<td>25, 25, 25, 25</td>
<td>1, 2, 3, 4</td>
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<tr>
<td>2</td>
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<td>1</td>
<td>2-1, 2-3, 2-4, 2-5</td>
<td>25, 25, 25, 25</td>
<td>1, 1, 2, 3</td>
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<td>3</td>
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<td>1</td>
<td>3-1, 3-2, 3-4, 3-5</td>
<td>25, 25, 25, 25</td>
<td>2, 1, 1, 2</td>
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</tr>
<tr>
<td>4</td>
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<td>1</td>
<td>4-1, 4-2, 4-3, 4-5</td>
<td>25, 25, 25, 25</td>
<td>3, 2, 1, 1</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>100</td>
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<td>5-1, 5-2, 5-3, 5-4</td>
<td>25, 25, 25, 25</td>
<td>4, 3, 2, 1</td>
<td>-</td>
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<tr>
<td>TOTAL</td>
<td>500</td>
<td></td>
<td></td>
<td>500, 60, 0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Hub-n-Spoke Network

- Total Passengers = 500
- Total Itineraries = 20
- # Flights = 4 + 4 = 8
- Aircraft Size = 100 seats
- Distance Traveled = 12
- Total Trip Time =
  - (4+2+4+5) +
  - (4+1+3+4) +
  - (2+1+1+2) +
  - (4+3+1+4) +
  - (5+4+2+4) = 60
- Total Arrival Displacement Time =
  - (some pax arrive earlier than needed)
- Average Trip Time = 60/16
- Max Simultaneous Arrivals at each airport = 4 (at hub only)
- Max Simultaneous use of airspace = 4 (at hub TRACON only)
## Hub-n-Spoke: Itinerary Table

<table>
<thead>
<tr>
<th>Origin</th>
<th>Originating Pax</th>
<th>Destination</th>
<th>Itinerary</th>
<th>Pax per Itinerary</th>
<th>Total Trip Time</th>
<th>Arrival Displacement (Early)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>2</td>
<td>1-3-2</td>
<td>25</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>1-3</td>
<td>25</td>
<td>2</td>
<td>2</td>
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<td>4</td>
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<td>25</td>
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<td><strong>TOTAL</strong></td>
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<td><strong>500</strong></td>
<td><strong>57</strong></td>
<td><strong>16</strong></td>
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</table>
# Hub-n-Spoke: Flight Table

<table>
<thead>
<tr>
<th>Origin</th>
<th>Destination</th>
<th>Pax per Flight</th>
<th>Total Trip Time</th>
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<tbody>
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<td>1</td>
<td>3</td>
<td>100</td>
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<td>2</td>
<td>3</td>
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</tr>
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<td>100</td>
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<tr>
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<td>5</td>
<td>100</td>
<td>2</td>
</tr>
</tbody>
</table>
Passenger Transportation System: Network Performance

Flight Performance

P(D), P(C), P(MC)
Ddelay, Dcancelled, DMissedConn

Pax Transportation Performance

Total Pax Trip Delay

% Disrupted Pax, Disrupted Pax Delay

Performance Characteristics

Performance Metrics

Airport & Airspace Capacity

Flight Schedules = Frequency of Service, Turnaround Times

Itinerary (Direct, Connecting)

Load Factor, Seat Capacity

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Network Performance Characteristics

- Transportation System has:
  - 16 itineraries
  - 500 trips

- Transportation Service is provided by:
  - Network Structure
  - Direct Flights vs. Hub-n-Spoke

- Each Flight has:
  - Seat Capacity = SC
  - Seat Utilization = Load Factor = LF
  - Likelihood of experiencing delay = P(D)
  - Likelihood of cancellation = P(C)

- Each Trip has Average Trip Delay
  - Trip Delay due to Delayed Flight = DDelayedFlight
  - Trip Delay due to Cancelled Flight = DCancelledFlight
  - Trip Delay due to Missed Connection = DMissedConnection
Network Performance

• Total Passenger Trip Delays =
  Total Passenger Trip Delay from Delayed Flights +
  Total Passenger Trip Delay from Cancelled Flights

• Total Passenger Trip Delay from Delayed Flights =
  \[ \sum_{i=1}^{n} \sum_{j=1}^{n} \text{LF}_{Oi-Dj} \times \text{SC}_{Oi-Dj} \times P(D)_{Oi-Dj} \times D_{\text{DelayedFlight} Oi-Dj} \]

• Total Passenger Trip Delay from Cancelled Flights =
  \[ \sum_{i=1}^{n} \sum_{j=1}^{n} \text{LF}_{Oi-Dj} \times \text{SC}_{Oi-Dj} \times P(C)_{Oi-Dj} \times D_{\text{CancelledFlight} Oi-Dj} \]
Network Performance

- Under assumption of homogeneous fleet, flight leg performance ....
  
  \[ \text{LF}_{O1-D1} = \text{LF}_{O1-D2} = \text{LF}_{O1-D3} = \cdots = \text{LF} \]
  
  \[ \text{SC}_{O1-D1} = \text{SC}_{O1-D2} = \text{SC}_{O1-D3} = \cdots = \text{SC} \]
  
  \[ \text{P(D)}_{O1-D1} = \text{P(D)}_{O1-D2} = \text{P(D)}_{O1-D3} = \cdots = \text{P(D)} \]
  
  \[ \text{D}_{\text{DelayedFlight O1-D1}} = \text{D}_{\text{DelayedFlight O1-D2}} = \cdots = \text{D}_{\text{DelayedFlight}} \]

- Total Passenger Trip Delay from Delayed Flights =
  
  \[ \sum_{i=1,n, j=1,n} \text{LF}_{O_i-D_j} \times \text{SC}_{O_i-D_j} \times \text{P(D)}_{O_i-D_j} \times \text{D}_{\text{DelayedFlight O_i-D_j}} \]

  \[ = \#\text{Flights} \times \text{LF} \times \text{SC} \times \text{P(D)} \times \text{D}_{\text{DelayedFlight}} \]
Performance Metrics

1. % Disrupted Passengers
   - Total Disrupted Passengers
     • Passengers on Delayed Flights
     • Passengers on Cancelled Flights

2. Total Passenger Trip Delay

3. Average Passenger Trip Delay

4. Average Disrupted Passenger Trip Delays
   - Average Passenger Trip Delays due to Delayed Flights
   - Average Passenger Trip Delays due to Cancelled Flights
   - Average Passenger Trip Delays due to Missed Connections
Performance: Direct Network

• Total Disrupted Passengers = \([P(D) + P(C)] \times (#\text{Flights} \times LF \times SC)\)

• % Passengers Disrupted = P(D)+P(C)

• Total Passenger Trip Delay = 
  \(#\text{Flights} \times LF \times SC \times [(P(D) \times D_{\text{DelayedFlight}}) + (P(C) \times D_{\text{CancelledFlight}})]\)

• Average Trip Delay = Total Passenger Trip Delay/#Pax

• Average Disrupted Passenger Trip Delays = Total Passenger Trip Delay/Total Disrupted Passengers
Performance: Hub-n-Spoke Network

- **Total Disrupted Passengers** =
  \[(P(D)_{H-D} \times \text{Flights}_{H-D} \times LF*SC) +
  (P(D)_{O-H} \times P(MC) \times \text{Flights}_{H-D} \times LF*SC) +
  (P(C)_{O-H} \times \text{Flights}_{O-H} \times LF*SC) +
  (P(C)_{H-D} \times \text{Flights}_{H-D} \times LF*SC)\]

- **% Passengers Disrupted** = \[P(D) + [P(D) \times P(MC)] + 2P(C)\]

- **Total Passenger Trip Delay** =
  \[(P(D)_{H-D} \times \text{Flights}_{H-D} \times LF \times SC \times D_{DelayedFlight}) +
  (P(D)_{O-H} \times P(MC) \times \text{Flights}_{H-D} \times LF*SC \times D_{MissedConnection}) +
  (P(C)_{O-H} \times \text{Flights}_{O-H} \times LF \times SC \times D_{CancelledFlight}) +
  (P(C)_{H-D} \times \text{Flights}_{H-D} \times LF \times SC \times D_{CancelledFlight})\]

- **Average Trip Delay** = Total Passenger Trip Delay/#Pax
Network Performance

Total Pax Trip Delay

\[
\begin{align*}
(P(D)_{H-D} \times \#Flights_{H-D} \times LF*SC \times D_{DelayedFlight}) & + \\
(P(D)_{O-H} \times P(MC) \times \#Flights_{H-D} \times LF*SC \times D_{MissedConnection}) & + \\
(P(C)_{O-H} \times \#Flights_{O-H} \times LF*SC \times D_{CancelledFlight}) & + \\
(P(C)_{H-D} \times \#Flights_{H-D} \times LF*SC \times D_{CancelledFlight}) & + \\
\end{align*}
\]

\[
\#Flights*LF*SC [(P(D) \times D_{DelayedFlight}) + (P(C) \times D_{CancelledFlight})]
\]
### PASSENGER TRIP DEMAND AND CAPACITY

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>Change 07 to 08</th>
<th>Change 08 to 09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger Itineraries (M)</td>
<td>453</td>
<td>432</td>
<td>308</td>
<td>-5%</td>
<td>-29%</td>
</tr>
<tr>
<td>Direct (M)</td>
<td>316</td>
<td>298</td>
<td>209</td>
<td>-5.5%</td>
<td>-30%</td>
</tr>
<tr>
<td>Connecting (M)</td>
<td>137</td>
<td>134</td>
<td>96</td>
<td>-3%</td>
<td>-26%</td>
</tr>
<tr>
<td>% Connect</td>
<td>30</td>
<td>31</td>
<td>32</td>
<td>+2%</td>
<td>+4%</td>
</tr>
<tr>
<td>Flights (millions)</td>
<td>7.4</td>
<td>7.0</td>
<td>6.4</td>
<td>-6%</td>
<td>-8%</td>
</tr>
<tr>
<td>Frequency of Service (average flights per day)</td>
<td>4</td>
<td>3.7</td>
<td>3.4</td>
<td>-7.5%</td>
<td>-8%</td>
</tr>
</tbody>
</table>

### DISRUPTED PASSENGERS

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>Change 07 to 08</th>
<th>Change 08 to 09</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Passengers</td>
<td>22%</td>
<td>20%</td>
<td>17%</td>
<td>-10%</td>
<td>-16%</td>
</tr>
<tr>
<td>Total Passengers Disrupted (millions)</td>
<td>138.5</td>
<td>118.4</td>
<td>93.3</td>
<td>-15%</td>
<td>-21%</td>
</tr>
<tr>
<td>Average Disrupted Passenger Trip Delay (minutes)</td>
<td>110</td>
<td>110</td>
<td>92</td>
<td>-</td>
<td>-10%</td>
</tr>
</tbody>
</table>

### AVERAGE TRIP DELAY

<table>
<thead>
<tr>
<th></th>
<th>07</th>
<th>08</th>
<th>09</th>
<th>Change 07 to 08</th>
<th>Change 08 to 09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passengers on Delayed Flights (mins)</td>
<td>57</td>
<td>57</td>
<td>52</td>
<td>-1.4%</td>
<td>-10%</td>
</tr>
<tr>
<td>Passengers on Cancelled Flights (mins)</td>
<td>653</td>
<td>644</td>
<td>588</td>
<td>-1.3%</td>
<td>-8.6%</td>
</tr>
<tr>
<td>Passengers on Diverted Flights (mins)</td>
<td>40</td>
<td>37</td>
<td>49</td>
<td>-6.2%</td>
<td>-31.2%</td>
</tr>
<tr>
<td>Passengers with Missed Connections (mins)</td>
<td>133</td>
<td>129</td>
<td>130</td>
<td>-2.8%</td>
<td>-7.2%</td>
</tr>
</tbody>
</table>

### TOTAL PASSENGER TRIP DELAYS

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>Change 07 to 08</th>
<th>Change 08 to 09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Passenger Trip Delays (million hours)</td>
<td>261.6</td>
<td>233</td>
<td>148.5</td>
<td>-11%</td>
<td>-36%</td>
</tr>
<tr>
<td>Average Passenger Trip Delay (minutes)</td>
<td>25</td>
<td>24</td>
<td>16</td>
<td>-6%</td>
<td>-32%</td>
</tr>
</tbody>
</table>

### % OF TOTAL PASSENGER TRIP DELAY

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>Change 07 to 08</th>
<th>Change 08 to 09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passengers on Delayed Flights (mins)</td>
<td>41%</td>
<td>42%</td>
<td>44%</td>
<td>2%</td>
<td>5%</td>
</tr>
<tr>
<td>Passengers on Cancelled Flights (mins)</td>
<td>45%</td>
<td>45%</td>
<td>39%</td>
<td>0%</td>
<td>-14%</td>
</tr>
<tr>
<td>Passengers on Diverted Flights (mins)</td>
<td>0%</td>
<td>0%</td>
<td>1%</td>
<td>12%</td>
<td>69%</td>
</tr>
<tr>
<td>Passengers with Missed Connections (mins)</td>
<td>13%</td>
<td>12%</td>
<td>16%</td>
<td>-7%</td>
<td>32%</td>
</tr>
</tbody>
</table>

### % OF TOTAL PASSENGER TRIP DELAY

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>Change 07 to 08</th>
<th>Change 08 to 09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passengers required to stay overnight</td>
<td>1.6</td>
<td>1.3</td>
<td>0.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of Total Itineraries</td>
<td>0.4%</td>
<td>0.3%</td>
<td>0.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of Canceled Itineraries</td>
<td>14.6%</td>
<td>13.8%</td>
<td>9.9%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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