General Insurance Pricing Seminar
17 June 2010

Everything you need to know about Aviation pricing!
Mike Hood/Richard Tunbridge

EMB
Agenda

• Introduction
• Overview of Aviation Industry
• Airline Insurance performance
• Price modelling approaches
• Future pricing data and modelling
• Conclusion
Aviation Market

- **Airlines**
  - ~US$2bn
  - Hull
  - Liability
  - War

- **Aerospace**
  - ~US$0.8bn
  - Airports
  - Manufacturers
  - Service providers

- **General Aviation**
  - ~US$2.5bn
  - Fixed Wing
  - Rotary Wing
  - Other

- **Satellites**
  - ~US$0.75bn
  - Launch
  - Orbit
Aerospace

Airports
- Slip & trip
- Poor runways
- Birds flying into engines…

Manufacturers
- Prime Airframe Manufacturers
- Major Engine Manufacturers
- Component Manufacturers
- Electronic
- MRO (maintenance/Repair and Overhaul)

Service Providers
- Refuelling
- Ground Handling
- In-flight Catering

Market premium approximately US$800m
“Aviation activity which is **neither scheduled airliner, charter or taxi operation, nor military flying**.” – General Aviation Awareness Council.

Market premium approximately £2.5bn
Airlines
## Airline and Insurance Market

<table>
<thead>
<tr>
<th></th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
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</thead>
<tbody>
<tr>
<td><strong>Revenues ($ billion)</strong></td>
<td>307</td>
<td>306</td>
<td>322</td>
<td>379</td>
<td>413</td>
<td>465</td>
<td>510</td>
<td>564</td>
<td>479</td>
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<tr>
<td><strong>Passenger numbers (millions)</strong></td>
<td>1,640</td>
<td>1,639</td>
<td>1,691</td>
<td>1,888</td>
<td>2,022</td>
<td>2,124</td>
<td>2,281</td>
<td>2,271</td>
<td>2,206</td>
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<tr>
<td><strong>Number of departures (millions)</strong></td>
<td>20.1</td>
<td>20.3</td>
<td>22.5</td>
<td>23.5</td>
<td>24.1</td>
<td>25.3</td>
<td>26.5</td>
<td>26.2</td>
<td>25.7</td>
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<tr>
<td><strong>Net Profit ($billion)</strong></td>
<td>-13</td>
<td>-11.3</td>
<td>-7.5</td>
<td>-5.6</td>
<td>-4.1</td>
<td>3.6</td>
<td>12.9</td>
<td>-15.9</td>
<td>-9.4</td>
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<tr>
<td><strong>Insurance Premium ($billion)</strong></td>
<td>3.5</td>
<td>3.4</td>
<td>2.7</td>
<td>2.3</td>
<td>2.1</td>
<td>1.6</td>
<td>1.4</td>
<td>1.6</td>
<td>1.9</td>
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<tr>
<td><strong>Premium per revenue</strong></td>
<td>1.140%</td>
<td>1.111%</td>
<td>0.893%</td>
<td>0.607%</td>
<td>0.508%</td>
<td>0.344%</td>
<td>0.275%</td>
<td>0.284%</td>
<td>0.397%</td>
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<tr>
<td><strong>Premium per passenger ($)</strong></td>
<td>2.13</td>
<td>2.07</td>
<td>1.60</td>
<td>1.22</td>
<td>1.04</td>
<td>0.75</td>
<td>0.61</td>
<td>0.70</td>
<td>0.86</td>
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<td><strong>Premium per departure ($)</strong></td>
<td>174.06</td>
<td>167.16</td>
<td>120.01</td>
<td>98.00</td>
<td>87.28</td>
<td>63.29</td>
<td>52.83</td>
<td>60.96</td>
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<td><strong>Premium Change</strong></td>
<td>-3%</td>
<td>-21%</td>
<td>-15%</td>
<td>-9%</td>
<td>-24%</td>
<td>-13%</td>
<td>14%</td>
<td>19%</td>
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<td><strong>Rate Change (revenue)</strong></td>
<td>-3%</td>
<td>-25%</td>
<td>-28%</td>
<td>-16%</td>
<td>-32%</td>
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<td>3%</td>
<td>40%</td>
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<td><strong>Rate Change (passengers)</strong></td>
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<td><strong>Rate Change (departures)</strong></td>
<td>-4%</td>
<td>-28%</td>
<td>-18%</td>
<td>-11%</td>
<td>-27%</td>
<td>-17%</td>
<td>15%</td>
<td>21%</td>
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</table>

Source: IATA, Aon, EMB and ICAO
Airline Underwriting Performance

- Long-term average loss ratio 91%

Source: Aon & EMB
Large Claims and Airline Insurance Profitability

Source: Aon & EMB
Airline Insurance Profitability

Source: Aon & EMB
Airline Insurance Profitability

<table>
<thead>
<tr>
<th>Calendar Year</th>
<th>Lead Premium</th>
<th>Projected Claims</th>
<th>Cumulative Hull and Liability Profit</th>
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<tbody>
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<td>2009</td>
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</tbody>
</table>

Source: Aon & EMB
Airline Insurance Rate Changes

Annual Premium Change

source: IATA, ICAO, Aon and EMB
Relative Premium by Region

**Premium per fleet value**

- Worldwide
- North America
- Middle East
- Latin America
- Europe
- Asia
- Africa

**Premium per passenger**

- Worldwide
- North America
- Middle East
- Latin America
- Europe
- Asia
- Africa

**Premium per departure**

- Worldwide
- North America
- Middle East
- Latin America
- Europe
- Asia
- Africa

**Premium by Region**

- North America
- Middle East
- Latin America
- Europe
- Asia
- Africa

*Source: EMB, IATA and Aon*
Common features in Hull models

**Experience rating**
- Attritional claims (<US$10m or US$20m)
- Highly predictable, stable pattern
- Large volumes of data readily available
- Simple to trend for period being priced
- Inflation adjustment
- Exposure adjusted to fleet value

**Exposure rating**
- Revenue Passenger Km
- Fleet Value
- Number of Aircraft
Common Features in Liability Models

Experience rating

- Attritional claims (<US$10m or US$20m)
- Large losses considered separately
- Inflation adjustment or per head liability award
- Liability relatively benign in recent years
- Exposure adjusted to RPK

Exposure rating

- Revenue Passenger Km
- Number of Passengers
- Maximum Seating
- Domicile of airline

- Allocation of exposure rate to individual airlines is critical
Large Loss Estimation by Territory

Common features
- 5 to 10 Territories
- By Continent or GDP/capita
- Losses estimated by Territory
- Past claims support estimates
- Allocated to Airline

Factors used for Allocation
- Cycles
- Revenue Passenger Km
- Fleet value
- Type of Plane – Widebody, Non, Regional
- Average Age of Fleet
- Airline safety rating
- Training rating
- Number of Passengers or Seats
- Load Factor
- Liability per passenger by Territory
- Routes flown / Passenger nationality mix
Why Cycles for frequency?

Accidents and Fatalities by Phase of Flight

- Fatal accidents: 12% Takeoff, 12% Initial climb, 8% Climb (flaps up), 10% Cruise, 4% Descent, 10% Initial approach, 11% Final approach, 25% Landing
- Onboard fatalities: 0% Takeoff, 16% Initial climb, 14% Climb (flaps up), 13% Cruise, 16% Descent, 4% Initial approach, 12% Final approach, 13% Landing
- Exposure (Percentage of flight time estimated for a 1.5 hour flight): 1% Takeoff, 1% Initial climb, 14% Climb (flaps up), 57% Cruise, 11% Descent, 12% Initial approach, 3% Final approach, 1% Landing

Percentages may not sum to 100% due to rounding.


Only 16% of fatalities occur in flight
Liability losses occur on take off and approach
Number of Fatal Accidents per 100,000 landings

Year | Number of fatal accidents
--- | ---
1989 | 0.25
1990 | 0.2
1991 | 0.15
1992 | 0.15
1993 | 0.2
1994 | 0.15
1995 | 0.15
1996 | 0.15
1997 | 0.1
1998 | 0.1
1999 | 0.1
2000 | 0.05
2001 | 0.05
2002 | 0.05
2003 | 0.05
2004 | 0.05
2005 | 0.05
2006 | 0.05
2007 | 0.05
2008 | 0.05

Source: ICAO
Airline Pilot training

Causes of Fatal Accidents by Decade (percentage)

<table>
<thead>
<tr>
<th></th>
<th>1950s</th>
<th>1960s</th>
<th>1970s</th>
<th>1980s</th>
<th>1990s</th>
<th>2000s</th>
<th>All</th>
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</thead>
<tbody>
<tr>
<td>Total Pilot Error</td>
<td>58</td>
<td>57</td>
<td>42</td>
<td>44</td>
<td>53</td>
<td>46</td>
<td>50</td>
</tr>
<tr>
<td>Other Human Error</td>
<td>0</td>
<td>8</td>
<td>9</td>
<td>6</td>
<td>8</td>
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<td>6</td>
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<tr>
<td>Weather</td>
<td>16</td>
<td>10</td>
<td>13</td>
<td>15</td>
<td>9</td>
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<td>12</td>
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<tr>
<td>Mechanical Failure</td>
<td>21</td>
<td>20</td>
<td>23</td>
<td>21</td>
<td>21</td>
<td>28</td>
<td>22</td>
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<tr>
<td>Sabotage</td>
<td>5</td>
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<td>11</td>
<td>13</td>
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<td>Other Cause</td>
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<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

*source: PlaneCrashInfo.com accident database*

- Improving cockpit technology but stable cause of incident
Data Sources

- IATA
- ICAO
- Bloomberg World Airlines Index
- AON
- Willis
- JLT
- Ascend
Conclusion

- The airline industry has continued to lose money, but not all operators
- Airline insurance industry continues to lose money but not all
- Market could be turning but could be a false dawn
- Cannot just wait for a harder market
- Exposure rating models vary significantly in their sophistication
- More sophisticated modelling needed in conjunction with experienced underwriters
- Lots of industry data is still not being used
Questions or comments?

Expressions of individual views by members of The Actuarial Profession and its staff are encouraged.

The views expressed in this presentation are those of the presenter.