

**NEXTOR** Annual Research Symposium

November 14, 1997

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Session I  
Safety and Security

World Aviation Safety Data  
Arnold Barnett, MIT

## UP WHERE WE BELONG?:

### Assessing The Safety of Air Travel

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MIT

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" NTSB studies show that, from 1993 through 1996, scheduled US carriers averaged only 0.2 fatal accidents per 100,000 flight hours, less than half the fatal-accident rate for the four year period a decade earlier."

---WALL STREET JOURNAL, 8/11/97

## AIRLINE REPORT CARDS:

(Air Traveler's Association)

Score =  $100 - 10,000(A/B)$

where

A= number of fatal crashes over 1987-96 and

B= total number of flights in 1000's

Letter Grades: A: 90-100 B: 80-89.9

C: 70-79.9 D: 60-69.9 F: below 60

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What about the simple ratio of passengers killed to passengers carried?

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Don't nonfatal accidents and incidents, which are much more numerous than fatal crashes, tell us something useful about the safety of air travel?

Between the early 1970's and the mid-1980's, accidents plus incidents per 100.000 flights doubled in U.S. domestic operations. The passenger death risk per flight FELL over that period by a factor of three.

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Some Correlations With Passenger Death Risk on Major U.S. Airlines, 1/1/90-3/31/96:

<u>Statistic</u>	<u>Correlation</u>
Incidents Only	-.10
Accidents + Incidents	-.21
Accidents Only	-.29
Serious Accidents Only	-.34

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Thus, as one tries to improve the safety indicator by removing minor events from the tally, it actually gets WORSE as a measure of passenger death risk.

## MORTALITY RISK MEASURE

If a passenger chooses a flight at random from among those of interest (e.g. U.S. domestic jets over 1990 - 1995), what is the probability that he will be killed during the flight?

This death risk per flight statistic is easy to calculate and has conceptual advantages.

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### WHAT CONCEPTUAL ADVANTAGES?

- (1) Ignores length and duration of flight, which are virtually unrelated to mortality risk
- (2) Weights each crash by the percentage of passengers killed
- (3) Easy to calculate and understand

DEATH RISK PER FLIGHT ON U.S.  
DOMESTIC JETS IN TWO SUCCESSIVE  
DECADES

- Period	Death Risk Per Flight
- 1976-86	1 in 7 Million
- 1987-96	1 in 7 Million

## AT THAT LEVEL OF RISK:

If a passenger chose one flight at random each day, she would on average go for 19,000 years before succumbing to a fatal crash.

**DEATH RISK PER U.S. DOMESTIC  
COMMUTER FLIGHT, 1987-96:**

**1 in 2.5 million**



**DEATH RISK PER FLIGHT IN TWO  
SUCCESSIVE DECADES, FIRST-  
WORLD DOMESTIC JET OPERATIONS  
OUTSIDE THE U.S.**

<b>PERIOD</b>	<b>RISK</b>
1977-86	1 in 2 million
1987-96	1 in 11 million

DEATH RISK PER FLIGHT IN TWO SUCCESSIVE DECADES, FIRST-WORLD DOMESTIC JET OPERATIONS OUTSIDE THE U.S.

THE RAW DATA: NON-U.S. FIRST-WORLD FATAL DOMESTIC  
CRASHES OVER 1977-96

1977-86
1977: Portugal (79%)
1977: France (1%)
1978: Italy (83%)
1978: Canada (2%)
1978: Canada (87%)
1979: Italy (100%)
1980: Italy (100%)
1981: Holland (100%)
1982: Japan (14%)
1983: Spain (100%)
1985: Japan (99%)
1985: Spain (100%)

1987-96
1989: UK (40%)
1992: France (91%)
1989: Canada (34%)

Percentages reflect fraction of passengers killed

In the above chart, the decade 1987-96 had only 1/4 as many fatal crashes as the previous decade. Moreover, the survival rate in the 1987-96 crashes (45%) was higher than that for 1977-86 (26%).

Appropriate calculations make clear that, absent any real improvement in safety between 1977-86 and 1987-96, the chance is only about 1 in 300 that sheer luck would have reduced these First-World Domestic jet fatalities as much as they actually fell.

Could this pattern be the first tangible evidence that an initiative like GAIN can succeed?

## MAIN POINTS:

- Work hard on finding the best performance indicators, whether about safety, efficiency, accessibility, or congestion. Be aware that all indicators have frailties.

"Be sure you're right, then go ahead."

--Davy Crockett

- Then apply those you've chosen, and watch as they demonstrate the progress you will surely make.