

# World Airline Safety: Better than Ever?



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Question:

To what extent (if any)  
does **passenger safety** in  
scheduled commercial  
aviation vary across the  
world?

Well, how should we  
**measure** aviation safety?

Given that a passenger's greatest fear is of being killed in a plane crash, there is **a natural interest** in statistics about the likelihood of that outcome.

**But which statistics are  
the most informative?**

Why not use the simple  
ratio of **passengers killed**  
to **passengers carried**?

*There **might be a** reason.*

**When a Boeing 737 hits a mountain killing all passengers, the implications about safety are the same whether it is full or only 1/3 full. Yet the number of passengers killed is 150 in one case and only 50 in the other. Thus, the “passengers killed” statistic treats the two events very differently, for no good reason.**

**A crash that kills 28 passengers out of 28 has a very different survival rate than another that kills 28 out of 280. Yet the statistic “number killed” treats the two events the same way, which is unfortunate.**

# Measure of Safety Performance Over a Past Period:

**Death Risk Per  
Randomly Chosen Flight**



# Question:

If a person chose a flight **at random** from among those of interest (e.g. Brazilian domestic flights over the period 1990-99), what is the probability that he would **not** survive it?

This death risk per flight statistic has **conceptual advantages** compared to other statistics about passenger mortality risk.

# What Conceptual Advantages?

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

**Death Risk per Flight,  
Worldwide Scheduled Service  
2000-07**

**1 in 3.0 million**

But, much as the center of mass of a doughnut is the center of the hole, **where there is no mass:**

There were **few if any** nations around the world where the death risk per flight was **1 in 3 million.**

**Key Question:**

**How might we model the diversity of aviation death risk across nations in a **simple yet defensible** way?**

We could summarize 2000-07 passenger mortality risk with a **three-population model**:

<u>Region</u>	<u>Death Risk per Flight</u>
• <b>Traditional First World</b>	1 in 10 million
• <b>Advancing Nations</b>	1 in 2 million
• <b>Less Advanced Developing World</b>	1 in 800,000

**But What About the  
Last Seven Years,  
2008-14?**



# 2008-14 Data:

<u>Group</u>	<u>Flights</u>	<u>FCE's</u>	<u>Passengers</u>	<u>Deaths</u>
First W	131 (mill)	5.21	10.5 (bill)	422
Adv	49	9.11	5.4	820
Least	28	44.1	2.1	2174

# Death Risk Per **Flight** 2008-14

<u>Group</u>	<u>Death Risk</u>	<u>Change Since 2000-07</u>
First World	<b>1 in 25 mill</b>	Better by 60%
Advancing	<b>1 in 5 mill</b>	Better by 60%
Less Developed	<b>1 in 700,000</b>	<b>Worse by 14%</b>
<b>Whole World</b>	<b>1 in 3.5 mill</b>	Better by 14%

# In the First World, an Air Traveler Is:

- More likely to win the jackpot in the lottery
- More likely to be elected Chief Executive  
**than to perish on next flight.**

## **Also:**

- Could take one flight a day an average of  
**68,000 years** before perishing in an aviation  
accident

# What about **Malaysia**?

(Funny you should ask.)

Malaysia fell into the category of **Advancing Nations**, which collectively had an average death risk per flight over 2000-07 of **1 in 2 million**.

**Malaysia, an Advancing Nation,  
Had **No Fatalities at All** Over 2000-  
07. However:**

**Bahrain Brazil China Cyprus  
India Mexico Philippines Singapore  
Taiwan Thailand Turkey**

**Are Advancing Nations that **Did** Suffer Fatal Crashes**

Would one have seriously argued on 1/1/08 that it is better to estimate Malaysia's underlying risk level as **zero** rather than as the **average risk level over 2000-07** for the Advancing group, which was **1 in 2 million**?

**Over 2008-14, the Advancing Nations  
with Fatal Crashes Were:**

**Brazil China India Malaysia**

**Mexico South Korea Taiwan Turkey**

A Question:

Why Should We Single Malaysia  
Out as **Especially Bad** Over 2008-  
14 When We Wouldn't Single It  
Out as **Especially Good** Over 2007-  
14?



## More Rigorously:

The mortality-risk performance of Malaysian air carriers over 2000-14 **did not differ to a statistically significant extent** from that of the Advancing Nations as a whole. In a simple binomial test, the p-value for the “no difference” hypothesis was **22%**.

Do the Differences in Passenger Death Risk per Flight Between the First World and the Rest of the World Mean that, Given a Choice, One Should Opt for a First-World Airline?

Well, have you heard of the **Ecological Fallacy**?

# Death Risk per Flight **Between** Traditional First World Cities and Cities in Other Nations, 2000-14:

**First World Carriers:** **1 in 2 million**

**Other Carriers:** **1 in 2.5 million**

# Death Risk per Flight, First-World Passenger Services, 1960-2014

<u>Period</u>	<u>Death Risk per Flight</u>
1960-69	1 in 400,000
1970-79	1 in 1 million
1980-89	1 in 4 million
1990-99	1 in 6 million
2000-07	1 in 10 million
2008-14	1 in 25 million

**However, we should discuss an issue that has troubled the speaker for some time.**

# *A Problem With “Death Risk per (Randomly Chosen) Flight” as a Risk Metric Is:*

- Passengers do **not** choose flights completely at random: the average A-380 carries far more passengers than the average Embraer-120.
- If there is any correlation between **size of aircraft and risk of crashing**, then death risk per flight might offer **a biased estimate** of the risk for a passenger selected at random.

To avoid that potential bias, we might return to **passengers killed divided by passengers carried**.

- Or equivalently:

If we choose **one boarding pass at random** from all those used by the passengers of interest (e.g. Brazilian domestic air travelers over 1990-99), what is the probability that its owner did not survive her flight?

**What Happens  
When We  
Compute Death  
Risk per Boarding?**



# Death Risk per Boarding, 2008-14

<u>Group</u>	<u>Death Risk per Boarding</u>
• First World	<b>1 in 25 million</b>
• Advancing	<b>1 in 7 million</b>
• Less Developed	<b>1 in 1 million</b>

***What Have We  
Left Out?***