# Motivation

## Why Risk Assessment matters?

Risk Analytics

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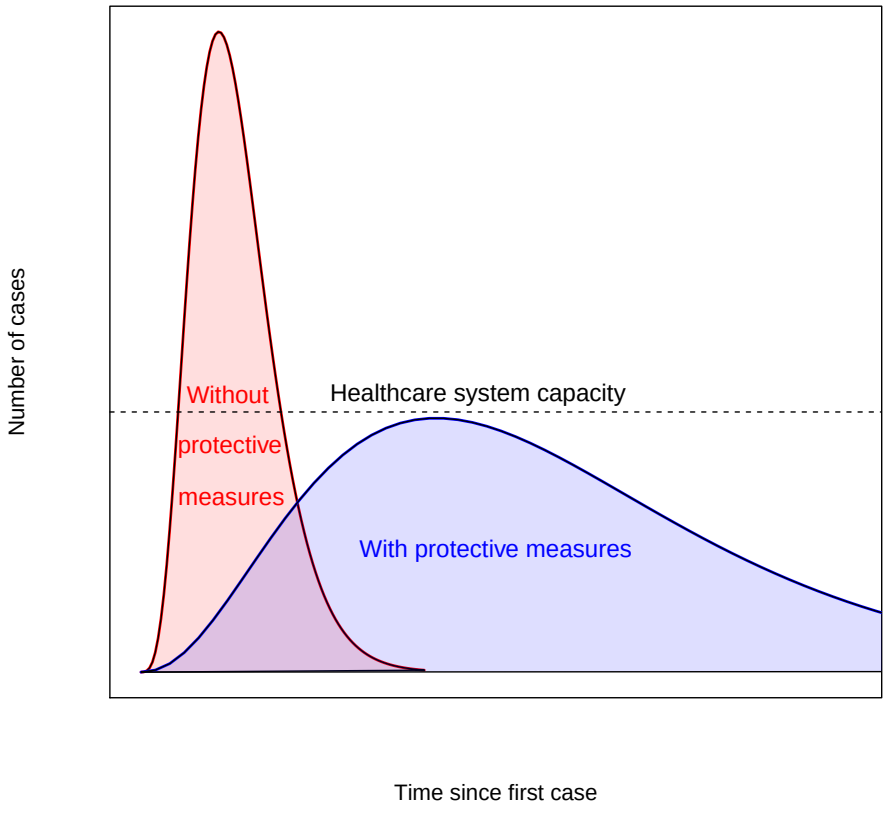
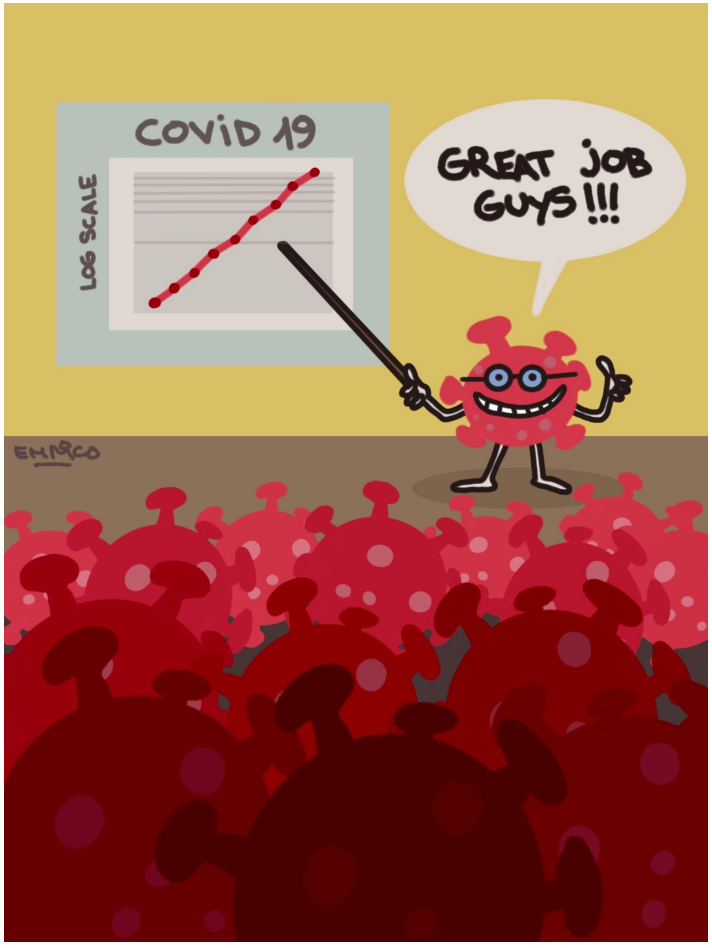
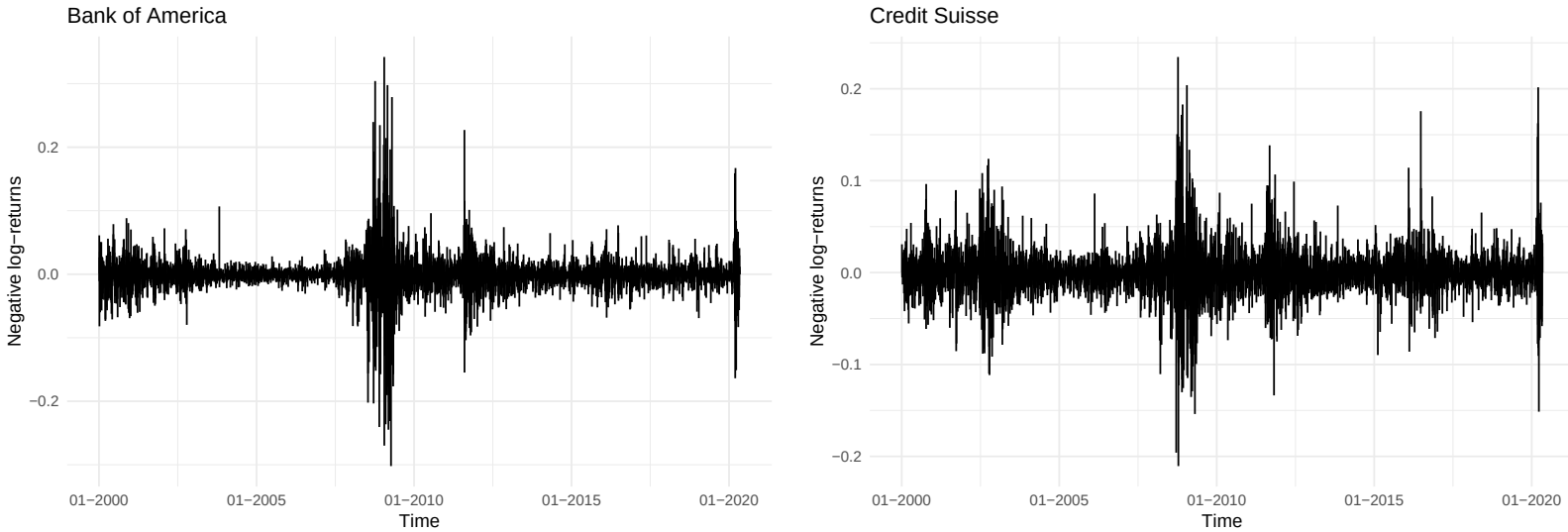
# Risk Assessment Matters:
# Health Care Risk and Hospital Congestion



# Risk Assessment Matters: Financial Risk




Source: Yahoo Finance

# Risk Assessment Matters: Environmental Risk

Source: Arolla.org(left) Cieau (right)

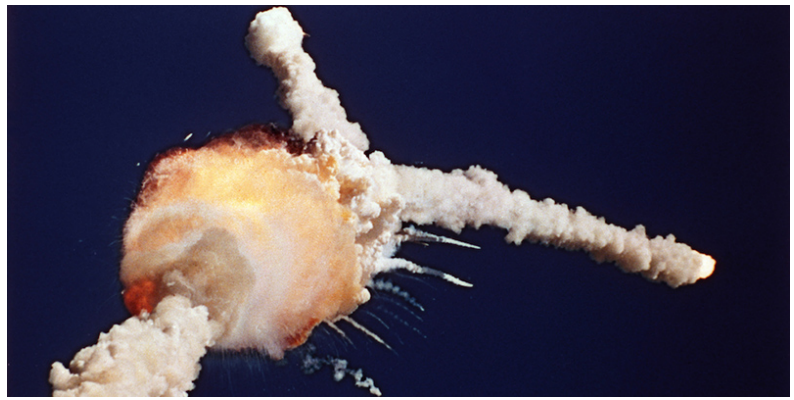
# Risk Assessment Matters:
# Environmental Risk → Enterprise/Insurance Risk


Source: 24 Heures (left) Good News Network (right)

# Risk Assessment Matters:
# Cybersecurity/Terrorist Risk → Enterprise/Insurance Risk

Source: Wärtsilä (top) Business Insider (bottom)

# Risk Assessment Matters:
# Engineering/Technology Risk → Enterprise/Insurance Risk



Source: Welt; deepsense.ai

# Challenger Disaster Case I

On January 28, 1986, at 11:38 EST (16:38 UTC) at Kennedy Space Center, Cap Canaveral, the space shuttle Challenger takes off for the last time.
This $24^{th}$ launch could have been just a routine, but 73 seconds after the launch, at 14,000 meters above sea level, the shuttle suffered a tragic structural failure.

Source: earthsky.org (left) Britanica.com (right)

# Challenger Disaster Case II


Source: Wikimedia Commons (left) and Wikipedia (right)

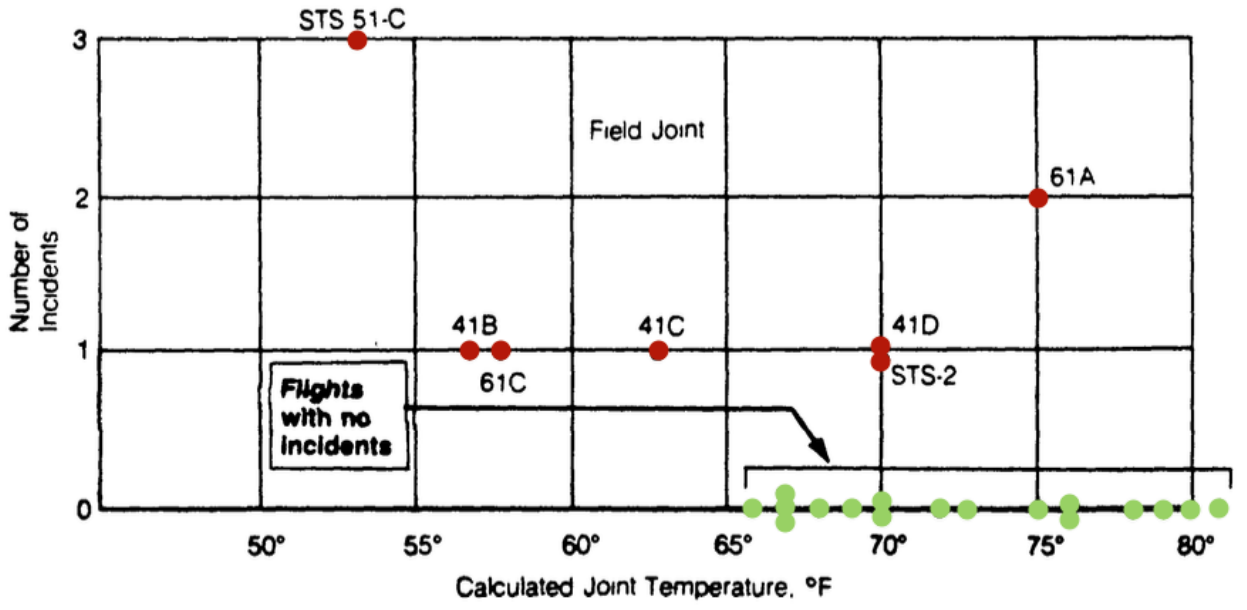
# Challenger Disaster Case III: Technical and cultural/Management problems

That day, America lost for the first time, people in space.
A commission reported both technical and managerial or cultural causes:

- On the technical side, a failed o-ring seal in the right solid rocket booster caused by an exceptional cold weather (30.92° F) at launch time.
- On the cultural side, communication problems: failure to report all problems to the launch decision team. The problem of the effect of low temperature on the o-ring performance was known. However, anxious to keep their schedule, the NASA managers did not communicate this information to their superiors and decided to maintain the launch. Unfortunately.

# Challenger Disaster Case IV: NASA Data Analysis

Number of o-ring failures against temperature:




*Source: Report of the Presidential Commission on the Space Shuttle Challenger Accident, 6 June 1986, Volume 1, page 145, color added by https://priceonomics.com/the-space-shuttle-challenger-explosion-and-the-o/*

NASA managers excluded the flights where no failures happened. This data selection mistake leads to "bias selection".

# Challenger Disaster Case V: Logistic Regression

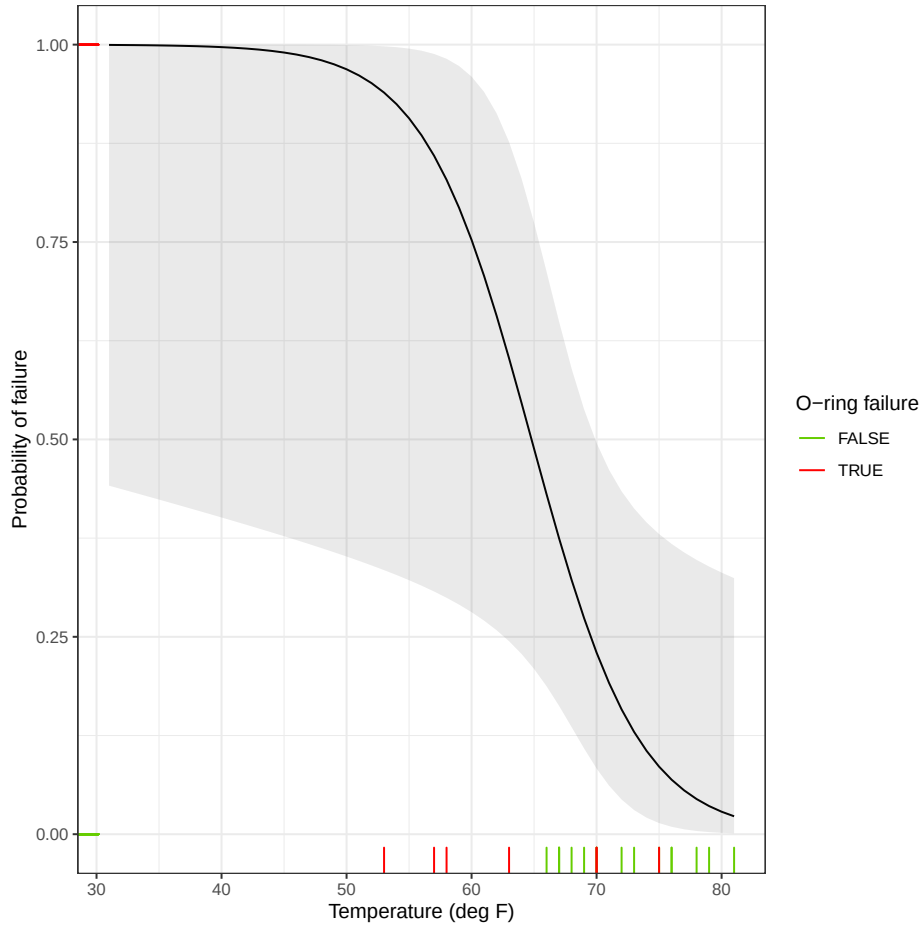
The information coming from the flights with no o-ring failure (especially happening at the lowest temperatures) should have been included !

- Logit model $\log\left(\frac{p(t)}{1-p(t)}\right) = \alpha + \beta t$ where $t$ represents ground temperature at launch time and $p(t)$ represents the probability of O-ring failure at temperature $t$
- $\hat{\alpha} = 15.0429(7.3786)$ and $\hat{\beta} = -0.2322(0.1082)$
- Point estimate of a probability of failure given a certain temperature $t$:

$$p(t) = \frac{e^{15.0429-0.2322t}}{1 + e^{15.0429-0.2322t}}$$

- For $t = 31$, this value is bigger than 0.999 (and check uncertainty!)

# Challenger Disaster Case VI: Logistic Regression Fit



# Challenger Disaster Case VII: Societal Pressure

Despite the recommendation from the motor engineers, NASA ignored the risk of an O-ring failure.
The pressure to launch was the biggest enemy of this tragedy.

- Political pressure, shareholders pressure
- Public pressure: space discovery, "Teacher in Space" (Christa McAuliffe)

Along with the Space Shuttle Columbia accident on February 1, 2003, during the atmospheric re-entry phase, Challenger accident is one of the most significant in the American conquest of space.