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Quantitative research methods: Statistical thinking and research process

Shuhei Nomura, PhD

s-nomura@keio.jp

https://researchmap.jp/nom3.shu

Associate Professor, Keio University, Japan

Department of Health Policy and Management
School of Medicine, Keio University

PhD in Biostatistics and Epidemiology

from Imperial College London

- Global Burden of Disease (GBD) GBD Scientific Council (Seattle)
- Global Health Policy

  Bill & Melinda Gates Foundation Tokyo Office (Tokyo), SEEK Development (Berlin),
  2023 Hiroshima G7 Global Health Taskforce (Tokyo)
- Domestic Health Policy
- Health Emergency and Disaster Risk Management (Health-EDRM)

  World Health Organization Centre for Health Development (Kobe)
- Nutrition Science and Policy Global Nutritipn Report (GNR) (London)
- Pandemic prevention, preparedness, and response (PPR)

  Google, LINE, Yahoo! Japan, Ministry of Health, Labour and Welfare

Outline

- Statistical thinking and research process
- Case study

Why learn statistics?

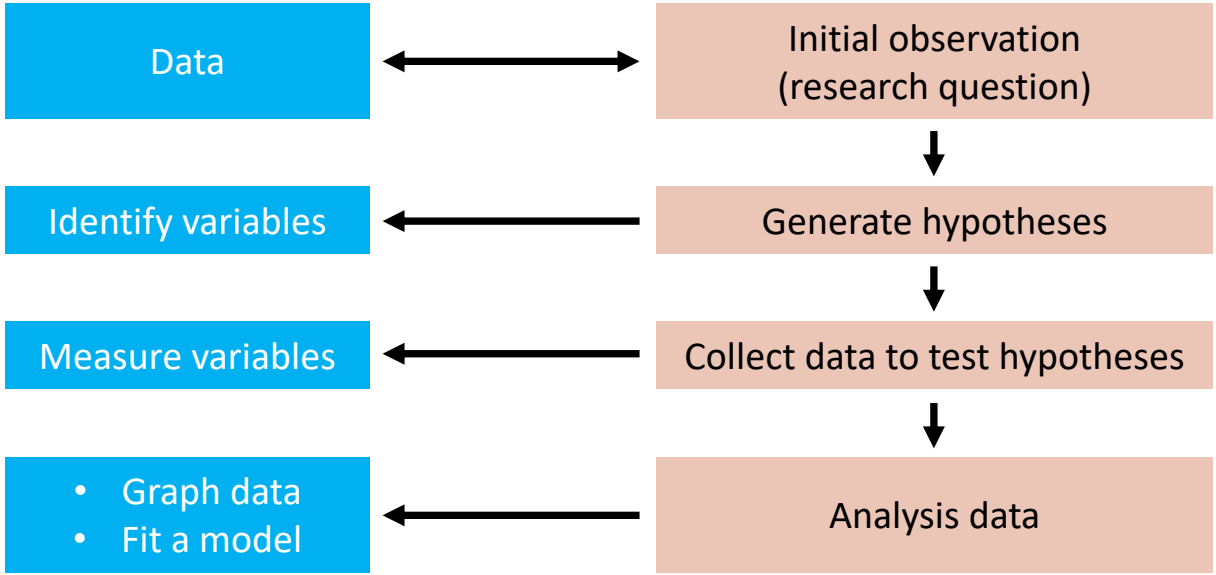
- The reason you are here is because you possess an inquiring mind!
  - What are the most in-demand medical procedures following an earthquake?
  - What potential health risks does climate change introduce?
  - To what extent does a building's earthquake resistance mitigate health damage?
  - Does a lockdown policy effectively reduce the risk of COVID-19 infection?

- To answer the questions of interest, **statistical thinking** is necessary.

What is statistical thinking?

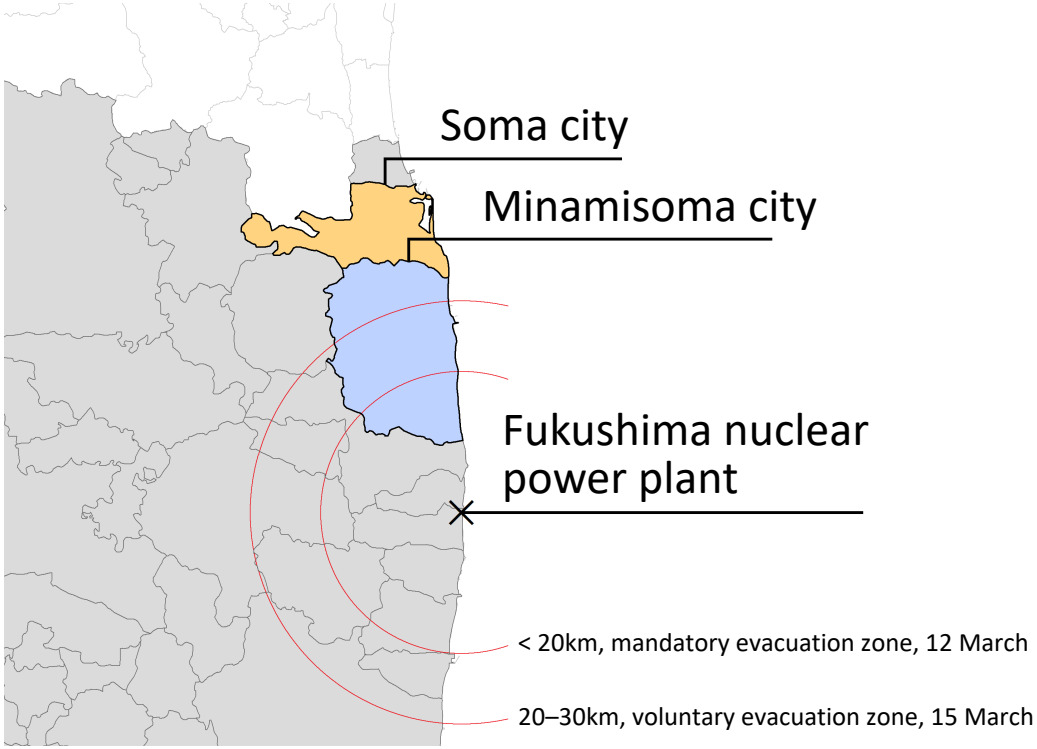
- **Statistical thinking** is an approach to problem-solving and decision-making that relies on statistics. It involves using data and statistical techniques to gain insights, make informed decisions, and draw valid conclusions.

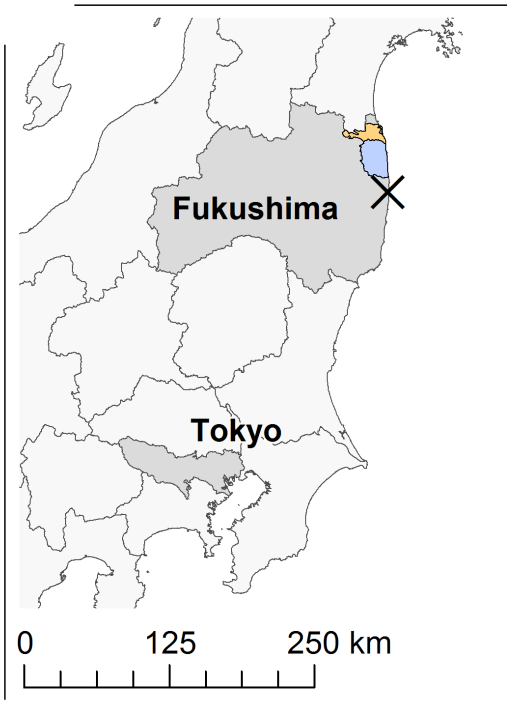
The quantitative research process



Statistical thinking plays a role in all these processes

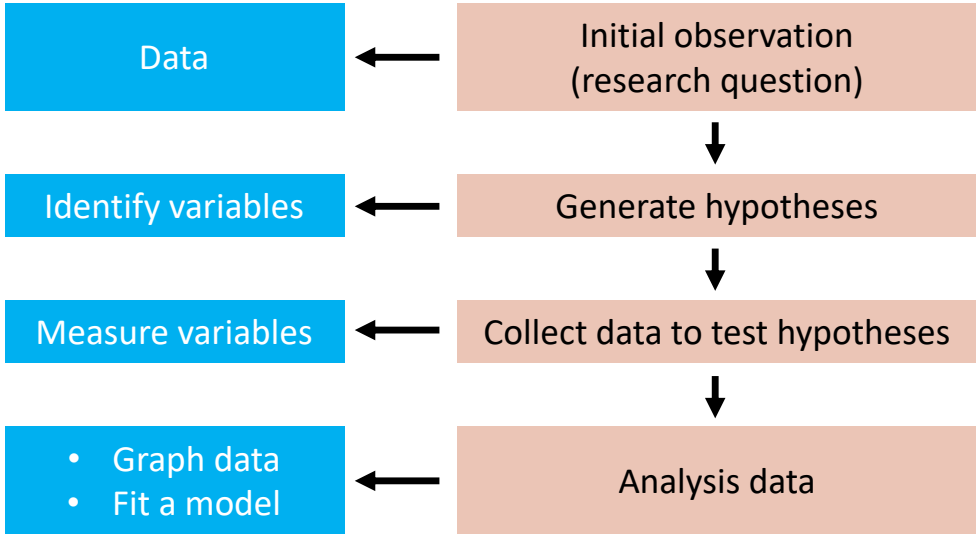
Case study – the Fukushima nuclear disaster on 11 March 2011





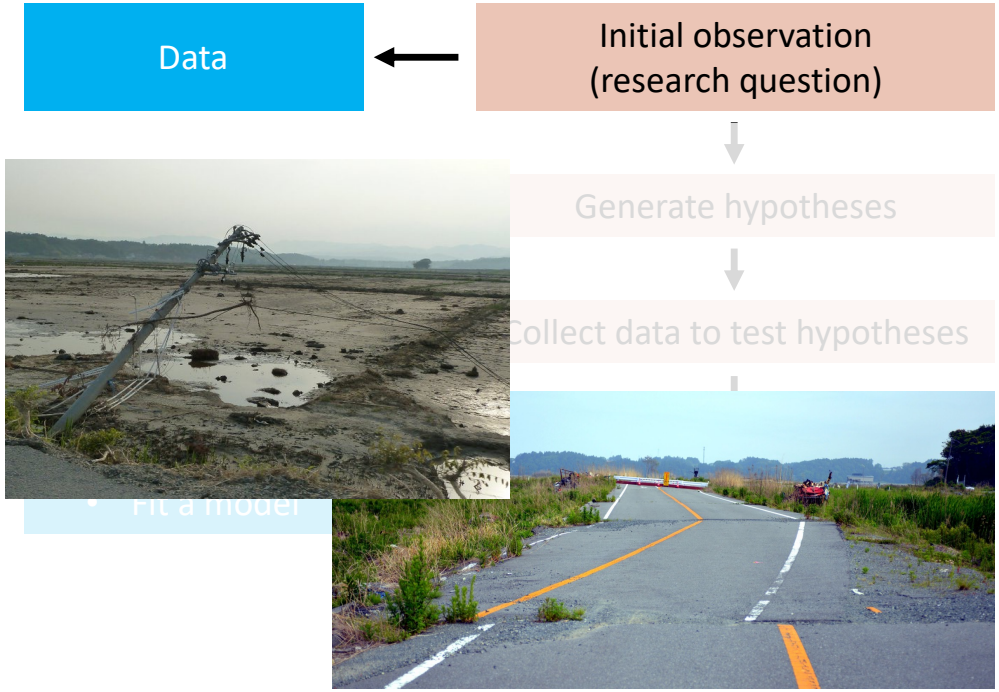
Case study – the Fukushima nuclear disaster on 11 March 2011

The quantitative research process



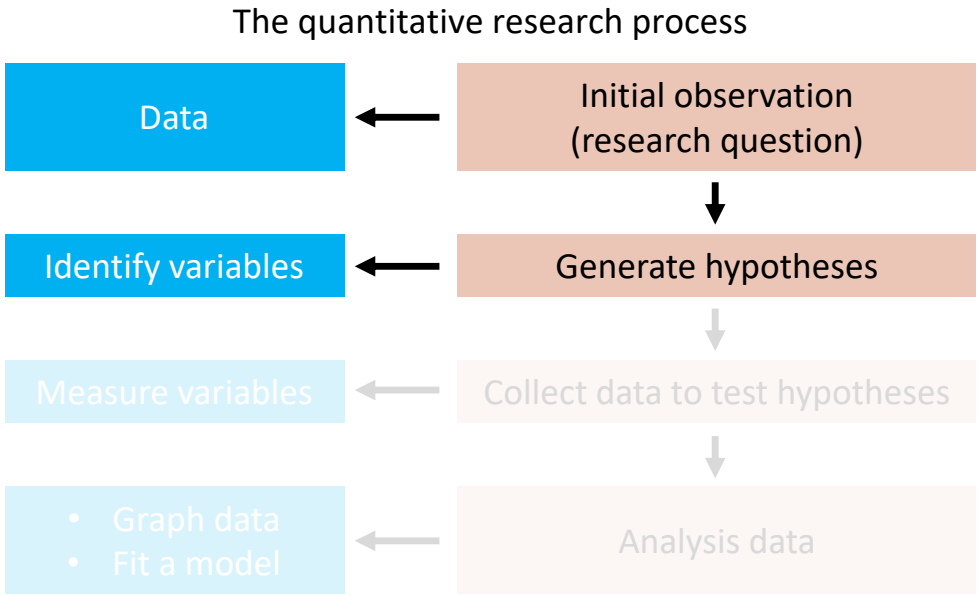
Case study – the Fukushima nuclear disaster on 11 March 2011

The quantitative research process



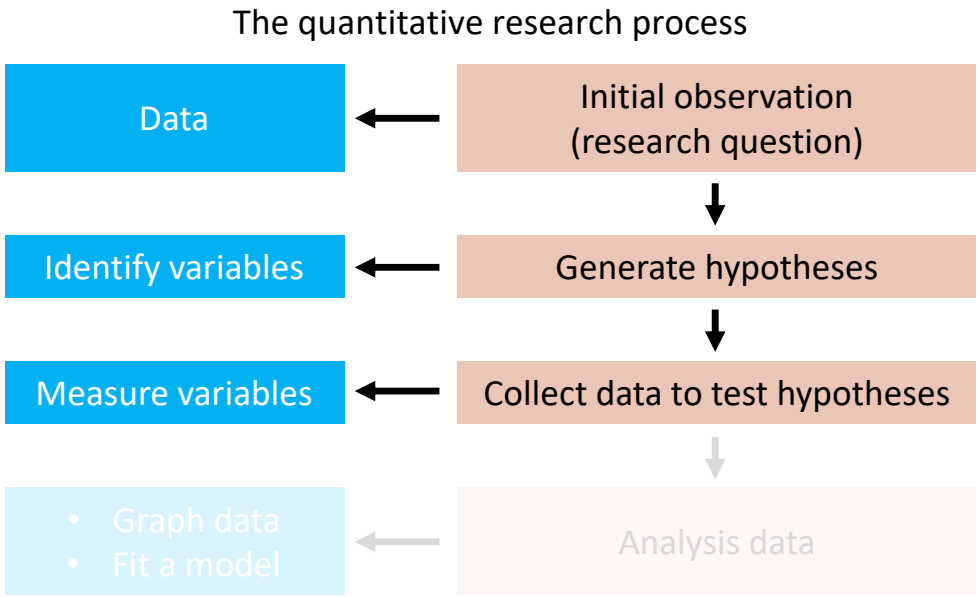
- A total of 328 individuals from all five nursing facilities in Minamisoma were evacuated within two weeks.
- However, reports have emerged of deaths occurring shortly after the evacuation.
- **[Question]** Has there been an increase in the mortality rate among facility residents after the evacuation compared to before?
- Data on residents of the nursing facilities.

Case study – the Fukushima nuclear disaster on 11 March 2011



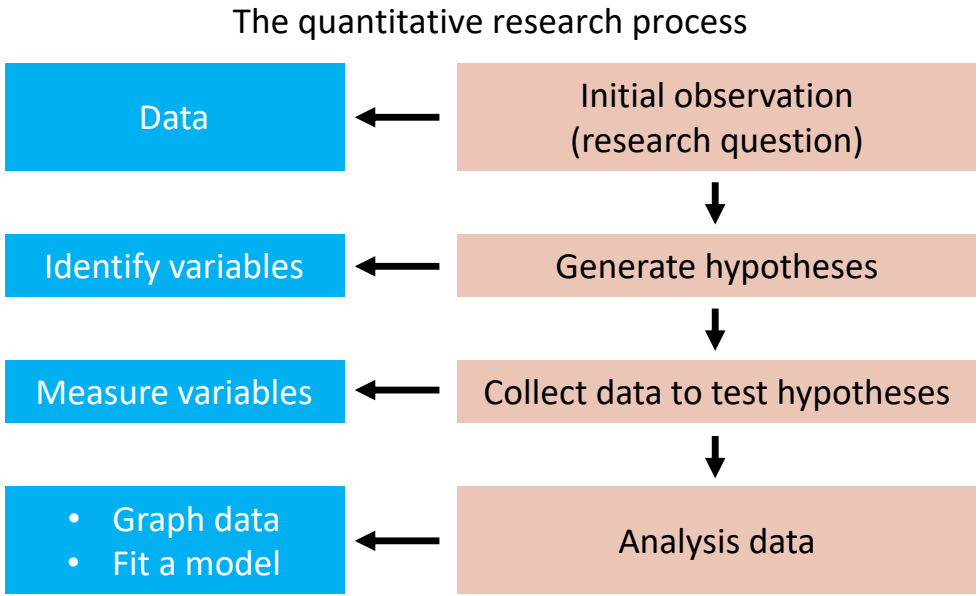
- **[Hypothesis]** Evacuation was related to mortality.
- More specifically, the duration of stay until death for facility residents differed before and after the evacuation.
- A variable indicating whether facility residents have survived or passed away is required.
- To be precise, this refers to the duration of each facility resident's stay, including prior to the disaster, and their mortality status at the end of the observation period – in other words, time to event.

Case study – the Fukushima nuclear disaster on 11 March 2011



- Coordinate with the original facilities and collect data on their residents, including information on past residents, date of evacuation, etc.
- Coordinate with the facilities that served as evacuation destinations to collect survival information on the evacuees.
- Monitor the evacuees, verify the dates of their deaths post-evacuation, and calculate the number of days they survived.

Case study – the Fukushima nuclear disaster on 11 March 2011

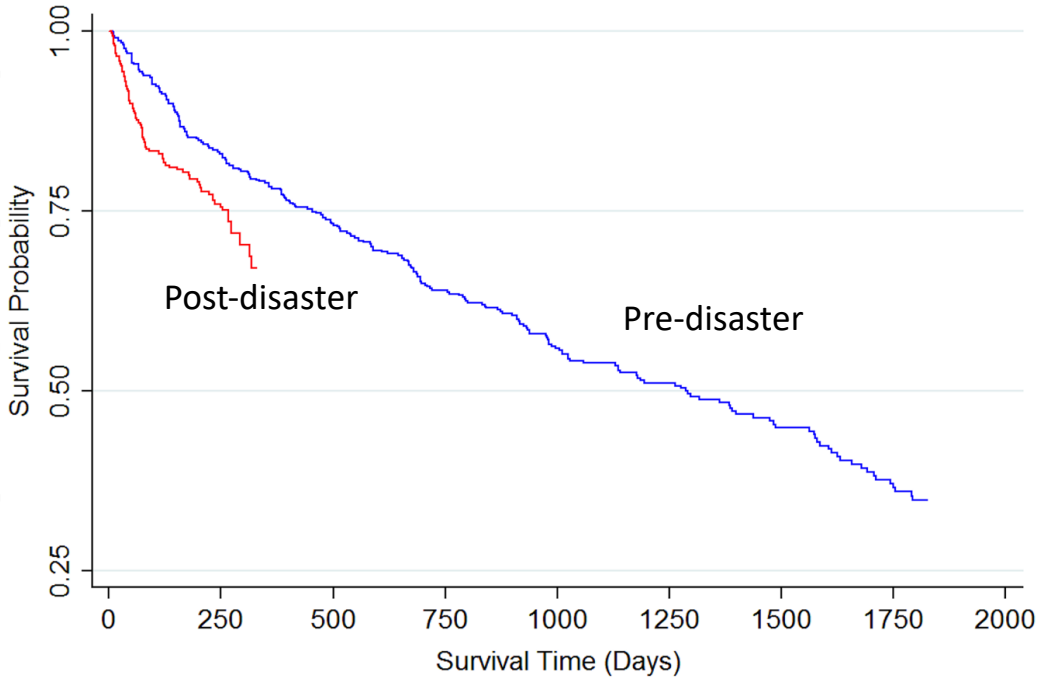


- Survival analysis, or more generally, time-to-event analysis.
- Next slide!

Case study – the Fukushima nuclear disaster on 11 March 2011

- Graph data
- Fit a model

Estimated pre- and post-disaster (evacuation) survival
(using the Kaplan-Meier product limit method)



Nomura S, et al. (2013) https://doi.org/10.1371/journal.pone.0060192

Case study – the Fukushima nuclear disaster on 11 March 2011

- Graph data
- Fit a model

Multiple regression model of survival
(using the Cox proportional hazards regression method)

Disaster (evacuation)	Hazard ratio	95% CI	P-value
Before	1.00	NA	
After	**2.88**	1.74 to 4.76	<0.001

Adjusted for age, gender, facility id, care level. CI: confidence interval

Nomura S, et al. (2013) https://doi.org/10.1371/journal.pone.0060192

Case study – the Fukushima nuclear disaster on 11 March 2011

- Implications for guiding policy
  - Evacuation of older adults carries health risks.
  - Preparations should be made to ensure safe evacuation - such as securing evacuation destinations and means of transport.
  - Temporary indoor evacuation is also an important option.

Nomura S, et al. (2013) https://doi.org/10.1371/journal.pone.0060192

Benchmarking outcomes is difficult

- Health measures and metrics are rarely comparable – across different data types, various locations, and/or timeframes.
- It poses a challenge to isolate differences in health performance to true differences in health outcomes – and not simply differences in measurement methods.
- Collecting data during disasters proves challenging, and there exist limitations to the kind and amount of data that can be acquired.

Summary

- **Importance of statistical thinking**: Statistical thinking plays a vital role in objectively analyzing and interpreting information, thus facilitating data-driven decision-making processes.
- **Understanding research processes**: The four main processes - observation, hypothesis formulation, data collection, and analysis - form the backbone of any quantitative research endeavor.
- **Lessons from case study**: While the Fukushima case offered valuable insights, it also shed light on how statistical thinking helped decipher complex situations.
- **Cooperation with statistical professionals**: Regardless of your own expertise, working with statistical professionals from the start can greatly enhance the research process and outcomes.