Decision Science:

Policy Design and Clinical Decision-Making Through Health Economics

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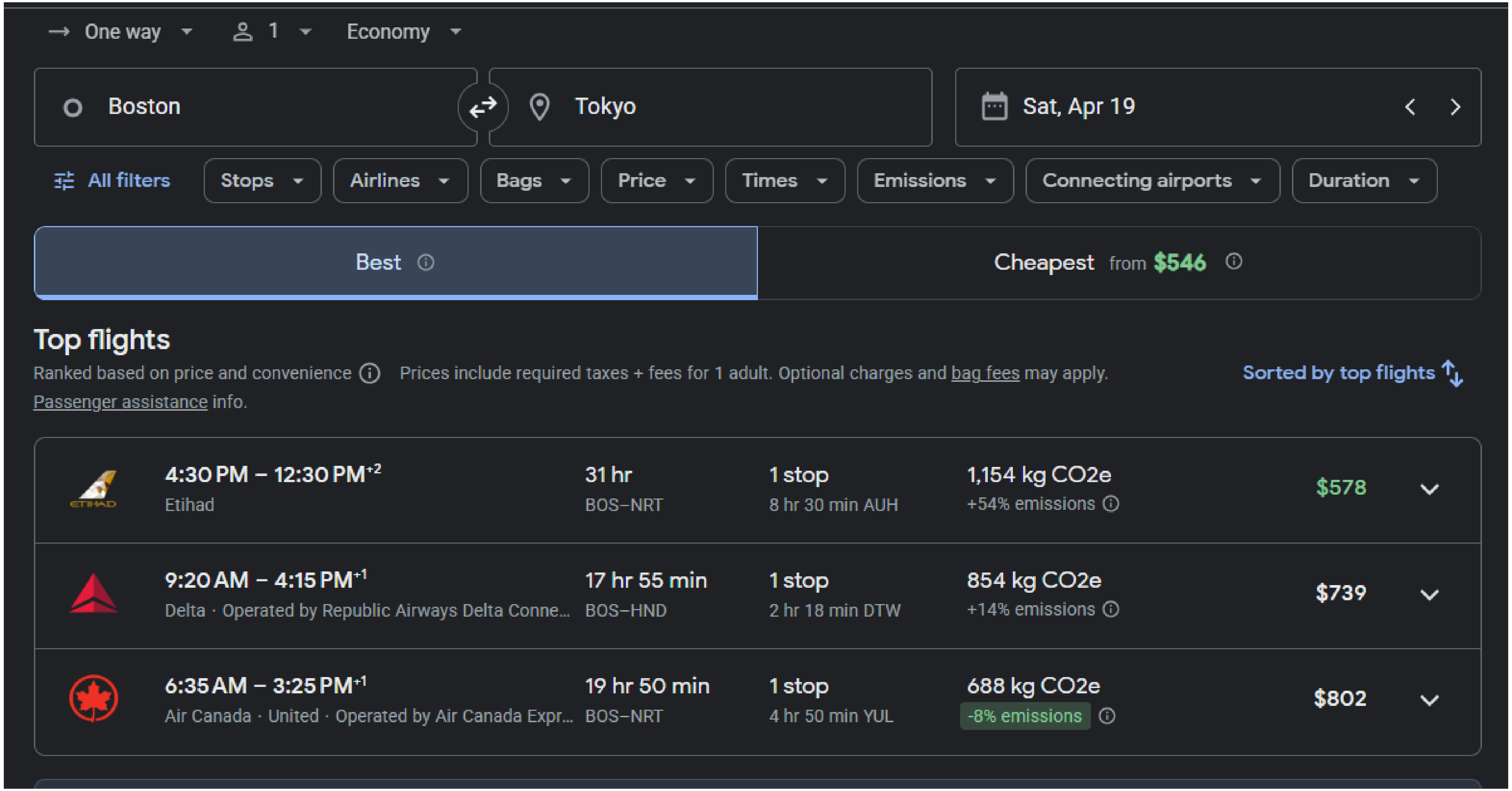
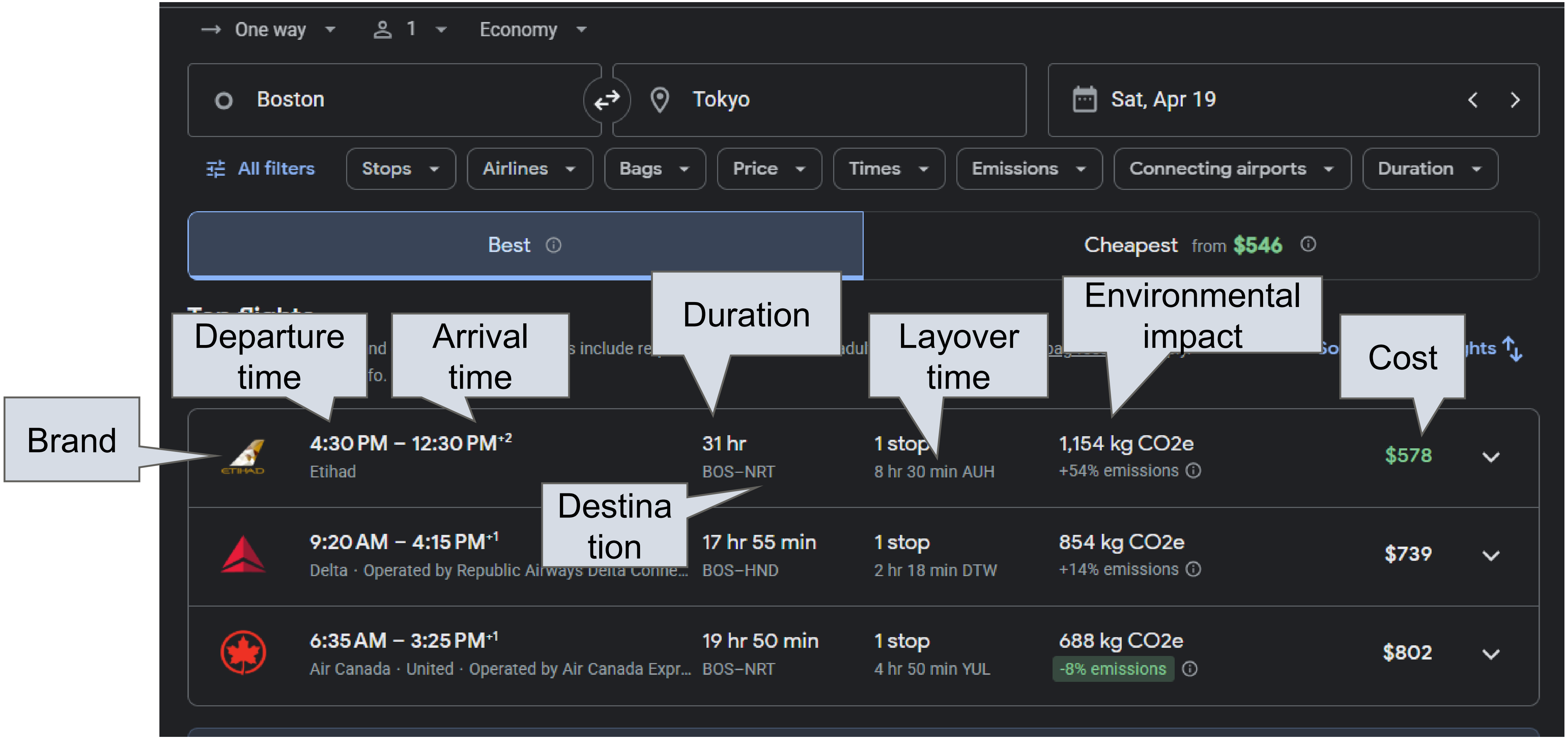
Preface

If you were to fly to Japan today, which flight would you choose?



Preface

What do you consider when choosing a flight?



What do we consider when making decisions?

We often consider benefits, downsides, and uncertainty unconsciously. There is, in fact, an academic field that analyzes decision-making scientifically by explicitly accounting for these elements.

- Expected benefits
  - convenience, comfort, in-flight services, etc.
- Expected downsides
  - cost, travel time, number of layovers, etc.
- Degree of uncertainty
  - delays, missed connections, cancellations, etc.

Purpose of This Talk

- Introduce the basic concepts and framework of Decision Science.
- Demonstrate how effects, costs, and uncertainty are incorporated into scientific decision analysis using concrete examples.
- Provide participants with a perspective for structuring decisions in their own research and professional practice, leading to new insights and ideas.

Agenda

1. What is Decision Science, and how do we analyze decisions?

2. Experiencing Decision Science in practice

3. Use cases of Decision Science

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1. What is Decision Science, and how do we analyze decisions?

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What Is Decision Science?

An interdisciplinary approach that integrates effects, costs, and uncertainty to support optimal decision-making.

- Integrates methods from economics, statistics, psychology, and behavioral science.
- Aims to identify optimal choices under limited resources and uncertainty.
- Widely applied in healthcare, public policy, and business.
- Enhances transparency and supports consensus-building in decision processes.

Analytical Process

I introduce an example using eight core steps.
(note: in practice, steps may not be strictly sequential)

1. Define the problem and objectives
2. Define outcomes
3. Select simulation model
4. Design simulation model
5. Select model inputs
6. Simulate multiple decision options
7. Sensitivity and scenario analyses
8. Evaluate results

Step① Defining the Problem and Objectives

Explicitly identify the value to be optimized when benefits and downsides are in tension.

1. **Define the problem and objectives**
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- Decision problems arise when trade-offs exist among options.
  - New drug (high efficacy, high cost) vs. existing drug (lower efficacy, lower cost)
  - Early cancer surgery (curative potential, high invasiveness) vs. watchful waiting
  - Additional pediatric vaccination (prevention, side effects) vs. no vaccination
- Clarify the objective
  - Maximize benefits? - Extend life expectancy; improve quality of life (QoL)
  - Minimize downsides? - Reduce the number of infections; contain costs
  - Maximize benefits relative to downsides? - Achieve the greatest gain in life expectancy per dollar spent

Step② Defining Outcomes

Define benefits (effects) and costs based on the decision objective. In health economics, effects are often measured using QALYs (QoL × survival years).

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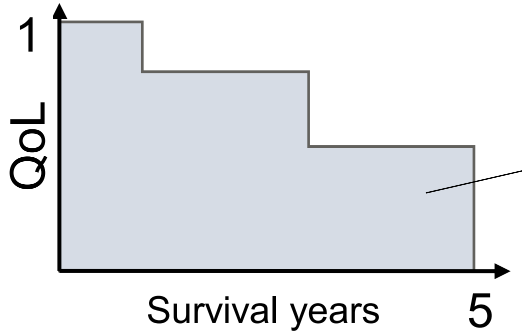
- Outcome measures that consider both “quality” and “quantity”
  - Quality (“utility”) = QoL
    - Measured on a scale from 0 = death to 1 = perfect health.
    - Not based on objective symptom severity, but on the individual’s subjective perception.
    - Utility is measured through questionnaires or experimental methods.
  - Quantity = survival years
  - Quality × Quantity = QALYs (Quality-Adjusted Life Years)
    - A numerical representation of how long and how well a person lives



$1\times1\text{yr}+0.8\times2\text{yrs}+0.5\times2\text{yrs}$
$=1+1.6+1$
$=3.6\text{QALYs}$

Step③ Selecting a Simulation Model

Choose the model that best fits the decision problem.

1. Define the problem and objectives
2. Define outcomes
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Model	Outline	Characteristics
Decision Tree Analysis(*)	Visualizes choices and outcomes as branches.	•Limited ability to model time-varying events
Markov model	Represents disease progression and state transitions over time.	•Suitable for long-term processes; population level
Microsimulation	Predicts outcomes accounting for individual characteristics.	•Individual level
Discrete Event Simulation	Simulates the timing of individual events.	•Focuses on process flows; individual level
Agent-based model	Simulates interactions among individuals following rules.	•Individual level

Complexity: Low → High

*:Different from machine-learning methods that identify predictors influencing the outcome variable.

Step④ Designing the Simulation Model

Structure the overall problem you are facing.

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2. Define outcomes
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- Structure the problem:
  - Decision timing
  - Causal relationships
  - Temporal relationships

- Results depend heavily on model design
  - Different decision-makers may conceptualize the same problem differently.
  - ➢Align implicit knowledge between decision-makers and modelers.

Step③ Selecting a Simulation Model (Example)

In decision tree analysis: ■ represents a decision; ● represents a chance event; ▲ represents an outcome.

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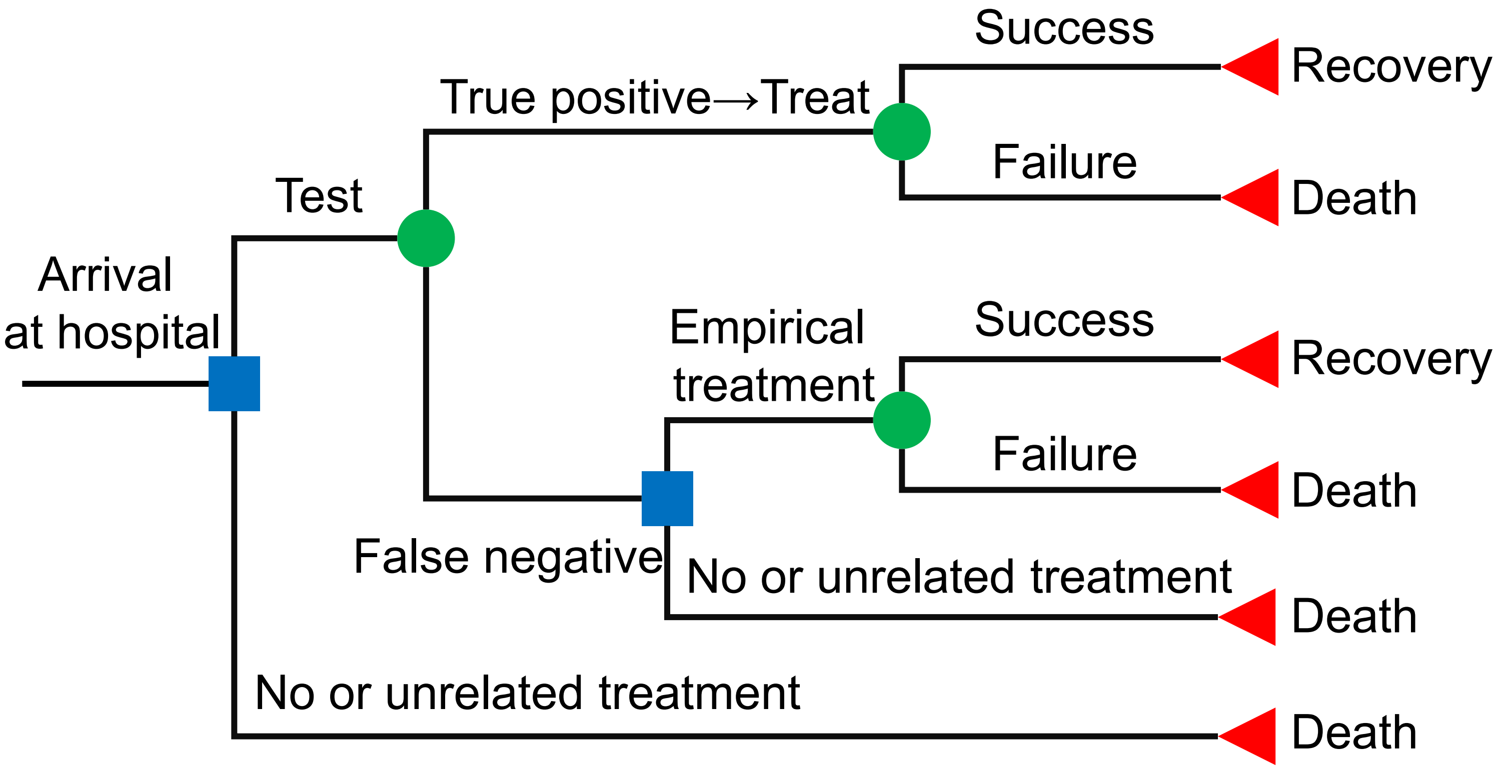
Example: Diagnosis and Treatment of Severe Malaria

■: Decision ●: Chance event ◀: Outcomes



Step④ Designing the Simulation Model (Example)

The structure of a model may differ depending on the decision-maker.

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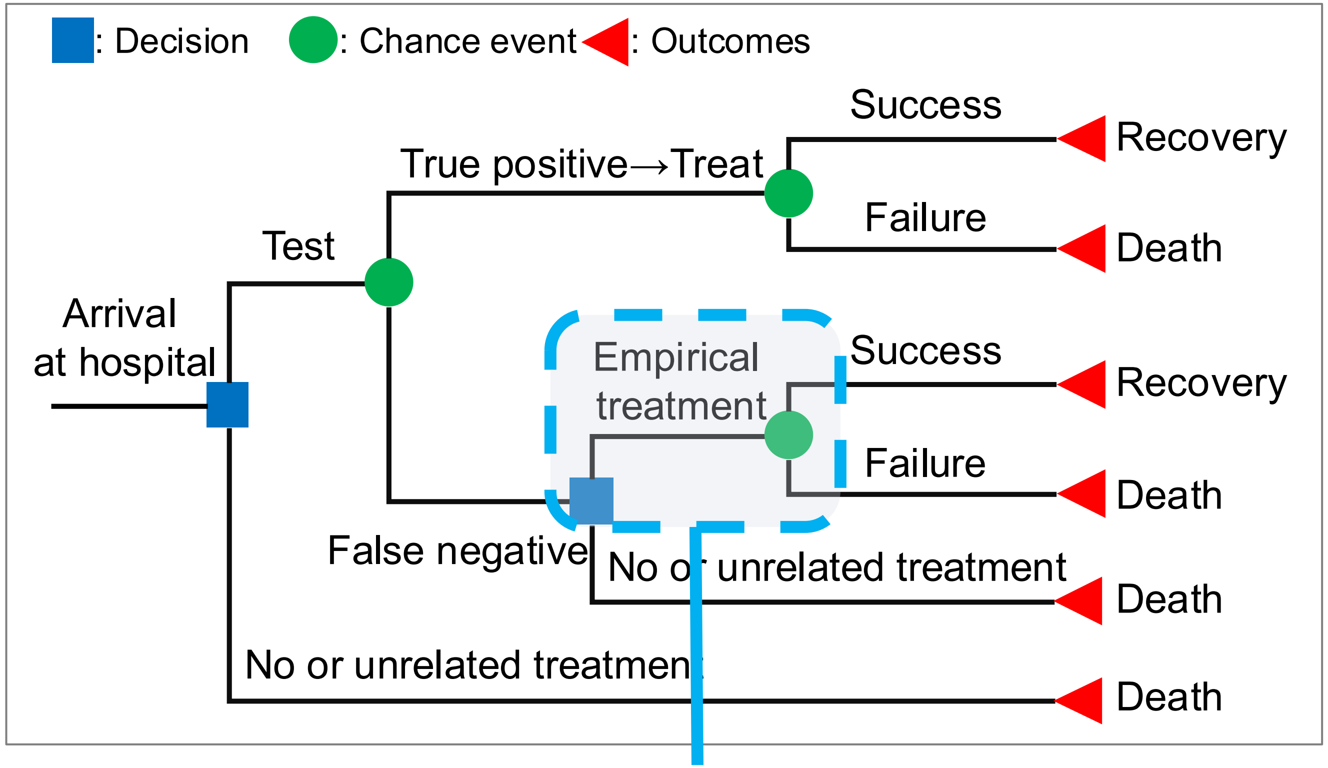
Example: Diagnosis and Treatment of Severe Malaria



“empirical treatment” could instead be “second diagnostic test”, depending on how the decision-maker frames the problem.

Step③ Selecting a Simulation Model (Example)

In a Markov model, the modeled population transitions between health states over time according to state-specific transition probabilities.

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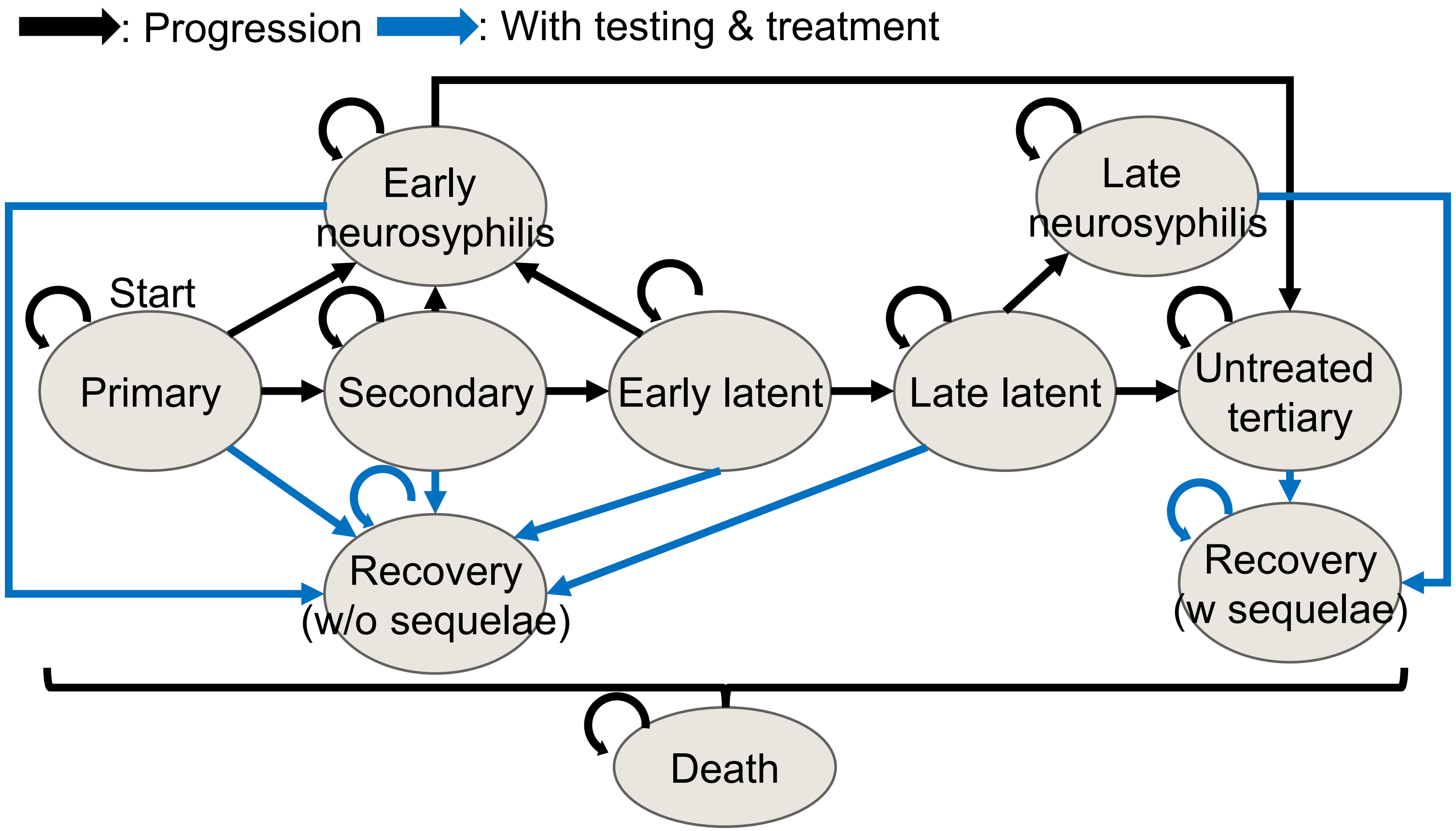
Example: Syphilis disease progression (Lee et al. 2023)



Lee K et al. Estimation of the Lifetime Quality-Adjusted Life Years (QALYs) Lost Due to Syphilis Acquired in the United States in 2018. CID. 2023;76(3):e810-e819. doi:10.1093/cid/ciac427

Step④ Designing the Simulation Model (Example)

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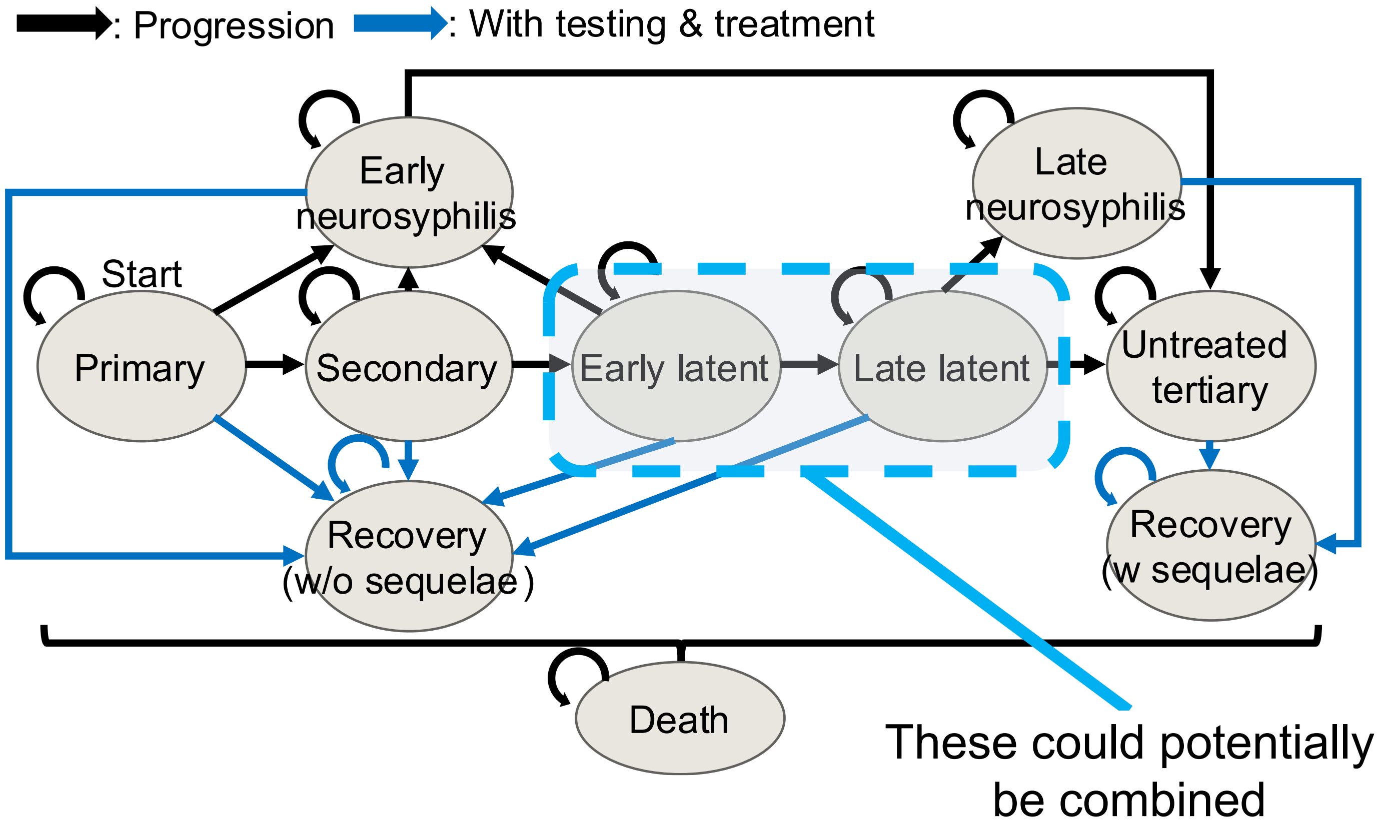

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Step⑤ Selecting Model Inputs

Identify numerical values for structured relationships and outcome measures from existing evidence.

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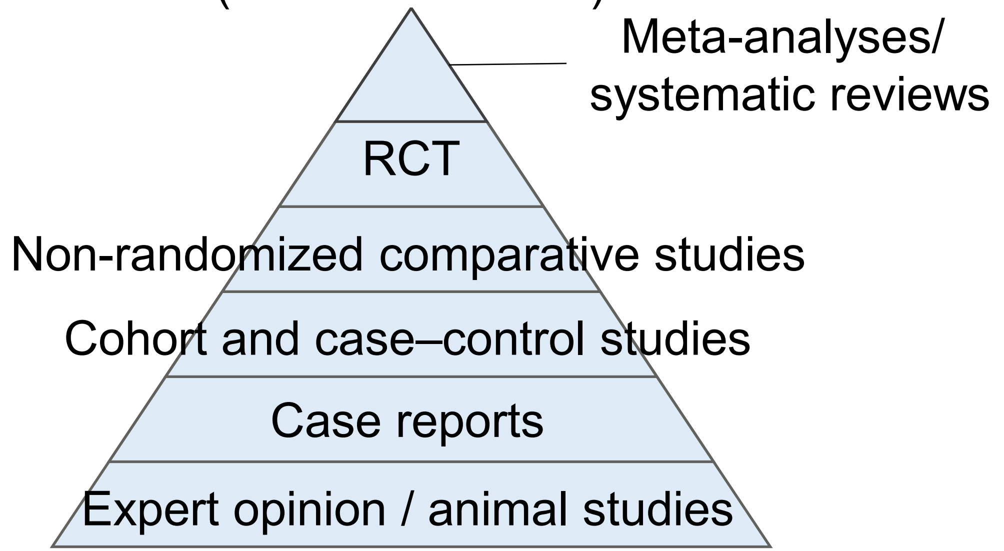
- Seek high-quality evidence, though not always be available

Hierarchy of evidence in evidence-based medicine (Burns et al. 2011)



- Uncertainty remains even with high-quality evidence.
  - e.g., 95% confidence intervals, interquartile ranges
  - Methods to address uncertainty are discussed later.

Burns PB et al. The levels of evidence and their role in evidence-based medicine. Plast Reconstr Surg. 2011;128(1):305-310. doi:10.1097/PRS.0b013e318219c171

Step⑤ Selecting Model Inputs (Example)

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Example: Syphilis disease progression (Lee et al. 2023)

Parameter	Value	[Confidence Interval]
Duration of primary stage (months)	0.7	[0.25-1.96]
Duration of secondary stage (months)	3.6	[2.16-5.99]
Monthly probability of recovery from neurosyphilis after treatment	0.18	[0.12–0.28]
Monthly probability of treatment failure	0.05	[0–0.1]
Utility decrement during primary stage	-.006	[-.004– -.01]
…		
etc		

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Step⑥ Simulating Multiple Decision Options

Simulate each decision option within the model.

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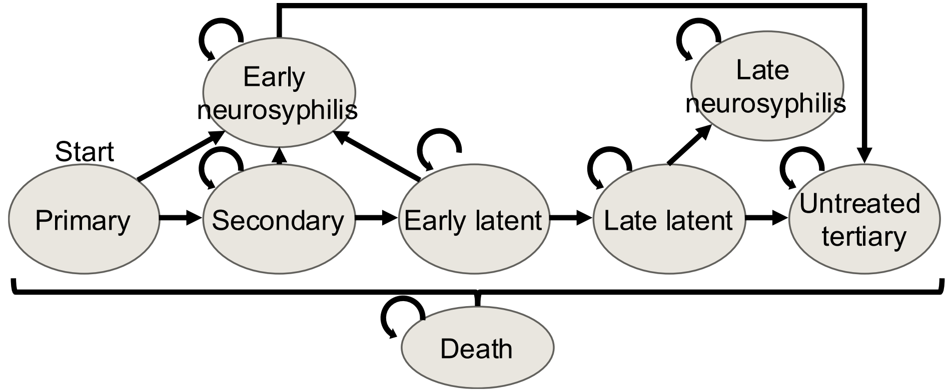
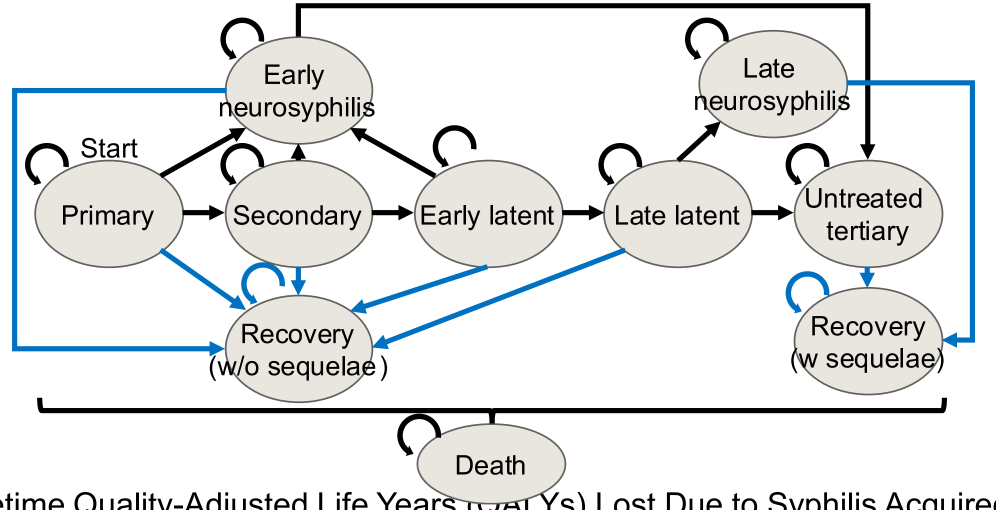
Example: Syphilis disease progression (Lee et al. 2023)

Without testing or treatment



With testing and treatment



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Step⑦ Sensitivity and Scenario Analyses

Accounting for multiple sources of uncertainty.

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2. Define outcomes
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6. Simulate multiple decision options
7. **Sensitivity and scenario analyses**
8. Evaluate results

- How do we handle uncertainty?
  - Stochastic uncertainty: Results are unknown until simulated.
    - ➢ Increase the number of simulated individuals or runs.
  - Model (structural) uncertainty: The correc.t model structure is unknown
    - ➢ Test multiple plausible model structures.
  - Parameter uncertainty: Input values are uncertain.
    - ➢ **Vary parameters over plausible ranges and re-run the model.**

Step⑦ Sensitivity and Scenario Analyses (Example)

To address parameter uncertainty, two common approaches are used.

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- Approaches to handling parameter uncertainty

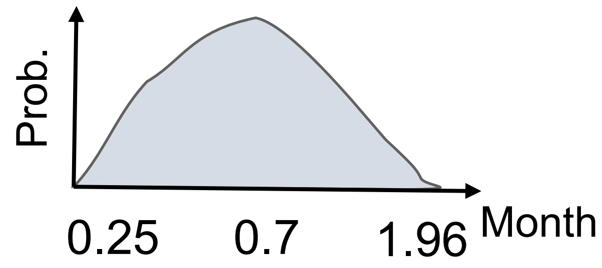
Parameter	Value	[Confidence Interval]
Duration of primary stage (months)	0.7	[0.25-1.96]
Duration of secondary stage (months)	3.6	[2.16-5.99]

Test plausible boundary values

Value	[Confidence Interval]
0.7	[0.25-1.96]
3.6	[2.16-5.99]

Produces a range of outcomes

Sample from probability distributions



Generates an outcome distribution across iterations

Step⑧ Evaluating Results

Evaluate the trade-offs between effects and costs across multiple decision options. In health economics, cost-effectiveness analysis is commonly used.

1. Define the problem and objectives
2. Define outcomes
3. Select simulation model
4. Design simulation model
5. Select model inputs
6. Simulate multiple decision options
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8. **Evaluate results**

- Methods for evaluating cost–effect trade-offs (WHO. 2003)
  - Cost-minimization analysis
    - Compare costs across options and select the least costly. Requires that outcomes be equivalent across options.
  - Cost-benefit analysis
    - Compare the difference between monetized benefits and costs. Select the option with the largest net benefit. Less commonly used due to the difficulty of monetizing health outcomes.
  - **Cot-effectiveness analysis**
    - **Compare options based on the incremental cost per incremental unit of effect.**

WHO. Introduction to Drug Utilization Research. 2003

Step⑧ Evaluating Results

In cost-effectiveness analysis, the preferred option is the one with the lowest incremental cost per additional unit of effect (ICER).

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2. Define outcomes
3. Select simulation model
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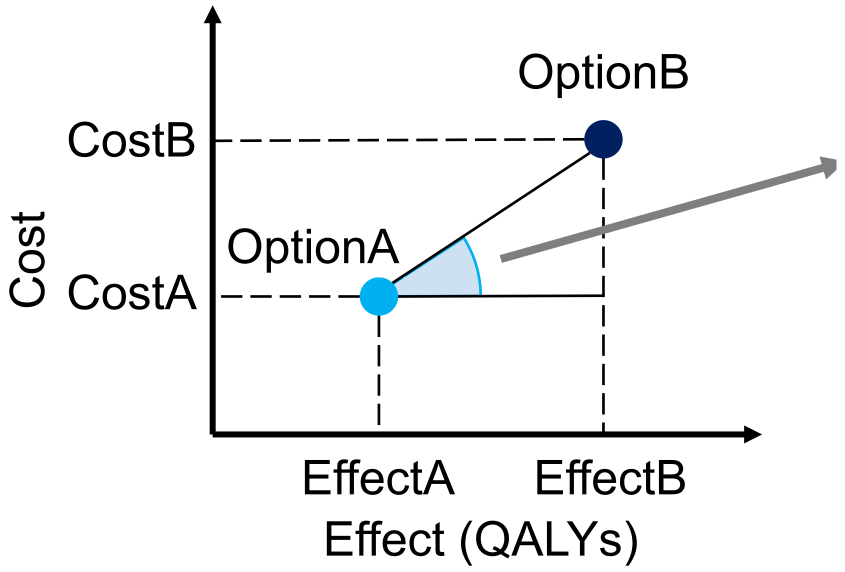
8. **Evaluate results**

- A lower increase in cost per increase in effect is preferable.
  - Incremental Cost-Effectiveness Ratio (ICER)

    = the slope between two options when plotting costs and effects of the options



$$\frac{\textbf{CostB} - \textbf{CostA}}{\textbf{EffectB} - \textbf{EffectA}}$$

  - In Japan, an ICER of ≤ ¥5 million per QALY is often considered cost-effective.

Agenda

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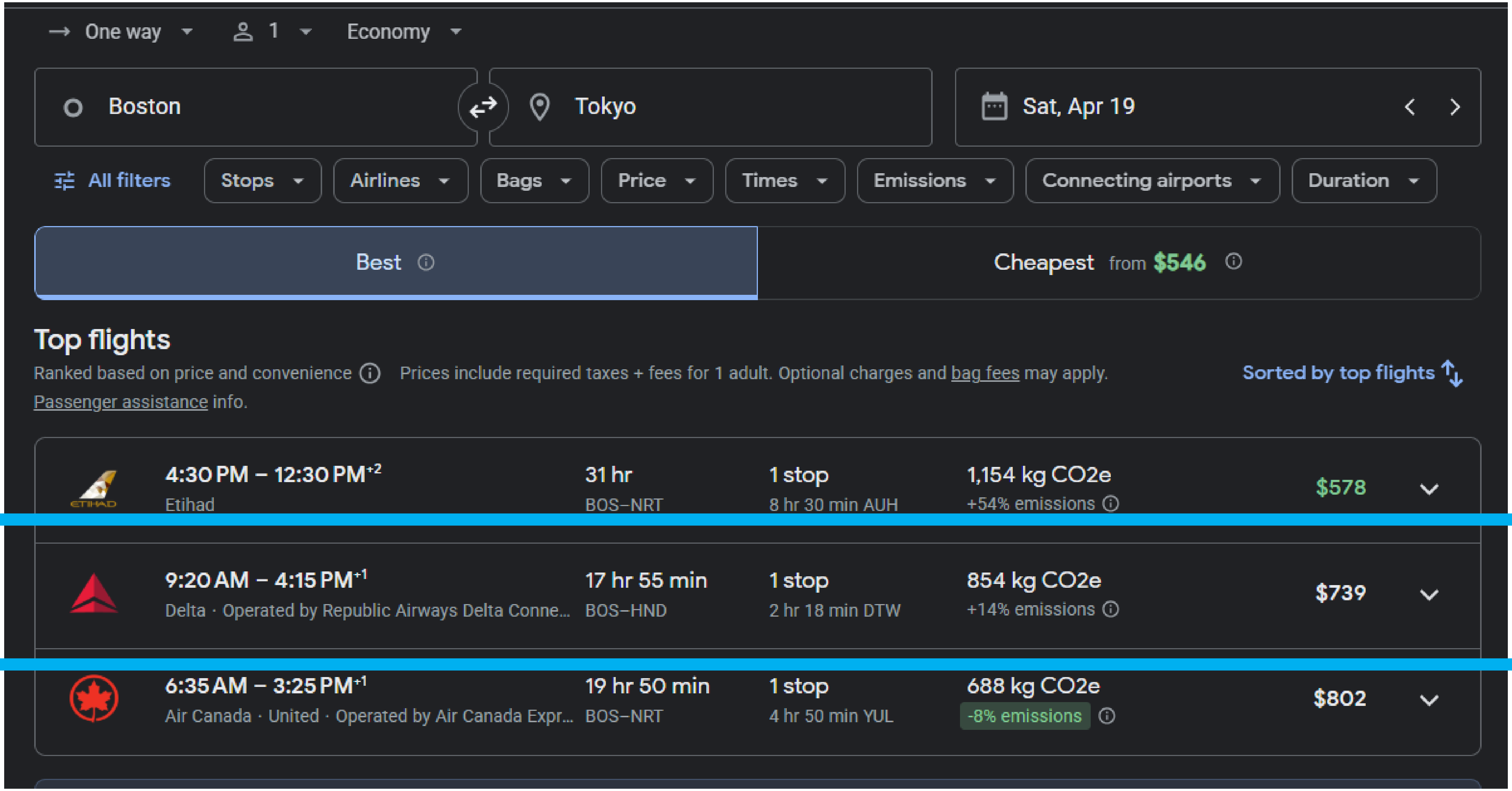
2. Experiencing Decision Science in practice

3. Use cases of Decision Science

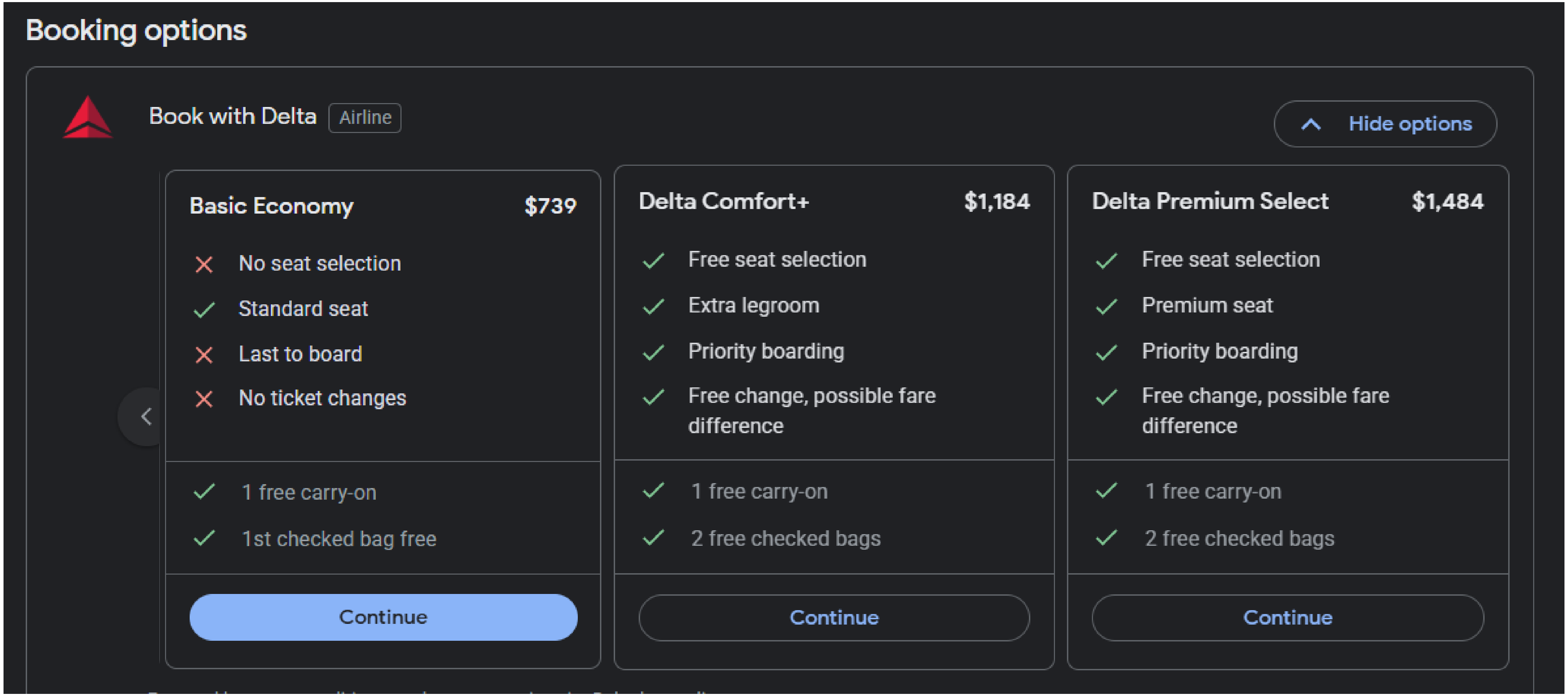
Choosing a Flight Seat Class

Assume we select Delta for the previously discussed flight to Tokyo.



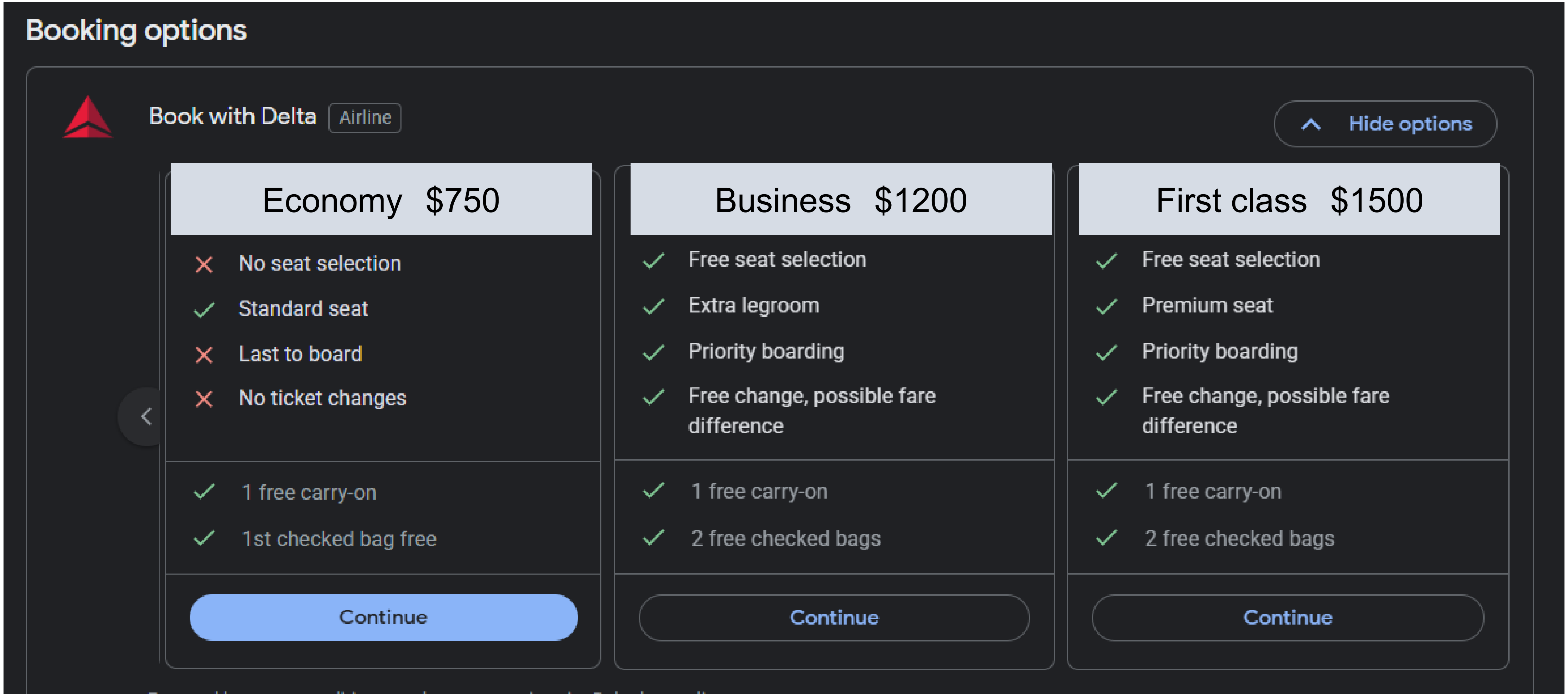
Choosing a Flight Seat Class

Selecting one option from three seat classes.



Choosing a Flight Seat Class

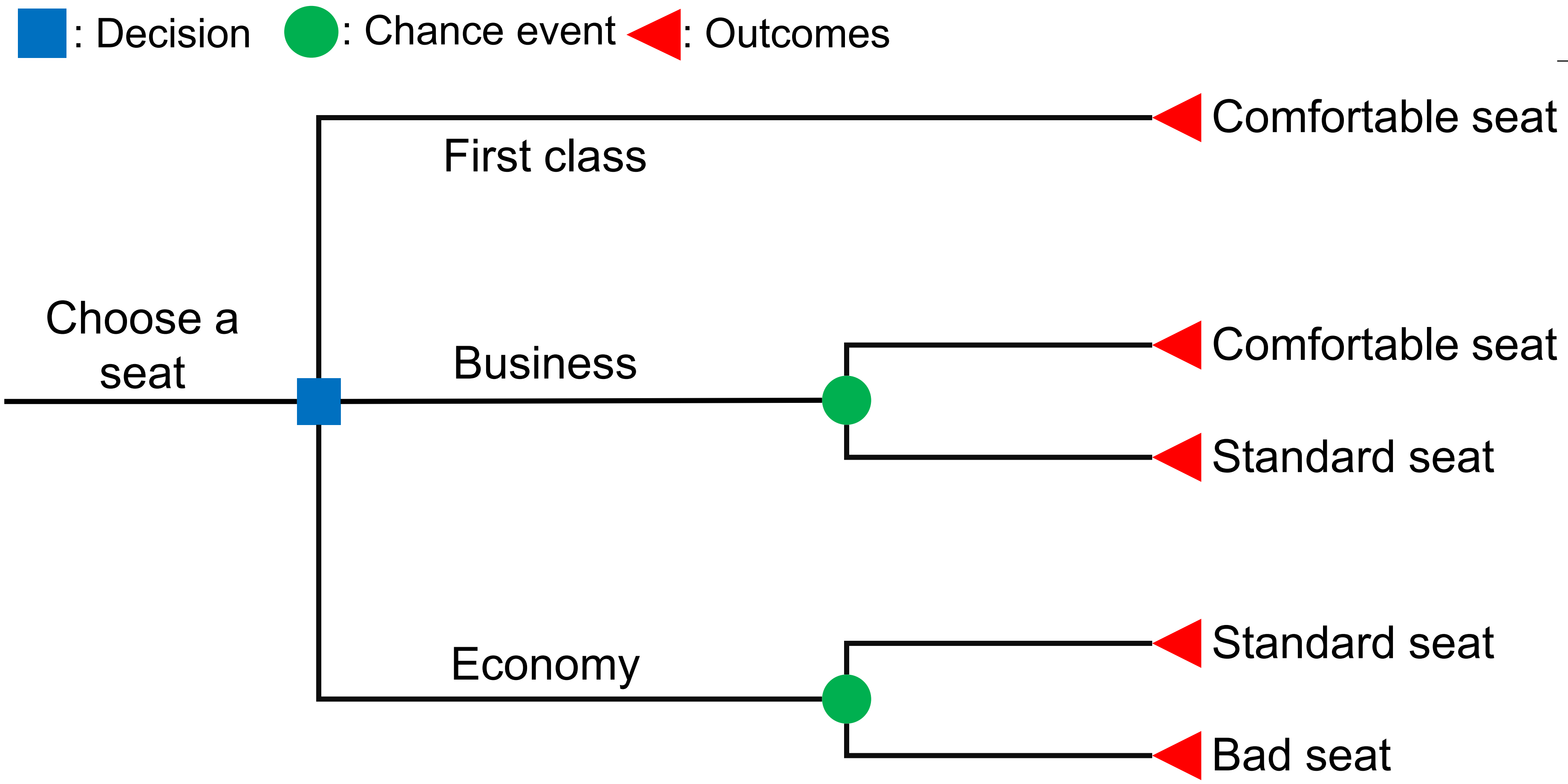
Assign simple labels for convenience.



Choosing a Flight Seat Class — Objective and Outcomes

- Decision problem and objective
  - For an 18-hour Boston–Tokyo flight, choose the seat class—Economy, Business, or First—that provides the greatest comfort relative to cost.
  - Although Economy is usually chosen, any class is affordable within the budget for this scenario.
- Outcomes
  - Effect: Comfort × Time → Quality-Adjusted Hours (QAH)
    - Comfort is defined on a scale from 0 = flight canceled to 1 = extremely comfortable (a premium travel experience)
    - Cost: Airfare
- Willingness to pay
  - Willing to pay up to $120 per QAH(i.e., per hour of an “extremely comfortable” travel experience)

Choosing a Flight Seat Class — Structuring the Decision Problem



Outcome	Cost ($)	Comfort
Comfortable seat	1500	1
Comfortable seat	1200	1
Standard seat	1200	0.8
Standard seat	750	0.8
Bad seat	750	?

Choosing a Flight Seat Class — Measuring Utility

- Occasionally, when flying, you encounter a “bad seat.”
  - Seat monitor is broken (there may be workarounds)
  - Seat does not recline
  - No power outlet etc.

- The comfort level of a “bad seat” is likely to influence the decision.

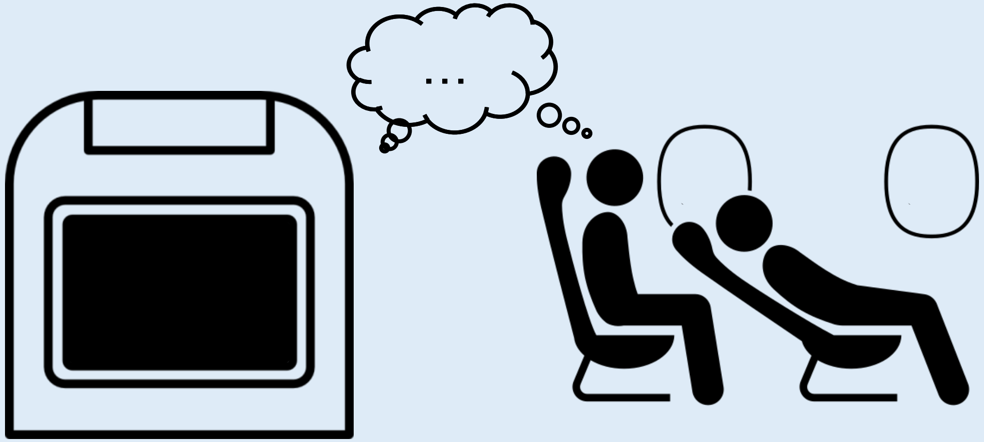
- Let’s design an experiment to measure the utility (comfort) of a “bad seat.”

Measuring the Utility of a "Bad Seat"

You can choose "a lottery between First Class with probability P, or Not boarding the flight." Raise your hand when you feel indifferent with varying P.

"Bad seat"

(Broken screen, Seat does not recline, No power outlet)

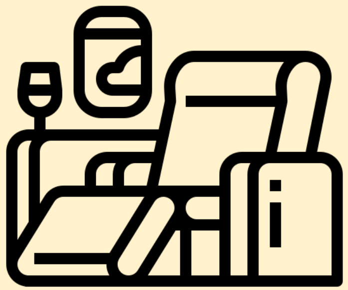


Lottery

No flight

100-P%

First Class



P%

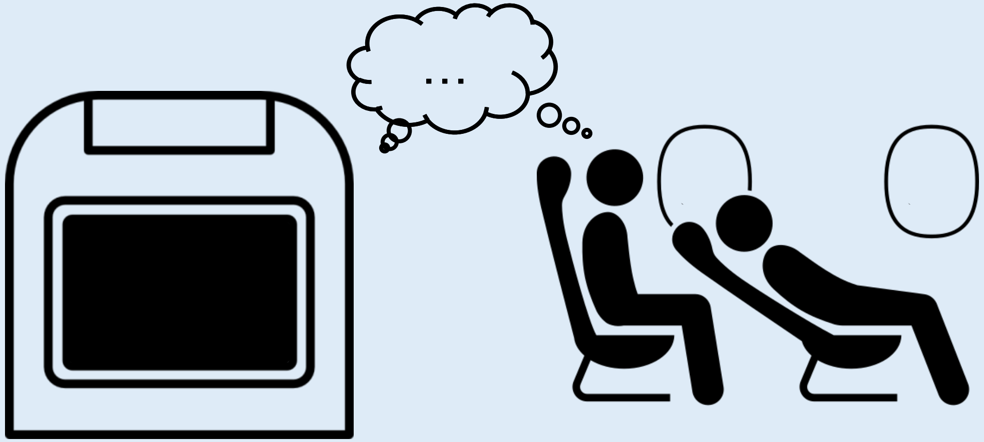
I am indifferent between the bad seat and the lottery

Measuring the Utility of a "Bad Seat"

Please raise your hand when you feel indifferent with varying P.

"Bad seat"

(Broken screen, Seat does not recline, No power outlet)

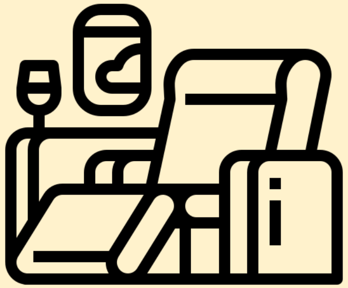


Lottery

No flight

0%

First Class



100%

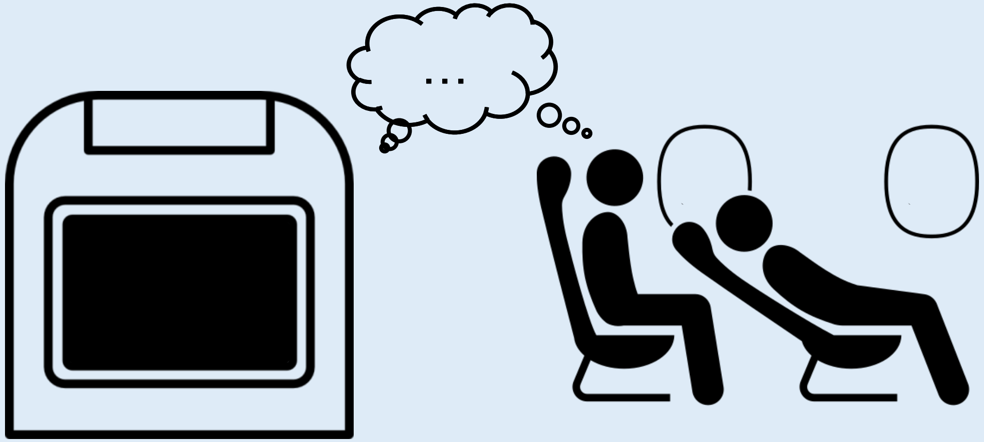
I am indifferent between the bad seat and the lottery

Measuring the Utility of a “Bad Seat”

Please raise your hand when you feel indifferent with varying P.

“Bad seat”

(Broken screen, Seat does not recline, No power outlet)

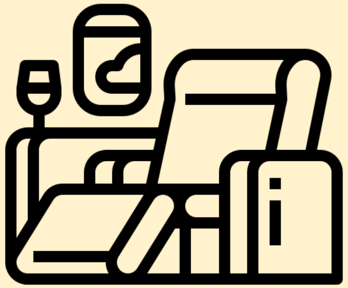


Lottery

No flight

10%

First Class



90%

I am indifferent between the bad seat and the lottery

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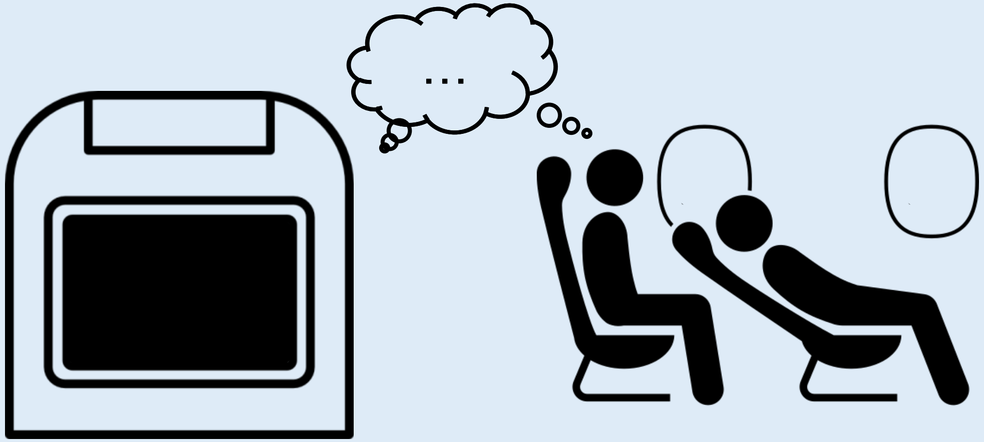
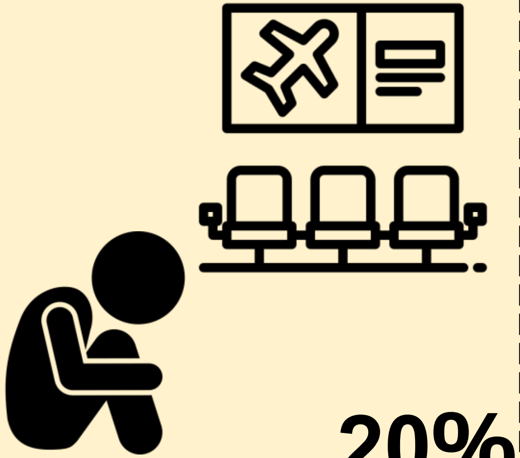


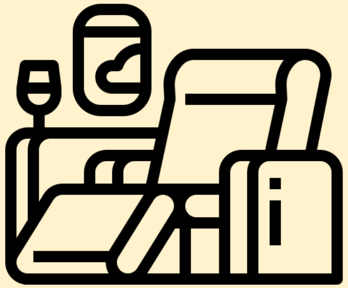
Lottery

No flight



20%

First Class



80%

I am indifferent between the bad seat and the lottery

Measuring the Utility of a "Bad Seat"

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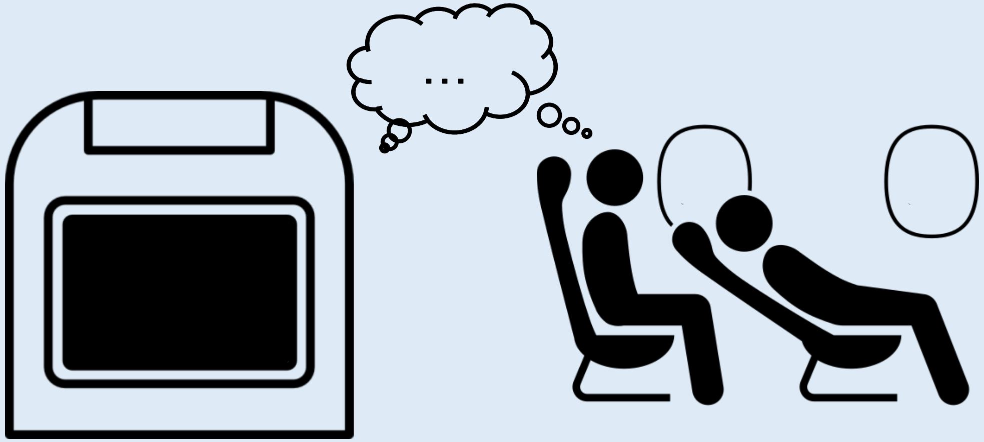
"Bad seat"

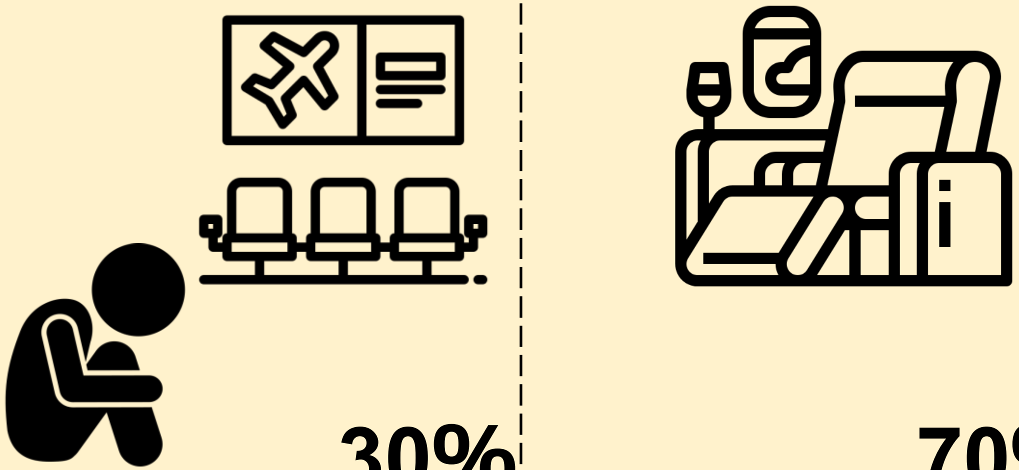
(Broken screen, Seat does not recline, No power outlet)



Lottery

No flight

First Class



30%

70%

I am indifferent between the bad seat and the lottery

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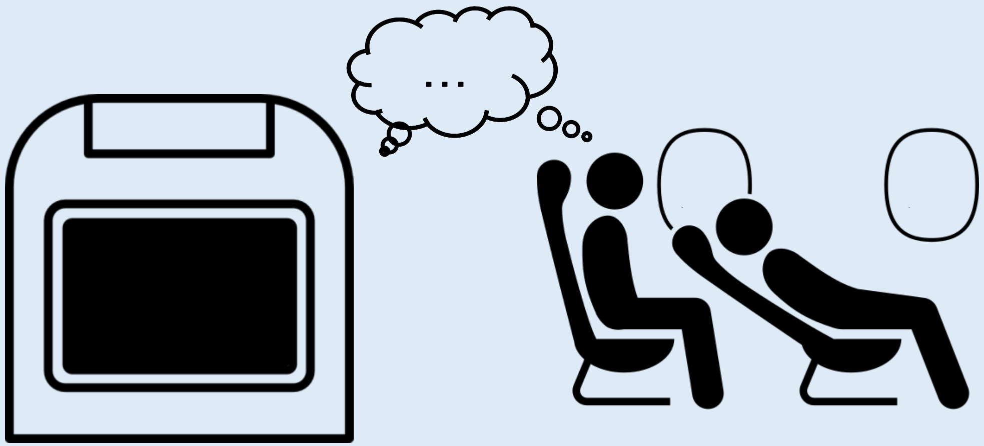
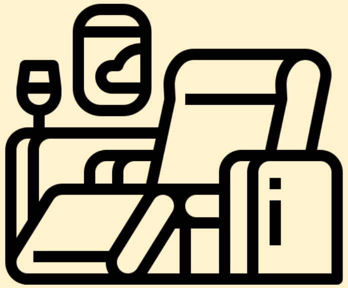


Lottery

No flight

40%

First Class



60%

I am indifferent between the bad seat and the lottery

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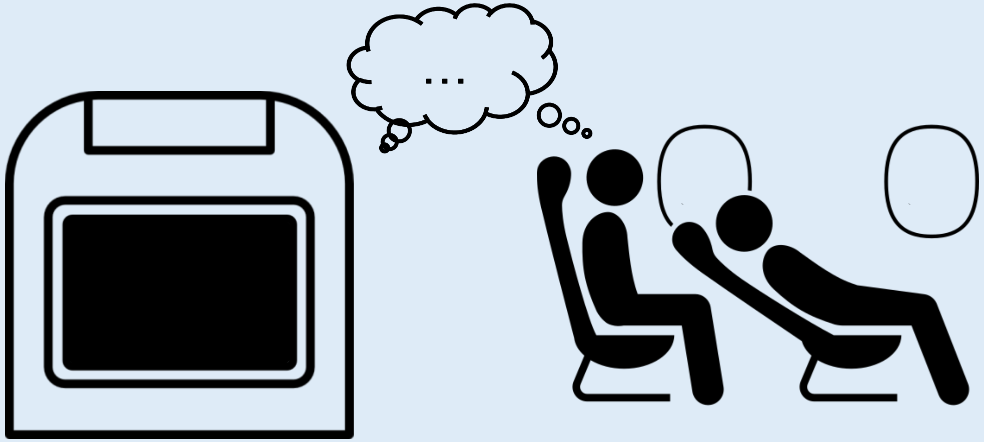
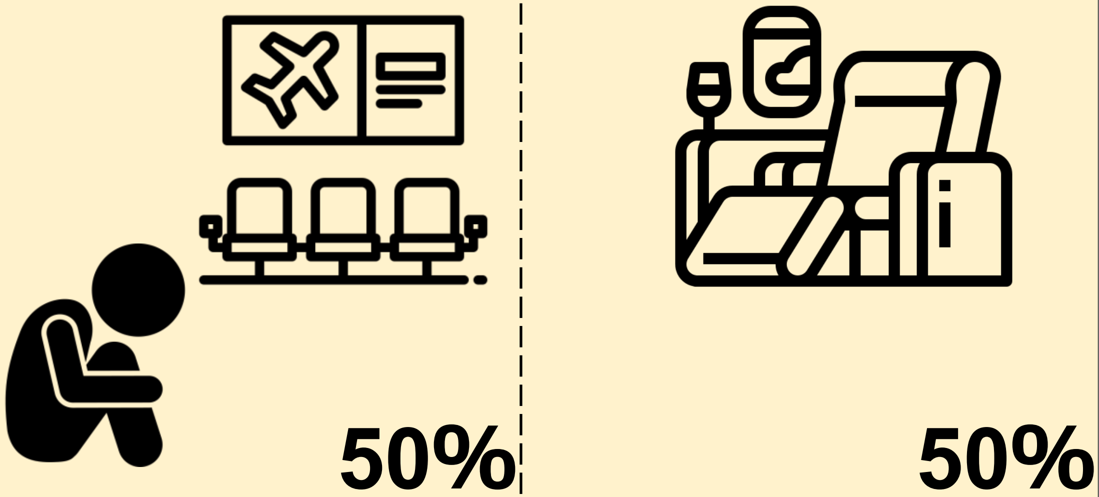


Lottery

No flight | First Class



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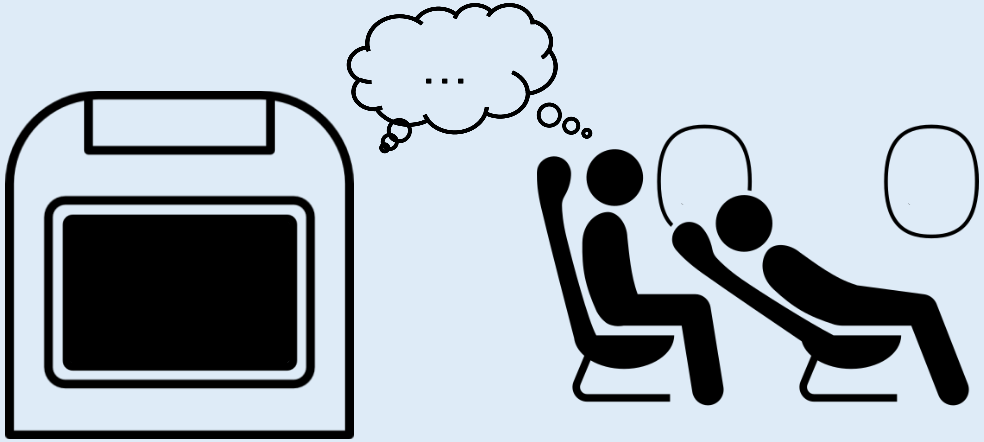
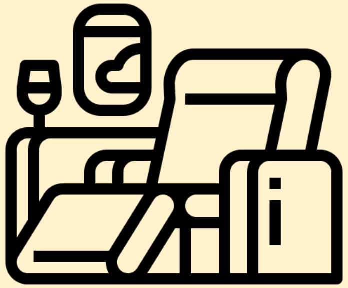


Lottery

No flight

60%

First Class



40%

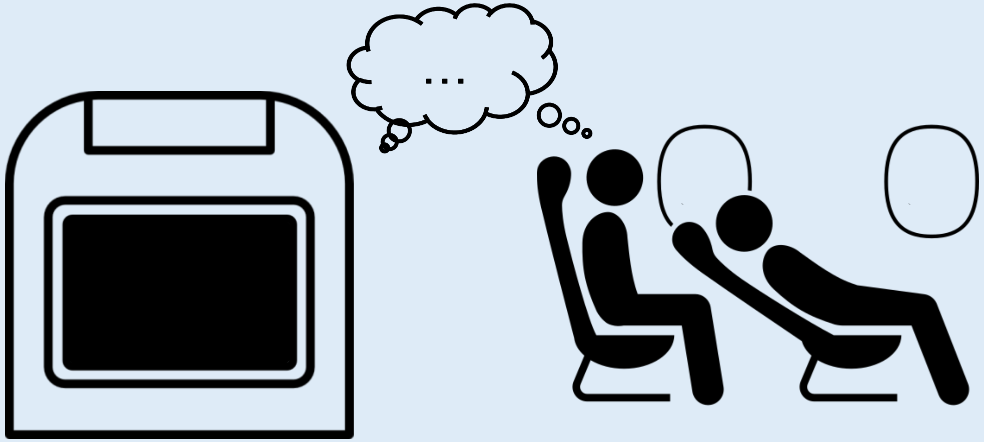
I am indifferent between the bad seat and the lottery

Measuring the Utility of a "Bad Seat"

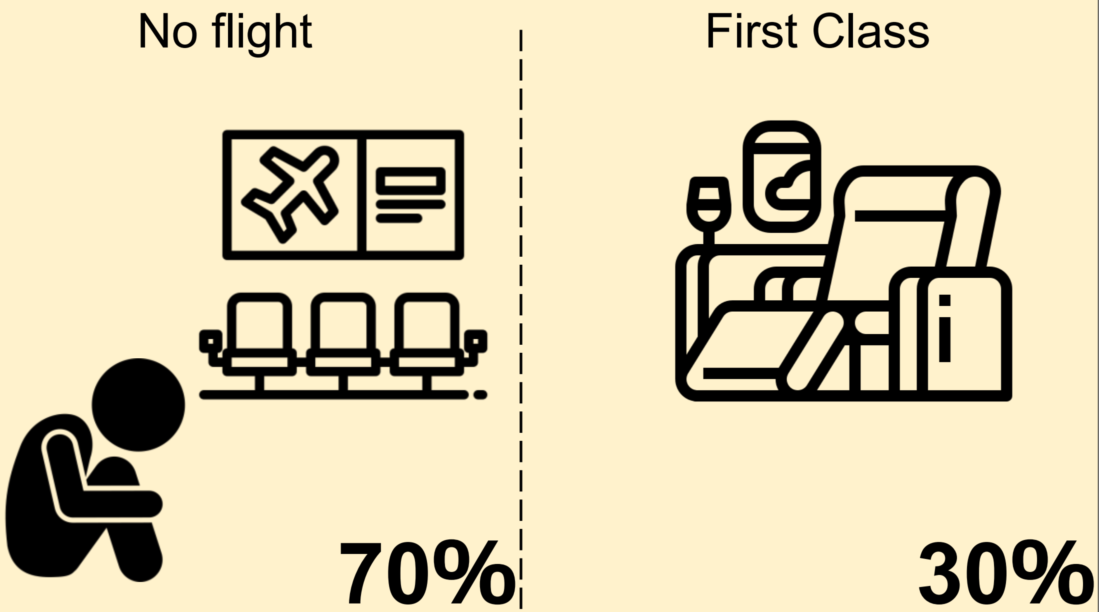
Please raise your hand when you feel indifferent with varying P.

"Bad seat"

(Broken screen, Seat does not recline, No power outlet)



Lottery



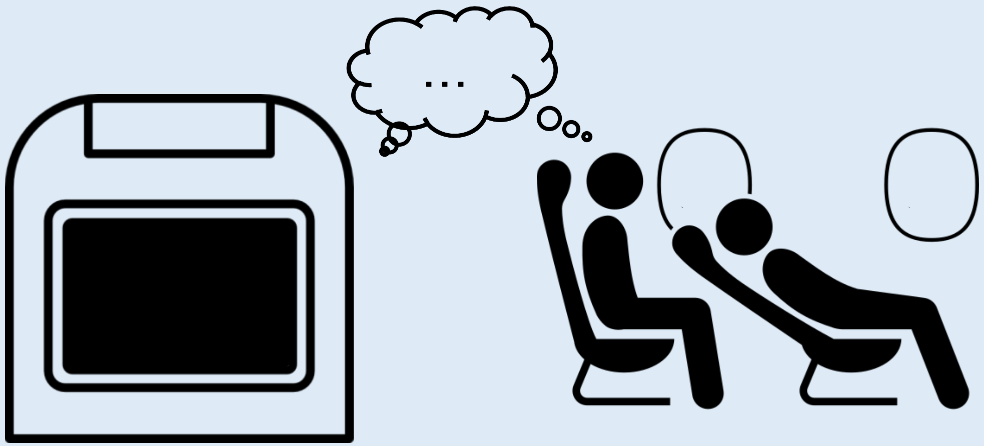
I am indifferent between the bad seat and the lottery

Measuring the Utility of a “Bad Seat”

Please raise your hand when you feel indifferent with varying P.

“Bad seat”

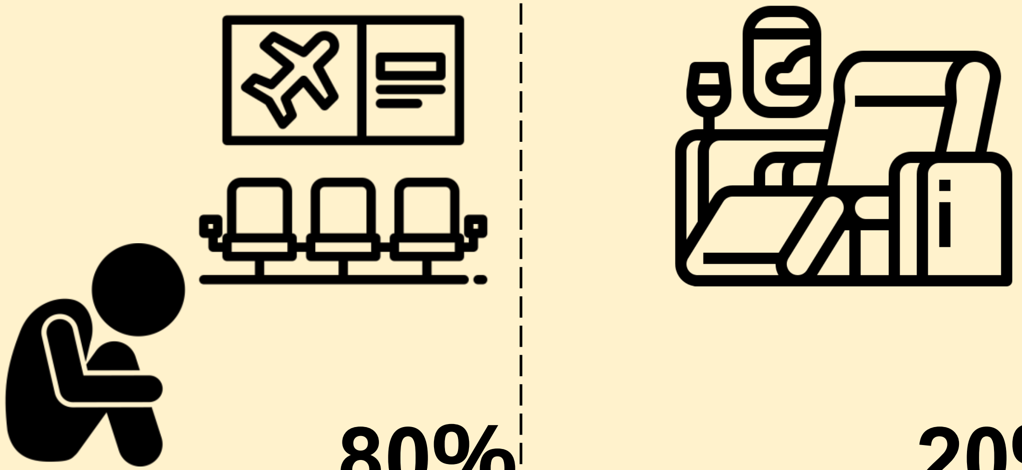
(Broken screen, Seat does not recline, No power outlet)



Lottery

No flight

First Class



80%

20%

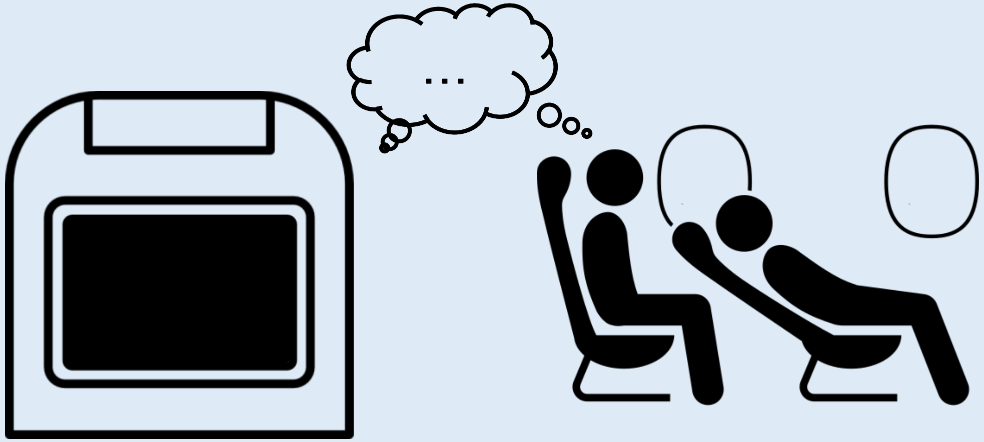
I am indifferent between the bad seat and the lottery

Measuring the Utility of a “Bad Seat”

Please raise your hand when you feel indifferent with varying P.

“Bad seat”

(Broken screen, Seat does not recline, No power outlet)

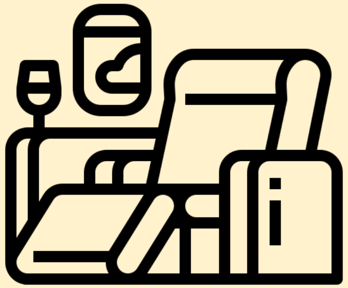


Lottery

No flight

90%

First Class



10%

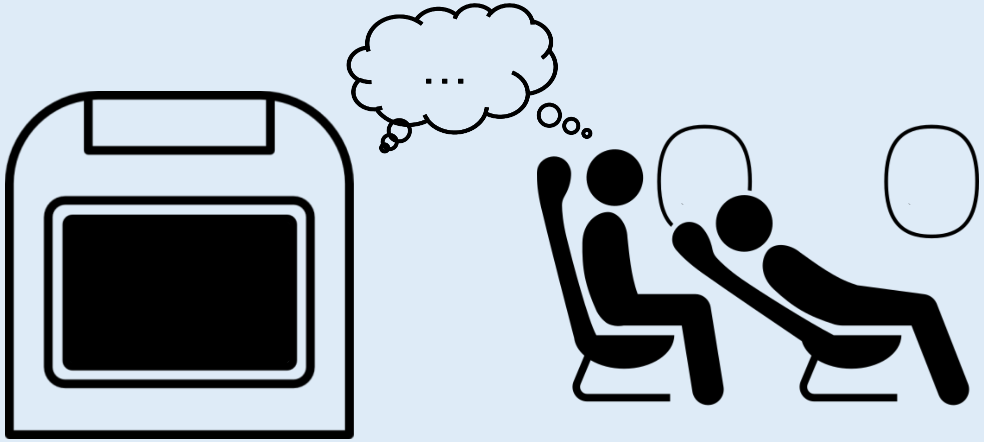
I am indifferent between the bad seat and the lottery

Measuring the Utility of a "Bad Seat"

Please raise your hand when you feel indifferent with varying P.

"Bad seat"

(Broken screen, Seat does not recline, No power outlet)

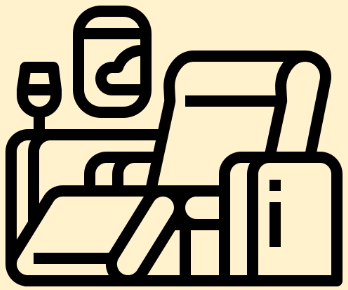


Lottery

No flight

100%

First Class



0%

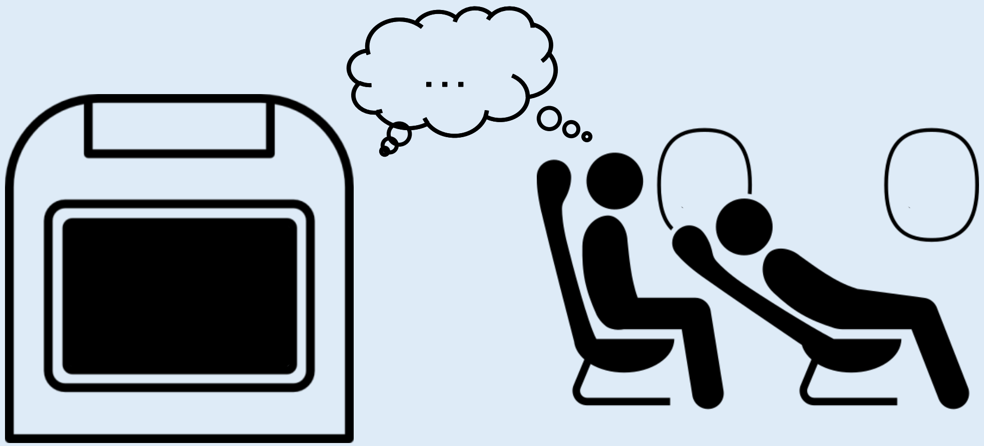
I am indifferent between the bad seat and the lottery

Measuring the Utility of a “Bad Seat”

When you are indifferent, the utility of the bad seat equals the expected utility of the lottery — this is the Standard Gamble method.

“Bad seat”

(Broken screen, Seat does not recline, No power outlet)

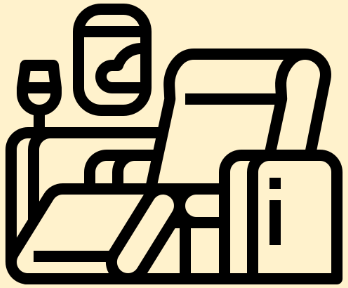


Lottery

No flight

100-P%

First Class

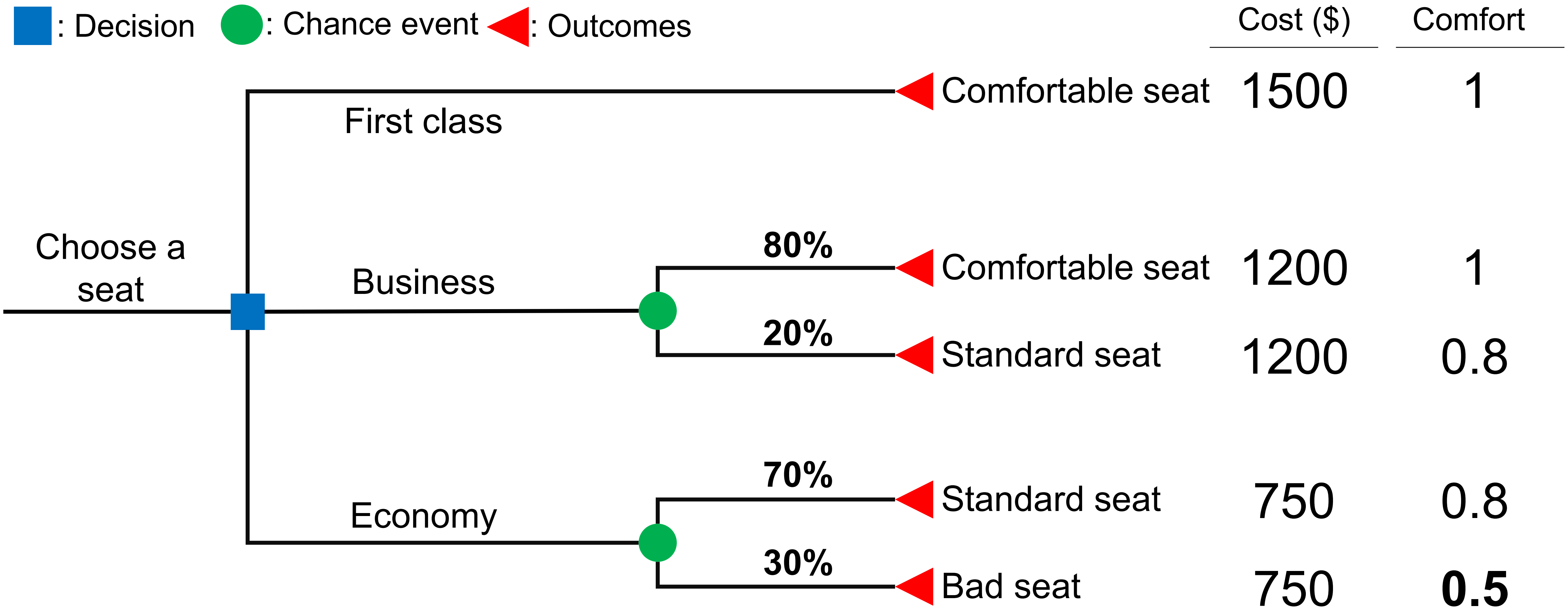


P%

Utility of a “Bad Seat” × 100% = 0 × (100-P%) + 1 × P%

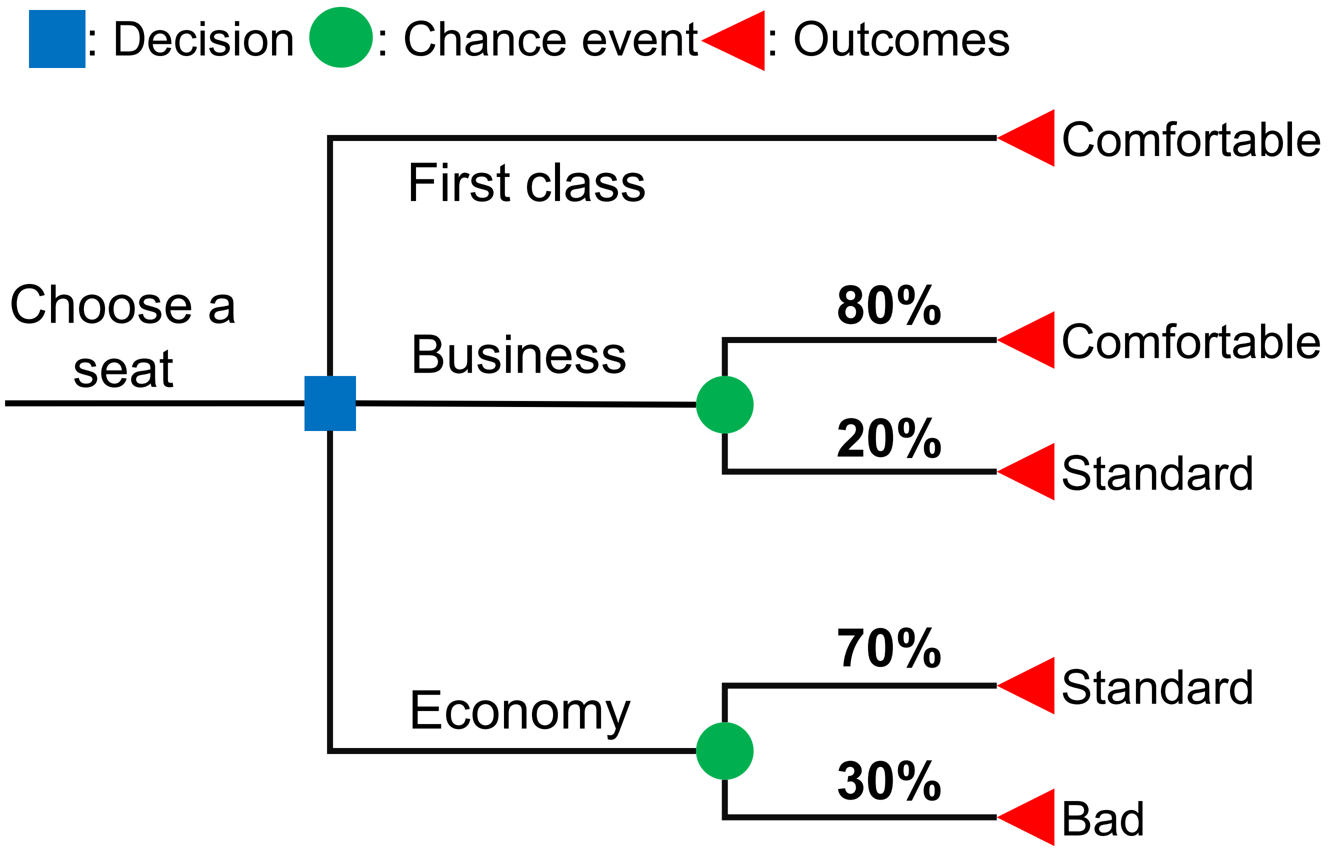
Choosing a Flight Seat Class — Plugging in Model Inputs

Assume the following values have been obtained.



Choosing a Flight Seat Class — Running the Simulation

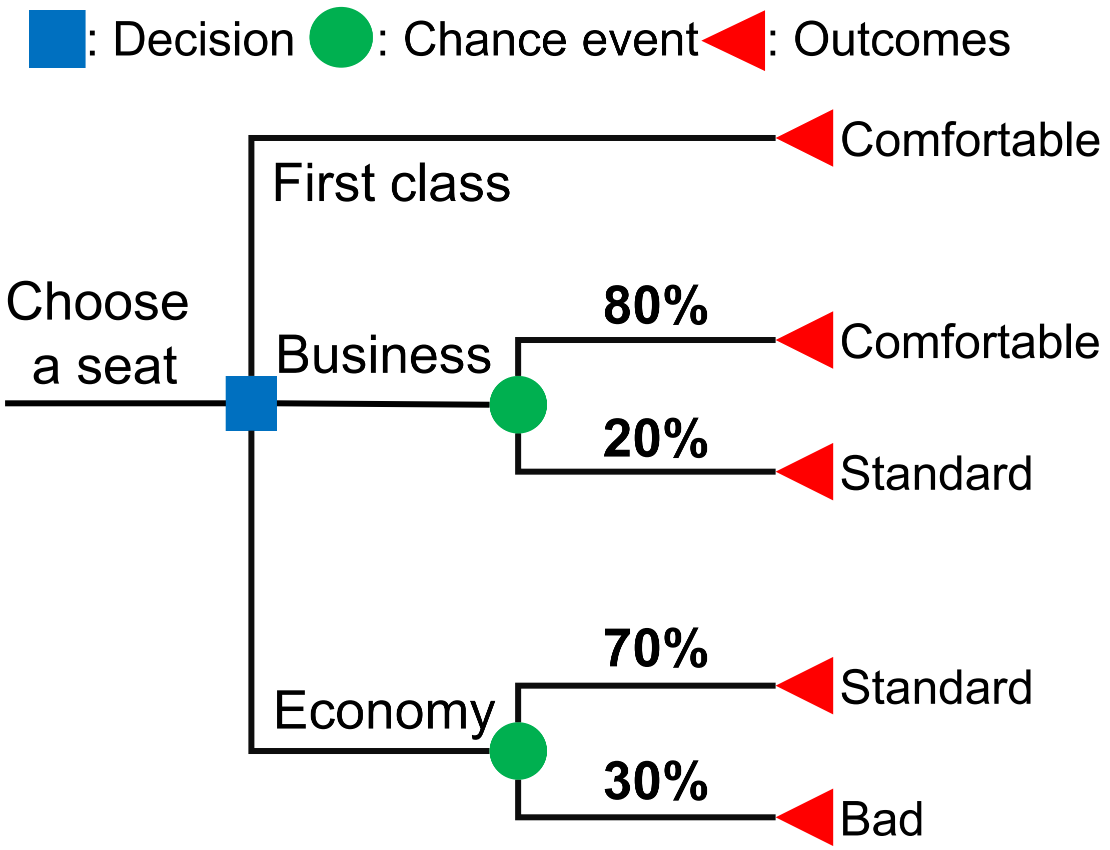
Estimating expected cost and expected comfort.



Cost ($)	Comfort	Expected cost ($)	Expected comfort
1500	1	1500	1
1200	1	960	0.8
1200	0.8	240	0.16
750	0.8	525	0.8
750	0.5	225	0.15

Choosing a Flight Seat Class — Running the Simulation

Calculating QAH for each seat class from expected values.



Cost ($)	Comfort	Expected cost($)	Expected comfort	QAH
1500	1	1500	1	18
			18h	
1200	1	960	0.8	
1200	0.8	240	0.16	
		1200	**0.96**	**17.28**
750	0.8	525	0.56	
750	0.5	225	0.15	
		750	**0.71**	**12.78**

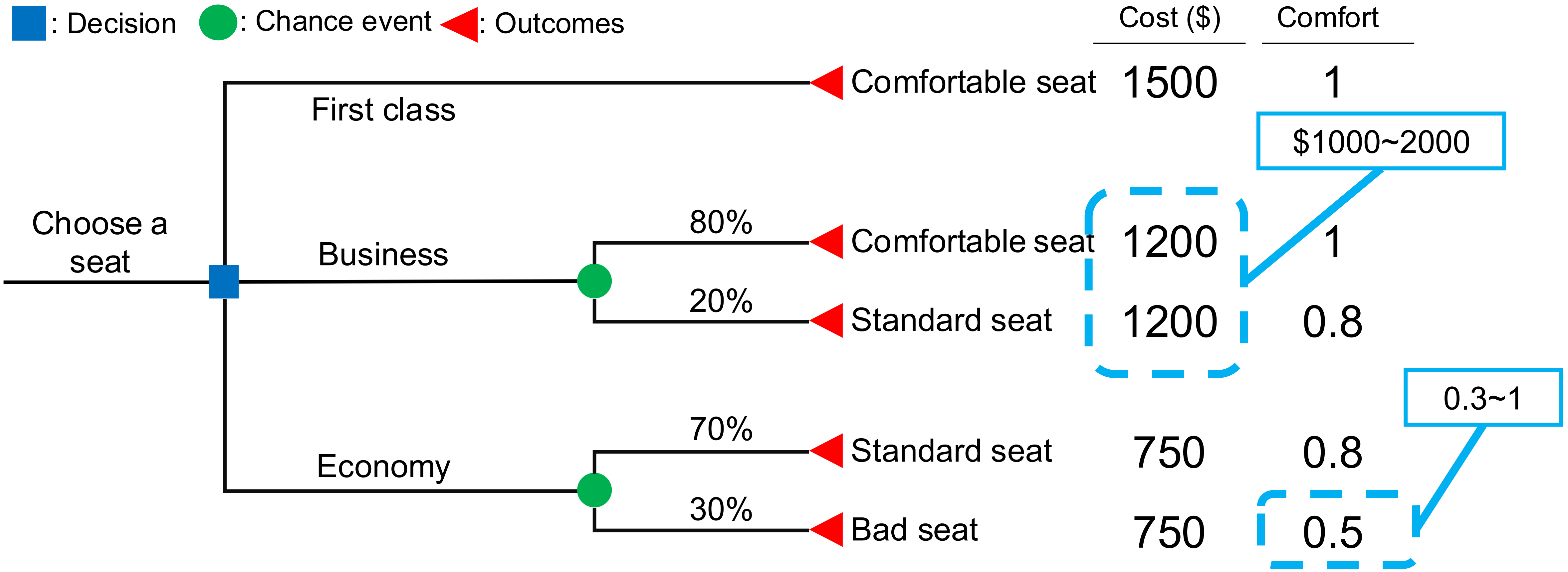
Choosing a Flight Seat Class — Evaluating Results

If you are willing to pay $120 per QAH, it is reasonable to upgrade from Economy to Business.

Seat class	Cost ($)	QAH	ICER ($/QAH)
Economy	750	12.78	-
Business	1200	17.28	100
First Class	1500	18.00	144

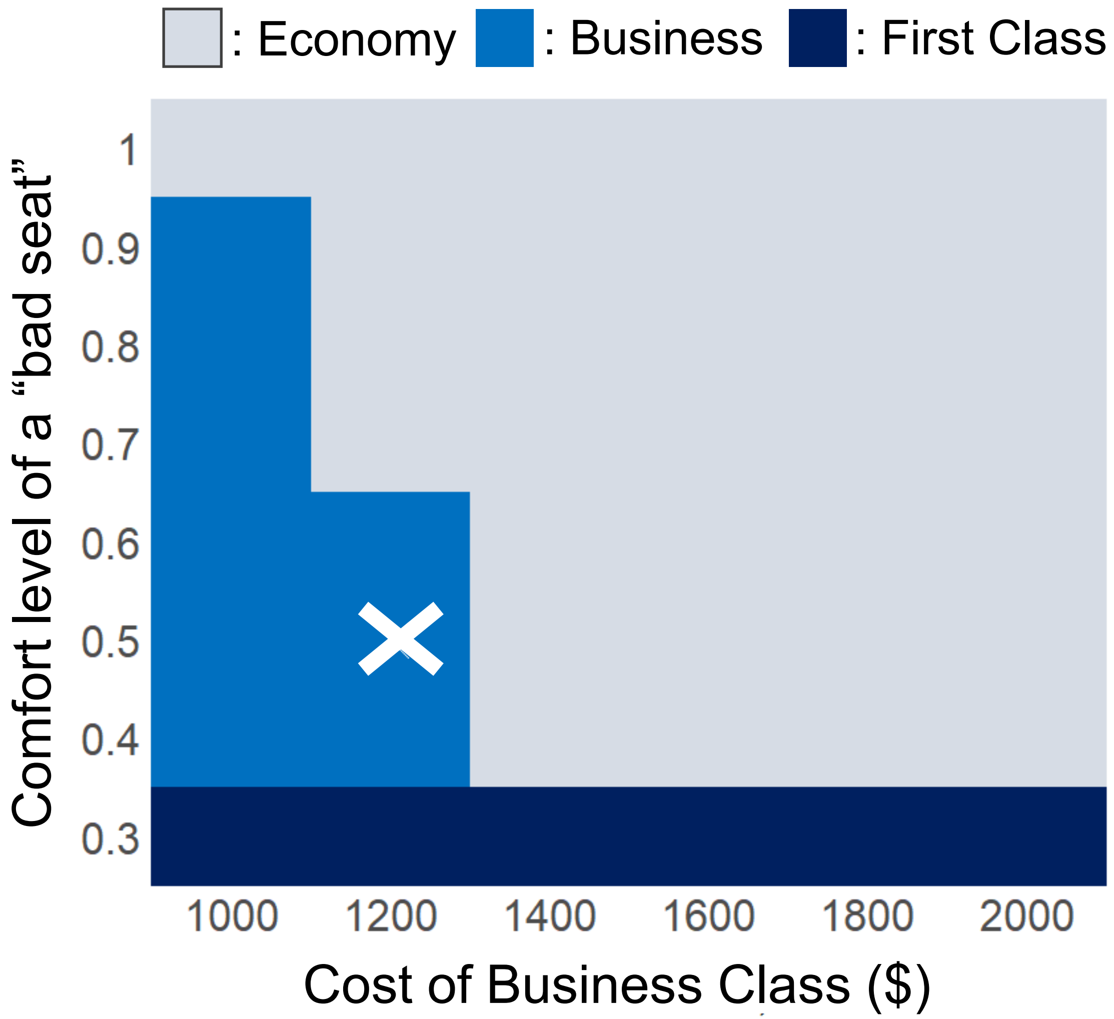
Choosing a Flight Seat Class — Sensitivity Analysis①

Does the most cost-effective seat class change depending on the comfort level of a “bad seat” and the cost of Business Class?



Choosing a Flight Seat Class — Sensitivity Analysis①

The most cost-effective seat class depends on the comfort level of a "bad seat" and the cost of Business Class.



- When the comfort of a "bad seat" is low
  - Choose First Class, regardless of the cost of Business Class.
- When the comfort of a "bad seat" is not too low and Business Class is inexpensive
  - Choose Business Class.
- Otherwise
  - Choose Economy Class.

Agenda

1. What is Decision Science, and how do we analyze decisions?

2. Experiencing Decision Science in practice

3. Use cases of Decision Science

Use Cases in Healthcare

Examples that contributed to the development and updating of national screening and treatment guidelines.

- Age-specific colorectal cancer screening guidelines (U.S. Preventive Services Task Force, 2021)
  - U.S. Preventive Services Task Force (USPSTF)
    - An independent expert panel that issues evidence-based recommendations on screening and preventive interventions in primary care

  - In updating colorectal cancer screening guidelines, simulation modeling was used to evaluate life-years gained, number of preventable colorectal cancer cases, and colorectal cancer deaths averted across multiple choices of screening start ages and screening modalities.

  - The work was commissioned to CISNET (Cancer Intervention and Surveillance Modeling Network)—a consortium of decision scientists, epidemiologists, and health economists from the U.S., Europe, and Australia.

  - Age-specific screening guidelines were developed by integrating simulation results with evidence from systematic reviews.

US Preventive Services Task Force. Screening for Colorectal Cancer: US Preventive Services Task Force Recommendation Statement. JAMA. 2021;325(19):1965–1977. doi:10.1001/jama.2021.6238

Use Cases in Healthcare

Examples that contributed to the development and updating of national screening and treatment guidelines.

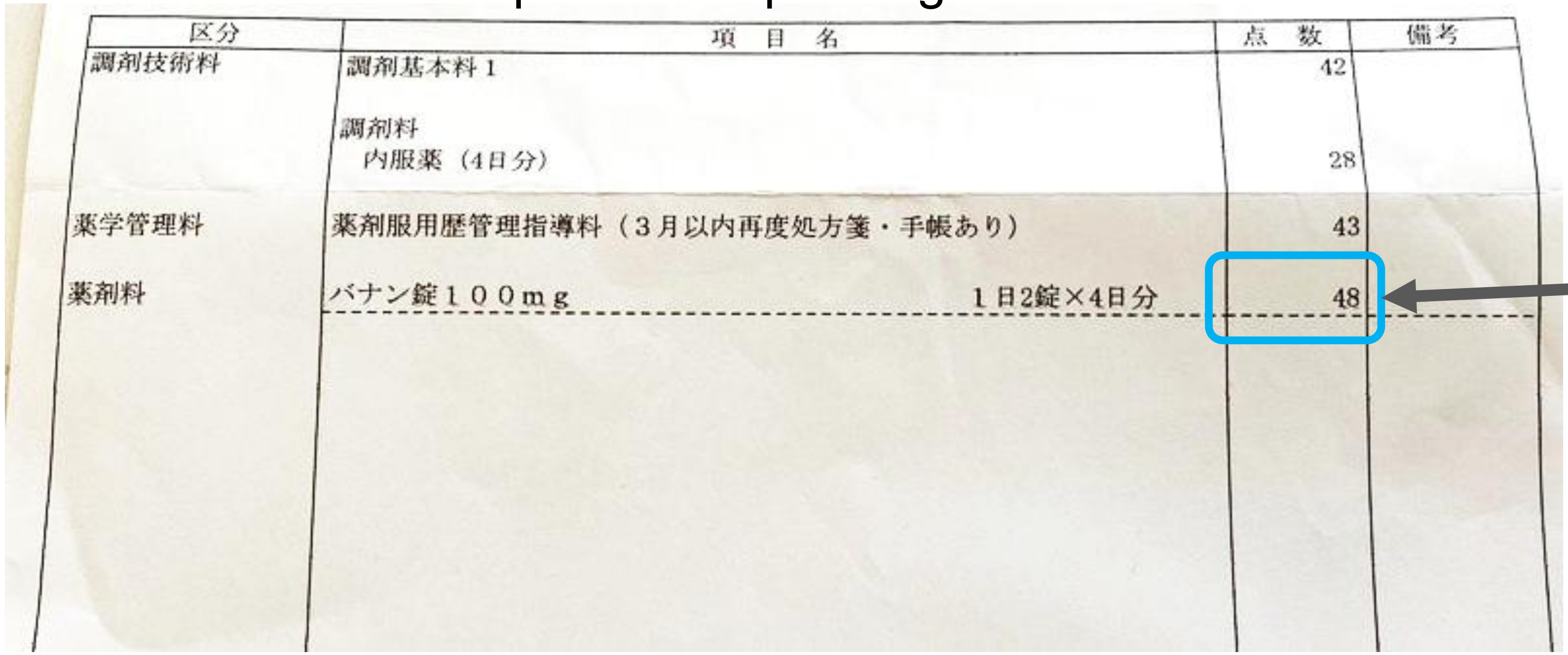
- COVID-19 booster vaccination guidelines (Roper et al., 2024)
  - Advisory Committee on Immunization Practices (ACIP)
    - A committee within the CDC that provides recommendations on vaccine use for the U.S. population
  - Conducted analyses to identify recommended target groups for booster vaccination in the 2024–2025 season.
  - In collaboration with the University of Michigan, simulation-based cost-effectiveness analyses were performed comparing two booster doses, one booster dose, no booster, evaluating clinical outcomes (number of infections, hospitalizations, deaths, and adverse events) and costs.
  - Recommendations for booster vaccination in older adults for 2024–2025 were informed by analyses of vaccine effectiveness using data from hospitals nationwide and the Medicare database, and Safety analyses based on systematic literature reviews.

Roper LE, Godfrey M, Link-Gelles R, et al. Use of Additional Doses of 2024–2025 COVID-19 Vaccine for Adults Aged ≥65 Years and Persons Aged ≥6 Months with Moderate or Severe Immunocompromise: Recommendations of the Advisory Committee on Immunization Practices—United States, 2024. MMWR Morb Mortal Wkly Rep 2024;73:1118–1123. DOI: http://dx.doi.org/10.15585/mmwr.mm7349a2

Use Case in Health Insurance Systems

In Japan, prices of prescription drugs covered by public health insurance are set by the Ministry of Health, Labour and Welfare (MHLW) and are regularly revised.

Example of a dispensing statement



区分	項目名	点数	備考
調剤技術料	調剤基本料１	42	
	調剤料 内服薬（4日分）	28	
薬学管理料	薬剤服用歴管理指導料（３月以内再度処方箋・手帳あり）	43	
薬剤料	バナン錠１００mg　１日2錠×4日分	48	

List of drugs listed in the official drug price schedule

アメブロ：処方箋の薬、同じ薬でもコストコの調剤薬局が激安 | 栄養士ママそっち～の簡単美味しいサイクル献立 https://ameblo.jp/socchidiary/entry-12687858014.html

Use Case in Health Insurance Systems

Since FY2019, cost-effectiveness analysis has been used to adjust prices after insurance listing for selected pharmaceuticals and medical devices.

Process (based on MHLW 2024)

Insurance listing of pharmaceuticals & medical devices

↓

Chuikyo selects products for cost-effectiveness analysis

↓

Manufacturer-led analysis ⇄ Independent re-analysis by C2H with health economists and clinical experts

↓

Comprehensive assessment

↓

Post–price-setting price adjustment

Chuikyo: The Central Social Insurance Medical Council
C2H: Center for Health Economics Research, National Institute of Public Health

Key Points

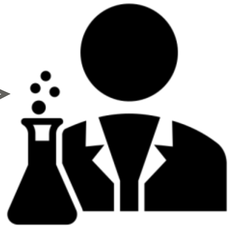
- Introduced in FY2019 in response to rising healthcare costs due to population aging.
- Applied only to products with large market size or very high unit prices.
- Company analyses are reviewed and re-analyzed by C2H with independent experts.
- After comprehensive assessment, products with poor cost-effectiveness (≥ ¥5 million/QALY) may face price cuts; products contributing to cost savings may receive price increases.
- Challenge: Limited evaluation capacity—currently about ~10 products per year; workforce development is needed.

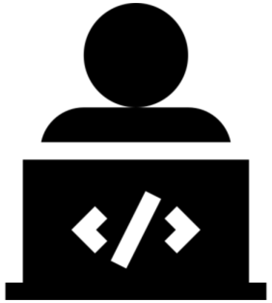
Overview of the FY2024 Medical Fee Revision: “Cost-Effectiveness Evaluation System” Health Insurance Bureau, Medical Affairs Division, MHLW; C2H

Use Case in Research

Researchers and funders face limited budgets, making it possible to plan additional studies with high cost-effectiveness.

For a given disease, existing studies show no significant difference between Treatment A and Treatment B. Should we conduct an interventional study comparing A vs. B, or an observational study?

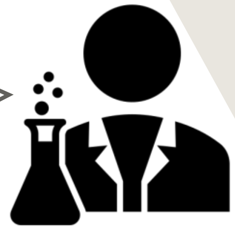




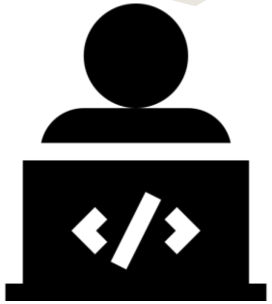
Use Case in Research

For decision problems faced by researchers and research funders, a model is built using existing evidence to estimate the value of eliminating uncertainty in key parameters.

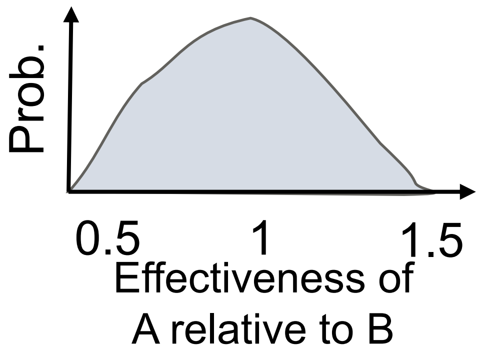
For a given disease, existing studies show no significant difference between Treatment A and Treatment B. Should we conduct an interventional study comparing A vs. B, or an observational study?



- Effectiveness w/ 95%CI
- Treatment costs
- Health benefits of treatment
- Acceptable budget for additional research, etc.



Existing data

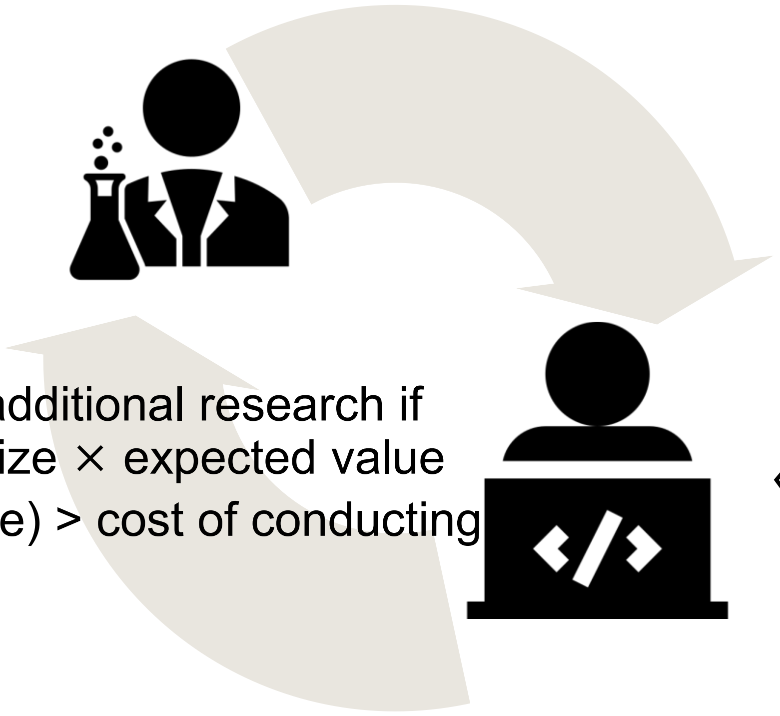


Build a model and run probabilistic simulations

We can estimate the expected value when unlimited information is available and effectiveness is known with certainty (zero uncertainty)—which **serves as a criterion for whether additional research is worth conducting.**

Use Case in Research

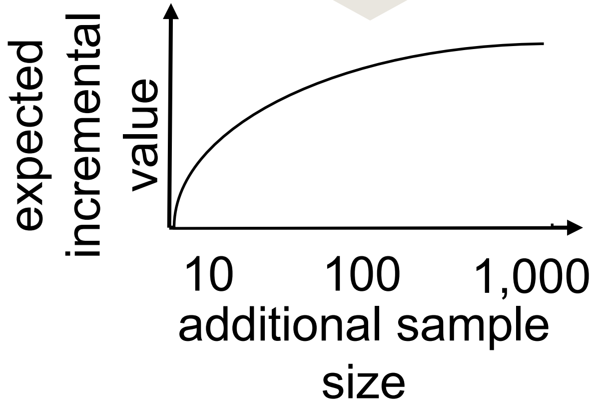
We can estimate the sample size that maximizes the value of information from additional research.



Conduct additional research if (sample size × expected value per sample) > cost of conducting the study

When further research is potentially valuable, a key question is: How large a sample is needed, given that a census is impossible?

Test different sample sizes in the model



Estimate the expected value of information for a given sample size.

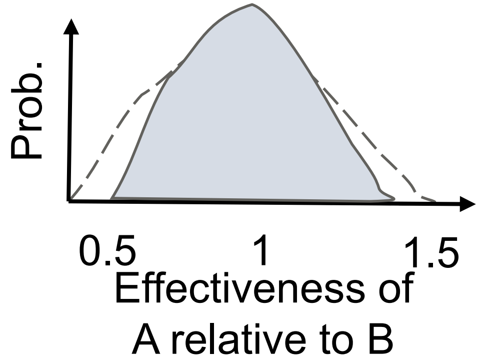
Use Case in Research

From pilot study data, we can estimate the value of information gained from conducting further research.

We've collected data from 100 participants for now, but should we continue the study?

Re-run the model using new data with slightly reduced uncertainty.

New collected data



We can estimate the expected value of additional information from further research.

Value of Information analysis
(VOI)

Use Case in Research

An example of Value of Information (VOI) analysis conducted by the UK National Health Service (NHS)

- RCT comparing wound dressings to prevent postoperative infection (Reeves et al., 2019)
  - Question: Should a large RCT be conducted to compare simple dressing, adhesive medical dressing, or no dressing for preventing postoperative infections?
  - Phase A: Model-based analysis using meta-analysis
    - Built a model using infection-reduction effects, dressing costs, infection costs, and utilities.
    - Results suggested adhesive dressing or no dressing was most cost-effective. Eliminating uncertainty in infection-reduction effects yields an expected value of £222 per wound (≈ £2.3 billion population value).
  - Phase B: Pilot RCT (~400 patients)Updated the model with trial data.
    - Adhesive dressing had the highest probability of being cost-effective.
    - Eliminating remaining uncertainty yields £177 per wound (≈ £1.8 billion population value).

Reeves BC, Rooshenas L, Macefield RC, et al. Three wound-dressing strategies to reduce surgical site infection after abdominal surgery: the Bluebelle feasibility study and pilot RCT. Health Technol Assess. 2019;23(39):1-166. doi:10.3310/hta23390

Challenges

Decision science is a support tool, not a substitute for decision-making

- Results depend on model assumptions and scope
  - Choices of assumptions, scope, and parameters can substantially change results.
  - Conclusions should be read as conditional (“cost-effective under assumptions X and Y”), not absolute.
  - Comparing analyses with slightly different assumptions helps assess robustness.

- Utility is subjective and heterogeneous
  - The same health state may be valued very differently across individuals.
  - Utility estimates reflect personal values and experiences and are inherently subjective.
  - Published average utilities are decision aids, not replacements for real-world decisions.

Challenges

Decision science is a support tool, not a substitute for decision-making.

- Fundamental limitations in measuring utility
  - Utility is typically defined on a continuous scale from 0 to 1.
  - Once utility reaches 0 (death), improvement beyond that point is not realistically observable.
  - Individuals who experience utility = 0 cannot participate in utility elicitation, creating a structural limitation in measurement.
- Limits to expanding the application of cost-effectiveness analysis
  - Healthcare (Japan)
    - Currently used mainly for drug and medical device price adjustments; extending it to clinical practice is difficult under the existing system.
    - Although cost-effectiveness analysis could theoretically justify price increases, in practice it tends to exert stronger downward pressure on prices.
    - Many Japanese hospitals already face financial strain; applying cost-effectiveness analysis alone risks further undermining hospital management. Complementary institutional reforms and support measures are essential to improve hospital sustainability.

Challenges

Decision science is a support tool, not a substitute for decision-making.

- Limits to expanding the application of cost-effectiveness analysis
  - Research
    - In basic research or early drug development, long time lags and high uncertainty reduce the usefulness of value-of-information analyses.
    - Some research should not be judged solely on economic efficiency (e.g., rare diseases with small populations).
    - Research aimed at fundamental scientific advancement may be worth pursuing even without immediate economic justification.

Summary

- Decision science is an interdisciplinary approach that quantitatively integrates effectiveness, costs, and uncertainty to guide optimal choices.
- In healthcare, it supports policy decisions such as screening guidelines and drug price revisions.
- Results do not provide a single “correct” answer; rather, they clarify which options are rational under which conditions, serving as a tool to facilitate dialogue and consensus-building in decision-making.

Thank you for your attention