Assignment 1: Cost-effectiveness Analysis

GHP 501: Modeling for Health System Analysis & Priority Setting

YOUR NAME HERE

You are welcome to work with others on this homework, however, all analyses and written answers must be your own. **If you worked with others on this homework, please indicate their names in the author section.**

Contents

```r
knitr::opts_chunk$set(collapse = TRUE, # the code and its output are shown together
                      warning = FALSE, # suppresses warning messages
                      error = FALSE, # suppresses error messages
                      message = FALSE # suppresses messages generated by the code
                      )
pacman::p_load(tidyverse, rio, here)
```

1 Background

Assignment Objective

In this assignment, we are evaluating two interventions for the same disease in country X over a *one-year* time horizon. All data and settings are virtual. The aim is to familiarize us with how to use secondary information obtained from the literature or government reports for economic evaluation.

Population

We will analyze a hypothetical cohort of 5 million individuals. They can be divided into 5 groups based on their wealth, from Q1 (the poorest), Q2 (the near-poor), Q3 (the middle), Q4 (the near-rich), and Q5 (the richest), each with 1 million people.

Disease Burden

To simplify, we assumed that there was no incidence of the disease in the analysis year. We will have data on the proportion of confirmed diagnosis cases (prevalence), who are currently alive patients diagnosed in previous years. If they die during the year, we assume that they die in the middle of the year.

Cost

We will analyze the costs from the *patient* perspective, the *governmental* perspective, and the *societal* perspective (patient + governmental perspective).

2 Status Quo

The status quo refers to current practices. This is the baseline or the reference for the new intervention we want to evaluate.

In the status quo, we obtained the prevalence of disease in each quintile from a national report, from a 6000 nationally representative sample. We could assume that this reflects the true prevalence of the disease nationally.

The insurance coverage varies across wealth quintiles but is independent of the proportion of care seeking and the choice of medical care/facility in each quintile.

If individuals do not seek care, they face a risk of death, 0.031. Seeking care in public facilities will lower the death risk, where the relative risk ratio (RR) is 0.68; however, the cost per person-year in public facilities is $24 on average. Seeking care in private facilities will lower the death risk more, where the RR is 0.35; but the unit cost is $63 on average.

If patients seek care in public facilities and have insurance, the government will cover 70% of their costs. If they are not insured or they seek care in private facilities, they have to pay themselves (out of pocket).

Table 1: Data inputs for each quintile (status quo).

Input	Q1	Q2	Q3	Q4	Q5
Prevalence (%)	7	9	11	16	18
Seek Care (%)	29	28	32	35	40
Public Facility (%)	95	90	83	71	58
Insurance (%)	30	41	54	58	67
Prob. of Death if not seeking care	0.031	0.031	0.031	0.031	0.031
RR of death if public facility	0.68	0.68	0.68	0.68	0.68
RR of death if private facility	0.35	0.35	0.35	0.35	0.35
Unit cost if public facility ($)	24	24	24	24	24
Unit cost if private facility ($)	63	63	63	63	63
Prop. of reimbursement (%)	70	70	70	70	70

```
data <- tibble(
  q = 1:5,
  n = rep(1000000, each = 5),
  prevalence = c(7,9,11,16,18)/100,
  seek_care = c(29,28,32,35,40)/100,
  public = c(95,90,83,71,58)/100,
  insurance = c(30,41,54,58,67)/100
) |>
```

```
mutate(
  prob_death_nocare = 0.031,
  rr_death_public = 0.68,
  rr_death_private = 0.35,
  unit_cost_public = 24,
  unit_cost_private = 63,
  reimburse = 70/100
)
```

1. When analyzing this kind of problem, it is important to draw a flow plot to show how individuals flow from state to state. Please draw a flow plot describing the process and flows of individuals.

(Hint: please do not show any specific number in the flow plot. You may want to mark variable names however.)

Answer

<YOUR CODE AND DESCRIPTION>

2. Please calculate the number of patients, number of care seekers, number of patients attending public facility, and number of patients attending public facility with insurance.

Answer

Quintile	Num. of patients	Num. of care seekers	Num. of patients with public facility	Num. of patients with public facility with insurance
1	?	?	?	?
2	?	?	?	?
3	?	?	?	?
4	?	?	?	?
5	?	?	?	?

<YOUR CODE AND DESCRIPTION>

3. Please calculate the number of deaths among non-care seekers, those seeking care in public facility, those seeking care in private facility, and the total number of deaths.

Answer

Quintile	Num. of Deaths among non-care seekers	Num. of Deaths among care seekers in public facility	Num. of Deaths among care seekers in private facility	Total Num. of Deaths
1	?	?	?	?
2	?	?	?	?
3	?	?	?	?

4	?	?	?	?
5	?	?	?	?

<YOUR CODE AND DESCRIPTION>

> **4. Please calculate the patient medical costs for patients choosing public facility, patient medical costs for patients choosing private facility, the total patient medical costs in each quintile, and the government costs in each quintile.**
>
> (Hint: For those dying, they would die at the middle of the year, so you could assume that they paid half of the treatment costs)

Answer

Quintile	Patient medical costs with public facility	Patient medical costs with private facility	Total Patient medical costs	Government costs
1	?	?	?	?
2	?	?	?	?
3	?	?	?	?
4	?	?	?	?
5	?	?	?	?

<YOUR CODE AND DESCRIPTION>

> **5. Let's organize the results above and fill in the table below.**

Answer

Quintile	Total deaths	Total patient costs	Government costs
1	?	?	?
2	?	?	?
3	?	?	?
4	?	?	?
5	?	?	?
Total	?	?	?

<YOUR CODE AND DESCRIPTION>

3 Intervention A

Suppose that the government is considering an intervention to promote healthcare utilization, where the proportion of care-seeking would be 1.72 times the status quo.

However, we assume that the effect is proportional with the coverage of insurance.

Under intervention A, the government will cover 100% of costs for those with insurance when attending public facility, and the government will pay $50 per person for each new care-seekers.

We assume that insurance coverage remains the same as in the status quo, similarly for all the other parameters.

> **6. Please calculate the total deaths, total patient costs and governmental costs in each quintile and in total if the intervention A is implemented.**

Answer

Qunitile	Total deaths	Total individual costs	Governmental costs
1	?	?	?
2	?	?	?
3	?	?	?
4	?	?	?
5	?	?	?
Total	?	?	?

<YOUR CODE AND DESCRIPTION>

4 ICER

7. Among the *whole population*, please fill in the following table comparing the number of deaths and the total costs (the sum of patients costs and governmental costs) between the status quo and intervention A. Then, interpret the ICER.

(Hint: the numerator of ICER is the difference in costs, and the denominator is the difference in *health benefits*. In this case, how should we define the health benefits?)

Answer

Intervention	Deaths	Costs	ICER
Status Quo	?	?	-
Intervention A	?	?	?

<YOUR CODE AND DESCRIPTION>

8. Now, let's analyze by quintile. How would your recommendation change if we consider the result by wealth quintile, instead of the whole population? Will you still recommend/reject intervention A? Any comment on the ICER in each quintile?

Answer

<YOUR CODE AND DESCRIPTION>