

School exam for HEVAL4200, March 21 2023

Suggested solutions and marking scheme

The exam consisted of 12 questions with a maximum total score was 100 points. The following relation between grades (A-F) and points [0-100] was used: A: [86, 100], B: [78, 85], C: [61, 77], D: [50, 60], E: [39, 49], F: [0, 38].

Explanation of grades. The candidates will receive a note with their individual scores on each question and the present suggested solution. Combined, these two documents explain the general principles for how scores and grades were awarded and constitute the formal explanation of grades.

Appeal against grades. Appeals against grades must be submitted following the procedure described on the course webpage (that is, not submitted to the course coordinator).

Informal feedback. Candidates who wish to receive additional feedback may ask the course coordinator for an informal talk (phone call or Zoom meeting). The candidates must then email the course coordinator 2-3 suggested times. These suggested times should be within normal office hours from 09.00am to 3.00pm, with at least two workdays notice, and within the period 24-28 April 2023.

1. In many countries around the world today, governments are using health economics tools and evidence to inform decisions about healthcare. Economic evaluation is one such tool used in health technology assessment and health priority setting when deciding about which interventions and services to fund. Considering this, give brief answers to the questions below. **(8 points)**

a) What is economic evaluation?

Answer: Economic evaluation is the comparative analysis of alternative course of action in terms of both their costs and consequences. In other words, it deals with the choice between alternatives, and the inputs and outputs associated with these alternatives.

b) Give an example of a decision problem faced in healthcare, where economic evaluation can be useful?

Answer: Several answers can be given here related to priority setting and choices that need to be made between various options or courses of action when delivering healthcare. Examples could include:

- **Should a new drug or surgical procedure be adopted?**
- **Should one form of treatment be expanded (while another is contracted)?**
- **After clinical effectiveness has been demonstrated, need to look at the balance of benefits and costs**
- **A specialist hospital requests a license to establish a kidney transplant program and claims it is cheaper than constant dialysis**

c) Why is there need for health priority setting in healthcare?

Answer: The rationale for economic evaluation is that we have limited resources, such as doctors, nurses and hospitals. At the same time, we have unlimited wants, meaning that we always wish to have “more health” or “better health”. These factors combined imply that it is not possible to satisfy all health needs when resources are limited. Thus, priority setting is unavoidable.

Marking scheme			
Question 1	a	b	c
Grade	2	2	4

2. Questions i-v below present instances where decisions have to be made about what and how to provide healthcare in a given health system. **(8 points)**

- i. When providing rheumatology clinics, is it best to provide a nurse practitioner service or a consultant based service?
- ii. Should there be an increase in funding to childhood vaccination or should the government expand family planning for adolescent girls?
- iii. Should we introduce screening for prostate cancer in men above the age of 55 years?
- iv. What is the best way of providing dialysis for patients with chronic renal failure – hospital-based or at the patient’s home?
- v. Should we expand provision of hospital haemodialysis?

Carefully consider questions i-v above and answer the following:

a) Which of the above questions represent technical and allocative efficiency?

Answer

- i. **Technical efficiency**
- ii. **Allocative efficiency**
- iii. **Allocative efficiency**

- iv. Technical efficiency
- v. Allocative efficiency

b) Explain the difference between technical and allocative efficiency

Answer

Allocative efficiency refers to how different resource inputs are combined to produce a mix of different outputs. Technical efficiency on the other hand is concerned with achieving maximum outputs with the least cost.

Technical efficiency: with technical efficiency, an objective such as the provision of tonsillectomy for children in need of this procedure is taken as given. Technical efficiency is about how best to achieve that objective. Strictly, technical efficiency is about ensuring the production of the same level of output with less of one input and no more of other inputs or, equivalently, maximising the output that one gets from given quantities of inputs. Technical efficiency is linked to cost effectiveness. The combination of technically efficient inputs that minimises the cost of achieving a given level of output is that which is cost effective.

Allocative efficiency: with allocative efficiency, all objectives compete with each other for implementation. For example, “should we allocate more resources to the prevention of childhood injury or improve clinics for children with chronic disease such as asthma?” is a question of allocative efficiency. Allocative efficiency is about whether to do something, or how much of it to do, rather than how to do it. Allocative efficiency in health care is achieved when it is not possible to increase the overall benefits produced by the health system by reallocating resources between programmes. This occurs where the ratio of marginal benefits to marginal costs is equal across all health care programmes in the system.

Marking scheme			
Question 2	a	b	
Grade	5	3	

3. A randomized controlled trial is examining the effectiveness of using peer supporters to promote exclusive breastfeeding among newborn children of mothers recruited into the study in a rural community. The aim of the intervention is to increase exclusive breastfeeding rates for 6 months after birth. The peer supporters are women living in the same community, who have been engaged as volunteers to give advice to breastfeeding mothers. The project provides bicycles for the peer supporters to use during fieldwork. Because the cycling distances are far, a vehicle is assigned to pick up the peer supporters at a central location to drop them off within cycling distance of their fieldwork. The peer supporters are trained before fieldwork and visit the mothers in their homes once a month. They each are provided with a t-shirt bearing the project logo, a backpack with information communication materials, notepads, pens and pencils and water bottles. In addition to the fieldwork coordinator, five community nurses are also recruited to supervise the peer supporters. Imagine that you are the health economist undertaking a cost analysis of the trial. (8 points)

a) Adopting a health service perspective, what are the costs you would include in your analysis?

Answer: Examples provided in the project description include costs related to training, printing, communication materials, bicycles and vehicles. Other costs in a project like this one could include personnel costs of peer supporter supervisors, drivers.

b) Define opportunity costs

Answer: An opportunity cost is value of the next best alternative that is foregone when an alternative is chosen.

c) What is an example of an opportunity cost that can be considered in the breastfeeding trial described above?

Answer: an example of an opportunity cost included in the project description are the time of the peer supporters who have volunteered in the project (considering a health service perspective)

Marking scheme			
Question 3	a	b	c
Grade	5	2	1

4. The World Health Organization defines health as “a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.” (6 points)

a) In your opinion, why might conceptions and definitions of health differ from person to person and from one culture to another?

Answer: Health is a personal matter and its description depends on one’s experience. Perceptions may differ due to cultural background and life’s experiences. For example, the views of lay people and healthcare professionals differ as do those of older people and teenagers.

b) Name any two types of measures of health.

Answer: Measures of health include the following

Measure	Instrument
Mortality	Deaths averted
	Life years gained (observed in life table)
Morbidity	Prevalence and incidence of disease
	Clinical measures of impairment (e.g. X-ray findings, blood levels)
Disease-specific measures	Disease profiles (e.g. chronic respiratory distress questionnaire)
	Disease indices (e.g. Arthritis Impact Management Scale – AIMS)
Generic health measures	Health profiles (e.g. WHO quality of life measure – WHOQOL 100)
	Health indices – e.g. Non-preference-based, such as Short Form-36; Preference-based, such as EQ5D

c) What are the characteristics of a good health measure for an economic evaluation?

Answer: a good measure for an economic evaluation should have the following main characteristics:

1. Should be able to compare changes across diseases and interventions
2. Scale with interval properties
 - If health has improved (or declined), by how much?
 - Changes in health must be related to expenditure (scaled up and down)
 - Best: Ratio scales (contain a true zero)
 - Good: Interval properties (11-20 = 71-80)
 - Problematic: Binary and ordinal variables
3. Reflect preferences
 - Individual or societal

Other things to consider include:

4. Reliability - The measure should be able to produce repeated results from an unchanged population
5. Validity - should capture what it is supposed to capture
6. Practicality - should be acceptable to respondents and easy to administer
7. Responsiveness - should be able to detect changes in health status

Marking scheme			
Question 4	a	b	c
Grade	2	2	2

5. The table below provides information on the health outcomes of two interventions treating diabetes and hypertension. Data are provided on the health related quality of life and life expectancy before and after the intervention. **(8 points)**

Disease	Health related quality of life			Life expectancy		
	Before intervention	After intervention	Change in quality of life	Before intervention	After intervention	Change in quantity of life
Diabetes	0.3	1	0.7	55	56	1
Hypertension	0.5	1	0.5	10	20	10

- a) Calculate the QALYs gained from treatment of diabetes and hypertension

Answer

Diabetes: change in quality = $55 \times 0.7 = 38.5$, change in quantity = $1 \times 1.0 = 1.0$. Total QALY gain = 39.5

Hypertension: change in quality = $10 \times 0.5 = 5$, change in quantity = $10.5 \times 1 = 10$, total QALY gain = 15

- b) If the total cost of treatment for diabetes was \$20,000 and that for hypertension was \$50, what would be the average cost per QALY gained for each intervention?

Answer

Diabetes: $20,000/39.5 = 506.33$

Hypertension: $50/15 = 3.3$

Marking scheme			
Question 5	a	b	
Grade	6	2	

6. A new hospital has been built at a total cost of NOK10 million. The useful life years of the building is 30 years and it is estimated to generate about NOK 2 million every year in revenue for at least the next 10 years. Given a discount rate of 3% **(10 points)**,

- a) What is the present value of the hospital's 10 year revenue stream?

Answer:

$$PV = FV / (1+r)^t$$

Where PV is the present value, FV is the future value, r is the discount rate and t is the time period or year

Using a 3% discount rate,

$$\begin{aligned}
 PV &= 2m/(1+0.03)^1 + 2m/(1+0.03)^2 + 2m/(1+0.03)^3 + 2m/(1+0.03)^4 + 2m/(1+0.03)^5 + 2m \\
 &/ (1+0.03)^6 + 2m/(1+0.03)^7 + 2m/(1+0.03)^8 + 2m/(1+0.03)^9 + 2m/(1+0.03)^{10} \\
 &= \text{NOK } 17,060,405.67
 \end{aligned}$$

Or NOK 17,572,217.84 if assuming payments made at beginning of period

b) Calculate the equivalent annual cost (EAC) of the building from an economic perspective

Answer

EAC= building value/annuity factor; annuity factor for 3% discount rate and 30 years useful life is 19.6004. The annuity factor is found in the present value table provided to students.

$$EAC = 10,000,000/19.6004 = \text{NOK } 510,193.67$$

c) Explain the difference between financial and economic costs

Answer: Economic costs are the opportunity cost of resources (i.e. the value of the highest-value alternative use). Financial costs are resources that are actually "paid for" or the actual outlay of expenditure incurred.

Marking scheme			
Question 6	a	b	c
Grade	5	3	2

7. A focus group has been asked about their willingness to pay for new car models. Two of the car models were identical except that one had a semi-automatic emergency braking system that could prevent some accidents. More specifically, the car manufacturer claims that the mentioned braking system could reduce the probability of loss of a life by 4/100,000. In the focus group, the willingness to pay for the models with and without the mentioned braking system was \$131,000 and \$130,000, respectively. (8 points)

a) What is the implied value of a statistical life?

Answer

$$\begin{aligned}
 \text{Value of a statistical life} &= \text{difference in value/difference in risk} \\
 &= (131,000 - 130,000) / (4/100,000) \\
 &= 1,000/0.00004 \\
 &= 25,000,000
 \end{aligned}$$

b) Discuss the advantages and disadvantages of cost-benefit analysis over cost-utility analysis

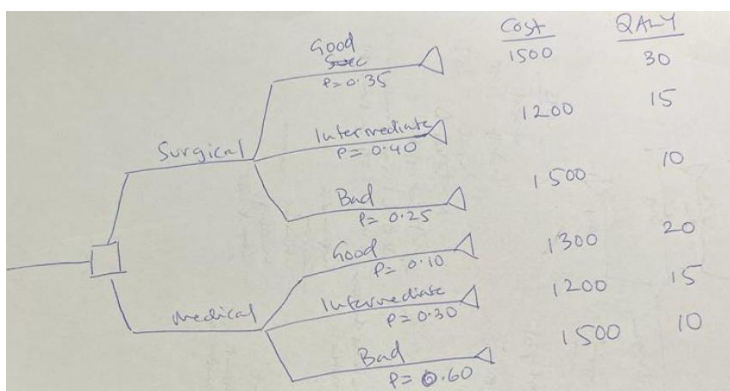
Advantages	Disadvantages
<ul style="list-style-type: none"> Answers whether a program or intervention is worth achieving given the social opportunity cost of all the resources consumed 	<ul style="list-style-type: none"> Potential inaccuracies in identification and monetary valuation of costs and benefits <ul style="list-style-type: none"> E.g. valuation of intangible benefits such as satisfaction
<ul style="list-style-type: none"> Converts all costs and benefits to money and is not restricted to comparing programs within a sector <ul style="list-style-type: none"> Can inform resource allocation decisions both within and between the sectors of the economy 	<ul style="list-style-type: none"> Complex procedure and method of monetary valuation might be biased
<ul style="list-style-type: none"> Informs questions of allocative efficiency 	<ul style="list-style-type: none"> Subjectivity: people use expectations or biased experiences to assign different values to benefit

Marking scheme			
Question 7	a	b	
Grade	3	5	

8. Consider the information provided in the table below which compares the costs and outcomes of two interventions for treating a given condition. A patient with the condition can take either surgical or medical intervention, with varying probabilities, costs and outcomes. Two interventions, Surgical and Medical that are offered to patients for a specific condition. For each intervention, a patient can follow one of three possible pathways resulting in a bad, intermediate, or good outcome. The expected probabilities (P), costs (NOK) and an outcomes (QALY) are shown in the table below. (10 points)

	Surgical			Medical		
	Cost	P	QALY	Cost	P	QALY
Success	NOK1 500	0.35	30	NOK1 300	0.10	20
Mild success	NOK1 200	0.40	15	NOK1 200	0.30	15
Unsuccessful	NOK1 500	0.25	10	NOK1 500	0.60	10

a) Draw a simple decision tree analysis comparing the surgical and medical interventions using the information given in the table.



b) Calculate the expected cost and outcome of each strategy.

Answer

Surgical:

$$\text{Expected costs} = 1500 \times 0.35 + 1200 \times 0.40 + 1500 \times 0.25 = 1380$$

Expected QALYs = $30 \times 0.35 + 15 \times 0.40 + 10 \times 0.25 = 19$

Medical:

Expected cost = $1300 \times 0.10 + 1200 \times 0.30 + 1500 \times 0.60 = 1390$

Expected QALYs = $20 \times 0.10 + 15 \times 0.30 + 10 \times 0.60 = 12.5$

c) Calculate the incremental cost-effectiveness ratio of surgery compared to medical.

Answer

ICER = $(\text{Cost surgical} - \text{Cost medical}) / (\text{QALY surgical} - \text{QALY medical}) = -1.54$

Marking scheme			
Question 8	a	b	c
Grade	3	5	2

9. Give an assessment of the article by Bruisnma A et al (2023) based on the following parts of Drummond et al.s’ checklist: Checklist point 1 (10 points)

1. Was a well-defined question posed in an answerable form?
 - 1.1. Did the study examine both costs and effects of the service(s) or programme(s) over an appropriate time horizon?
 - 1.2. Did the study involve a comparison of alternatives?
 - 1.3. Was a perspective for the analysis stated and was the study placed in any particular decision-making context?
 - 1.4. Were the patient population and any relevant subgroups adequately defined?

Solution

The objective of the evaluation was to assess the cost-effectiveness of elective induction of labour (IOL) at 41 weeks and expectant management (EM) until 42 weeks. The economic evaluation is based on a trial and compared the alternatives considered in the trial. The trial included low-risk women with an uncomplicated pregnancy of a singleton in stable cephalic position and a certain gestational age between 40 and 41 weeks without a contraindication for expectant management until 42 weeks at time of randomization. Women were randomized to either elective induction of labour at 41 weeks or expectant management. Women randomized to induction at 41 weeks underwent an induction of labour at 41 or 41 weeks. Women randomized to expectant management awaited spontaneous onset of labour with subsequent induction if necessary at 42 weeks.

The analysts use a healthcare perspective to inform decisions at health facility or hospital level. Costs and outcomes are studied over a one-year period to capture all pregnancy and birth related outcomes. The patient population is low-risk women with late-term pregnancy. Sub group analyses are conducted for nulliparous and multiparous women.

10. Give an assessment of the article by Bruisnma A et al (2023) based on the following parts of Drummond et al.s’ checklist: Checklist point 2 (10 points)

2. Was a comprehensive description of the competing alternatives given (i.e. can you tell who did what to whom, where, and how often?)
 - 2.1. Were any relevant alternatives omitted?
 - 2.2. Was (should) a ‘do-nothing’ alternative (be) considered?
 - 2.3. Were relevant alternatives identified for the patient subgroups?

Solution

The alternatives compared in the evaluation were elective induction of labour (IOL) at 41 weeks and expectant management (EM) until 42 weeks. Low-risk women with late-term pregnancy. were randomized to either elective induction of labour at 41 weeks or expectant management. Women randomized to induction at 41 weeks underwent an induction of labour at 41 or 41 weeks. Women randomized to expectant management awaited spontaneous onset of labour with subsequent induction if necessary at 42 weeks. Both groups received obstetrical care according to **local protocol**. Note: the local protocol is not described or quoted as a reference, so the lay reader is not given enough information to fully understand what 'treatment' entails. Otherwise, the alternatives are described. A do nothing scenario in this case may not be appropriate.

11. Give an assessment of the article by Bruisnma A et al (2023) based on the following parts of Drummond et al.s' checklist: Checklist point 5 (**10 points**)

5. Were costs and consequences measured accurately in appropriate physical units prior to valuation (e.g. hours of nursing time, number of physician visits, lost work-days, gained life-years)?
 - 5.1. Were the sources of resource utilization described and justified?
 - 5.2. Were any of the identified items omitted from measurement? If so, does this mean that they carried no weight in the subsequent analysis?
 - 5.3. Were there any special circumstances (e.g. joint use of resources) that made measurement difficult? Were these circumstances handled appropriately?

Resource use data was collected from the Case Report Form (CRF) and measured separately for antepartum, intrapartum and postpartum phases. Included in the antepartum phase for example were number of outpatient consultations (from obstetrics department and/or independent midwife) and the number of ultrasounds and CTGs performed; while the Postpartum phase included neonatal and maternal admission, length of stay (in days) and ambulance transport to another hospital.

Unit costs were estimated with different methods and sources, all according to recent guidelines on costing of healthcare services. Some unit cost data was provided by the hospital conducting the trial (Amsterdam UMC). Mean costs from academic and non-academic hospitals were used. Medication prices were obtained from the Dutch drug registry or from other Dutch studies if not available in the Dutch costing guideline.

Obstetric procedures included analgesics during labour, mode of delivery, labour room in hours, FBS, MRP, repair perineal tear in operating theatre and blood transfusion. **Potential costs for neonatal admission to the maternity ward were not counted, but these do not affect the analysis. Because mostly secondary data sources are used, there is no attempt to make adjustments for things such as joint resource use and these are implicitly taken care of in the unit costs .**

12. Give an assessment of the article by Bruisnma A et al (2023) based on the following parts of Drummond et al.s' checklist: Checklist point 7 (**4 points**)

7. Were costs and consequences adjusted for differential timing?
 - 7.1. Were costs and consequences that occur in the future "discounted" to their present values?
 - 7.2. Was any justification given for the discount rate(s) used?

Solution

There was no adjustment for differential timing. Costs and outcomes were not discounted because all costs were calculated over one year. Annuity for example is implicitly accounted for in unit costs used.