GMS5222 Introduction to Health Economic Modelling

Meeting time: Weekly from 6.00-9.00pm SGT

Meeting Location: Zoom

Instructors: Junxing Chay PhD, Eric Finkelstein PhD

Synopsis of Course Content

This course aims to equip students with skills required to perform their own cost-effectiveness analyses of health technologies and to critically assess the quality of evaluations conducted by others. This course begins with an introduction to key concepts in economic evaluation and decision-analytic modelling. We then transition to building decision-analytic models. We focus on two models commonly used in cost-effectiveness analyses in healthcare: namely decision trees and Markov models. The course includes hands-on-training on how to build these models in Microsoft Excel using real-world examples, so students understand how to implement these methods from first principles.

Prerequisites

None.

Textbooks

Weekly readings (textbook chapters and published articles) are provided under each lecture.

Software

Microsoft Excel

Performance Assessment

Performance will be assessed on i) short in-class quizzes at the beginning of each lecture; ii) assignments; iii) a group presentation; and iv) a final assessment. Assignments 1 and 2 can be completed individually or in groups of up to 3 students.

Grade Breakdown

Component	**Weightage (%)**	**Assessment Due Date**
1. Weekly in-class quizzes	30% (Excluding the two lowest scores)	N/A
2. Assignment 1	10%	Week 8
3. Assignment 2	10%	Week 11
4. Group Presentation	20%	Week 12
5. Final Assessment	30%	Week 13

Course Outline

Week	Lecture	Lead Instructor
1	Five Steps to develop a value proposition for health innovations: Examples from Obesity	Eric Finkelstein
2	Quantifying Economic Burden	Eric Finkelstein
3	Valuing Health Gains	Eric Finkelstein
4	Introduction to Cost-Effectiveness Analysis	Eric Finkelstein
5	Decision Trees and Applications	Junxing Chay
6	Decision Tree Modelling Exercise*	Junxing Chay
7	Reporting and Interpreting Uncertainty	Junxing Chay
8	Markov Models and Applications	Junxing Chay
9	Markov Modelling Exercise I*	Junxing Chay
10	Markov Modelling Exercise II*	Junxing Chay
11	Estimating Transition Probabilities for Decision Modelling	Junxing Chay
12	Appraisal of CEA Articles (Group Presentation)	All
13	Final Assessment	N/A

*Flipped class

Week 1: Five Steps to develop a value proposition for health innovations: Examples from Obesity

Class Outline:

Five Steps to Develop a Value Proposition for Health Innovations

- Quantifying burden
- Showing intervention effectiveness
- Showing cost-effectiveness
- Quantifying market/budget impact
- Incorporating non-economic arguments

Reading List for Week 1:

- Finkelstein, E. A., Krishnan, A., & Doble, B. (2020). Beyond cost-effectiveness: A five-step framework for appraising the value of health technologies in Asia-Pacific. *The International Journal of Health Planning and Management*, *35*(1), 397-408.

Week 2: Quantifying Economic Burden

Class Outline:

- Review exercise: ROI for bariatric surgery
- Common approaches for quantifying economic burden.
    - Econometric approach
    - Epidemiological (PAF) approach
- Key considerations in economic evaluation

- In-class exercises

Reading List for Week 2:

- Gray et al., *Applied methods of cost-effectiveness analysis in healthcare*. Ch 6.
- Drummond et al., *Methods for the Economic Evaluation of Health Care Programmes*, 4th Ed. Oxford University Press. Ch 7.

Week 3: Valuing Intervention Costs and Health Gains

Class Outline:

Intervention costing

I. Costing strategies and perspectives.
II. Activity Based Costing (ABC) method.
III. Costing considerations.

Determine intervention effectiveness.

I. Introduction to quality-adjusted life years (QALYs) and QoL weights.
II. Direct and indirect valuation methods of determining QoL weights.
III. Mapping between non-preference-based and preference-based measures
IV. Using discrete choice experiments to elicit preferences.
V. Limitations of QALYs.
VI. In-class exercises.

Reading List for Week 3:

- Gray et al., *Applied methods*. Ch 5.
- Drummond et al., *Methods*. Ch 5, Ch. 6.

Week 4: Introduction to Cost-Effectiveness and Budget Impact Analyses

Class Outline:

I. Conducting CEA with multiple interventions
II. Thinking about the CEA threshold
III. Step 4: Budget Impact/Market Analysis
IV. In-class exercises

Reading List for Week 4:

- Gray et al., *Applied methods*. Ch 2.
- Drummond et al., *Methods*. Ch 4.

Week 5. Decision Trees and Applications

Class Outline:

I. Elements and selection of decision-analytic models for economic evaluation
II. Elements and mechanics of decision trees
III. Advantages and limitations of using decision trees.
IV. Examples and appraisal of studies using decision trees.

Reading List:

- Gray et al., *Applied methods*. Ch 8.
- Drummond et al., *Methods*. Ch 9.

- [*Optional*] Barton, P., Bryan, S., & Robinson, S. (2004). Modelling in the economic evaluation of health care: selecting the appropriate approach. *Journal of health services research & policy*, *9*(2), 110-118.
- [*Optional*] Dong, D., Sung, C., & Finkelstein, E. A. (2012). Cost-effectiveness of HLA-B* 1502 genotyping in adult patients with newly diagnosed epilepsy in Singapore. *Neurology*, *79*(12), 1259-1267.

Week 6: Decision Tree Modelling Exercise

Class Outline:

This class will be conducted as a flipped classroom. Students should watch and practice along with the pre-recorded tutorial before class. During class, students will form groups of up to 4 to complete decision tree modelling exercises and present their models to peers for feedback.

Reading List:

- Pre-recorded tutorial on building decision trees in Excel

Assignment:

- Assignment 1 will require students to build, analyse and interpret a decision tree model using Excel. Please submit your assignment before the start of class in Week 8.

Week 7: Reporting and Interpreting Uncertainty

Class Outline:

I. Sources of model variability: uncertainty, heterogeneity, and sampling variability
II. Deterministic sensitivity analysis (one-way, two-way)
III. Probabilistic sensitivity analysis
IV. Examples and appraisal of sensitivity analysis from studies
V. [Time permitting] Value of information analysis

Reading List:

- Gray et al., *Applied methods*. Ch 10.
- Drummond et al., *Methods*. Ch 11.
- Briggs et al. (2012). Model parameter estimation and uncertainty: a report of the ISPOR-SMDM Modelling Good Research Practices Task Force-6. Value in Health, 15(6), 835-842.
- [*Optional*] Dong, D., Sung, C., & Finkelstein, E. A. (2012). Cost-effectiveness of HLA-B* 1502 genotyping in adult patients with newly diagnosed epilepsy in Singapore. *Neurology*, *79*(12), 1259-1267.
- [*Optional*] Lin, F. J., Shyu, K. G., Hsieh, I. C., Sheu, W. H. H., Tu, S. T., Yeh, S. J., ... & Yeh, H. I. (2020). Cost-effectiveness of statin therapy for secondary prevention among patients with coronary artery disease and baseline LDL-C 70–100 mg/dL in Taiwan. Journal of the Formosan Medical Association, 119(5), 907-916.
- [*Optional*] Pandya, A., Gupta, A., Kamel, H., Navi, B. B., Sanelli, P. C., & Schackman, B. R. (2015). Carotid artery stenosis: cost-effectiveness of assessment of cerebrovascular reserve to guide treatment of asymptomatic patients. *Radiology*, *274*(2), 455-463.
- [*Optional*] Ong, J. C. M., Than, H., Tripathi, S., Gkitzia, C., & Wang, X. (2023). A cost-effectiveness analysis of ruxolitinib versus best alternative therapy for patients with steroid-refractory chronic graft-versus-host disease aged> 12 years in Singapore. *Cost Effectiveness and Resource Allocation*, *21*(1), 34.

Week 8: Markov Models and Applications

Class Outline:

I. Elements and mechanics of Markov models
II. Advantages and limitations of using Markov models
III. Examples and appraisal of studies using Markov models

Reading List:

- Gray et al., *Applied methods*. Ch 9.
- Drummond et al., *Methods*. Ch 9.
- [*Optional*] Doble, B., Finkelstein, E. A., Tian, Y., Saxena, N., Patil, S., Wong, T. Y., & Cheung, C. M. G. (2020). Cost-effectiveness of intravitreal ranibizumab with verteporfin photodynamic therapy compared with ranibizumab monotherapy for patients with polypoidal choroidal vasculopathy. *JAMA ophthalmology*, *138*(3), 251-259.
- [*Optional*] Chay, J., Fenner, B. J., Finkelstein, E. A., Teo, K. Y., & Cheung, C. M. G. (2022). Real-world cost-effectiveness of anti-VEGF monotherapy and combination therapy for the treatment of polypoidal choroidal vasculopathy. *Eye*, *36*(12), 2265-2270.

Week 9: Markov Modelling Exercise I

Class Outline:

This class will be conducted as a flipped classroom. Students should watch and practice along with the pre-recorded tutorial before class. During class, students will form groups of up to 4 to complete Markov modelling exercises and present their models to peers for feedback.

Reading List:

- Pre-recorded tutorial on building Markov models in Excel

Assignment:

- Assignment 2 will require students to build, analyse and interpret a Markov model using Excel. Please submit your assignment before the start of class in Week 11.

Week 10: Markov Modelling Exercise II

Class Outline:

This class will continue the Markov modelling exercise from the previous week. During class, students will form groups of up to 4 to complete Markov modelling exercises and present their models to peers for feedback.

Week 11: Estimating Transition Probabilities for Decision Modelling

Class Outline:

I. Introduction to survival analysis
II. Adjusting transition probabilities using published data
III. Estimating transition probabilities from observational data

Reading List:

- Gray et al., *Applied methods of cost-effectiveness analysis in healthcare*. Chapter 3 and 4.
- Gidwani, R., & Russell, L. B. (2020). Estimating transition probabilities from published evidence: a tutorial for decision modelers. *Pharmacoeconomics*, *38*(11), 1153-1164.

- [*Optional*] Aguiar, P. N., Haaland, B., Park, W., San Tan, P., Del Giglio, A., & de Lima Lopes, G. (2018). Cost-effectiveness of osimertinib in the first-line treatment of patients with EGFR-mutated advanced non–small cell lung cancer. *JAMA oncology*, *4*(8), 1080-1084.

Assignment:

- Students will work in groups to critique an assigned CEA article and present their findings to the class. Presentations will take place in week 12. More information will be provided.

Week 12: Appraisal of CEA Articles (Group Presentation)

Class Outline:

In this class, students will present their group's appraisal of an assigned CEA article. More information will be provided.

Week 13: Final Assessment

Class Outline:

Students will work individually to conceptualize and implement a decision-analytic model in Excel, and use it to conduct cost-effectiveness analysis. More information will be provided.