

Course Title/Code: **Advanced Epidemiological Methods II (MMPH6210)**

Department: School of Public Health

Objective: At the completion of the course, students will be able to:

1. Formalize notions of cause and effect within experimental and non-experimental contexts.
2. Articulate assumptions under which such effects can be identified from a variety of study designs prominent in epidemiologic practice.
3. Develop competence in modern causal inference methodology.

Content: Course topics include:

- Review of counterfactuals and causal DAGs for point exposure: d-separation and the back-door criterion
- Identification and estimation of the single occasion g-formula: g-estimation, IPW and double robustness.
- Instrumental variable methods for continuous, discrete and binary outcome: Part I
- Instrumental variable methods for continuous, discrete and binary outcome: Part II
- Causal mediation analysis and counterfactual effect decomposition: Part I
- Causal mediation analysis and counterfactual effect decomposition: Part II
- Causal DAGS for time dependent exposure and time dependent confounding. Introduction to Marginal structural models.

Learning Outcomes: By the end of this Course, students should be able to:

1. Explain causation using counterfactuals in ideal randomized experiments and apply causal directed acyclic graphs (DAGs) to identify potential confounders, mediators and colliders and decide when adjustment is appropriate for examining associations from observational studies
2. Distinguish g-formula, g-estimation, inverse probability weighting (IPW) and double robustness from conventional regression approach particularly on their relevance in addressing confounding and selection bias
3. Describe the assumptions of instrumental variable methods and appraise the strengths and weaknesses for drawing causal inference
4. Distinguish the more generalized causal mediation analysis from traditional Baron & Kenny approach and identify various counterfactual effect decomposition, i.e., how to decompose total effects into direct effect of exposure and indirect effect of mediators focusing on controlled direct effects, natural direct and indirect effects
5. Describe how marginal structural models can address time dependent exposure and confounders when conventional approaches for confounding adjustment could introduce bias

Prerequisite: MMPH6003 Introduction to epidemiology; MMPH6106 Advanced epidemiological methods I

Duration: 3 hours/week; 30 bcontact hours

**Continuous assessment/
examination ratio:** Assignment: 70%
Examination: 30%

**Examination method/
duration:** Written examination / 1 hour