DEPARTMENT OF MEDICAL EPIDEMIOLOGY AND BIOSTATISTICS

C8F2893, Design and Analysis of Twin and Family-based Studies, 1.5 credits (hec)

Design och analys av tvilling- och familjebaserade studier, 1,5 högskolepoäng

Third-cycle level / Forskarnivå

Approval

This syllabus was approved by The Committee for Doctoral Education on 2023-11-09, and was last revised on 2026-02-20. The revised course syllabus is valid from autumn semester 2026.

Responsible department

Department of Medical Epidemiology and Biostatistics, Faculty of Medicine

Prerequisite courses, or equivalent

Epidemiology I: Introduction to Epidemiology, Biostatistics I: Introduction for epidemiologists, Epidemiology II: Design of epidemiological studies, Biostatistics II: Logistic regression for epidemiologists and Biostatistics III: Survival analysis for epidemiologists or corresponding courses

Purpose & Intended learning outcomes

Purpose

This course focuses on potential designs and analyses using twin- and family-data. Methods to estimate within-family associations and heritability are covered.

Intended learning outcomes

After successfully completing this course you as a participant are expected to be able to:

- discuss the difference between a within-family analysis and a more standard (e.g. between-family) statistical analysis,
- select and apply an appropriate within-family/heritability analysis for a given dataset, based on a specific research question,
- discuss how to perform within-family/heritability analyses using standard statistical softwares,

- interpret the output from a within-family/heritability analysis, and compare with a more standard statistical analysis,
- discuss assumptions made in heritability analysis, and how violations may affect the results.

Course content

1. In this course we will focus on the theory and practice of within-family analyses.
The aim of empirical research is often to estimate the causal effect of a particular exposure on a particular outcome. A complicating feature of observational studies is that the exposure-outcome association is typically confounded, and cannot be given a causal interpretation. The standard approach to deal with confounding is to control for confounders in the analysis, e.g. by regression modelling. However, many confounders may be difficult to measure, or unknown to the investigator. An appealing solution is to study within-family associations, which are automatically controlled for all factors that are shared within the family (e.g. socioeconomic status, genetic factors).

2. In this course we will cover the concept of heritability, its underlying assumptions, and applications in the classic twin method.
In many studies, the research question is to what extent a phenotype is caused by genetic factors. Frequently though, there may be no obvious candidate gene, and financial limitations may prohibit a genome wide scan. An appealing solution is to study whether the phenotype tends to run in families; the stronger genetic influence, the larger familial heredity. A commonly used design to estimate the fraction of variation in an outcome which may be attributable to genes and environment is the classic twin methodology.

3. In this course we will also compare and contrast within-family and bivariate heritability analysis (i.e., quantitative genetic analysis of two phenotypes), two methods that complement each other. Although within-family analyses require fewer assumptions, bivariate heritability analyses may yield additional information.

Forms of teaching and learning

Different strategies for teaching and learning, such as interactive lectures, small group discussions and exercises on selected topics, will be used. For teaching and in computer labs the statistical software used is R. Student may use other softwares, but teacher may not be able to give support.

Language of instruction

The course is given in English

Grading scale

Pass (G) /Fail (U)

Compulsory components & forms of assessment

Compulsory components

The individual examination (summative assessment).

Forms of assessment

The student must show that the learning outcomes have been achieved to pass the exam. The course grade is based on the individual written examination (summative assessment).

Students who do not obtain a passing grade in the first examination will be offered a second examination occasion within two months of the final day of the course.

Students may be granted additional examination sessions, up to six in total, subject to discussion with and approval by the examiner.

Course literature

Suggested reading:

Allison PD. (2009). Fixed effects regression models, Quantitative Applications in the Social Sciences, Vol. 160. SAGE: Los Angeles.

Neale & Maes (2004). Methodology for Genetic Studies of Twins and Families. Kluwer Academic Publishers B.V. Dordrecht, The Netherlands. Available at http://ibgwww.colorado.edu/workshop2004/cdrom/HTML/book2004a.pdf