Genetic Association Course
with Application to Sequence and Genotype Data
September 16 - 20, 2025
Delbrück Center for Molecular Medicine–Berlin, Germany

Each session will begin with a theoretical introduction followed by practical exercises. The instructors for the course are Suzanne Leal (Columbia University) and Michael Nothnagel (University of Cologne). Please feel free to bring your own data sets for discussion and/or analysis.

The course will be held daily from 9:00 a.m. to 5:00 p.m., except for Wednesday, when the course will end at 1:00 pm to have free time in the afternoon for sightseeing. On Monday, registration will be held from 8:30 to 9:00 am. A dinner at a local restaurant will be held for students and faculty directly following the course on Monday.

MONDAY September 16th	Morning	*Lecture* Introduction to genetic epidemiology, population genetics and statistical testing. Introduction to PLINK and R; file formats *Computer Exercises*; PLINK and R – manipulating data
	Afternoon	*Lecture* Basic statistical test for the analysis of genotype and sequence data Introduction to PLINK and R; file formats *Computer Exercises*; PLINK and R – simple tests of association
	18:00 -22:00	Dinner at Il Castelo – alt Buch Karower Str. 1. 13125 Berlin
TUESDAY September 17th	Morning	*Lecture* Linkage disequilibrium (LD), pairwise measures of LD Data quality control for genotype array and sequence data *Computer Exercises* PLINK – Data quality control *Pencil and Paper Exercises* r2, D', etc.
	Afternoon	*Lecture* Analysis of quantitative and qualitative traits using linear and logistic regression; confounding and how to control for it in the analysis Haplotype reconstruction and estimation *Computer Exercises* PLINK & R – Logistic and linear regression – adjusting for covariates

WEDNESDAY September 18th	Morning	*Lecture* Population substructure/admixture detection and control of confounding due to population substructure (structure, principal components analysis, etc.) *Computer Exercises* PLINK – Multidimensionality scaling (MDS) and principal components analysis (PCA)
	Afternoon	Free for sightseeing
THURSDAY September 19th	Morning	*Lecture* Generalized linear mixed models and linear mixed models; Data quality control for rare variant data obtained from next generation sequencing. *Computer Exercises* VCF-Tools and ANNOVAR
	Afternoon	*Lecture* *C*omplex trait rare variant association analysis of sequence data. *Computer Exercises* REGENIE
FRIDAY September 20th	Morning	*Lecture* Sample size estimation and power calculations (for Rare Variant Aggregation Tests) and Genome-Wide Association Studies (GWAS); the multiple testing problem; controlling the family wise error rate (FWER); and permutation and false discovery rate (FDR) *Computer Exercises* Cochran-Armitage test for trend power tool, GAS, Genetic Power Calculator R-permutation, FDR
	Afternoon	*Lecture* Imputing genotype data from sequence and genotype data; analyzing imputed genotype data; polygenic risk scores; detecting gene x gene and gene x environment interactions *Computer Exercises* PLINK & R -Testing for gene x gene interactions, LDPhred2