

**Genetic Association Course**  
**with Application to Sequence and Genotype Data**  
**September 26 - 30, 2022**  
**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.

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|----------------------------------------------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>MONDAY</b><br>September 26 <sup>th</sup>  | Morning      | <i>Lecture</i><br>Introduction to genetic epidemiology, population genetics and statistical testing.<br>Introduction to PLINK and R; file formats<br><i>Computer Exercises</i> ;<br>PLINK and R – manipulating data                                                                                                                                                                                                              |
|                                              | Afternoon    | <i>Lecture</i><br>Basic statistical test for the analysis of genotype and sequence data<br>Introduction to PLINK and R; file formats<br><i>Computer Exercises</i> ;<br>PLINK and R – simple tests of association                                                                                                                                                                                                                 |
|                                              | 18:00 -22:00 | Dinner at a local restaurant                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>TUESDAY</b><br>September 27 <sup>th</sup> | Morning      | <i>Lecture</i><br>Linkage disequilibrium (LD), pairwise measures of LD<br>Data quality control, cleaning genotype data<br><i>Computer Exercises</i><br>PLINK – Data quality control<br><i>Pencil and Paper Exercises</i><br>r <sup>2</sup> , D', etc.                                                                                                                                                                            |
|                                              | Afternoon    | <i>Lecture</i><br>Analysis of quantitative and qualitative traits using linear and logistic regression;<br>confounding and how to control for it in the analysis<br>Haplotype reconstruction and estimation, testing for associations using haplotype data<br><i>Computer Exercises</i><br>UNPHASED – Haplotype and LD estimation & association testing<br>PLINK & R – Logistic and linear regression – adjusting for covariates |

**WEDNESDAY**  
September 28<sup>th</sup>

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 29<sup>th</sup>

Morning

*Lecture*

Generalized linear mixed models and linear mixed models; Data quality control for rare variant data obtained from next generation sequencing

*Computer Exercises*

REGENIE, Variant Association Tools (VAT)-part I

Afternoon

*Lecture*

Complex trait rare variant association analysis of sequence data. population and family-based aggregate tests.

*Computer Exercises*

VAT-part II and PSEQ

**FRIDAY**  
September 30<sup>th</sup>

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