

TIGP Bioinformatics Program
Advanced Statistical Methods in Bioinformatics (S2)
Spring 2025 Syllabus

For the latest syllabus, please visit the BP website: <https://idv.sinica.edu.tw/tigpbio/>

Place: Room 308, Institute of Statistical Science, Academia Sinica
Time: Thursday 9:00-12:00
Chair: Dr. Grace S. Shieh (gshieh@stat.sinica.edu.tw)
Outline: Introduction to useful and advanced statistical methods in computational biology. The topics include: Analysis of next generation sequencing (NGS) Data (e.g., RNA-Seq and ChIP-Seq), maximum likelihood estimation, the EM algorithm, Bayesian inference, Monte Carlo methods, Resampling (Bootstrap & permutation test), Human Genetics, clustering and classification, dimension-reduction and missing data.
Textbook: N/A
TA: N/A (Please refer to the lectures respectively shall you have any questions for each class)□
Grades: Midterm exam 50%. Final exam 50%.

【For Non-BP student】

For Non-BP student to register/sit-in any BP course, it is required to gain course chair's permission:
(1) Basic Enrollment Information form: <https://forms.gle/oK7vJzrx9EvybbT9>
(2) TIGP-BP Course Registration Consent Form:
https://idv.sinica.edu.tw/tigpbio/index/TIGP%20Bioinformatics_Class%20Registration%20Consent%20Form.docx
※ Deadline: **the 4th week** of each semester.
※ Signature of the course chair should be collected before submission. Incomplete form will not be accepted.
※ Course grade will NOT be given (even class enrollment is completed at school) if fail to follow the above procedures.

Week	Date	Topics/Brief Description	Sub-topics/Detail Descriptions	Lecturers	Evaluation Method	Email
1	2025/2/19 (Wed) 9:00-12:00	Analysis of NGS data I	Analysis of DNA sequencing data	Dr. Shih-Kai Chu	Take-home exam with a specified deadline: ▶ 11:59 PM, April 12th	uhcnivag@gm.ntpu.edu.tw
2	2025/2/26 (Wed) 9:00-12:00	Analysis of NGS data II	Analysis of RNA sequencing data	Dr. Shih-Kai Chu		
3	2025/3/6	Maximum likelihood estimates and the EM algorithm I	Maximum likelihood estimates	Dr. Yen-Tsung Huang	Take-home exam with a specified deadline: ▶ 11:59 PM, April 10th	ythuang@stat.sinica.edu.tw
4	2025/3/13	Maximum likelihood estimates and the EM algorithm II	The EM algorithm	Dr. Yen-Tsung Huang		
5	2025/3/20	Bayesian Statistics	prior dist., conjugate families & applications to genetics	Dr. Grace S. Shieh	In-class exam on midterm exam date	gshieh@stat.sinica.edu.tw
6	2025/3/27	Resampling methods	Bootstrap for hypothesis testing , confidence interval, and Permutation method	Dr. Grace S. Shieh	Take-home exam with a specified deadline: ▶ 11:59 PM, April 30th	
7	2025/4/2 (Wed) 9:00~12:00	Monte Carlo Markov Chains	Monte Carlo Markov Chains	Dr. Shin-Sheng Yuan	Take-home exam with a specified deadline: ▶ 11:59 PM, April 30th	syuan@stat.sinica.edu.tw
7	2025/4/3	Makeup Holiday for Children's Day (no class)	--	--	--	--
8	2025/4/10	Midterm Exam	--	--	--	--
9	2025/4/17	Prediction of Drug Response	Feature selection, logistic ridge, KNN, ML and transfer learning	Dr. Grace S. Shieh	No exam. (was HW with a specified deadline)	gshieh@stat.sinica.edu.tw
10	2025/4/24	Cluster Analysis	K-Means, Hierarchical Clustering, Heatmap, Cluster Validation	Dr. Han-Ming Wu	Take-home exam with a specified deadline: ▶ June 5th	wuhm@g.nccu.edu.tw
11	2025/5/1	Classification and Its Assessment	ROC Curve, Decision Tree, Ensemble Methods	Dr. Han-Ming Wu		
12	2025/5/8	Statistics in Human Genetics/Genomics I	Concept of Statistical Genetics, International Genomic Projects, Linkage Analysis, Genetic Association Analysis	Dr. Hsin-Chou Yang	Take-home exam with a specified deadline: ▶ June 5th	hsinchou@stat.sinica.edu.tw
13	2025/5/15	Statistics in Human Genetics/Genomics II	Genome-Wide Association Study, Gene-Gene Interaction, Rare Variant Analysis, Polygenic Risk Score	Dr. Hsin-Chou Yang		
14	2025/5/22	Advanced regression and dimension reduction II	Liquid Association and related developments	Dr. Kang-Chung Yang	Take-home exam with a specified deadline: ▶ June 5th	keyang@stat.sinica.edu.tw
15	2025/5/29	Advanced regression and dimension reduction I	Sliced Inverse Regression and PHD	Dr. Shin-Sheng Yuan	Take-home exam with a specified deadline: ▶ June 5th	syuan@stat.sinica.edu.tw
16	2025/6/5	Final Exam (take-home exams, no class)	--	--	--	--