

TIGP Bio 2021 Fall Syllabus
Fundamental Statistical Methods in Bioinformatics (S1)

Place: Room 107, New Building of the Institute of Information Science, Academia Sinica.

Time: Thursday 09:00-12:00

Chair: Dr. Shinsheng Yuan (shinshengyuan@gmail.com)

Outline: This course covers the fundamentals of statistics and basic tools for bioinformatics analysis. In the first part students will learn basic statistical concepts and methods, including probability, random variables and distributions, parameter estimation, hypothesis testing, regression analysis, and categorical data analysis. In the second part several commonly used methods in bioinformatics will be introduced, including statistical meta analysis, survival analysis, clustering, classification, and nonparametric statistics.

Textbook: Fundamentals of Biostatistics (author: Bernard Rosner), Cengage Learning.

Reference book: Pattern Recognition (author: Richard O. Duda, Peter E. Hart, and David G. Stork), Wiley.

TA: Jia-Ying Su **Email:** dasiav7@gmail.com **TA Office hours:** Monday 15:00 pm-17:00pm **TA Office location:** N420, IMB, AS

Grades: Midterm exam 50%. Final exam 50%.

Note: For **Non-BP student** to register/sit-in any BP course, it is required to gain course chair's permission and follow the steps:

(1) Submit the hard copy or PDF file of the completed [TIGP Bioinformatics Course Registration Consent Form](#) to the TIGP BP office

(2) Provide the information via the google form at [BP Class Enrollment Information](#).

The deadline for above requirement is **the 4th week** of each semester. Signature of corresponding BP Course Chair should be collected and 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.

For the most up-to-date syllabus, please visit <https://tigppb.iis.sinica.edu.tw/tigppbio/index.html>

Week	Date	Topics/Brief Description	Lecturers
1	2021/9/16@Webex	(1) Introduction to statistics (2) Descriptive statistics (3) Fundamental of molecular biology (4) Genomic data analysis	Dr. Chen-Hsiang Yeang
2	2021/9/23@Webex	(1) Applications in statistical genetics (2) Combinatorial analysis (3) Axioms of probabilities (4) Conditional probability and independence (5) Random variable and distribution function	Dr. Hsin-Chou Yang
3	2021/9/30@Webex	(1) An application in pharmacogenetic study (2) Discrete/continuous/mixed distributions (3) Joint/marginal/conditional distributions (4) Special discrete distributions (5) Introduction to contingency table	Dr. Hsin-Chou Yang
4	2021/10/7@Webex	(1) Continuous random variable (2) Expectation (3) Basic statistics (4) Limit theorems (optional)	Dr. Hsin-Chou Yang
5	2021/10/14@Webex	(1) Unbiasedness (2) Point estimation (substitution principles, least square estimate, maximum likelihood estimate) (3) Interval estimation	Dr. Shinsheng Yuan
6	2021/10/21	(1) Hypothesis testing (2) Applications in cancer researches (3) Type I & type II errors and p-value (4) One-sample and two-sample z-tests (5) One-sample, two-sample, and paired t-tests (6) Bonferroni adjustment, false discovery rate, and q value	Dr. Grace Shieh
7	2021/10/28	Review Week (No class)	
8	2021/11/4	Midterm Exam	
9	2021/11/11	(1) Applications to predictions of drug responses (2) Simple linear regression & inference (3) Diagnostic and remedial measures	Dr. Grace Shieh

		(4) Matrix approach to simple linear regression (5) Multiple linear regression (6) Building the regression model	
10	2021/11/18	(1) Mantel-Haenszel test (2) Survival and hazard functions (3) Kaplan Meier estimate (4) Log-rank test (5) Proportional-hazards model (6) Lung cancer study	Dr. Hsuan-Yu Chen
11	2021/11/25 Moved to 12/17	--	--
12	2021/12/2	(1) Clustering by geometry (K-means, EM algorithm, hierarchical clustering, self-organizing map, principal component analysis, independent component analysis) (2) Clustering on graphs (Basic concepts, max flow – min cut, normal cuts, spectral clustering, and community detection) (3) Advanced topics (Chinese restaurant process and affinity propagation)	Dr. Chen-Hsiang Yeang
13	2021/12/9	(1) Bootstrap (2) One-sample sign test (3) One-sample Wilcoxon signed-rank test (4) Wilcoxon rank-sum test (Mann-Whitney U test) (5) Sign test for paired data (6) Wilcoxon signed-rank test for paired data	Dr. Wei-Chung Liu
14	2021/12/16 @Webex	(1) Kruskal-Wallis test (2) Randomization/permutation test for two-way ANOVA (3) The product-moment correlation coefficient (4) Spearman rank correlation (5) Kendall's coefficient of rank correlation	Dr. Wei-Chung Liu
14	2021/12/17 (Fri) 14:00-17:00 @Webex	(1) Logistic regression (2) Meta analysis (effect size, precision, study weights, summary effect, heterogeneity, fixed-effect model, random-effect model, software)	Dr. Shinsheng Yuan
15	2021/12/23	Review Week (No class)	
16	2021/12/30	Final Exam	