STAT502
Statistical Inference and Decision Theory

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<u>Instructor Contact Details</u>

Lecturer-in-charge: Wei WANG

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<u>Teaching Times, Modes and Locations</u>

Course Duration: 11 Jan 2026 to 30 Jan 2026
Modes: Face-to-face
Location: Huajiachi Campus, Zhejiang University via face-to-face

<u>Academic Level</u>

Undergraduate

<u>Credit Points:</u>

The course is worth 6 units of credit point.

<u>Credit Hours</u>

The number of credit hours of this course equals to the credits of a standard semester- long course.

<u>Contact Hours</u>

The course contains a total of 53 contact hours, which consists of orientation, lectures, seminars, quiz, discussion, research, case study, small tests, assignments, on-site field trip(s), in-class and after-class activities, revision, self-study, and final exam. Students will receive an official transcript which is issued by Zhejiang University when completing this course.

<u>Enrolment Requirements</u>

Eligibility requires enrollment in an overseas university as an undergraduate or postgraduate student, proficiency in English, and pre-approval from the student's home institution.

Course Description:

This unit introduces students to the theoretical foundations and optimal methods of statistical inference, bridging classical principles with modern decision-theoretic approaches. Through a study of distribution theory, exponential families, and likelihood methods, students will develop a rigorous understanding of statistical estimation and hypothesis testing. The unit emphasizes optimality concepts such as minimum variance unbiased estimation, most powerful tests, Bayes rules, and minimax decision rules. Students will learn how to critically evaluate statistical methods, derive optimal procedures, and choose appropriate techniques for real-world data problems. Hands-on lab sessions will provide experience applying these concepts to practical analysis tasks.

Prerequisite:

N/A

Learning Resources

● George Casella and Roger L. Berger, Statistical Inference, 2nd Edition, Duxbury Press. ISBN: 9780534243128
● R.P. Dobrow, Introduction to Stochastic Processes with R （2nd Edition, Wiley, 2021）

Learning Objectives

By the end of this course, you should be able to:

● Deduce the (limiting) distribution of sums of random variables using moment-generating functions.

● Derive the distribution of a transformation of two (or more) continuous random variables.

● Derive marginal and conditional distributions associated with certain multivariate distributions.

● Classify many common distributions as belonging to an exponential family.

● Derive and implement maximum likelihood methods in various estimation and testing problems.

● Formulate and solve various inferential problems using a decision-theoretic framework.

● Apply optimal inference methods such as Bayes rules, minimax rules, MVUEs, and most powerful tests.

Course Delivery:

● Face-to-face Lecture mode includes lectures, seminars, quiz, discussion,

research, case study, small tests, assignments, on-site field trip(s), in-class and after-class activities, revision, and final exam.

The following course will be taught in English. There will also be guest speakers and optional field trips available for students who would like to enhance their learning experience. All courses and other sessions will be run during weekdays.

Topics and Course Schedule:

WK	Topic Activities	
1	Moment-Generating Functions and Applications	Lecture; Tutorial
1	Multivariate Distributions (Introduction to joint, marginal, and conditional distributions for multivariate random variables.)	Lecture; Tutorial
1	Transformations of Random Vectors Techniques for transforming random variables and finding resulting distributions.	Lecture; Tutorial
1	Exponential Families Defining and classifying exponential family distributions and their key properties.	Lecture; Tutorial
1	Minimum Variance Unbiased Estimation Finding MVUEs using the Rao-Blackwell and Lehmann–Scheffé theorems.	Lecture; Tutorial
2	Derivation and interpretation of Neyman–Pearson lemma and uniformly most powerful tests.	Lecture; Tutorial
2	Statistical Decision Theory and Prediction Framework for decisions under uncertainty; prediction problems and risk functions.	Lecture; Tutorial
2	Bayes Risk and Bayes Decision Rules Derivation and implementation of Bayesian decision procedures with loss functions.	Lecture; Tutorial
2	Minimax Decision Rules Definition and application of minimax rules in estimation and testing problems.	Lecture; Tutorial
2	Applications in Model Selection and Testing Practical examples illustrating estimation and testing methods in model contexts.	Lecture; Tutorial
3	Asymptotic Optimality and Local Minimaxity Introduction to asymptotic properties of estimators and locally optimal tests.	Lecture; Tutorial
3	Examples of Asymptotically Optimal Procedures	Lecture; Tutorial
3	Capstone Review and Exam Preparation	Lecture; Tutorial

3	Final project presentation & peer review	Lecture; Tutorial
3	Revision	Tutorial
	Final exam	Closed book

Assessments:

Class participation	15%
In-class Test	15%
Assignments	20%
Final exam	50%
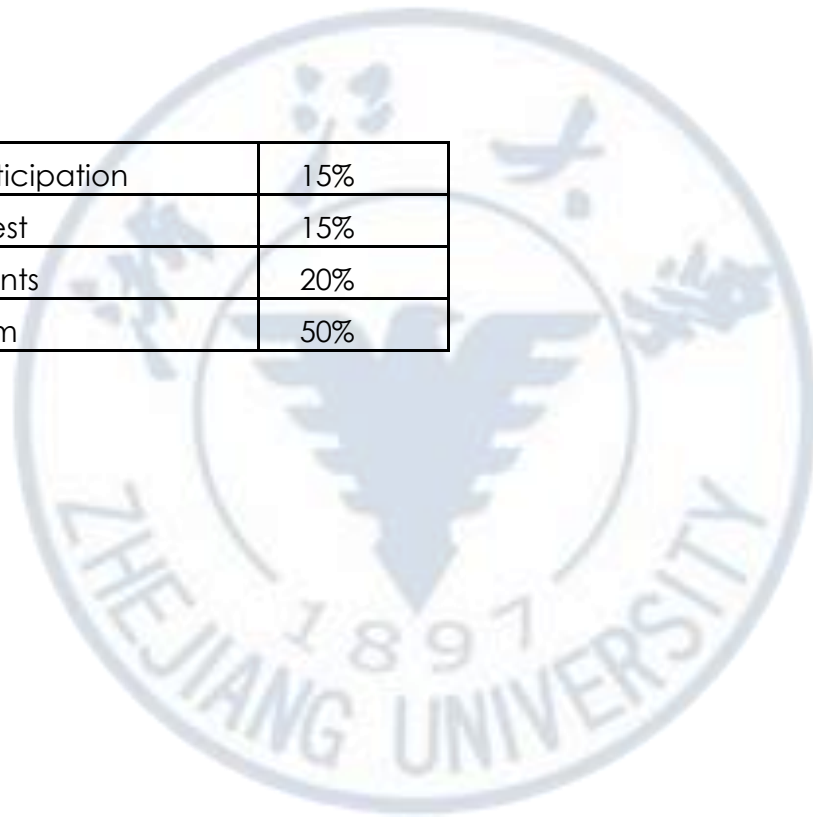
HD	High Distinction	85-100
D	Distinction	75-84
Cr	Credit	65-74
P	Pass	50-64
F	Fail	0-49

High Distinction 85-100

• Treatment of material evidences an advanced synthesis of ideas Demonstration of initiative, complex understanding, and analysis.
• Work is well-written and stylistically sophisticated, including appropriate referencing, clarity, and some creativity where appropriate.
• All criteria addressed to a high level.

Distinction 75-84
• Treatment of material evidences an advanced understanding of ideas Demonstration of initiative, complex understanding and analysis Work is well-written and stylistically strong.
• All criteria addressed strongly.

Credit 65-74
• Treatment of material displays a good understanding of ideas
• Work is well-written and stylistically sound, with a minimum of syntactical errors.
• All criteria addressed clearly.

Pass 50-64
• Treatment of material indicates a satisfactory understanding of ideas Work is adequately written, with some syntactical errors.
• Most criteria addressed adequately.

Fail 0-49
• Treatment of ideas indicates an inadequate understanding of ideas Written style inappropriate to task, major problems with expression.
• Most criteria not clearly or adequately addressed.

Academic Integrity

Students are expected to uphold the university's academic honesty principles which are an integral part of the university's core values and principles. If a student fails to observe the acceptable standards of academic honesty, they could attract penalties and even disqualification from the course in more serious circumstances. Students are responsible for knowing and observing accepted principles of research, writing and any other task which they are required to complete.

Academic dishonesty or cheating includes acts of plagiarism, misrepresentation, fabrication, failure to reference materials used properly and forgery. These may include, but are not limited to: claiming the work of others as your own, deliberately applying false and inaccurate information, copying the work of others in part or whole, allowing others in the course to copy your work in part or whole, failing to appropriately acknowledge the work of other scholars/authors through acceptable referencing standards, purchasing papers or writing papers for other students and submitting the same paper twice for the same subject.

This Academic Integrity policy applies to all students of the Zhejiang University in all programs of study, including non-graduating students. It is to reinforce the University's commitment to maintain integrity and honesty in all academic activities of the University community.

Policy

The foundation of good academic work is honesty. Maintaining academic integrity upholds the standards of the University. The responsibility for maintaining integrity in all the activities of the academic community lies with the students as well as the faculty and the University. Everyone in this community must work together to ensure that the values of truth, trust and justice are upheld.

Academic dishonesty affects the University's reputation and devalues the degrees offered. The University will impose serious penalties on students who are found to have violated this policy. The following penalties may be imposed:

- ✓ Expulsion
- ✓ Suspension
- ✓ Zero mark /fail grade
- ✓ Marking down
- ✓ Re-doing/re-submitting of assignments or reports, and
- ✓ Verbal or written warning.