University of Tehran
School of Electrical and Computer Engineering

<table>
<tr><td>Course:</td><td>Statistical Inference</td></tr>
<tr><td>Course type:</td><td>
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<tr><td></td><td colspan="6">EE*</td><td colspan="4">CE*</td><td rowspan="2">Credit:

3</td></tr>
<tr><td></td><td>Com</td><td>E</td><td>P</td><td>B</td><td>Con</td><td>D</td><td>SW</td><td>HW</td><td>IT</td><td>MI</td></tr>
<tr><td>Required</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td></td></tr>
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<tr><td>Level:</td><td>Undergraduate ☐
Graduate ☒</td></tr>
<tr><td>Co-requisite(s):</td><td>None.</td></tr>
<tr><td>Prerequisite(s):</td><td>None.</td></tr>
<tr><td>Prerequisite by topic:</td><td>Familiarity with probability theory.</td></tr>
<tr><td>Textbook(s):</td><td>Main textbooks

[1] L. Ott and M. Longnecker, “An Introduction to Statistical Methods and Data Analysis”, 6th Edition, Duxbury, 2008.

For further reading

[2] D. Freedman, R. Pisani, and R. Purves, “Statistics,” 4th ed., W. W. Norton and Company, 2007.
[3] G. Casella and R. Berger, “Statistical Inference,” 2nd ed., Duxbury, 2001.</td></tr>
<tr><td>Coordinator:</td><td>Behnam Bahrak, Assistant Professor, School of ECE.</td></tr>
<tr><td>Goals:</td><td>This course provides an overview of fundamental concepts in statistics and probability. It begins with Probability Theory, which delves into the foundations of probability and its significance in statistical inference. Next, Sampling Techniques are explored, with a focus on various sampling methods and their implications in data analysis. Estimation techniques follow, covering how to estimate population parameters using sample data, including point and interval estimates. The concept of Hypothesis Testing is then introduced, detailing procedures for making decisions based on sample data. Regression Analysis comes next, highlighting the use of linear regression models to predict outcomes. Analysis of Variance (ANOVA) is discussed as a means of comparing means across multiple groups. Additionally, Non-parametric Methods are introduced, offering alternatives to traditional statistical techniques for data analysis. Finally, Bayesian Inference is presented as an introduction to Bayesian statistics and its differences from classical (frequentist) approaches. Overall, this summary provides a comprehensive glimpse into key statistical concepts and their applications.</td></tr>
<tr><td>Outcome:</td><td>Upon successful completion of the course, students will be able to:</td></tr>
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	1. The importance of data collection, its limitations, and its effects on statistical inference. 2. How to use R statistical software to summarize data both numerically and visually. 3. The fundamental concepts of statistical inference, data analysis, modeling, and the examination of relationships between different variables. 4. Students will be able to ensure the correct interpretation of results from statistical tests. 5. The ability to evaluate claims based on data and assess decisions based on these claims using hypothesis tests. 6. Conducting a practical research project to apply what has been learned to solve an actual problem.
Topics:	1- Introduction to data 1.1- Data collection methods 1.2- Sampling Strategies 1.3- Design experiment 1.4- Visualizing Numerical Data 1.5- Visualizing Categorical Data 2- Probability theory 2.1- Probability definition 2.2- Conditional Probability 2.3- Bayes Theorem 2.4- Random Variables 2.5- Probability distributions 3- Foundation for Inference 3.1- Parameter estimation 3.2- Central Limit Theorem (CLT) 3.3- Confidence Interval 3.4- Hypothesis Testing 3.5- Types of Error 4- Inference for Numerical Variables 4.1- t-distribution 4.2- Comparing two Means 4.3- Analysis of Variance (ANOVA) 4.4- Power of a test 4.5- Multiple Comparison 4.6- Bootstrapping 5- Inference for Categorical Variables 5.1- Inference for proportion 5.2- Comparing two proportions 5.3- Small sample proportion 5.4- Goodness of fit test 5.5- Independent test 6- Introduction to Linear Regression 6.1- Linear Regression 6.2- Conditions for Linear Regression 6.3- Hypothesis testing for Linear Regression 6.4- Multiple Linear Regression (MLR) 6.5- Hypothesis testing for MLR 6.6- Backward Elimination 6.7- Forward Selection

	7- Introduction to Logistic Regression 7.1- Logistic Regression 7.2- Hypothesis testing for Logistic Regression 8- Non-parametric tests 8.1- Sign test 8.2- Wilcoxon Signed Rank test 8.3- Mann-Whitney Wilcoxon Rank Sum test
Computer usage:	Accomplishing the assignments and final project using R Software for statistical analysis.
Assignments:	Students are expected to complete seven theoretical homework and seven computer assignments.
Projects:	Conducting a data analysis project on a large dataset using R software.
Grading:	Assignments: 20% Midterm exams: 20% Final exam: 40% Project: 20%
Further readings:	-
Prepared by:	Behnam Bahrak, Assistant Professor, School of ECE.
Date:	February 1, 2021

*EE: Electrical Engineering		CE: Computer Engineering	
Com	Communications	SW	Software
E	Electronics	HW	Hardware
P	Power	IT	Information Technology
B	Bioelectronics	MI	Machine Intelligence and Robotics
Con	Control		