

**Block I: Data and Randomness**

LSN	Topic	Lesson Objectives	Reading
1	Types of Data, Sampling, & Study Design	Distinguish populations, samples, and processes in studies. Classify variables as categorical or quantitative. Identify parameters vs. statistics in context.	1.1
2	Sampling & Study Design	Contrast observational studies and designed experiments. Describe common sampling methods and potential biases. Explain why randomization and control strengthen inference.	1.2
3	Measures of Location	Calculate and interpret mean, median, and mode. Determine percentiles and quartiles. Compare measures of center for different distributions.	1.3
4	Measures of Variability	Calculate and interpret range and inter-quartile range (IQR). Calculate and interpret variance and standard deviation.	1.4
5	Exploratory Data Analysis Lab	Execute EDA using appropriate graphs and summaries. Justify choices of displays for variable types. Communicate findings with clear, concise annotations.	
6	Probability Basics	Understand the Kolmogorov Axioms. Understand the Inclusion-Exclusion Principle.	2.1, 2.2
7	Conditional Probability	Apply conditional probability and the multiplication rule. Apply Bayes' Rule and the Law of Total Probability.	2.4
8	Independence	Count sample spaces of ordered or unordered events in conjunction with or without replacement. Understand how to account for independent events.	2.3, 2.5
9	Discrete Random Variables	Understand how PMFs are created and used in discrete RVs. Understand how CDFs are used in discrete RVs. Understand and calculate Expected Value and Variance	3.1, 3.2, 3.3
10	Binomial Distribution	Verify binomial conditions for counts of successes. Compute binomial pmf/cdf values. Interpret binomial mean and variance.	3.4
11	Poisson Distribution	Model counts and rare events with Poisson distributions. Calculate Poisson probabilities and parameters. Use Poisson as a binomial approximation when valid.	3.6
12	Continuous Random Variables	Interpret pdfs and areas as probabilities. Compute probabilities from pdfs and cdfs. Find $E(X)$ and $\text{Var}(X)$ for continuous rvs.	4.1, 4.2
13	Normal Distribution	Standardize and use normal probabilities. Find normal quantiles for given tail areas. Assess plausibility using normal models.	4.3

14	Exponential Distribution	Recognize the memoryless property Understand the rate-mean relationship. Compute exponential probabilities and quantiles.	4.4
15	Review	Review Lessons 1-14	
16	WPR 1	Covers Concepts from LSNs 1-14.	

## Block II: Inference

LSN	Topic	Lesson Objectives	Reading
17	Central Limit Theorem	State CLT conditions for $\bar{X}$ and $\hat{p}$ . Use normal approximations to sampling distributions. Relate accuracy to $n$ and population shape.	5.3, 5.4
18	Confidence Intervals I	Define confidence level and margin of error. Construct one-sample CIs for means or proportions. Justify $z$ vs. $t$ procedures and conditions.	7.1, 7.2
19	Confidence Intervals II	Interpret CIs correctly in context. Determine $n$ for a target margin of error. Assess robustness of CI assumptions.	7.3
20	Intro to Hypothesis Testing	State $H_0$ and $H_a$ for practical questions. Compute test statistics and $p$ -values. Link significance, Type I error, and $\alpha$ .	8.1, 8.2
21	One Sample t-Test	Check conditions for the one-sample $t$ -test. Carry out and interpret a one-sample $t$ -test. Compare $p$ -value and CI conclusions.	8.3
22	One Proportion Z-Test	Check success-failure conditions for proportions. Perform a one-proportion $z$ -test and interpret. Distinguish practical vs. statistical significance.	8.4
23	Two Sample t-Test	Test $\mu_1 - \mu_2$ with independent samples. Choose pooled vs. Welch procedures appropriately. Construct and interpret CIs for $\mu_1 - \mu_2$ .	9.2
24	Paired t-Test	Identify paired versus independent designs. Test a mean difference using paired $t$ . Construct a CI for a mean difference.	9.3
25	Two Population Proportions	Check large-sample conditions for two proportions. Test $p_1 - p_2$ using pooled SE. Construct a CI for $p_1 - p_2$ and interpret.	9.4
26	Review	Review Lessons 17-25	
27	WPR II	Covers Concepts from LSNs 17-25.	

## Block III: Regression Modeling

LSN	Topic	Lesson Objectives	Reading
28	Simple Linear Regression I	Fit and interpret the least-squares line. Decompose variability with SSE, SST, and $R^2$ . Check linearity and equal-variance graphically.	12.1, 12.2
29	Course Drop	This lesson is a course drop due to Plebe Parent Weekend	
30	Simple Linear Regression II	Test slope significance; build CIs for $\beta_1$ . Produce prediction and mean-response intervals. Use residual and QQ plots to assess adequacy.	12.3, 12.5
31	Multiple Linear Regression I	Interpret coefficients in multiple regression carefully. Assess multicollinearity and variable importance. Use adjusted $R^2$ and diagnostics for selection. Understand threats to causal inference.	Supplement: Causality
32	Multiple Linear Regression II	Incorporate categorical variables in regression model. Understand indicator terms and interpret their meaning. Identify and address confounding variables. Control for confounders in statistical models.	Supplement: Confounding
33	Multiple Linear Regression III	Incorporate interaction terms into regression models. Interpret interaction effects in context. Test for and visualize interactions. Distinguish main effects from interaction effects.	Supplement: Interactions
34	Project Peer Review	Seek and provide tech-report feedback from three classmates.	
35	Course Lecture Drop	Drop for course-wide guest lecture.	Tech Report Due Lesson 36
36	ANOVA I	State ANOVA assumptions and hypotheses. Compute the $F$ -statistic from sums of squares. Conduct one-way ANOVA tests. Report differences with CIs and effect sizes.	10.1
37	Project IPR	Seek instructor and peer feedback on project presentations.	
38	ANOVA II	Conduct two-way ANOVA with or without replication. Test for interaction and simple effects. Use multiple comparisons for factor levels. Explain blocking vs. factorial trade-offs.	10.2
39	Project Presentations	Present project to a variety of audiences.	
40	Project Presentations	Review course material in preparation for Term End Exam.	

## Textbook

The text for this class is *Probability and Statistics for Engineering and the Sciences, 9th Ed., by Jay Devore*. All of the readings will be out of the text with the exception of posted supplemental readings posted on Canvas.

You will need access to the Cengage WebAssign platform for lesson preparation, instructions and access are available on Canvas.

## Course Policies

1. All assignments will be due by the due date posted in Canvas with the exception of the WebAssign homeworks, which will be due at the start of class that lesson (ignore exact Canvas due dates). All late assignments will be deducted 10% per 24 hour period that has elapsed from the published date time group.
2. Generative AI is encouraged throughout the use of this course. Ensure it is cited IAW the current DAAW and follow the assignment-specific guidance.

## Grade Breakdown

Graded Event	Points
Web Assign Homework	150
WPR I	175
WPR II	175
Exploratory Data Analysis	25
Tech Report	125
Project Presentation	50
TEE	300
<b>Total</b>	<b>1000</b>

## Course Project

Throughout this course you will be executing a statistical investigation into data hosted inside the Vantage enterprise on actual data from an Army unit. It is expected that you work concurrently on this project and still executing the other requirements of the course.

In order to gain access to Army Vantage, you will need an account. Instructions on establishing an account are published on Canvas. You will pick one of the five published unit-level datasets to use as your project dataset. It is strongly encouraged you use Generative AI to assist you in **ONLY** the CODING portion of this project, and course writ large.