

Exam Questions - Probability Theory *Spring 2026*

1. Definition of probability space $(\Omega, \mathbf{F}, \mathcal{P})$. Definition of Probability distributions. Cumulative Distribution Functions. Properties of CDF.
2. Types of probability distributions. Discrete probability distributions. Examples: Bernoulli, Binomial, Geometric, Poisson. Absolutely continuous distributions. Properties of PDF. Examples: Uniform, Exponential, Normal, Gamma.
3. Probability distributions in \mathbb{R}^2 . CDF in \mathbb{R}^2 . Properties of CDF in \mathbb{R}^2 . Marginal distributions. Absolutely continuous distributions in \mathbb{R}^2 . Properties of PDF in \mathbb{R}^2 .
4. Definition of independence of random variables. PDF of a random vector with independent components. Criterion for independence of random variables using CDF. Convolution formula for the sum and difference of random variables. Example with uniform distributions.
5. Definition of $E\xi$ for continuous random vectors.
6. Expected value and variance of some distributions: Binomial, Poisson, Geometric, Uniform continuous, Exponential, Normal, Gamma.
7. Important distributions in statistics. Definition and properties of Chi-squared distribution, t-distribution, F-distribution.
8. Statement of CLT and Poisson limit theorems.
9. Confidence intervals for One population (Derivation of each used formula): Confidence Interval for a Proportion. Sample Size Calculation for a Proportion. Z-Interval for a Mean. Sample Size for a Mean. t-Interval for a Mean.
10. Hypothesis testing for a single population: Type I and Type II errors; one- and two-sided alternative hypotheses; critical values and distribution quantiles.
11. One-sample Z-Test for proportions. One-sample Z-Test for the Mean. One-sample T-Test for the Mean. [Derivation of each used formula]
12. Hypothesis testing and confidence intervals for two populations: two-sample z-test for proportions; paired t-test for mean differences; two-sample t-tests for independent samples with equal variances (pooled) and unequal variances (Welch's method).
13. Chi-square tests: goodness-of-fit and test of association.
14. Simple Linear Regression. Least-squares regression line.