

Statistics and Econometrics I: Exam (40 points), December 15, 2017

An assignment will include a statement with longer proof (20 points), another theoretical question, with simpler proof where it is applicable (10 points), and a problem on Probability Theory (10 points).

Selected statements with longer proof

1. Chebyshev's Theorem about the percent of observations around the mean.
2. Expectation and variance of binomial distribution.
3. Expectation and variance of Poisson distribution.
4. A sum of two independent Poisson random variables has Poisson distribution as well.
5. Expectation and variance of uniform distribution.
6. Expectation and variance of exponential distribution.
7. Characteristic function of normal random variable. A sum of two independent normally distributed random variables has normal distribution as well.
8. If jointly Gaussian random variables are uncorrelated then they are independent.
9. The lemma about chi-square distribution and corollary: the distribution of the sample variance for normal population.
10. Expectation and variance of chi-square distribution.
11. Optimal investment in two stocks.
12. Sample mean and sample variance from normal population are independent.
13. Power function of one-sided test for the mean with known variance.
14. Power function of two-sided test for population proportion (large samples).
15. Least-squares estimators of regression parameters in univariate linear model.
16. Unbiased estimator of the variance in linear model.
17. Least-squares estimator for vector of regression parameters in multiple linear model.
18. Gauss-Markov theorem 1 in multiple linear model.
19. Gauss-Markov theorem 2 in multiple linear model.
20. Consistency of LS estimators in univariate linear model.
21. Consistency of LS estimators in multiple linear model.
22. Distribution of estimator for the variance in normal linear model.
23. Independence of LS estimators for regression parameters and for the variance in normal linear model.
24. Maximum likelihood estimators in normal linear model.
25. Mean prediction and individual prediction in linear model: confidence intervals.
26. Mean prediction and individual prediction in linear model: confidence bands constructed by Scheffe's method.

Other theoretical questions, with simpler proof where it is applicable

1. Classification of variables.
2. Graphs to describe categorical variables.

3. Histograms and ogives, stem-and leaf display.
4. Mean value, median, mode, percentile, and quartile of a sample. Box-and-whisker plot.
5. Approximate mean and variance of grouped data.
6. Operations for events. Mutually exclusive and collectively exhaustive events.
7. Classical probability. Orderings, permutations (i.e., arrangements) and combinations.
8. Conditional probability. Independent events.
9. Bivariate probabilities.
10. Overinvolvement ratios.
11. Bayes' Theorem.
12. Discrete random variables.
13. Poisson approximation and normal approximation of binomial distribution.
14. Hypergeometric distribution.
15. Expectation and variance of a sum of random variables.
16. Normal probability plot.
17. Population proportion, its mean and variance.
18. Acceptance interval for sample mean with known population variance.
19. Unbiased and efficient estimators. Relative efficiency. List efficient estimators.
20. Confidence interval for the mean with known population variance.
21. Confidence interval for the mean of normal distribution with unknown population variance.
22. Confidence interval for population proportion.
23. Confidence interval for the variance of normal population.
24. Confidence interval for the difference between two means: matched pairs.
25. Confidence interval for the difference between two means: independent normal samples with known variances.
26. Confidence interval for the difference between two means: independent normal samples with unknown but equal variances.
27. Tests of the mean of normal population with known variance.
28. The concept of p-value.
29. Tests of the mean of normal population with unknown variance.
30. Tests of the population proportion (large samples).
31. Tests of the variance of normal population.
32. Statistical properties of least-squares estimators in univariate linear model.
33. Variances and correlation of least-squares estimators in univariate linear model.
34. Coefficient of determination.
35. Confidence intervals in normal linear model.
36. Hypothesis testing in normal linear model: variance is unknown.