Qualifying Exam Preparation III
Theory of Statistics

Xi Tan (tan19@purdue.edu)

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Contents

Preface

STAT 528: References: Bickel & Doksum (Mathematical Statistics: Basic Ideas and Selected Topics, 2nd ed.); Casella & Berger (Statistical Inference, 2nd ed.).

STAT 553: References; Seber and Lee (Linear Regression Analysis, 2nd ed.) Stapleton (Linear Statistical Models), Christensen (Plane Answers to Complex Questions), Schervish (Theory of Statistics).

TBD

Part I

STAT528 Topics

Chapter 1

Data, Models, Statistics, Parameters

Definition 1.0.1 The set, S, of all possible outcomes of a particular experiment is called the sample space for the experiment.

Definition 1.0.2 An event is any collection of possible outcomes of an experiment, that is, any subset of S (including S itself).

Definition 1.0.3 A random variable is a function from a sample sapce S into the real numbers.

1.1 Distributions of Functions of a Random Variable

Theorem 1.1.1 From Casella & Berger Theorem 2.1.5) Let X have pdf $f_X(x)$ and let $Y = g(X)$, where g is a monotone function. Suppose that $f_X(x)$ is continuous and that $g^{-1}(y)$ has a continuous derivative. Then the pdf of Y is given by

$$f_Y(y) = f_X(g^{-1}(y))\Big|\frac{d}{dy}g^{-1}(y)\Big| \tag{1.1}$$

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Chapter 2

Decision Theory (Bayes and Minimax Criteria, Risk Functions, Estimation and Testing in Terms of the Decision Theoretic Framework

Chapter 3

Bayesian Models, Conjugate (and Other) Prior Distributions

Chapter 4

Prediction (Optimal MSPE and Optimal Linear MSPE)

Chapter 5

Sufficiency (Factorization Theorem)

Chapter 6

Natural Sufficient Statistics

Chapter 7

Minimal Sufficiency

Chapter 8

Estimation (Least Squares, MLE, Frequency Plug-in, Method of Moments, Combinations of These)

Chapter 9

Exponential Families & Properties, Canonical Exponential Families (& Fisher Information)

Chapter 10

Information Inequality, Fisher Information, UMVU Estimates, Cramer-Rao Lower Bound

Chapter 11

Neyman-Pearson Testing Theory (Form, MP Test, UMP Test, MLR Family, Likelihood Ratio Tests)

Chapter 12

Asymptotic Approximation / Large Sample Theory (Consistency, Delta Method, Asymptotic Normality of MLE, Slutsky's Theorem, Efficiency, Pearson's Chi-Square)

Part II

Stat 553 Topics

Chapter 13

Linear Models, Estimable Functions, Least Squares Estimates=LSE, Normal Equations, Projections, Gauss Markov Theorem, BLUE

Chapter 14

Multivariate Normal Distribution and Distribution of Linear and Quadratic Forms

Chapter 15

Properties of LSE and Generalized LSE

Chapter 16

General Linear Hypothesis=GLH, Testing of GLH

Chapter 17

Orthogonalization of Design Matrix and Canonical Reduction of GLH; Adding Variables To The Model

Chapter 18

Correlation, Multiple Correlation and Partial Correlation

Chapter 19

Confidence Regions and Prediction Regions

Chapter 20

Simultaneous Confidence Sets, Bonferroni, Scheffe Projection Method, Tukey Studentized Range

Chapter 21

Introduction to Design of Experiments, ANOVA and ANOCOVA, Factorial and Block Designs, Random, Fixed and Mixed Models, Components of Variance

Chapter 22

Hierarchial Bayes Analysis of Variance; (Schervish Ch. 8, 8.1,8.2) Partial Exchangeability and Hierarchical, Models, Examples and Representations, Normal One Way ANOVA and Two Way Mixed Model ANOVA