

# Part IB - Statistics

## Theorems

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### **Estimation**

Review of distribution and density functions, parametric families. Examples: binomial, Poisson, gamma. Sufficiency, minimal sufficiency, the Rao-Blackwell theorem. Maximum likelihood estimation. Confidence intervals. Use of prior distributions and Bayesian inference. [5]

### **Hypothesis testing**

Simple examples of hypothesis testing, null and alternative hypothesis, critical region, size, power, type I and type II errors, Neyman-Pearson lemma. Significance level of outcome. Uniformly most powerful tests. Likelihood ratio, and use of generalised likelihood ratio to construct test statistics for composite hypotheses. Examples, including  $t$ -tests and  $F$ -tests. Relationship with confidence intervals. Goodness-of-fit tests and contingency tables. [4]

### **Linear models**

Derivation and joint distribution of maximum likelihood estimators, least squares, Gauss-Markov theorem. Testing hypotheses, geometric interpretation. Examples, including simple linear regression and one-way analysis of variance. Use of software. [7]

## Contents

<b>1</b>	<b>Introduction and probability review</b>	<b>3</b>
<b>2</b>	<b>Estimation, bias and mean squared error</b>	<b>4</b>
2.1	Mean squared error . . . . .	4

## 1 Introduction and probability review

## 2 Estimation, bias and mean squared error

### 2.1 Mean squared error