

# 基礎數學範圍

## Calculus

1. Functions, inverse functions and limits
2. Derivatives and partial derivatives
  - (a) Chain rule
  - (b) Mean value theorem
  - (c) Optimization
  - (d) Newton's method
  - (e) Lagrange multipliers
3. Integrals and multiple integrals
  - (a) The fundamental theorem of Calculus
  - (b) L'Hospital's rule
  - (c) Integration by parts
  - (d) Change of coordinates
  - (e) Differential equations
4. Infinite Sequence and series
  - (a) Sequence
  - (b) Series and the tests of convergence
  - (c) Taylor series

## Linear Algebra

1. System of linear equations
2. Matrices
  - (a) Basic operations
  - (b) Inverse
3. Determinants
  - (a) Evaluation of determinants
  - (b) Properties of determinants
4. Vector spaces
  - (a) Subspaces

- (b) Span Sets
  - (c) Basis
  - (d) Rank
5. Eigenvalues and eigenvectors
- (a) Diagonalization
  - (b) Application

# 機率與統計範圍

## Probability

1. Axioms of probability and conditional probability
2. Random variables
  - (a) Distribution functions (cdf, pdf and pmf)
  - (b) Transformations of random variables
  - (c) Binomial, Poisson, Geometric and Negative binomial random variables
  - (d) Normal, Exponential, Gamma and Beta random variables
  - (e) Sum of independent random variables
3. Expectation
  - (a) Mean, variance, covariance and correlations
  - (b) Conditional expectation
  - (c) Conditional variance
  - (d) Moments and moment generating functions
4. Basic limit theorems
  - (a) Chebyshev's inequality
  - (b) Weak law of large numbers
  - (c) Central limit theorem
  - (d) The Poisson approximation to the binomial distribution

## Statistics

1. Sampling distributions
  - (a) Order statistics
  - (b) Sampling from the normal distribution,  $\chi^2$ ,  $t$ , and  $F$  distributions
  - (c) Sufficient statistics
  - (d) Unbiasedness
2. Point estimation
  - (a) Method of moments

- (b) Maximum likelihood estimators
  - (c) Bayes estimators
  - (d) Rao-Blackwell theorem
  - (e)  $\bar{X}$  and  $S^2$
3. Hypothesis testing
- (a) General concepts: type I error, type II error, power and  $p$ -value
  - (b) Neyman-Pearson lemma and most powerful tests
  - (c) Likelihood ratio tests
  - (d) Testing of parameters of a normal distribution
  - (e) Comparing the parameters of two normal distributions
4. Confidence intervals (CI)
- (a) General concepts: confidence coefficient
  - (b) CI of the parameters of a normal distribution
  - (c) CI of the function of parameters of two normal distributions