

Descriptive List of Upper-Division and Graduate Coursework

Tobin Carlton Van Buizen

Mathematics

MATH4204 Algebraic Topology Honours 2023

Mathematical Sciences Institute, ANU

Instructor: Dr. Vigleik Angeltveit

Topics: Fundamental group and covering spaces; Brouwer fixed point theorem and Fundamental Theorem of Algebra; homology and cohomology; Jordan–Brouwer separation; Lefschetz fixed point; orientation and Poincaré duality.

MATH3349 Special Topics: Stable Homotopy Theory 2024

Mathematical Sciences Institute, ANU

Instructor: Dr. Vigleik Angeltveit

Topics: Homotopy groups; fibrations; spectra and stable categories; computing (stable) homotopy groups of spheres; Thom spectra; Serre spectral sequence; Adams spectral sequence; simplicial objects; topological Hochschild homology.

MATH4349 Special Topics: Vector Bundles and K -Theory 2025

Mathematical Sciences Institute, ANU

Instructor: Dr. Vigleik Angeltveit

Topics: Vector bundles; sections; inner products; tensor products; fiber bundles and pullbacks; clutching functions; universal bundle; Grassmannians; $K(X)$ and the fundamental product theorem; Bott periodicity; Stiefel–Whitney and Chern classes; J -homomorphism; Thom spaces; Chern character.

MATH3349 Special Topics: Differential Forms in Algebraic Topology 2024

Mathematical Sciences Institute, ANU

Instructor: Dr. Anand Deopurkar

Topics: Differential forms; de Rham cohomology; integration on chains; Mayer–Vietoris; rational homotopy via DGAs; Sullivan models.

MATH3325 Functional Analysis and Spectral Theory 2023

Mathematical Sciences Institute, ANU

Instructor: Dr. Joseph Feneuil

Topics: Hilbert spaces; compact operators; spectral theorem for compact self-adjoint operators; Fourier transform; links to PDE and CLT. Measure theory: Fubini–Tonelli; Radon–Nikodym; Hausdorff measure; fractals. Banach spaces: Hahn–Banach; open mapping; Banach–Alaoglu; duals of L^p and $C(X)$.

MATH3342 Advanced Differential Geometry 2023

Mathematical Sciences Institute, ANU

Instructor: Pr. Ben Andrews

Topics: Smooth manifolds; tangent/cotangent bundles; differential forms; Riemannian metrics; Gauss–Bonnet; selected topics in curvature.

MATH3320 Advanced Analysis 2: Lebesgue Integration and Hilbert Spaces 2023
Mathematical Sciences Institute, ANU

Instructor: AsPr. Bryan Wang

Topics: Lebesgue outer measure; measurable sets; convergence theorems; Fubini; L^p spaces; Riesz representation; orthonormal bases; Parseval.

MATH4343 Foundations of Mathematics 2025
Mathematical Sciences Institute, ANU

Instructor: AsPr. James Borger; Pr. John Hutchinson

Topics: First-order logic; axiomatic set theory; model theory; computability; Gödel's incompleteness.

MATH4349 Special Topics: Operator Algebras 2025
Mathematical Sciences Institute, ANU

Instructor: Dr. Galina Letvina

Topics: C^* -algebras and $*$ -homomorphisms; ideals and quotients; representations; states and GNS construction; dynamical systems; crossed products.

Probability, Statistics & Stochastic Analysis

MATH3015 Stochastic Analysis and Financial Applications 2024
Mathematical Sciences Institute, ANU

Instructor: AsPr. Pierre Portal

Topics: Martingales; Lévy processes; Brownian motion; Itô integration; SDEs; option pricing, Black–Scholes and hedging.

STAT3013 Statistical Inference 2023
Research School of Finance, Actuarial Studies and Statistics, ANU

Instructor: Dr. Anton Westveld

Topics: MoM and MLE; bias/variance/MSE; sufficiency and completeness; Cramér–Rao; Rao–Blackwell; UMVUE; Bayesian estimation; confidence intervals; LRT and UMP tests; non-parametrics.

STAT3015 Generalised Linear Models 2022
Research School of Finance, Actuarial Studies and Statistics, ANU

Instructor: Pr. Andrew Wood

Topics: GLMs for categorical/count data; logistic and Poisson regression; model selection and checking; mixed effects.

STAT3056 Advanced Mathematical Statistics 2023
Research School of Finance, Actuarial Studies and Statistics, ANU

Instructor: Pr. Alan Welsh

Topics: Robustness; large-sample theory; asymptotics for estimators/tests; advanced tools underlying common statistical procedures.

STAT3006 Advanced Stochastic Processes 2023
Research School of Finance, Actuarial Studies and Statistics, ANU

Instructor: AsPr. Boris Buchmann

Topics: Brownian motion; continuous-time martingales; Itô calculus; Markov processes; SDEs; point processes.

STAT3011 Graphical Data Analysis 2022

Research School of Finance, Actuarial Studies and Statistics, ANU

Instructor: Pr. Michael Martin

Topics: Principles of statistical graphics; univariate/multivariate displays; smoothing; regression diagnostics; dynamic graphics; time-series visuals (R throughout).

Australian Mathematical Sciences Institute Summer School

Hyperbolic Knot Theory 2024

Australian Mathematical Sciences Institute

Instructor: Pr. Jessica Purcell

Topics: Hyperbolic structures on knot/link complements; polyhedral decomposition; Dehn filling; thick-thin decomposition; volume.

A Century of Harmonic Analysis 2024

Australian Mathematical Sciences Institute

Instructor: AsPr. Po-Lam Yung; Pr. Anthony Dooley

Topics: Fourier analysis milestones of the 20th century; modern L^p techniques and applications; noncommutative harmonic analysis.