Durham University

Mathematics at Durham

Open Days 2022

Why study Maths At Durham University?

- Because you enjoy mathematics
- Because you will be trained in logical thinking, analysis etc..
- Because you will get a good job
- League Tables, Reputation, Personal Recommendation, flexibility of course, the feel of the place..

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The Department - Facts and Figures

Academic Staff

- 89 permanent faculty
- 6 temporary lecturers

Research Staff

- 18 postdoctoral researchers/fellows

Postgraduate Students

- 52 PhD students
- 40 MSc students

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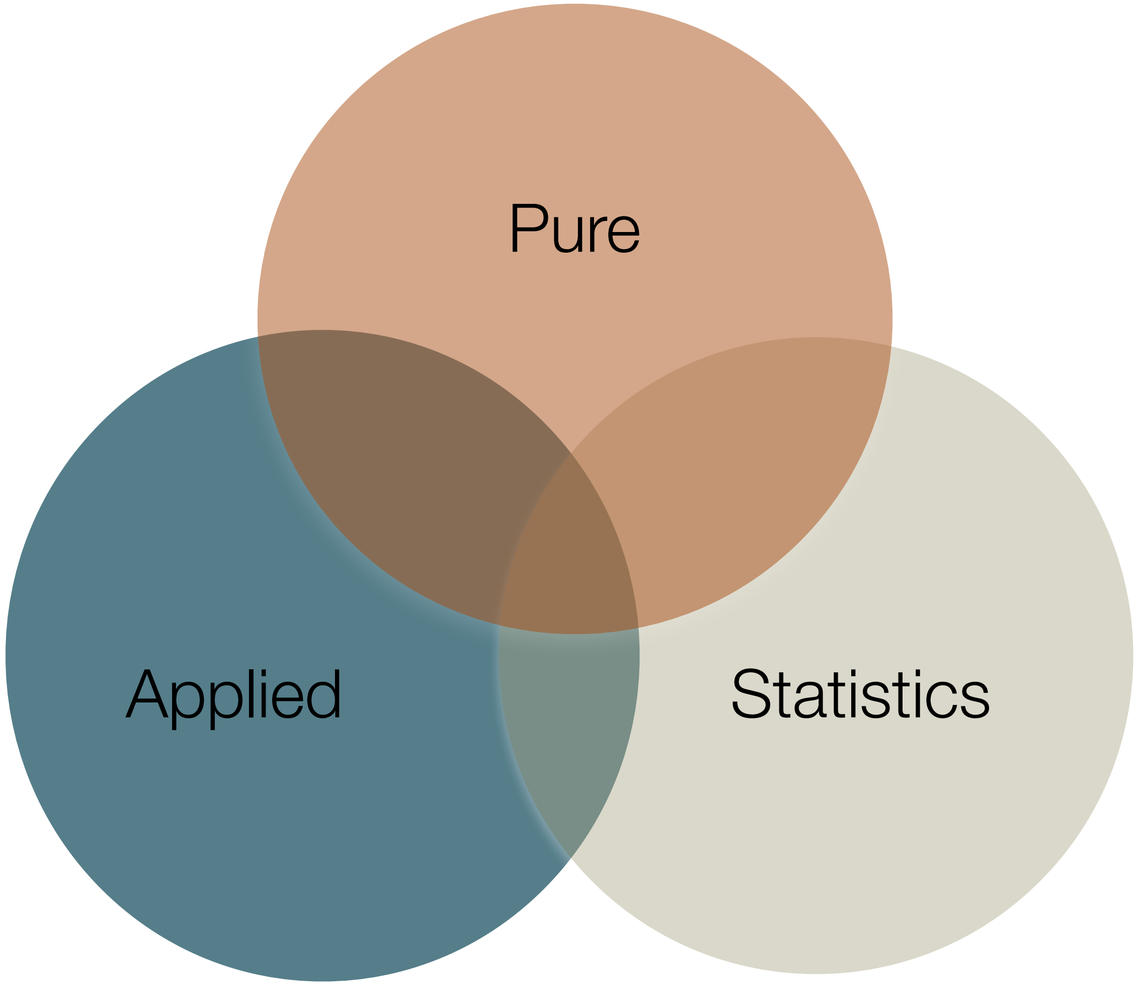
The Department - Research



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The Department - Research

- **PURE**
  - Number Theory
  - Topology
  - Geometry
  - Analysis of PDEs
- **APPLIED**
  - Theoretical Physics (String Theory)
  - MagnetoHydrodynamics
  - Mathematical Biology
- **STATISTICS**
  - Bayesian Statistics
  - Probability

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Research-Led Teaching

Research feeds into the undergraduate programme:

- Third and Fourth Year Courses (Number Theory, Advanced Quantum Theory, Bayesian Statistics)
- Final Year Projects

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Undergraduates

- Around 300 Maths Undergraduates/Year
- High average UCAS entry tariff (3rd-5th nationally)
- 80% State School/20% Independent School
- 30% Female 70% Male
- 10-15% International 85-90% UK

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Entry Degrees

	BSc (3 Year)	MMath (4 Year)
Mathematics	G100	G103
Maths & Stats	G111	G114

- First year of programmes identical
- Possibility to transfer from one to the other up to the end of year 2
- Split between G100/G103 is approximately 50:50

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Other Degrees offered by Maths

- Year Abroad Degrees
- Placement Degrees
- MMATH (Year Abroad) G101

} Year out after second year

- Typically transfer in at the end of Year 1
- May need language requirement for study at a European University
- All involve spending Year 3 away from Durham

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Structure - Modules

- 6 Modules per year
- 1st Year Pass/Fail (40%=Pass, Resit opportunity)
- Final Degree Classification depends on results from Years 2, 3, (4 if MMath)
- BSc in Ratio 2:3 for Year 2/3
- MMath in Ratio 2:3:4 for Year 2/3/4

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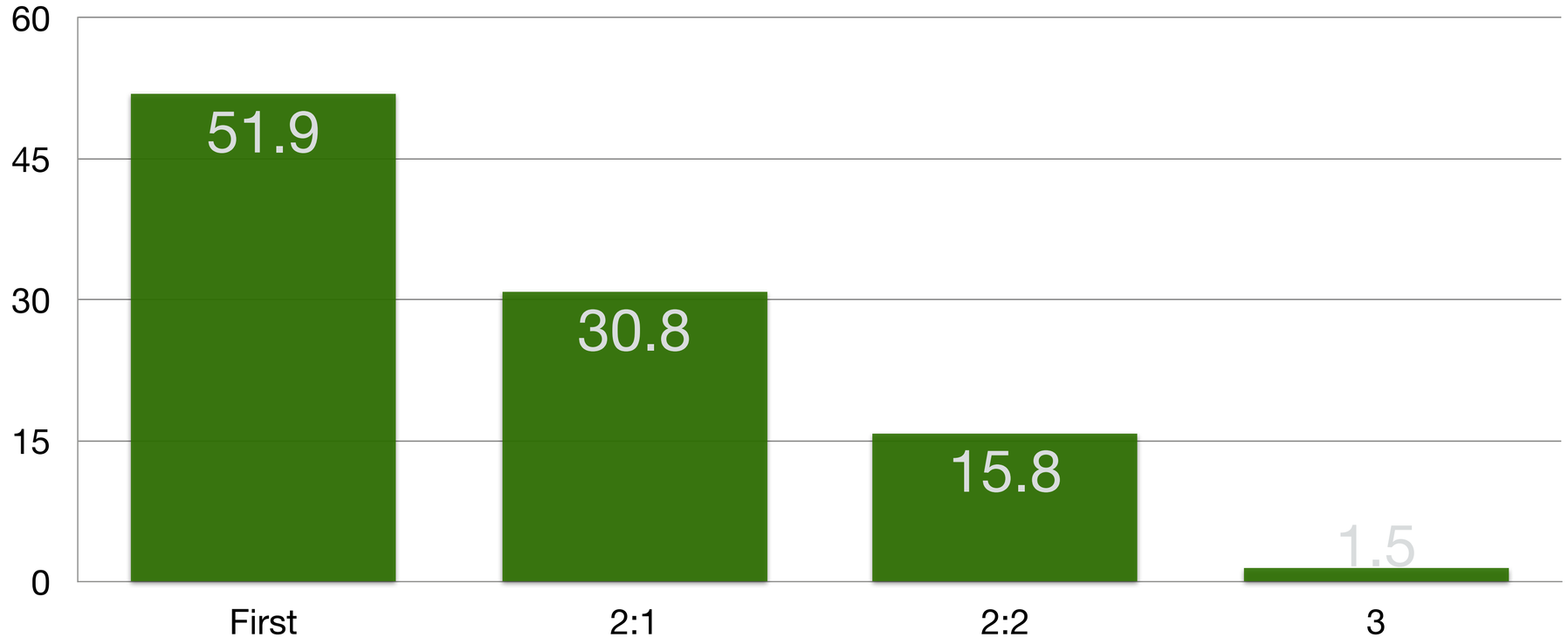

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Durham Maths Degrees

Modules - First Year

Five Core Modules:

Calculus 1
Analysis 1
Linear Algebra 1
Programming and Dynamics
Probability & Statistics

One Elective Module:

Discrete Maths

Modules from other Departments

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Modules - Second Year (Mathematics)

Two Core Modules:

- Analysis in Many Variables
- Complex Analysis

4 Elective Modules:

- Algebra
- Mathematical Physics
- Numerical Analysis
- Statistical Inference

- Elementary Number Theory
- Geometric Topology
- Special Relativity & Electromagnetism
- Mathematical Modelling
- Markov Chains
- Probability
- Data Science and Statistical Computing
- Statistical Modelling

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Modules - Second Year (Maths & Stats)

Core Modules:

- Analysis in Many Variables
- Statistical Inference
- Statistical Modelling
- Data Science and Statistical Computing

Elective Modules:

- Algebra
- Complex Analysis
- Mathematical Physics
- Numerical Analysis

- Elementary Number Theory
- Geometric Topology
- Special Relativity & Electromagnetism
- Mathematical Modelling
- Markov Chains
- Probability

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Modules

Third and Fourth Year

Pure

Analysis 3
Galois Theory
Topology
Representation Theory
Algebraic Geometry
Differential Geometry
Algebraic Topology
Number Theory
Riemannian Geometry
Geometry
Codes & Cryptography
Ergodic Theory & Dynamics
Functional Analysis & Appl.
Topics in Algebra and Geometry

Applied

Quantum Mechanics
Quantum Information
Solitons
General Relativity
Continuum Mechanics
Partial Diff Eqns
Mathematical Biology
Geometry of Mathematical Physics
Dynamical Systems
Numerical Diff Eqns
Adv Quantum Theory
Statistical Mechanics
Maths Teaching
Topics in Applied Maths

Statistics

Adv. Stat Modelling
Bayesian Computation and Modelling
Decision Theory
Machine Learning and Neural Networks
Mathematical Finance
Probability 3
Stochastic Processes
Spatio-Temporal Statistics
Deep Learning and AI
Discrete & Continuous Probability
High Dimensional Data Analysis
Non-Parametric Statistics
Object-Oriented Statistics
Robust Bayesian Analysis
Topics in Probability
Uncertainty Quantification

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Projects

- Every final year student does a double module project
- Highly commended by external examiners
- A research experience
- Vast choice informed by research interests of staff…

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Projects - 3rd Year Titles 2021/22

Applications of Lebesgue and Hausdorff measures	Games and Codes	Path Integral QM
Approximation Theory	Geometry of Quantum States	Points on a sphere
A relativistic perspective	Graph Polynomials	Primes, Polynomials and Polynomial Time
Bayesian Emulation and History Matching for Complex Models	Graph Theory	Pursuit problems
Black Holes	Infinitesimals and Internal Set Theory	Quasi-Exactly Solvable Systems
Bootstrap	Interstellar	Relativistic Field Theories of Massless Particles
Commutators in rings	Introduction to additive combinatorics	Ridge Regression
Computing Dynamics	Introduction to neural networks	Sampling
Contact geometry and intergalactic jets	Introduction to thermodynamic formalism: dimension theory of Schottky groups	Set theory
Convex Functions and Convex Analysis	Ising Model and related models	Sheepdog trials: collective motion in 2D
Cosmology	Kejeokeoqjn jeejqxk vl qazgevhajgcz	Singularity Theory
Density estimation	Low dimensional dynamics	Some economical models via optimal mass transport
Einstein's theory of General Relativity	Magnetic Equilibria	Statistical Physics: Phase Transitions and Simulations
Elliptic Curves	Market Segmentation using Unsupervised Machine Learning	Statistical techniques and models for the analysis of functional data
EM and stochastic EM algorithms for parameter estimation	Markov Chain Mixing Times	Statistics, Machine Learning, and Data Science
Embedding random walks in a Brownian motion	Markov Random Fields and Images	Symmetries of Surfaces
Fermions: The sign that matters	Mathematical aspects of crystallography	The Banach-Tarski Paradox
Fourier series and applications	Mathematical modelling of convection in stars and planets	The mathematics of Origami and Kirigami
Fourier Theory of finite groups and applications	Matrix models	The numerical range of a matrix
Fractal Geometry	Models of Axion Inflation	Time series modelling
Fractals, Substitution tilings and Lindenmayer systems	Multiple zeta values	Tropical Geometry
Free quantum fields	Non-archimedian analysis	

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Projects - 4th Year Titles 2021/22

Additive problems in Number Theory	How on Earth to define curvature on non-smooth spaces?	Random parking
Advances in Bayesian Emulation and History Matching for	Introduction to Conformal Field Theory	Regularisation approaches for high dimensional data
Algebraic Curves and Error-Correcting Codes	Local class field theory: extensions of local fields with	Representations of symmetric groups
Application of neural networks to visual tasks	Loewner Evolutions	Self-avoiding Walk
Arithmetic Dynamics	Machine learning through the lenses of Optimal Transport	Shape Modelling
Beyond mean regression	Magnetic monopoles in hyperbolic space	Solving the Riemann problem
Beyond Normal	Mathematical Modelling of Musical Instruments	Spatial Population Dynamics in Changing Ecosystems
Black Holes	Matrix models	Spatio-temporal pattern formation in nature.
Change point detection	Measure Theory Beyond the Real Line	Spectral pollution
Codes and Lattices	MHD Waves in the Solar Atmosphere and Wind	Strings and Gravity
Computational Topology	Minimal symbolic dynamics	Survival Analysis
Conformal Field Theory	Modelling the spread of a coronavirus	Symmetries of Riemannian manifolds
Ensemble Learning	Models of traffic flow	The Fractional Quantum Hall Effect: from Electrons to
Evaluate Probabilistic Forecast via Scoring Rules	Nonlinear Expectations	The Geometry of Rearrangements
Exact Tests in Analysis of Categorical Data	On the statistical analysis of functional data: methods,	The Polynomial Method
Further Topics in Decision Theory	Patterns via Topology	The Probabilistic Method
Gaming vicariously	Penalized Regression	The Standard Model
Gaussian Analysis	Percolation	The Weyr form and its applications to problems in algebra
Gaussian Process Regression of Computer Models of	Physics with machine learning	Topics in Analysis
Geometrical Aspects of Gauge theories	Piecewise linear manifolds	Topology and Physics
Geometric Applications of Heat Flow Analysis	Polylogarithms	Uncertainty quantification for data and models arising in
Graphical Models for Multivariate Statistics	Quantum Field Theory in anti-de Sitter space	Vertex Operator Algebras
Group theory and Physics	Quantum Walks	
How do microorganisms swim?	Random Graphs	

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How It’s taught - Academic Year

MICHAELMAS (10 Weeks)
(Lectures/Tutorials/Homeworks)

EPIPHANY (10 Weeks)
(Lectures/Tutorials/Homeworks)

EASTER (9 Weeks)
(2 weeks Revision/ 4 Weeks Exams /3 Weeks …)

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LECTURES

How it’s Taught - Lectures

- Most courses are 40/50 lectures
- 50 minutes long
- 2/3 lectures per week
- Most popular style is ``chalk and talk”

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Tutorials

How It’s Taught - Tutorials

- Interactive - its about doing the Maths!
- In groups of about 12
- Given by Academic Staff/PhD students
- One per module/week to begin with
- Replaced gradually by problems classes
- Extra ``Brush up your skills” tutorials

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HOMEWORKS

How It’s Taught - Homeworks

- Lecturer sets homeworks every week in years 1/2 (every fortnight in years 3/4)
- Almost all are formative not summative
- Use a mixture of written assessments and `electronic’ assessments for many first year courses.
- We encourage you to work together

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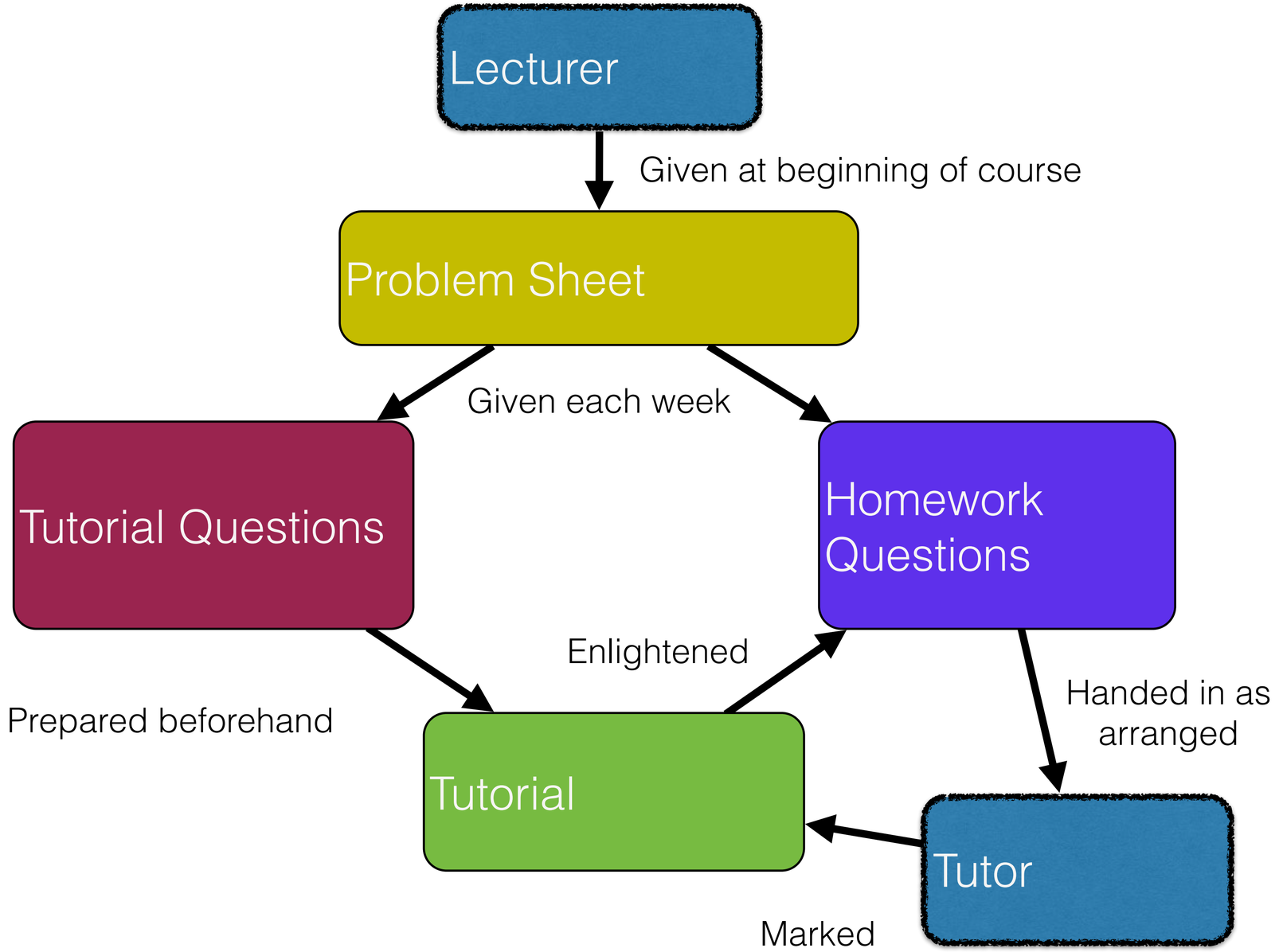

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Contact Hours

Course	Lectures (Hrs/Wk)	Tutorials (Hrs/Wk)	Comp Class (Hrs/Wk)	Prob Class (Hrs Wk)
Calculus	3	1		
Linear Algebra	3	1		
Analysis	2	1		
Programming	1		2	
Probability	2.5	0.5		0.5
Discrete	2	1		
Total	13.5	4.5	2	0.5

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Grand Total = 20.5 (Michaelmas Term, assuming all Maths)

Applying

UCAS

THE COMMON APPLICATION

Applying

- Apply via UCAS before January 25 2023 (or Oct 15 2022 if applying to Oxbridge)
- The process of making offers continues until March (Even if you apply in October we may not be able to make a decision until March)

Standard Offer in Maths

- **A*A* (Maths + Further Maths) + A**
- **TMUA 6.5 + A*A (Maths + Further Maths) + A (or A*A*+B)**

  (TMUA 6.5 = MAT 55%= 2 in any STEP)
- We do not accept General Studies and Critical Thinking
- We have no preferences for third A: A-level History is as good as A-level Physics.
- Contextual offers

No Further maths?

- We prefer full A-level Further Maths
- AS-level Further Maths is required
  - if the A-level is not available at school, via the “Advanced Mathematics Support Programme” (AMSP)
- Offer without A-level F maths:
  - TMUA 6.5 + A* (Maths) + AA + a (in AS level Further Maths).

Equivalent non A-level offers

- IB: TMUA 6.5 + 38 points including 766 with a 7 in Maths.
- IB: 38 points + 776 with a 7 in Maths. All grades must be at higher level.

- Cambridge Pre-U: TMUA6.5 + D2(Maths)+ D3D3 (any others)
- Cambridge Pre-U: D2 (Maths)+ D2D3 (any others)

The TMUA test

- Used by Durham, Bath, Cambridge, Cardiff, Lancaster, LSE, Nottingham, Sheffield, Southampton, Warwick
- Run by CAAT (Cambridge Assessment Admissions Testing) who also run MAT/STEP
- 2 x 75 minute papers in **early November**
- Details for 2022 but last year you needed to register by **October 15th** (cheaper by **October 1st**) cost was £57 - school may pay or if on free school meals or similar scheme cost reimbursed by TMUA

The TMUA test

- Your score (on a scale from 1.0 to 9.0) will be released to you at end November by CAAT
- Pass mark for Durham (and Warwick) is **6.5** (entitles you to reduced offer)
- Good mark (**>4.5**) score will still increase your chances of a standard offer
- More details on CAAT webpages (just Google “TMUA test”)

Important Evidence:

- **TMUA score**: TMUA 6.5 for reduced offer, anything >4.5 counts as positive evidence
- **Achieved and Predicted Grades**: Predictions should at least meet our offer.
- **Personal Statement**: We look for motivation to study the programme, and initiative in taking your studies further.
- **Reference**: We expect very strong references. Quantitative evidence is most useful.
- Quality is more important than quantity. We don’t focus on GCSE grades.