Introducing Automated e-Assessment to New Courses and Colleagues

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Introduction to Maths at Durham

- Mathematical Sciences is a growing department, with an annual intake of about 300 students.
- We teach a varied range of modules from our various research group.

Introduction to Maths at Durham

Year 1 Modules

Analysis

Linear Algebra

Calculus

Programming

Dynamics

Probability

Statistics

Discrete Maths

Year 2 Modules

Complex Analysis

Analysis in Many Variables

Numerical Analysis

Statistical Concepts

Mathematical Physics

Algebra

Elementary Number Theory

Probability II

Mathematical Modelling

Geometric Topology

Monte Carlo

Actuarial Mathematics

Special Relativity and EM

Discrete Maths

Introduction to Maths at Durham

- At higher levels we teach a number of modules from our research groups
  - Applied and Computational Mathematics
  - Mathematical and Theoretical Particle Physics
  - Pure Mathematics
  - Statistics and Probability

Introduction to Maths at Durham

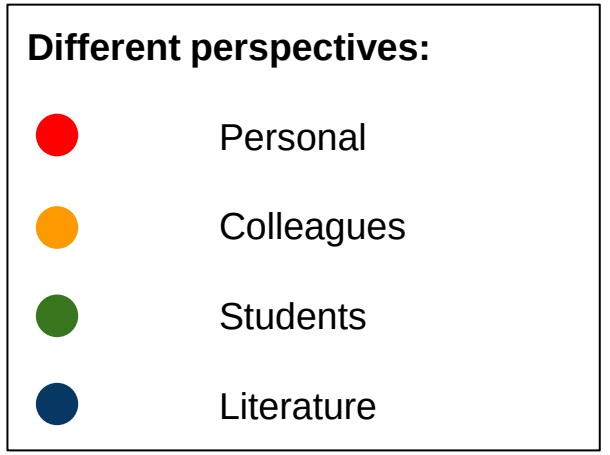
- We offer service courses to students from other departments in the Natural Sciences Faculty (e.g. Physics)
- Joint Honours students also have the option to take courses from the department.
- Our largest courses therefore have over 500 students.

Introduction to Maths at Durham

- Students in first two years have compulsory homework every week for every module.
- There is a lot of marking!

Issues with Manual Marking

- Feedback
  - Slow
  - Inconsistent
  - Lacks detail
- Staff time
  - Marking often repetitive
  - Requires manual data entry



Issues with Manual Marking

"Formative feedback might be likened to 'a good murder' in that effective and useful feedback depends on three things: (a) *motive* (the student needs it), (b) *opportunity* (the student receives it in time to use it), (c) *means* (the student is able and willing to use it)."

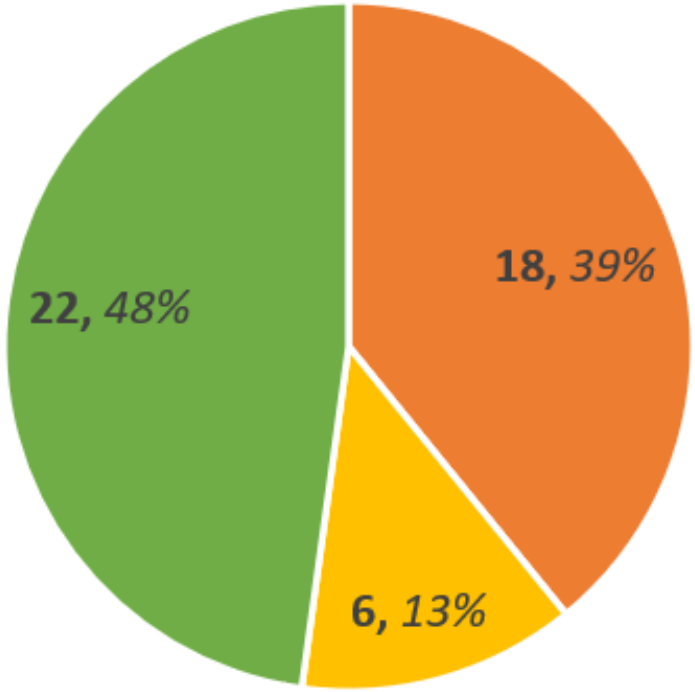
Shute, V.J. (2007), **Focus on Formative Feedback**. ETS Research Report Series, 2007: i-47. DOI: 10.1002/j.2333-8504.2007.tb02053.x

Introducing e-Assessment

- We introduced e-Assessment in the 2019-2020 academic year for a selection of first year courses, using both Numbas and STACK.
- Half of the homework assessments were replaced with e-Assessment, the rest remained written assessments.
- This was expanded during COVID.
- We are now looking to implement e-Assessment in as many year 1 and 2 modules as we can.

Results of e-Assessment

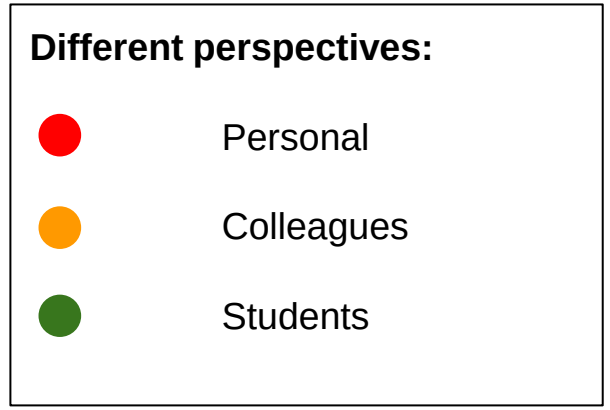
- I prefer the automated e-assessment
- I prefer the Gradescope written assessments
- I find both about equally useful



Results of e-Assessment

- Better feedback
- Save on staff time

- Technical issues
- More centralised question setting
- Difficult to write advanced questions
- Do students use feedback?



Procedure for Question Setting

- Different modules require different approaches.
- Need to liaise with lecturers. Generally we will adapt questions from written problem sheets from previous years.
- Decisions need to be made about what is suitable for e-Assessment.

Procedure for Question Setting

- Examples!
  - Dynamics

2. A particle of unit mass (i.e. $m = 1$) moves in one dimension under the influence of a force F. Denoting its displacement by x and velocity by $v = \dot{x}$, use the equation of motion to find the most general form for $x(t)$ in each of the following cases.

   (a) $F = 3\sqrt{2}$

   (b) $F = 2t/(1 + t^2)^2$

   (c) $F = 1/(v + 3)$ with $v > -3$

   (d) $F = 2v^2/x$ with $v > 0$

   (e) $F = 2v + e^t$

Procedure for Question Setting

- Examples!
  - Discrete

73 Find the number of 7 letter words using the letters V, W, X, Y, Z in which X, Y and Z each occurs at least once.

Procedure for Question Setting

- Examples!
  - Discrete

69 (a) Show that, if S is a 10-element subset of $\{1, 2, \ldots, 106\}$, then there are at least two disjoint non-empty subsets of S that have the same sum.
(b)(*) Now suppose that S is a 10-element subset of $\{1, 2, \ldots, 117\}$. Again show that there are at least two disjoint non-empty subsets of S that have the same sum. [*Hint:* Since $117 > 106$, the proof of part (a) will not work for part (b), but it can be adapted: Suppose a is the smallest member of S, and think about possible sums (highest and lowest) in terms of a.]

Conclusions

- We've had good success with implementing e-Assessment.
- For years 1 and 2 our current arrangement has clear advantages.
- We need to think carefully about how to implement it further.

Conclusions

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