Mathematics for Economics and Business – Business Focused Case Studies

1. The project

(i)   The project has seen the development of 15 real-word case studies to help students more fully *engage* with *level 1 mathematics*. Each case study is *embedded with specific mathematical concepts and techniques*.

(ii)   The case studies are designed to encourage *engagement* with mathematics by demonstrating its <u>*relevance*</u> to economists. They demonstrate how mathematics can heighten an economist's understanding of important economic issues.

(iii)   The case studies facilitate a *problem or issue-based approach to teaching and learning*. They can be used not only in the teaching of level 1 quantitative modules but across a variety of undergraduate economic modules and non-specialist economic modules.

(iv)   Their design allows the case studies to be used *flexibly* by students and educators. Permission is given for educators to redistribute and alter these materials as much as they like.

(v)   The economic issues covered by the case studies come from the following four topic areas:
- *Household Finances*
- *Consumer Spending*
- *UK Economy*
- *Gambling, Competition and Sport*

(vi)   This project has been made possible through funding from the Joint Information Systems Committee.

(vii)   The project's objectives are closely aligned with the FDTL funded METAL (Mathematics for Economics: enhancing Teaching and Learning) project. The case studies complement the freely available METAL resources (*videos*, an *online question bank* and *teaching and learning guides*).

2. The Project Team

Nottingham Trent University
The project team comprises several colleagues from the Department of Economics, Nottingham Trent University.[1]

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3. METAL

METAL (Mathematics for Economics: enhancing Teaching and Learning) provides lecturers and students with a selection of free learning resources designed to engage Level 1 students more fully and enthusiastically in mathematics for economics.

METAL was made possible through a HEFCE funded FDTL5 project. It has been enhanced by the involvement of many dozens of UK economics academics and students, and by exposure and demonstration at regional project workshops and other events around the UK.

Project aim
To maximise student attendance, engagement and participation in mathematics for economics through the provision of an accessible and fully interactive toolkit of varied and flexible resources.

Project outcomes
The project team have produced the following resources.

- An online question bank of mathematics teaching and assessment materials specifically applied to the field of economics.

- Five interactive <u>video units</u> (covering 10 units of study) using streaming video and animation to relate mathematical concepts to the field of economics.
- Ten <u>teaching and learning guides</u> that provide an extensive bank of teaching activities (for large and small groups) covering all aspects of Level 1 Mathematics for Economics.
- An interactive website to present the teaching and learning resources, to facilitate distance learning and to foster students' autonomy and ownership of the learning process.

4. The Case Studies

A. Household Finances

1.   Spending on plastic: The potential for financial distress
Dean Garratt

Mathematical concepts covered:
- *Compound interest*
- *APR*
- *Monthly and daily interest*

Recommended <u>METAL</u> materials:
- *Film Series 3*
- *Teaching and Learning Guide 5* (pdf)

2.   Saving for the future: Don't leave it too late!
Dean Garratt and Philip Quinn

Mathematical concepts covered:
- *Compound interest*
- *Exponential constant*
- *Definite integration*

Recommended <u>METAL</u> materials:
- *Film Series 3. In particular, see 3.02 Building up Personal Saving*
- *Teaching and Learning Guide 5* (pdf) (see also *Guide 9* (pdf) for resources on integration)

3.   Affording the mortgage
Dean Garratt and Philip Quinn

Mathematical concepts covered:
- *Compound interest*
- *Geometric progression*
- *Continuous compounding*
- *Exponential constant*
- *Definite integration*

Recommended <u>METAL</u> materials:
- *Film Series 3. In particular, see 3.04 Clearing a Mortgage Debt*
- *Teaching and Learning Guide 5* (pdf) (see also *Guide 9* (pdf) for resources on integration)

B. Consumer Spending

4.   Does income constrain household spending?
Dean Garratt

Mathematical concepts covered:
- *Compound growth rates*
- *Linear equations*
- *Power functions*
- *Differentiation*
- *Elasticity*
- *Logarithms*

Recommended METAL materials:
- *Film Series 2. In particular, see 2.02 Linear consumption functions – East and West Germany (see also Film Series 5 for resources on differentiation)*
- *Teaching and Learning Guide 2 (pdf),Guide 3 (pdf) and Guide 7 (pdf)*

5.   Do households smooth their consumption?
Dean Garratt

Mathematical concepts covered:
- *Log-linear functions*
- *Line of best fit*
- *Elasticity*
- *Logarithms*

Recommended METAL materials:
- *Film Series 2. In particular, see 2.02 Linear consumption functions – East and West Germany (see also Film Series 5 for resources on differentiation)*
- *Teaching and Learning Guide 2 (pdf),Guide 3 (pdf) and Guide 7 (pdf)*

C. UK Economy

6.   Deriving constant price estimates of GDP: An illustration of chain-linking
Dean Garratt

Mathematical concepts covered:
- *Chain-linking*
- *Price relatives*
- *Nominal and real values*
- *Percentage changes*
- *Compound growth rate*

Recommended METAL materials:
- *Film Series 3. In particular, see 3.09 Changes over time in a Country's Living Standards*
- *Teaching and Learning Guide 1 (pdf)*

7.   UK house prices: Going through the roof?
Dean Garratt

Mathematical concepts covered:
- *Price relatives*
- *Nominal and real values*
- *Levels and growth rates*
- *Percentage changes*
- *Compound growth rate*
- *Logarithms*

Recommended METAL materials:
- *Teaching and Learning Guide 1 (pdf)*

8.   Economic Growth: What factors matter?
Dean Garratt

Mathematical concepts covered:
- *Logarithms*
- *Percentages*
- *Ratios*
- *Short-run and long-run growth rates*

Recommended METAL materials:
- *Film Series 3. In particular, see 3.09 Changes over time in a Country's Living Standards and 3.10 Growth in European Economies*

D. Social Issues

9.   Estimating a demand curve for un-priced environmental goods
Andrew Cooke

Mathematical concepts covered:
- *Ratios*
- *Linear equations*
- *Definite integrals*

Recommended METAL materials:
- *Film Series 2*
- *Teaching and Learning Guide 2 (pdf) and Guide 9 (pdf)*

10. Counting the cost of effective health policy
Stephen Heasell

Mathematical concepts covered:
- *Probability*
- *Sensitivity analysis*
- *Marginal or incremental quantities*
- *Interpolated figures*

Recommended METAL materials:

- *Teaching and Learning Guide 1* (pdf)

11.   Measuring health improvements for a cost effectiveness analysis
Stephen Heasell

Mathematical concepts covered:
- *Index numbers*
- *Discounted present values*
- *Probability*
- *Implicit figures*

Recommended <u>METAL</u> materials:
- *Teaching and Learning Guide 3* *(pdf) (see Section 4)*
- *Film Series 3. In particular, see 3.07 DCF – Europa Food's Decision to Save Labour Costs and 3.08 Eurotunnel – A Bad Investment.*

12.   **Measuring inequality: Using the Lorenz Curve and Gini Coefficient**
Andrew Cooke

Mathematical concepts covered:
- *Percentages*
- *Cumulative percentages*
- *Summary statistics*
- *Time series and cross sectional*

Recommended <u>METAL</u> materials:
- *Teaching and Learning Guide 1* *(pdf) and* *Guide 9* *(pdf)*

E. Gambling, Competition and Sport

13.   Measuring the competitiveness of sport: are the top teams getting too strong?
Andrew Cooke

Mathematical concepts covered:
- *Concentration Index*
- *Sigma notation*
- *Summary statistics*

Recommended <u>METAL</u> materials:
- *Teaching and Learning Guide 1* *(pdf)*

14.   Is the Scottish Premier League less competitive than its English Counterpart?
Andrew Cooke

Mathematical concepts covered:
- *Hirschman-Herfindahl Index*
- *Sigma notation*
- *Summary statistics*

Recommended <u>METAL</u> materials:
- *Teaching and Learning Guide 1* *(pdf)*

- *Film Series 1. In particular, see 1.05 Powers – US Merger Policy and 1.06 Fractions, Percentages and Powers: Conclusion.*

15. **Probability in action: Gambling, the US Presidency and the market for car insurance**
   Leighton Vaughan Williams and Philip Quinn

   Mathematical concepts covered:
   - *Betting odds and probabilities*
   - *Conditional probability*
   - *Fractions and percentages*

   Recommended METAL materials:
   - *Teaching and Learning Guide 1 (pdf)*
   - *Film Series 1. In particular, see 1.01 Understanding Fractions – Introduction.*

5. Economics Network

The Economics Network has more advice and pointers to resources on teaching mathematical concepts in an Economics course. Go to
http://www.economicsnetwork.ac.uk/themes/maths

6. Guideline solutions to the Tasks

Each case study includes a series of tasks that enable the student to test and enhance their understanding of the mathematical concepts in the context of economics issues. In most cases this involves tackling a series of questions. In the cases studies looking at the competitive balance of the top-flight English and Scottish football leagues students are encouraged to engage in further research and are directed to potential sources of information.

Educators can receive the *guideline solutions* by e-mail by clicking on the following link
http://www.economicsnetwork.ac.uk/archive/maths_worksheets/request.asp