Enhancing cross-disciplinary mathematical skills through a collaborative e-assessment initiative

NUMBAS

LTC Presentation 2022

Numbas at Glasgow

- Previous projects (Chemistry, Life Sciences)
- Other existing use (Geospatial, Access)
- Further potential (Maths Support, more questions, other subject areas)
- Project team and Chancellor's Fund
- Recruitment of undergraduate student project assistants
    - Named appointments
    - 3 x 80 hours (~5 hours a week for 4 months)
    - Support from Newcastle

Project Team

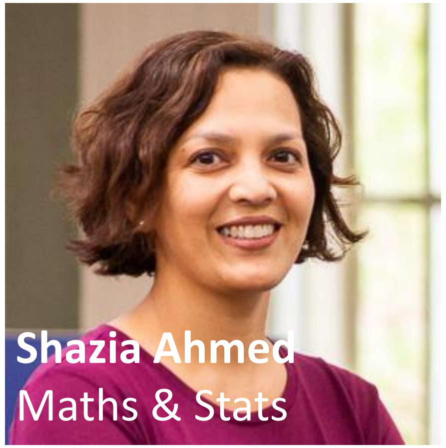

Elizabeth Petrie, GES


Michael O'Connor
2nd year Economics


Beth Paschke
Chemistry


Clare Brown,
Lifelong learning

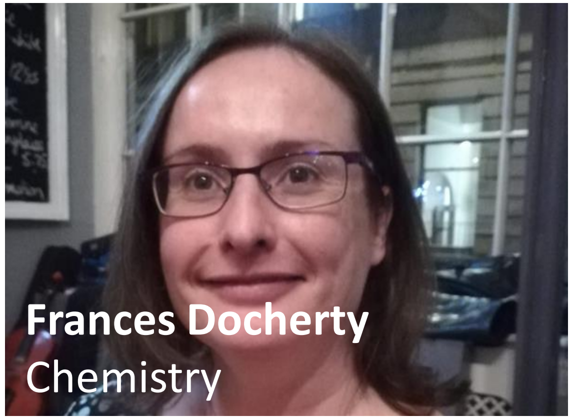

Ruth Douglas
Maths Adviser (SLD)


Shazia Ahmed
Maths & Stats


Anna Cartlidge
2nd year Economics


William Finlay
Finance (ASBS)


Niall Barr, CoSE


Frances Docherty
Chemistry


Tess Lynn
3rd year Chemistry

Project team development interests

- **Frances Docherty & Beth Paschke**, Chemistry: Maths support for chemists, online lab reporting, practice exercises on lecture material, maths support for science fundamentals course

- **Clare Brown**, Lifelong Learning: self-diagnostic assessment for prospective students, practice questions for mastering key skills

- **Ruth Douglas**, Maths Support resources for students requiring extra practice on particular topics; Access Maths formative tests and practice exercises

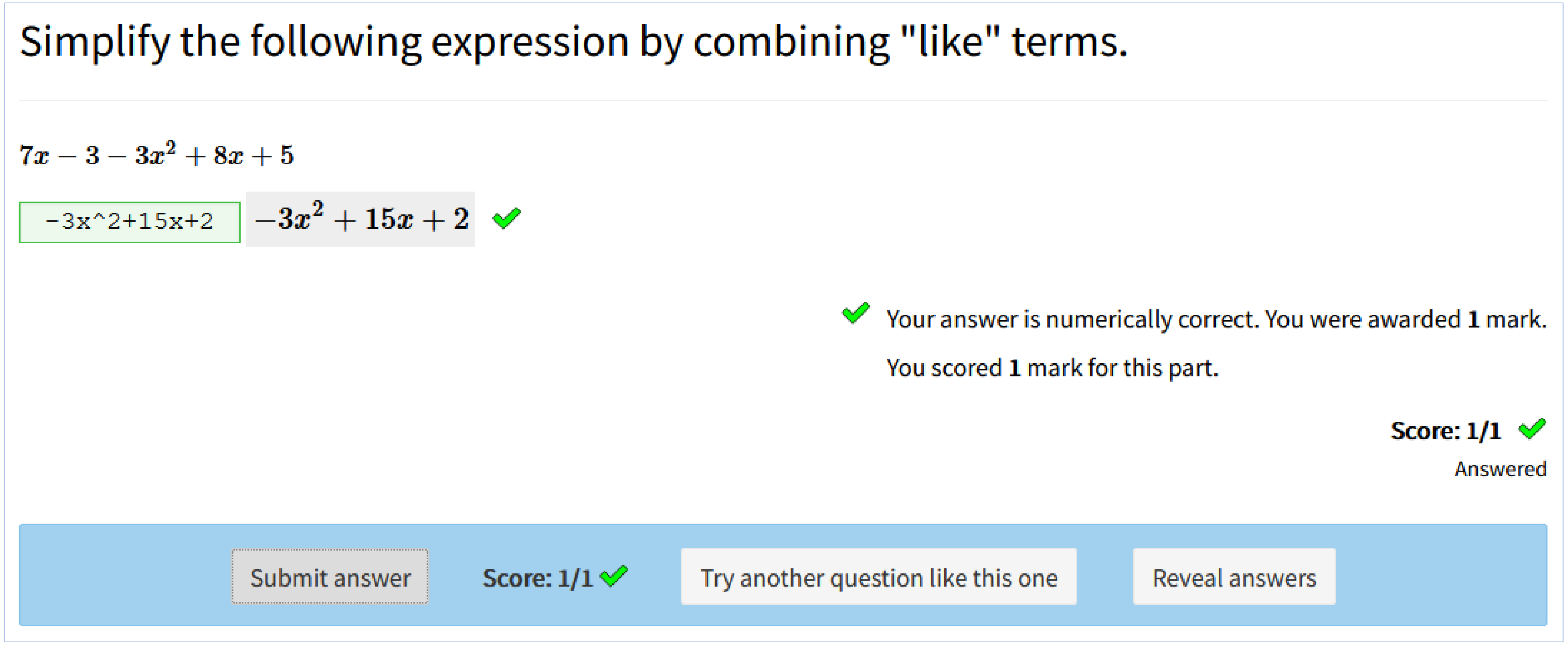
- **William Finlay**, Adam Smith Business School: Building maths confidence without the need for as much staff involvement, creating an accessible learning environment

- **Elizabeth Petrie**, GES: Geospatial PGT - improve by increased variety in Q pool

Numbas

- Online assessment system designed for mathematical subjects
- Free to use and open source
- Designed for accessibility
- Adaptive marking & diagnostic and explore modes
- Graphics and programming
- Lots of info at:

https://www.numbas.org.uk



If questions are ready, creating an exam is simple:

- Put questions in 'shopping basket' and decide on exam settings
- Import the exam package to Moodle and set up

Possibilities

Consider strategy/needs carefully, test, evaluate including student feedback

Use	Randomisation
Additional optional student resource	Students can keep practicing areas they find difficult
Formative testing	Allows repeated tests
Low credit summative testing	Allows repeated tests and keep max score.
Summative testing – can be review tests	Numerical answers can be different for each student
Diagnostic testing	Numerical answers can be different for each student

Example - GES PGT mixed experience maths

- Numbas approach evolved and tested over three years
- Assessment 10% of 20 credit module
- 10 weekly tests (minimal credit, repeat as wish before deadline)
- 2 review tests (single timed sitting, most of credit)
- Further experience with Lab reporting in Chemistry

Glasgow Numbas Question Pool

Glasgow Numbas Question Pool

+ New: Folder | Question | Exam

8 items in this folder.

Select all   Select none

Status	Name	Type	Last modified
☐	Basic Algebra Skills		
☐	Basic Statistics		
☐	Basic Trigonometry and Pythagoras		
☐	Linear Graphs		
☐	Logs and Exponentials		
☐	Numeracy		
☐	Quadratics		
☐	Roots and Indices		

Undergraduate Project Assistants

Anna Cartlidge

Tess Lynn

Michael O'Connor

NUMBAS logs Explore

65 results for "logs".

Show results for

- Questions
- Exams

Refine by

Status

- Any status
- Draft
- Ready to use
- Should not be used
- Has some problems
- Doesn't work
- Needs to be tested

Author

Equations involving logs

Ready to use

Exam (5 questions) in Martin's workspace by Martin Jones

Solve equations involving logs and exponential functions, by using inverse operations.

Equations involving logs

Ready to use

Exam (5 questions) in Glasgow Numbas Question Pool by Tess Lynn and 1 other

Solve equations involving logs and exponential functions, by using inverse operations.

Solving exponential equations using logs

Ready to use

Question in Glasgow Numbas Question Pool by Tess Lynn and 1 other

No description given

Combining use of multiple laws of logarithms into one equation

Ready to use

Question in Glasgow Numbas Question Pool by Tess Lynn and 3 others

Given a sum of logs, all numbers are integers,

$\log_b(a_1) + \alpha \log_b(a_2) + \beta \log_b(a_3)$ write as $\log_b(a)$ for some fraction a.

Also calculate to 3 decimal places $\log_b(a)$.

Advice

Edit Insert View Format Table Tools

Formats

In order to solve this question, you need to ident

Therefore to solve for the future value:

We know that the PV is £{num_PV}million, we k
periods of compounding. Therefore:

Alternative ap

You may also so

The future value
to 4 decimal pla

Advice

In order to solve this question, you need to identify that we are solving for this equation:
$FV = PV(1+r)^n$

Therefore to solve for the future value:

$$FV = PV(1+r)^n$$

We know that the PV is £{num_PV}million, we know that r = {num_return*100}% and we have {num_period} periods of compounding. Therefore:

$$FV = PV(1+r)^n$$

$$FV = \{num_{PV}\}(1 + \{num\_return\})^{\{num\_period\}}$$

$$FV = \{answer\} \text{ million}$$

tor} or

)

Click to edit

A government bond issued in {place} has a coupon rate of {coupon}%, face value of €{face} and the bond matures in {period_years} years.

Assuming that the coupons are paid on an annual basis. Calculate the price of a bond (in euro) if the yield to maturity is {ytm}%.

€ Unnamed gap

Click to edit

Example Question

€ 67.15 *Round your answer to 2 decimal places.*

You were awarded **1** mark.

You scored **1** mark for this part.

Score: 1/1

Answered

Submit answer

Answer the question below:

PV_bond

A government bond issued in France has a coupon rate of 2.1%, face value of €100 and the bond matures in 30 years.

Assuming that the coupons are paid on an annual basis. Calculate the price of a bond (in euro) if the yield to maturity is 4%.

€ *Round your answer to 2 decimal places.*

Submit answer **Score: 0/1** Try another question like this one Reveal answers

Questions?

If interested:

- info and demo of question types at: https://www.numbas.org.uk/
- contact one of the project team:

Ruth Douglas	Ruth Douglas@glasgow.ac.uk
Elizabeth Petrie	Elizabeth.Petrie@glasgow.ac.uk
Niall Barr	Niall.Barr@glasgow.ac.uk
William Finlay	William.Finlay@glasgow.ac.uk
Shazia Ahmed	Shazia.Ahmed@glasgow.ac.uk
Beth Paschke	Beth.Paschke@glasgow.ac.uk
Frances Docherty	Frances.Docherty@glasgow.ac.uk
Clare Brown	Clare.Brown.2@glasgow.ac.uk

Thanks for listening!

Appendix - Examples

Examples

Foundations of FINANCE

Writing the question in NUMBAS:

Write the question

A government bond issued in {place} has a coupon rate of {coupon}%, face value of €{face} and the bond matures in {period_years} years.

Assuming that the coupons are paid on an annual basis. Calculate the price of a bond (in euro) if the yield to maturity is {ytm}%.

€ [Unnamed gap]

Click to edit

Define the variables

Name: period_years

Data type: Random number from a range

Value: A random number between 1 and 50 (inclusive) with step size 1

Description: Click to edit

Describe what this variable represents, and list any assumptions made about its value.

Can an exam override the value of this variable?

→ Used by: PVAF_dec PVIF_dec

Advice "PV_bond" - prompt

Ungrouped variables

Name	Type	Generated Value
coupon	number	8.6
period_years	integer	45
ytm	number	1.6
coupon_dec	number	0.086
ytm_dec	number	0.016
PVAF_dec	number	31.9041051506
face	integer	100
coupon_payment	number	8.6
PVIF_dec	number	0.4895343176
PV_bond	number	323.33
place	string	the Netherlands

Examples

Foundations of FINANCE

Writing the question in NUMBAS:

Write advice

Advice

In order to solve this question, we need to recognize that we are trying to solve the present value of a government bond.

To calculate the price of a bond:

$$PV\,bond = coupon * \left(\frac{1}{r} - \frac{1}{r(1+r)^n}\right) + \frac{Par}{(1+r)^n}$$

Using the information provided in the question:

The coupon is {currency({coupon_payment},"€","p")}, this is calculated as {coupon}% of the face value of €{face}. The number of periods in this problem is {period_years} and the yield to maturity is {ytm}%.

Therefore to solve the value of this bond from {place}:

$$PV\,bond = \{\texttt{coupon\_payment}\} * (\frac{1}{\{\texttt{ytm\_dec}\}} - \frac{1}{\{\texttt{ytm\_dec}\}(1+\{\texttt{ytm\_dec}\})^{\{\texttt{period\_years}\}}}) + \frac{\{\texttt{face}\}}{1+\{\texttt{ytm\_dec}\}^{\{\texttt{period\_years}\}}}$$

The present value of the bond = {currency(PV_bond,"€","cents")}

Click to edit

Examples

Foundations of FINANCE

Student facing NUMBAS:

The question

Answer the question below:

PV_bond

A government bond issued in France has a coupon rate of 2.1%, face value of €100 and the bond matures in 30 years.

Assuming that the coupons are paid on an annual basis. Calculate the price of a bond (in euro) if the yield to maturity is 4%.

€ ____ *Round your answer to 2 decimal places.*

Submit answer | **Score: 0/1** | Try another question like this one | Reveal answers

€ 67.15 *Round your answer to 2 decimal places.*

✔ You were awarded **1** mark.

You scored **1** mark for this part.

Score: 1/1 ✔

Answered

Submit answer | **Score: 1/1** ✔

Examples

Foundations of FINANCE

Student facing NUMBAS:

Advice

Advice

In order to solve this question, we need to recognize that we are trying to solve the present value of a government bond.

To calculate the price of a bond:

$$PV\,bond = coupon * \left(\frac{1}{r} - \frac{1}{r(1+r)^n}\right) + \frac{Par}{(1+r)^n}$$

Using the information provided in the question:

The coupon is €2.10, this is calculated as 2.1% of the face value of €100. The number of periods in this problem is 30 and the yield to maturity is 4%.

Therefore to solve the value of this bond from France:

$$PV\,bond = 2.1 * \left(\frac{1}{0.04} - \frac{1}{0.04(1+0.04)^{30}}\right) + \frac{100}{1+0.04^{30}}$$

The present value of the bond = €67.15

Examples

Foundations of FINANCE

Student facing NUMBAS:

Infinite number of questions

PV_bond

A government bond issued in Germany has a coupon rate of 1.8%, face value of €100 and the bond matures in 27 years.

Assuming that the coupons are paid on an annual basis. Calculate the price of a bond (in euro) if the yield to maturity is 5.9%.

PV_bond

A government bond issued in France has a coupon rate of 3.4%, face value of €100 and the bond matures in 2 years.

Assuming that the coupons are paid on an annual basis. Calculate the price of a bond (in euro) if the yield to maturity is 13.6%.

PV_bond

A government bond issued in Italy has a coupon rate of 9%, face value of €100 and the bond matures in 30 years.

Assuming that the coupons are paid on an annual basis. Calculate the price of a bond (in euro) if the yield to maturity is 10.2%.

PV_bond

A government bond issued in the Netherlands has a coupon rate of 6.3%, face value of €100 and the bond matures in 36 years.

Assuming that the coupons are paid on an annual basis. Calculate the price of a bond (in euro) if the yield to maturity is 15.6%.

PV_bond

A government bond issued in Italy has a coupon rate of 3.6%, face value of €100 and the bond matures in 5 years.

Assuming that the coupons are paid on an annual basis. Calculate the price of a bond (in euro) if the yield to maturity is 16.8%.

PV_bond

A government bond issued in the Netherlands has a coupon rate of 4.6%, face value of €100 and the bond matures in 8 years.

Assuming that the coupons are paid on an annual basis. Calculate the price of a bond (in euro) if the yield to maturity is 3.4%.

PV_bond

A government bond issued in Italy has a coupon rate of 9.5%, face value of €100 and the bond matures in 26 years.

Assuming that the coupons are paid on an annual basis. Calculate the price of a bond (in euro) if the yield to maturity is 19.3%.

Examples

Foundations of FINANCE

Writing advice

Advice

Edit Insert View Format Table Tools

Formats B I

```
In order to solve this question, you need to identify that we are solving for this equation: $FV=PV(1+r)^n$

Therefore to solve for the future value:

$FV=PV(1+r)^n$

We know that the PV is £{num_PV}million, we know that r = {num_return*100}% and we have {num_period}
periods of compounding.  Therefore:

\(FV = PV(1+r)^n\)

\(FV = \var{num_PV}(1+\var{num_return})^\var{num_period}\)

\(FV = \var{answer}\text{million}\)

Alternative approach to solving:

You may also solve this question using the financial tables.

The future value factor (FVF) of {num_return*100}% for {num_period} periods is: {factor} or {factor_rounded}
to 4 decimal places.

\(FV = PV * FVF(\var{num_return*100} \text{%,} \var{num_period})\)
\(FV = \var{num_PV}*\var{factor_rounded}\)
\(FV = \var{answer}\text{million}\)
```

Give a worked solution to the whole question.

Advice

In order to solve this question, you need to identify that we are solving for this equation: $FV = PV(1+r)^n$

Therefore to solve for the future value:

$$FV = PV(1+r)^n$$

We know that the PV is £{num_PV}million, we know that r = {num_return*100}% and we have {num_period} periods of compounding. Therefore:

$$FV = PV(1+r)^n$$

$$FV = \{num_{PV}\}(1+\{num\_return\})^{\{num\_period\}}$$

$$FV = \{answer\}\text{ million}$$

Alternative approach to solving:

You may also solve this question using the financial tables.

The future value factor (FVF) of {num_return*100}% for {num_period} periods is: {factor} or {factor_rounded} to 4 decimal places.

$$FV = PV * FVF(\{num\_return \times 100\}\ \%, \{num\_period\})$$

$$FV = \{num_{PV}\} * \{factor\_rounded\}$$

$$FV = \{answer\}\text{ million}$$

Click to edit