Numbas question writing tasks

Use these tasks as prompts to help develop your understanding of Numbas.

Task 1) Addition of numbers

This task is covered in more detail in the online Numbas documentation under "Writing your first question".

The question we would like to create in Numbas

What is $5 + 8$?

Hints and things to think about

- You may wish to set up your question without randomisation first, especially if this is your first experience of using Numbas.
- Mark up your expression using LaTeX by delimiting it with dollar signs, `$6+5$`. This will sit on the same line as the surrounding text. (Note that you can also place the expression inside `\[` and `\]`, to format it in 'display-mode', on its own line with generous spacing).
- Use the `random()` function to generate two random variables to use in the question. Don't forget to use these where the correct answer is defined too.
- Now consider the implications of allowing your variables to take on negative values. Look at the documentation for the LaTeX command `\simplify{}`, in particular to choose the correct options to avoid the expression being simplified too far and simply displaying the correct answer.

Task 2) Solve a system of equations

The question we would like to create in Numbas

Solve the simultaneous equations
$3x + y = 11$ and $x - y = 1$

Hints and things to think about

- The question has two numeric answers; consider using a *gap-fill* part type, with two *number entry* gaps, allowing answer boxes to sit inline with text.
- The wrong choice of coefficients could result in tricky manipulation, where you might really only be interested in assessing the method for solving such a system. So think about how you can make sure that the answers *x* and *y* are 'nice', by considering what variables should be randomised.
- Think about whether you want to allow missing terms on the left and negative coefficients.
- With this in mind, you're going to need the `\simplify{}` LaTeX command again.
- This might be a good opportunity to look at the advice tab, where you could include a full solution to the problem, specific to the randomisation.
- Note that the form of the solution could change, depending on the given equations. If you are writing advice then you might like to experiment with the conditional visibility button `V`, at the top of the rich text editor.

Task 3) Factorise a quadratic

The question we would like to create in Numbas

Find the roots of the quadratic
$x^2 - x - 6 = 0$

Hints and things to think about

- Consider whether you want the root of the quadratic to be, say, integers or simple fractions. If so, then you will want to randomise the roots, rather than the coefficients of the equation.
- You have a challenge here, that there are two answers which may not be given by the student in any particular order: a typical approach, until recently, was to give two answer boxes and to ask for solutions in a particular order. You might like to try this.
- Now have a look at the examples of the custom part type *List of numbers* (search for “custom part types” in the Numbas editor for examples, or consult the documentation). This would allow the student to input a comma separated list of numbers in any order.
- You could consider adding an additional part before the existing, asking the student to factorise the equation. If you do so, then you will need to consider how to check that the solution is indeed factorised and that, for example, the mathematically equivalent original expression is not accepted as a correct answer.

Task 4) Multiple choice questions

The question we would like to create in Numbas

Match each European city on the left with a country from the right

Bern	Hungary
Bucharest	Norway
Madrid	Romania
Oslo	Spain
	Switzerland

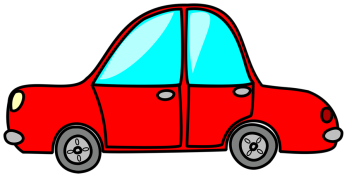
Hints and things to think about

- Investigate the different part types for multiple choice questions and choose an appropriate one.
- Have a look at options to shuffle the order of answers and think about when this is appropriate. In this example you might like to retain alphabetical order, but in other cases shuffling can complement the randomisation.
- Think about what can be randomised. You might choose several cities from a list of possibilities. Have a go at substituting variables into answers/choices, which can be done by placing variables inside curly braces `{}`.
- Think about the most efficient data type, for example here each city has a corresponding correct country (and perhaps a good distractor in the case of Bucharest/Budapest confusion!). You could store this in a variable using the *JSON data* type and construct the question from that.
- Take a look at the options for negative marking and consider how you might use this.
- Have a think about the way in which a multiple choice question can fit into a longer maths question, for example to check a student's understanding of a concept.

Task 5) Adding context

The question we would like to create in Numbas

Bob sets off from Newcastle by car at 11am and arrives in London at 4pm.
What was the average speed of his journey?



Hints and things to think about

- Images (and other media) can be added to a question by using the insert/edit image button .
- You should add the image into your question on the Numbas Editor, rather than linking to an external source, to ensure that it is distributed correctly when you compile and export your test.
- Numbas tests can contain other media, such as embedded videos. Interactive diagrams can be added with the *jsxgraph* and *geogebra* extensions.
- The *random person* extension can be used to generate random names and corresponding pronouns to avoid stereotyping or gender bias in your questions!

Task 6) Summary statistics

The question we would like to create in Numbas

The ages of 20 players in a football squad are as follows.

22	17	20	29	31	18	21	27	22	28
25	25	34	19	26	25	24	28	22	21

Find the mean, median and mode age.

Hints and things to think about

- For this question you will want a variable containing a list of numbers. Add a variable using one of the presets from the *data types* dropdown, or alternatively, JME has a function `list()`.
- There are many functions for manipulating lists, for example you may or may not wish to sort your list. See the `sort()` function, and others which perform operations on lists, in the Numbas documentation.
- Think about how you are going to present the data. If you would like to follow the formatting above, then a table can be created from the *Table* dropdown menu in the part prompt or statement.
- You can access an element of a list with, for example, `a[2]`. Note that indexing starts from zero.
- Numbas offers functions such as `mean()` in the *statistical functions* extension.
- Think about the precision restrictions that you going to place on the answers. Are you going to ensure that the mode is unique?

Task 7) Vectors and matrices

The question we would like to create in Numbas

Calculate the matrix-vector product $\begin{pmatrix} -1 & 2 & 1 \\ -3 & 2 & 0 \end{pmatrix} \begin{pmatrix} 1 \\ -2 \\ 2 \end{pmatrix}$

Hints and things to think about

- Numbas has a *matrix entry* part type for just this sort of thing. This can also be used in a *gap fill* part.
- Working with vectors and matrices is very straightforward in Numbas. Use the built-in functions `matrix()` and `vector()` to set them up.
- If you present the student with a blank vector/matrix then you are giving away a significant part of the solution (the dimensions of the result). *Allow student to change size of matrix* is an option that lets the student choose the dimensions and then input values.
- You could use similar methods to ask a student to invert a matrix, or carry out a vector cross product.

Useful links

Public website: numbas.org.uk

Numbas editor: numbas.mathcentre.ac.uk

Documentation: docs.numbas.org.uk

Numbas is developed by the School of Mathematics, Statistics & Physics at Newcastle University.