

The `ou-tma` and `ou-tma-sup` Packages*

Geoff Riley
`geoffr@adaso.com`

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Abstract

The `ou-tma` package provides macros and environments to assist in writing Tutor Marked Assessments (TMAs) for Open University courses. The companion file `ou-tma-sup` package provides a number of extra macros that may be useful for some modules.

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1 Introduction

The `ou-tma` package simplifies the creation of TMAs by providing an environment to encompass answers to questions commands to enumerate parts and subparts of those questions, and a set of macros facilitating mathematical entry based on the styles used by the Open University (OU).

2 Compiling and installing **ou-tma**

To compile the **ou-tma** package:

Enter ⇒ `pdflatex tma.ins`

To compile the **ou-tma** documentation:

Enter ⇒ `pdflatex ou-tma.dtx`

(several times)

Enter ⇒ `makeindex -s gglo.ist -o ou-tma-chg-tma.gls ou-tma-chg-tma.glo`

Enter ⇒ `makeindex -s gglo.ist -o ou-tma-chg-sup.gls ou-tma-chg-sup.glo`

Enter ⇒ `makeindex -s gglo.ist -o ou-tma-chg-chg.gls ou-tma-chg-chg.glo`

Enter ⇒ `makeindex -s gind.ist ou-tma`

Enter ⇒ `pdflatex ou-tma.dtx`

(several times)

The files **ou-tma.sty** and **ou-tma-sup.sty** should be placed in an appropriate location within the **TeX** directory structure. For example in a directory such as **tex/latex/tma**. The file **doc-changes.sty** is only used for formatting this documentation and may safely be ignored thereafter.

3 Usage

To use the **ou-tma** package, in its most basic form, it should be included in the preamble of your **L^AT_EX** document:

```
\documentclass[a4paper,11pt]{article}
\usepackage{ou-tma}
:
\begin{document}
:
\end{document}
```

3.1 Options

A number of options are available to modify the results of using the **ou-tma** package. These should be included within the `\usepackage` declaration:

```
\usepackage[<option,...>]{ou-tma}
```

The following options are available:

alph (*Opt*) **alph**: (default) question numbering as 1(b)(iii);

roman (*Opt*) **roman**: varies question numbering to sequence used by M381 i.e. 1(ii)(c);

cleveref (*Opt*) **cleveref**: question numbering creates automatic referencing for use with cleveref package;

pdfbookmark (*Opt*) **pdfbookmark**: add PDF bookmarks for each question using hyperref package; and

legacy (*Opt*) **legacy**: enables old definitions of \vec and \C for backward compatibility.

3.2 Macros and environments

The **ou-tma** package provides several valuable macros and environments, most are documented here.

3.2.1 Document level commands

The document-level commands are intended for use within the document's preamble. They generally affect what appears on the title page and the headers/footers.

The most essential part of an assignment is to identify who it has been written by \myname and what it has been written for. To this end, the \myname macro is used to specify your name: this should be your name as recorded with the University. As names are not unique, the OU allocates a Personal Identification Number (or PIN) as a \mypin unique identifier for each student; this should be declared with the \mypin macro.

It is formed by a letter, followed by seven digits—or six digits and a letter X. This is distinct from the OUCU, or OU Computer User identifier that is used to log in to the OU website. Once the personal identification has been done, the module being worked needs to be declared, the course code of your module should be given \mycourse with the \mycourse macro and the number of the assignment using the \mytma \mytma macro. Note that this is just the assignment number; there is no need to include the characters TMA. The final document level command is used if you wish to set a specific date that will be displayed on the compiled document title page; you may \setdate use \setdate. This will override the default of using the compile date.

Example:

```
%   \myname{Anthony Neil Other}
%   \mypin{A1234567}
%   \mycourse{M101} % The original Maths introduction module
%   \mytma{02} % TMA02
%   \setdate{March 2025}
```

3.2.2 Question environment commands

These commands are the ones that, though few, comprise the bulk of the body of the TMA answer content of a paper.

question (env.) Within a TMA, each answer should be placed in a **question** environment. The question number is printed across the left margin, preceded by the question string which defaults to ‘Q’ but may be redefined by use of the command

\setquestionstring **\setquestionstring[⟨alignment⟩]{⟨required question number introduction⟩}**. By setting *alignment* to ‘1’ it is possible to left align the question string and number from the margin rather than into it, this is particularly useful for languages where the translation of ‘Question’ is long enough to disappear past the left hand edge of the page: the default is ‘r’ for right aligned. The question number itself is automatically incremented unless one is specified in the optional parameter. Since the question is presented as an environment, it may be convenient to place each question in a separate file to be included in the main paper.

\qpart Often questions are comprised of multiple parts, therefore, **\qpart** indicates the start of a question part. It will set the part identifier within the left-hand margin space. Normally, the parts are lettered as **a**, **b**, **c**... unless the option **roman** has been given to the **ou-tma** package when the parts are numbered as **i**, **ii**, **iii**... As with the actual questions, this is an auto-incrementing value unless an optional value is given. Note that the value should be numerical even if the parts are lettered or in Roman numerals. Each new question restarts the numbering at 1, which will be rendered as **a** or **i** as dictated by the options in effect.

There are frequent occasions that the parts of questions may be further divided into **\qsubpart** sub-parts; these may be declared using the **\qsubpart** macro. As with **\qpart**, this is set in the left margin and automatically incremented: an option to choose the sub-part number is also available. If a **\qsubpart** immediately follows a **\qpart**, both marginal markers will be set on the same line.

Infrequently, there may arise the need for alternative questioning paths. This is most frequently the case when there has been some form of practical that may not be feasible for all students to take part in. Under these circumstances questions get issued with tracking version, so there will be a question line ‘1’ and a question **\qsubpart** line ‘2’, to accomodate these the **\qsubpart** macro is made available. As with the standard **\qsubpart** macro, it may be followed by an optional number to restart the sequence, but it has, in addition, a required parameter to give the track number.
This is included in the ou-tma-sup package.

Note that **question** is an environment to be used with the **\begin{...}\end** structure, **\qpart** and **\qsubpart** are both macros that lay down titles in the margin and are designed to be used on a line on their own.

Example:

```
\begin{question}[⟨question number⟩]
:
\qpart[⟨part number⟩]
```

```

⋮
\qsubpart[⟨sub-part number⟩]
⋮
\qsubparte[⟨sub-part number⟩]{⟨postfix track number⟩}
⋮
\end{question}
```

3.2.3 Mathematical symbology

Various mathematical symbols and elements are defined for convenience, working from the normal suggested formats used within Open University courses. These are mostly as proscribed by the various standards bodies too, for reference see “Quantities and units - Part 2: Mathematics” ISO 80000-2:2019*

These commands are created in such a manner that they will work correctly in both text and maths modes.

\dd **Differential operators** The general advise for most OU modules is to use an upright letter ‘d’ when specifying differential variables, thus \dd is provided to \e allow simple accomodation of this. Similarly, Euler’s number and the imaginary unit representation of $\sqrt{-1}$ are both usually given upright letters of ‘e’, (\e), and ‘i’, (\ii), respectively.

Remember that it is always the exception that proves the rule: follow the module guidebook for the course being completed.

Example 1: Differential

Code:

In display mode, compare \dd\ with \$d\$:

$$\frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = 2\sin(x)$$

and in line mode $\mathrm{e}^{\mathrm{i}x} = \cos(x) + \mathrm{i}\sin(x)$

Result:

In display mode, compare d with *d*:

$$\frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = 2\sin(x)$$

and in line mode $\mathrm{e}^{\mathrm{i}x} = \cos(x) + \mathrm{i}\sin(x)$

Number sets Standard ‘black-board’ fonts are used to indicate a number of frequently designated groups of numbers.

\N \N: N represents all natural numbers;

* Available from British Standards Online as BS EN ISO-2:2019 (ISBN 978 0 539 23108 3), The European Standards Agency and The International Standard Organisetion. All are purchasable publications.

\Z	\Z: \mathbb{Z} represents all integers;
\Q	\Q: \mathbb{Q} represents all rational numbers;
\R	\R: \mathbb{R} represents all real numbers; and
\Complex	\Complex: \mathbb{C} represents all complex numbers.

Example 2: Number sets*Code:*

The relationship between number sets:

```
\begin{itemize}
\item \N (Natural numbers)  $\subseteq \mathbb{Z}$  (Integers); every natural number is also an integer.
\item \Z (Integers)  $\subseteq \mathbb{Q}$  (Rational numbers); every integer is also a rational number.
\item \Q (Rational numbers)  $\subseteq \mathbb{R}$  (Real numbers); every rational number is also a real number.
\item \Complex (Complex numbers)  $\supseteq \mathbb{R}$  (Real number); complex numbers include real numbers as a subset, since they can be represented by  $a+bi$  where  $a$  and  $b$  are real numbers.
\end{itemize}
```

Result:

The relationship between number sets:

- \mathbb{N} (Natural numbers) $\subseteq \mathbb{Z}$ (Integers); every natural number is also an integer.
- \mathbb{Z} (Integers) $\subseteq \mathbb{Q}$ (Rational numbers); every integer is also a rational number.
- \mathbb{Q} (Rational numbers) $\subseteq \mathbb{R}$ (Real numbers); every rational number is also a real number.
- \mathbb{C} (Complex numbers) $\supseteq \mathbb{R}$ (Real number); complex numbers include real numbers as a subset, since they can be represented by $a + bi$ where a and b are real numbers.

\vect **Vector notation** Two different vector representations are typically used on OU modules, there is the two, or more, letter with an over arrow version given with \vect; and the emboldened upright letter version \ve—the latter is commonly handwritten as an underlined letter.

Example 3: Vectors

Code:

Given a point \$A\$ at the co-ordinate \$(6, 3)\$ and a point \$B\$ at the co-ordinate \$(-4, 8)\$, the vector \$\vec{AB}\$ has a gradient of \$\frac{8-3}{-4-6} = \frac{5}{-10} = -\frac{1}{2}\$
The standard unit vectors are \$\hat{i}\$ and \$\hat{j}\$. They are usually at right angles to each other.

Result:

Given a point A at the co-ordinate $(6, 3)$ and a point B at the co-ordinate $(-4, 8)$, the vector \vec{AB} has a gradient of $\frac{8-3}{-4-6} = \frac{5}{-10} = -\frac{1}{2}$. The standard unit vectors are \mathbf{i} and \mathbf{j} . They are usually at right angles to each other.

- \st **Ordinal indicators** The use of ordinal indicators is not specific to OU modules, but frequently is a useful element that is just inconvenient to produce.
- \nd
- \rd So the standard four English ordinals are provided \st, \nd, \rd, and \nth, e.g. 1st, 2nd, 3rd, and 4th.
- \nth Note that the last ordinal is \nth not \th, the latter produces a thorn character, þ, and that only works if you have other than the default 7-bit font encoding (OT1).

Combinatorial notations There are two combinatorial forms that are commonly used in OU modules, the combination selecting r out of a total of n items where order does not matter, and the permutations of r out of n items where order matters.

- \comb \comb: $\{\langle n \rangle\}\{\langle r \rangle\}$. This is equivalent to

$${}^nC_r = \frac{n!}{r!(n-r)!}$$

- \perm \perm: $\{\langle n \rangle\}\{\langle r \rangle\}$. This is equivalent to

$${}^nP_r = \frac{n!}{(n-r)!}$$

Mathematical operators Additional mathematical operators are defined, again for convenience of entry.

- \re \re: $\mapsto \operatorname{Re}$
- \im \im: $\mapsto \operatorname{Im}$
- \Log \Log: $\mapsto \operatorname{Log}$
- \Arg \Arg: $\mapsto \operatorname{Arg}$
- \Wnd \Wnd: $\mapsto \operatorname{Wnd}$
- \Res \Res: $\mapsto \operatorname{Res}$

\Ker	\Ker: $\mapsto \text{Ker}$
\Orb	\Orb: $\mapsto \text{Orb}$
\Stab	\Stab: $\mapsto \text{Stab}$
\Fix	\Fix: $\mapsto \text{Fix}$

Derivatives There are three derivative forms defined specifically for speeding calculus entry and accuracy. One used the dx form and two use the partial, ∂x , form.

\deriv	\deriv: $\{\langle y \rangle\}\{\langle x \rangle\} \mapsto \frac{dy}{dx}$
\pderiv	\pderiv: $\{\langle y \rangle\}\{\langle x \rangle\} \mapsto \frac{\partial y}{\partial x}$
\psderiv	\psderiv: $\{\langle y \rangle\}\{\langle x \rangle\}\{\langle z \rangle\} \mapsto \frac{\partial^2 y}{\partial x \partial z}$

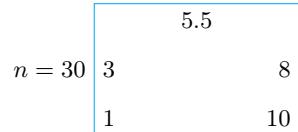
Additional symbols A couple of additional symbols are available for use in different modules, or purely for convenience.

\rect	\rect: \rect, \square , is defined particularly for the use of M208 people although others may find it useful.
\ld	\ld: \ld, λ , is another useful definition for M208 student who may be taxed by the number of times they need to type, and then correct their spelling of, \lambda. The macro will work correctly in both text and maths mode. <i>This is an ou-tma-sup macro.</i>
\Pounds	\Pounds: \Pounds displays a Pound Sterling amount in the appropriate format with two decimal places (rounded as necessary). For example \Pounds{2.56} renders as £ 2.56. <i>This is an ou-tma-sup macro.</i>

Statistics devices A common device in statistics is the ‘Five value statistic summary’, it is communicated via a standardised graphic.

\FiveStats $[\langle n \rangle]\{\langle min \rangle\}\{\langle max \rangle\}\{\langle median \rangle\}\{\langle Q1 \rangle\}\{\langle Q3 \rangle\}$ \FiveStats uses TikZto draw the appropriate diagram. For example:

\FiveStats[30]{1}{10}{5.5}{3}{8} results in



The count of values, n , is optional. *This is part of the ou-tma-sup package.*

Legacy elements There are a couple of macros which become enabled when using the legacy option. These are now deprecated and may be removed from a future version. There are name clashes with standard LATEX commands, so please be aware of this if used.

\C	\C: is the original version of \Complex
\vec	\vec: is the original version of \vect

4 Implementation of **ou-tma**

```

1 %% ou-tma.sty
2 %% Copyright 2025 G. I. Riley <geoffr@adaso.com>
3 %
4 % This work may be distributed and/or modified under the
5 % conditions of the LaTeX Project Public License, either version 1.3
6 % of this license or (at your option) any later version.
7 % The latest version of this license is in
8 %   http://www.latex-project.org/lppl.txt
9 % and version 1.3 or later is part of all distributions of LaTeX
10 % version 2005-12-01 or later.
11 %
12 % This work has the LPPL maintenance status 'maintained.'
13 %
14 % The Current Maintainer of this work is Geoff Riley.
15 %
16 %% This package may be freely used, especially by, but not limited to,
17 %% students, lecturers and staff of the Open University. It was created
18 %% by the efforts of many who are now or have been connected with the
19 %% Open University Students Association. No acknowledgement is
20 %% _required_ for using this package within the production of a _Tutor
21 %% Marked Assessment._
```

Adapted by Peter McFarlane from various sources. All errors of style or content are mine or subsequent contributors. Acknowledgements to Bob Margolis and Rob Lynas (from whom some macros are plagiarised). Further contributions from Steve Mayer and Tim Dale. Annotations, in part, and further modification by Geoff Riley.

Package Options

- \[alph] (default) question numbering as 1(b)(iii)
- \[roman] varies question numbering to sequence used by M381 i.e. 1(ii)(c)
- \[cleveref] question numbering creates automatic referencing for use with cleveref package
- \[pdfbookmark] add PDF bookmarks for each question using hyperref package
- \[legacy] enables old definitions of \vec and \C for backward compatibility

To use a package option, place the option(s) before the package name:

```
\usepackage[roman,cleveref]{ou-tma}
```

Before getting into the main package, it is necessary to ensure that the L^AT_EX3 extensions are loaded. Most modern versions of the L^AT_EX core have this rolled in as standard, but as a belt and braces approach, inclusion here does no harm.

```
22 \RequirePackage{expl3} % LaTeX3 "experimental"
```

4.1 Package Initialisation

We are starting off using the \ExplSyntaxOn command to enable the L^AT_EX3 extensions before declaring a set of ‘constants’ that will be used by our package. Working

with the established conventions the constants are declared as variables are named to reflect their ownership and function. These are all declared as ‘token lists’ so that they may, effectively, hold string elements. Make the underscore character a letter!

```

g_tma_constant_name g_tma_constant_name: holds the students personal name
(Var)
g_tma_constant_tma g_tma_constant_tma: holds the number of the TMA being answered
(Var)
g_tma_constant_course g_tma_constant_course: holds the OU course code for the module being studied
(Var) g_tma_constant_pin: holds the students personal identification number
g_tma_constant_pin
(Var) g_tma_constant_thedate: holds the date to be printed on the front page of the
g_tma_constant_thedate      TMA
(Var)
23 % %%%%%%%%
24 %% Package Initialization
25 % %%%%%%%%
26 \ExplSyntaxOn
27 \tl_new:N \g_tma_constant_name
28 \tl_new:N \g_tma_constant_tma
29 \tl_new:N \g_tma_constant_course
30 \tl_new:N \g_tma_constant_pin
31 \tl_new:N \g_tma_constant_thedate

```

These ‘constants’ are given initial generic values.

```

32 \tl_gset:Nn \g_tma_constant_name {name}
33 \tl_gset:Nn \g_tma_constant_tma {tma}
34 \tl_gset:Nn \g_tma_constant_course {course}
35 \tl_gset:Nn \g_tma_constant_pin {pin}
36 \tl_gset:Nn \g_tma_constant_thedate {the^date}

```

Then commands are provided to retrieve the values when required.

\name \name: returns the students name

\tma \tma: returns the working TMA number

\course \course: returns the OU course reference

\pin \pin: returns the students personal identification number

\thedate \thedate: returns the date to be printed on the title page of the TMA

```

37 \newcommand{\name}{\g_tma_constant_name}
38 \newcommand{\tma}{\g_tma_constant_tma}
39 \newcommand{\course}{\g_tma_constant_course}
40 \newcommand{\pin}{\g_tma_constant_pin}
41 \newcommand{\thedate}{\g_tma_constant_thedate}

```

Finally, macros are provided to set the values of the ‘constants’: these should only be used within the preamble. Use within the body of the text is unpredictable.

```
\myname \myname: {<name>} Set the students name
\mytma \mytma: {<TMA number>} Set the TMA number
\mycourse \mycourse: {<course code>} Set the OU course code for the module
\mypin \mypin: {<pin>} Set the students personal identification number
\setdate \setdate: {<the date>} Set the required date to display on the title page, default
is the date of report generation

42 \NewDocumentCommand{\myname}{m}{%
43   \tl_gset:Nn \g_tma_constant_name{#1}%
44 \NewDocumentCommand{\mytma}{m}{%
45   \tl_gset:Nn \g_tma_constant_tma{#1}%
46 \NewDocumentCommand{\mycourse}{m}{%
47   \tl_gset:Nn \g_tma_constant_course{#1}%
48 \NewDocumentCommand{\mypin}{m}{%
49   \tl_gset:Nn \g_tma_constant_pin{#1}%
50 \NewDocumentCommand{\setdate}{m}{%
51   \date{#1}\tl_gset:Nn \g_tma_constant_thedate{#1}}}
```

That’s the end of the L^AT_EX3 extensions requiring the extension switch, so it can be turned off.

```
52 \ExplSyntaxOff
```

Set the `\title` and `\author` ready for use by the `\maketitle` macro at the start of the main document. They use the constants defined above so that changes are automatically reflected. They may be redefined by the user if required.

```
53 \title{\textbf{TMA: \course-\tma}}
54 \author{\textbf{\name\space\pin}}
```

In order to allow the question introduction string to be modified, a general L^AT_EX string is created along with a macro to set it.

`\tma@questionalignment \tma@questionalignment`: Holds the string alignment to the left margin, the default is ‘r’. This is particularly useful for question strings that might otherwise extend beyond the left hand reach of the left hand page border.

`\tma@questionstring \tma@questionstring`: Hold the string to be printed before the question number, the default is ‘Q’.

`\setquestionstring \setquestionstring: [<char>]{<string>}` Set the string to precede the question number

```
55 \NewDocumentCommand{\tma@questionalignment}{}{r}
```

```

56 \NewDocumentCommand{\tma@questionstring}{}{\relax}
57 \NewDocumentCommand{\setquestionstring}{O{r} m}{%
58     \RenewDocumentCommand{\tma@questionalignment}{}{\#1}%
59     \RenewDocumentCommand{\tma@questionstring}{}{\#2}%
60 }

```

Set the default date to ‘today’.

```

61 \setdate{\today}

```

4.2 Package Loading

Here we load the useful packages that have proven their worth for OU students over the years. Many have properties that are utilised by the rest of the `ou-tma` package.

```

62 % %%%%%%%%%%%%%%
63 %% Package Loading
64 % %%%%%%%%%%%%%%
65
66 \RequirePackage{amsmath}
67 \RequirePackage{amssymb}
68 \RequirePackage{amsthm}
69 \RequirePackage{wasysym}
70 \RequirePackage{bm}
71 \RequirePackage{upgreek}
72 \RequirePackage{graphicx}
73 \RequirePackage{lastpage}
74 \RequirePackage{xifthen}
75 \RequirePackage{verbatim}
76 \RequirePackage{fancyhdr}
77 \RequirePackage{geometry}
78 \RequirePackage{calc}
79 \RequirePackage{etoolbox}
80 \RequirePackage[UKenglish]{isodate} % use UK format for date
81 \cleanlookdateon % remove th,st, rd from date
82

```

4.3 Geometry Settings

An important part of TMA answering is providing a consistent output, to this end the following page geometry has been brought together as a compromise suitable for most modules.

```

83 % %%%%%%%%%%%%%%
84 %% Geometry Settings
85 % %%%%%%%%%%%%%%
86
87 \geometry{
88   headheight=10mm,
89   headsep=5mm,
90   bottom=25mm,
91   footskip=15mm,

```

```

92   left=30mm,
93   right=30mm,
94   marginparwidth=0mm,
95   marginparsep=0mm,
96   includemp
97 }

```

4.4 Margin Notes

By default, no margin notes are assumed to be required, however, if one is wanted, `\marginnotes` the `\marginnote` command will set up the side margin ready to accept notes using `\marginnote{<note>}` command.

```

98 % %%%%%%%%%%%%%%
99 %% Margin Notes
100 % %%%%%%%%%%%%%%
101
102 \NewDocumentCommand{\marginnote}{m}{\marginpar{#1}}
103 \NewDocumentCommand{\marginnotes}{}{
104   \geometry{
105     marginparwidth=40mm,
106     marginparsep=5mm,
107     left=20mm,
108     right=15mm
109   }
110 }

```

4.5 Question Numbering

We set up three counters to keep track of the question number along with associated parts and subparts.

question (Ctr) question: Holds the current question number, when a new question is started this value is used unless one is provided, in either case the used value is incremented as saved back here. When used, the `\qpart` is automatically reset so that the first part will be part 1.

qpart (Ctr) qpart: Holds the current part number as a numeric value, as with the question number this may be overridden and is incremented after being used. When used, the `\qsubpart` is automatically reset so that the first subpart will be sub-part 1.

qsubpart (Ctr) qsubpart: Holds the current sub-part number as a numeric value, again, the value may be overridden and is incremented after being used.

```

111 % %%%%%%%%%%%%%%
112 %% Question Numbering
113 % %%%%%%%%%%%%%%
114
115 \newcounter{question}

```

```
116 \newcounter{qpart}[question]
117 \newcounter{qsubpart}[qpart]
```

The question number is set to print as arabic digits,

```
118 \renewcommand{\thequestion}{\arabic{question}}
```

4.6 Option Handling

In order to handle the incoming options for the `ou-tma` package, we create a set of four new boolean tokens.

`tma@roman (bool) tma@roman:` False indicates ‘alph’ numbering, true indicates ‘roman’ numbering of parts and subpart.

`tma@usecleveref (bool) tma@usecleveref:` True indicates that the `cleveref` package is requested.

`tma@usepdfbookmark tma@usepdfbookmark (bool)` True indicated that the `pdfbookmark` package is requested.

`tma@legacy (bool) tma@legacy:` True indicted that the commands `\Complex` and `\vect` will be redefined to the legacy commands `\C` and `\vec`.

```
119 % %%%%
120 %% Option Handling
121 % %%%%%
122 % Define boolean flags
123 \newif\iftma@roman
124 \newif\iftma@usecleveref
125 \newif\iftma@usepdfbookmark
126 \newif\iftma@legacy
127
128 % Set default options
129 \tma@romanfalse          % Default numbering is ‘alph’
130 \tma@useclevereffalse    % Default is not to use cleveref
131 \tma@usepdfbookmarkfalse % Default is not to use pdfbookmark
132 \tma@legacyfalse         % Default is not to use legacy definitions
```

We now set up the default states and commands for the `ou-tma` package operation.

`\theqpart \theqpart:` returns the current question part number as either an alpha or roman index.

`\theqsubpart \theqsubpart:` returns the current question subpart number as either a roman or an alpha index.

`\tma@crefname \tma@crefname: {<label type>} {<singular name>} {<plural name>}` Declares a label with singular and plural spellings for the `cleveref` package.

`\tma@stepcounter \tma@stepcounter: {<counter name>}` Increments the named counter by one.

\tma@bookmark \tma@bookmark: [*level*] {*text*} {*name*} The level is optional, numerical, the default is zero, the top level. The text is what will appear in the bookmark panel, and the name is what may be used as a reference to the location from other parts of the document.

\tma@pageref \tma@pageref: {*name*} returns the page number, if known, that contains the bookmark with the label name.

```

133 % Define commands with default values
134 \renewcommand{\theqpart}{\alph{qpart}}
135 \renewcommand{\theqsubpart}{\roman{qsubpart}}
136 \NewDocumentCommand{\tma@crefname}{m}{\relax}
137 \NewDocumentCommand{\tma@stepcounter}{m}{\stepcounter{#1}}
138 \NewDocumentCommand{\tma@bookmark}{O{0}mm}{\relax}
139 \NewDocumentCommand{\tma@pageref}{m}{\pageref{#1}}
```

Declare each of the valid options for the option processing system. In each case, the action is to set the appropriate boolean to true or false.

```

140 % Declare options
141 \DeclareOption{roman}{%
142   \tma@romantrue%
143 }
144 \DeclareOption{alph}{%
145   \tma@romanfalse%
146 }
147 \DeclareOption{cleveref}{%
148   \tma@useclevereftrue%
149 }
150 \DeclareOption{pdfbookmark}{%
151   \tma@usepdfbookmarktrue%
152 }
153 \DeclareOption{legacy}{%
154   \tma@legacytrue%
155 }
156 \DeclareOption*{%
157   \PackageWarning{ou-tma}{Unknown option '\CurrentOption'}%
158 }
```

Go ahead, process those options!

```

159 % Process options
160 \ProcessOptions\relax
```

4.7 Debugging Options

A short section of code outputting to the log the state of the four main options that may be passed to the ou-tma package.

```

161 \typeout{***** OPTION RESULTS *****}
162 \iftma@usepdfbookmark
163 \typeout{pdfbookmark is TRUE}
```

```

164 \else
165 \typeout{pdfbookmark is FALSE}
166 \fi
167 \iftma@roman
168 \typeout{roman is TRUE}
169 \else
170 \typeout{roman is FALSE}
171 \fi
172 \iftma@usecleveref
173 \typeout{cleveref is TRUE}
174 \else
175 \typeout{cleveref is FALSE}
176 \fi
177 \iftma@legacy
178 \typeout{legacy is TRUE}
179 \else
180 \typeout{legacy is FALSE}
181 \fi
182 \typeout{***** END OPTION RESULTS *****}

```

4.8 Package adjustments based on Options

```

183 % %%%%%%%%%%%%%%
184 %% Set Up Package Based on Options
185 % %%%%%%%%%%%%%%
186
187 % Set question numbering
188 \iftma@roman
189 \renewcommand{\theqpart}{\roman{qpart}}
190 \renewcommand{\theqsubpart}{\alph{qsubpart}}
191 \else
192 \renewcommand{\theqpart}{\alph{qpart}}
193 \renewcommand{\theqsubpart}{\roman{qsubpart}}
194 \fi
195 % Load hyperref if necessary
196 \iftma@usepdfbookmark
197 \AtBeginDocument{%
198   \hypersetup{%
199     colorlinks=true,%
200     linkcolor=blue,%
201     urlcolor=blue,%
202     pdfstartview=FitH,%
203     pdftitle={TMA~\tma}, %
204     pdfauthor={\name~\textemdash~\pin}, %
205     pdfkeywords={OUCU:\pin, TMA~\tma}, %
206     pdfsubject=\course%
207 }%
208 }
209 \RequirePackage[pdfencoding=unicode,psdextra]{hyperref}
210 \fi
211
212 % Load cleveref if necessary
213 \iftma@usecleveref
214 % Ensure hyperref is loaded before cleveref
215 \@ifpackageloaded{hyperref}%

```

```

216 {}%
217 {\RequirePackage[pdfencoding=unicode,psdextra]{hyperref}}
218 \RequirePackage{cleveref}
219 % Redefine commands for cleveref
220 \RenewDocumentCommand{\tma@crefname}{m}{\crefname{#1}{#2}{#3}}
221 \RenewDocumentCommand{\tma@stepcounter}{m}{\refstepcounter{#1}}
222 \fi
223
224 % Redefine commands for pdfbookmark
225 \iftma@usepdfbookmark
226 \RenewDocumentCommand{\tma@pageref}{m}{\pageref*{#1}}
227 \RenewDocumentCommand{\tma@bookmark}{O{0} +m +m}{%
228   \pdfbookmark[#1]{#2}{#3}%
229 }
230 \fi
231
232 \setquestionstring{Q}

```

4.9 Question Environment

```

233 % %%%%%%%%%%%%%%
234 %% Question Environment
235 % %%%%%%%%%%%%%%
236
237 % Set up cref names if cleveref is used
238 \iftma@usecleveref
239 \tma@crefname{question}{question}{questions}
240 \tma@crefname{qpart}{part}{parts}
241 \tma@crefname{qsubpart}{section}{sections}
242 \fi

```

Commands to introduce Questions, parts and subparts.

In each case, an optional argument allows a fixed starting ‘number’ to be included to override the default of using the next.

```

243 \NewDocumentEnvironment{question}{O{0}}{%
244   \ifthenelse{#1>0}{\setcounter{question}{#1-1}}{\relax}%
245   \tma@stepcounter{question}%
246   \tma@bookmark{Question \thequestion}%
247   {question\thequestion}%
248   \makebox[0em][\tma@questionalignment]{\large\tma@questionstring^\thequestion}%
249   \hspace{0.3em}}\par%
250 }{%
251   \par \vspace{3em}%
252 }
253
254 \NewDocumentCommand{\qpart}{O{0}}{%
255   \ifthenelse{#1>0}{\setcounter{qpart}{#1-1}}{\relax}%
256   \tma@stepcounter{qpart}%
257   \tma@bookmark[1]{\thequestion.\theqpart}%
258   {qpart.\thequestion.\theqpart}%
259   \par%
260   \makebox[0pt][r]{\large{(\theqpart)\hspace{1.5em}}}%
261 }
262

```

```

263 \NewDocumentCommand{\qsubpart}{O{0}}{%
264   \ifthenelse{#1>0}{\setcounter{qsubpart}{#1-1}\relax\%%
265     \tma@stepcounter{qsubpart}\%
266     \tma@bookmark[2]{\thequestion.\theqpart.\theqsubpart}\%
267     {qsubpart.\thequestion.\theqpart.\theqsubpart}\%
268   \ifthenelse{\value{qsubpart}>1}\%
269     {\par}\{}\%
270   \hspace{-2em}\makebox[2em][l]{\large{(\theqsubpart)}}\%
271 }

```

4.10 Mathematical commands

```

272 %% Mathematical Commands
273 %% Mathematical Operators
274 %% Differential Operators
275 \NewDocumentCommand{\dd}{}{\ensuremath{\mathop{}!\mathit{d}}}
276 \NewDocumentCommand{\e}{}{\ensuremath{\mathit{e}}}
277 \NewDocumentCommand{\ii}{}{\ensuremath{\mathit{i}}}
278
279 %% Number Sets
280 \NewDocumentCommand{\N}{}{\ensuremath{\mathbb{N}}}
281 \NewDocumentCommand{\Z}{}{\ensuremath{\mathbb{Z}}}
282 \NewDocumentCommand{\Q}{}{\ensuremath{\mathbb{Q}}}
283 \NewDocumentCommand{\R}{}{\ensuremath{\mathbb{R}}}
284 \NewDocumentCommand{\Complex}{}{\%
285   \ensuremath{\mathbb{C}}} % Changed from \mathcal{C} to \Complex
286 \NewDocumentCommand{\Rr}{}{\ensuremath{\mathcal{R}}}
287
288 %% Vector Notation
289 \NewDocumentCommand{\vect}{m}{%
290   \ensuremath{\overrightarrow{#1}}} % Changed from \vec to \vect
291 \NewDocumentCommand{\ve}{m}{\ensuremath{\textbf{#1}}}
292
293 %% Ordinal Indicators
294 \NewDocumentCommand{\st}{}{\textsuperscript{st}}
295 \NewDocumentCommand{\nd}{}{\textsuperscript{nd}}
296 \NewDocumentCommand{\rd}{}{\textsuperscript{rd}}
297 \NewDocumentCommand{\nth}{}{\textsuperscript{th}}
298
299 %% Additional Symbols
300 \NewDocumentCommand{\rect}{}{\ensuremath{\sqsubset\!\!\!\sqsupset}}
301
302 %% Combinatorial Notations
303 \NewDocumentCommand{\comb}{mm}{\ensuremath{{}^{\#1}\!C_{\#2}}}
304
305 \NewDocumentCommand{\perm}{mm}{\ensuremath{{}^{\#1}\!P_{\#2}}}
306
307 %% Mathematical Operators
308 \DeclareMathOperator{\re}{Re}
309 \DeclareMathOperator{\im}{Im}
310 \DeclareMathOperator{\Log}{Log}
311 \DeclareMathOperator{\Arg}{Arg}
312 \DeclareMathOperator{\Wnd}{Wnd}
313 \DeclareMathOperator{\Res}{Res}

```

```

315 \DeclareMathOperator{\Ker}{Ker}
316 \DeclareMathOperator{\Orb}{Orb}
317 \DeclareMathOperator{\Stab}{Stab}
318 \DeclareMathOperator{\Fix}{Fix}
319
320 %% Derivatives
321 \NewDocumentCommand{\deriv}{mm}{%
322   \frac{\partial #1}{\partial #2}}
323 \NewDocumentCommand{\pderiv}{mm}{%
324   \frac{\partial #1}{\partial #2}}
325 \NewDocumentCommand{\psderiv}{mmm}{%
326   \frac{\partial^2 #1}{\partial #2 \partial #3}}
327
328 % Legacy Definitions
329 \iftma@legacy
330 % Redefine \vec to old definition
331 \RenewDocumentCommand{\vec}{m}{\ensuremath{\overrightarrow{#1}}}
332 % Redefine \C to old definition
333 \ProvideDocumentCommand{\C}{}{\ensuremath{\mathbb{C}}}
334 \RenewDocumentCommand{\C}{}{\ensuremath{\mathbb{C}}}
335 \fi

```

4.11 Theorem Environment

Theorems and Lemmas. Predefined environments for setting... the obvious.

\Theory \Theory: [*<title>*] If title is given, then it will replace the incrementing number normally attached to the theorem. It will also be used to automatically create a label in the form `thm:title` which may be used by the referencing system.

\Lemma \Lemma: [*<title>*] As with ‘Theory’ above, specifying a title will replace the incrementing number and create an automatic label in the form `lem:title`.

```

336 % %%%%%%%%%%%%%%
337 %% Theorem Environment
338 % %%%%%%%%%%%%%%
339 \@ifpackageloaded{hyperref}%
340 {}%
341 {\RequirePackage[pdfencoding=unicode,psdextra]{hyperref}}
342 \RequirePackage{cleveref}
343 \ExplSyntaxOn
344 % Declare global variables to store the sanitised tag
345 \tl_new:N \g_sanitise_tag_tl
346 \tl_new:N \l_sanitise_result_tl
347
348 % Define a sentinel value for no tag
349 \def\NOTAG{\NOTAG}
350
351 % Helper function to sanitise a tag
352 \cs_new_protected:Npn \sanitisetag_check:n #1
353 {
354     \tl_set:Nn \l_tmpb_tl {#1}
355     \regex_replace_all:nnN {[^a-zA-Z0-9:\.\-\_]+} {} \l_tmpb_tl

```

```

356     \tl_put_right:Nx \l_sanitise_result_tl \l_tmpb_tl
357 }
358
359 % Accessor command
360 \cs_set:Npn \ConcatSanitisedTag #1 {
361     #1 : \tl_use:N \g_sanitise_tag_tl
362 }
363
364 \NewDocumentCommand{\SanitiseTag}{m}
365 {
366     \group_begin:
367     \tl_set:Nn \l_sanitise_result_tl {}
368     \tl_set:Nx \l_tmpa_tl {\text_lowercase:n {#1}}
369     \str_map_function:NN \l_tmpa_tl \sanitisetag_check:n
370     \tl_gset_eq:NN \g_sanitise_tag_tl \l_sanitise_result_tl
371     \group_end:
372 }
373 \ExplSyntaxOff

```

Here we have the **Theorem Factory**. The function is used to declare families of names that may be used as Theorem-like environments.

The resultant commands will create numerically sequenced entities, each with the option of having the numerical index being replaced by a supplied tag.

Wrapper (Arg) [] Wrapper: The wrapper is the name of the class of entities that you wish to use. It will be used as the title of the declaration preceding either the number or the tag.

Base (Arg) [] Base: The base is the name of the underlying **asmthm** counter. If two or more wrappers share the same base, they will share the same count.

Outer wrapper (Arg) [] Outer wrapper: The outer wrapper is an optional parameter (default: section) which will supply the first half of a dot separated counter. Any bounding environment with an associated count will be acceptable such as ‘chapter’ or ‘section’. Giving a blank outer wrapper eliminates the wrapper from the counter.

Prefix (Arg) [] Prefix: The prefix is a short character sequence used to categorise automatically created labels. The default is to use the base name, but tradition dictates that a three or four letter abbreviation is provided such as ‘thm’ for theorem or ‘lem’ for lemma.

An example declaration would be

```
\NewTheoremWithAutoLabel{Lemma}{lemma}[] [lem]
```

```

374 % Theorem factory
375 \NewDocumentCommand{\NewTheoremWithAutoLabel}{m m O{section} O{#2}}
376 {
377     \newtheorem{#2}{#1}[#3]
378     % Define the wrapper environment
379     \NewDocumentEnvironment{#1}{O{\NOTAG}}{

```

4.12 Miscellaneous Settings

```
408 % %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
409 %% Miscellaneous Settings
410 % %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
411
412 \RenewDocumentCommand{\thefootnote}{}{\fnsymbol{footnote}}
413 \numberwithin{equation}{question}
414 \setlength{\parindent}{0pt}
415 \setlength{\parskip}{2ex plus 0.3ex minus 0.2ex}
```

4.13 Header and Footer Settings

```

429 \% %%%%%%%%%%%%%%
430
431 \%endinput

```

5 Implementation of ou-tma-sup

```

1 \% ou-tma-sup.sty
2 \% Copyright 2025 G. I. Riley <geoffr@adaso.com>
3 \% This package may be freely used, especially by, but not limited to,
4 \% students, lecturers and staff of the Open University. It was created
5 \% by the efforts of many who are now or have been connected with the
6 \% Open University Students Association. No acknowledgement is
7 \% _required_ for using this package within the production of a _Tutor
8 \% Marked Assessment.__

```

This is the OU TMA supplementary file. Its purpose is to contain commands that are less commonly used, probably used by only one or two modules; and for experimental commands that may be included for testing by a wider audience but may be deemed unnecessary in the long run.

```

9 \% \RequirePackage{expl3} \% Automatically loaded with the \ProvidesExplPackage
10 \RequirePackage{ou-tma} \% main ou-tma package
11 \ExplSyntaxOn

```

This package provides macros for formatting numeric approximations, probability expressions, monetary values, and statistical diagrams, using `expl3` and `siunitx`. It is intended for typesetting mathematics and statistics answers in OU TMAs.

5.1 Main formatting commands

`\tmadp [⟨options⟩]{⟨value(s)⟩}[⟨units⟩]`: Round to <n> decimal places

`\tmasf [⟨options⟩]{⟨value(s)⟩}[⟨units⟩]`: Round to <n> significant figures

`value(s) (Arg)` [] : should be a comma separated lists giving either two or three numbers:

- {x, n} for one value to n dp/sf
- {x, y, n} for a range from x to y to n dp/sf

`options (Arg)` [] : may be one or more pairs of strings joined by an equals sign. Currently defined are the mutually exclusive:

- `style=bracket` for bracketed range: (x, y)
- `style=to` (default) for range using: ‘x to y’

5.2 Other useful commands

`\prob {⟨event⟩}`: Formats P (event) when in maths mode. The event may contain logically

connecting commands, `\and`, `\or`, `\bar` and `\not`, to build probability expressions so that expressions like

`$\prob{(Journey A \or Journey B) \and Bus}$` may be set:
`P ((Journey A or Journey B) and Bus).`

`\Pounds{\langle amount \rangle}`: Formats an amount in pounds sterling with two dp, e.g. £3.45

`\FiveStats[⟨n⟩]{⟨min⟩}{⟨max⟩}{⟨med⟩}{⟨Q1⟩}{⟨Q3⟩}`: Draws a 5-number summary diagram using TikZ.

`n (Arg) || n:` : (Optional) number of samples

`min (Arg) || min:` : Extreme minimum value

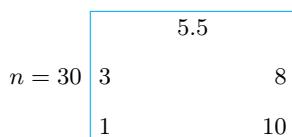
`max (Arg) || max:` : Extreme Maximum value

`median (Arg) || median:` : Median average

`Q1 (Arg) || Q1:` : First quartile value

`Q3 (Arg) || Q3:` : Third quartile value

e.g. `\FiveStats[30]{1}{10}{5.5}{3}{8}`



5.3 Package Initialisation

```

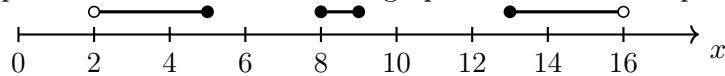
12 \ExplSyntaxOff
13 \RequirePackage{amsmath}
14 \RequirePackage{ifthen}
15
16 \RequirePackage{siunitx}
17 \sisetup{per-mode = symbol}
18 \sisetup{uncertainty-mode = separate}
19
20 \RequirePackage{tikz}
21 \RequirePackage{pgfplots}
22 \pgfplotsset{compat=1.18}
23 \usepgfplotslibrary[units]
24 \usetikzlibrary{angles,
25   quotes,
26   calc,
27   arrows.meta,
28   positioning,
29   decorations.markings}

```

5.4 TikZ styles for solid and hollow dots

```
30 % %%%%%%%%%%%%%%
31 %% TikZ styles for solid and hollow dots
32 % %%%%%%%%%%%%%%
```

Create TikZ styles for solid and hollow dots: used to mark included and excluded points on number lines and graphs etc. For example $(2, 5] \cup [8, 10] \cup [12, 16]$:



```
33 \tikzset{
34     soliddot/.style={
35         fill=black,
36         draw=black,
37         circle,
38         minimum size=4pt,
39         inner sep=0pt,
40     },
41     hollowdot/.style={
42         fill=white,
43         draw=black,
44         circle,
45         line width=0.6pt,
46         minimum size=4pt,
47         inner sep=0pt,
48     },
49 }
```

5.5 Question subpart with extention

```
50 % %%%%%%%%%%%%%%
51 %% Question subpart with extention
52 % %%%%%%%%%%%%%%
```

Make a question subpart with an extension, eg: Q1.a.i-1

Usage:

`\qsubpart[n]{ext}`

- where `n` is an optional value to reset the counter, a decimal value, if omitted, or zero, then continues the previous count; and
- `ext` is the required extension string.

```
53 \NewDocumentCommand{\qsubpart}{O{0}m}{
54     {
55         \iftma@roman
56             \renewcommand{\theqsubpart}{\alph{qsubpart}-#2}
57         \else
58             \renewcommand{\theqsubpart}{\rom{qsubpart}-#2}
59         \fi
60         \qsubpart[#1]
61     }
62 }
63
```

```
\tmadp [⟨options⟩]{⟨values⟩}[⟨units⟩]
\tmASF [⟨options⟩]{⟨values⟩}[⟨units⟩]
```

Each of these macros follow the same format, they produce automatically rendered n decimal places or significant figures, and can optionally display ranges and units thereof. The values should be a comma separated list of two or three numbers, the last specifying the appropriate digit count. If two values are given then they represent a real number followed by the digit count; and if three values are given, then they represent a range of two real numbers followed by the digit count.

Zero padding is applied where needed, so:

`\tmadp(5.5,3)` correctly returns 5.500 (to 3 dp); and

`\tmadp[style=bracket]{2.25,7.25,2}[\gram]` returns (2.25 g, 7.25 g) (to 2 dp)

5.6 Macros to render appropriate decimal places and significant figures

```
64 % %%%%%%%%%%%%%%
65 %% Decimal places and significant figures
66 % %%%%%%%%%%%%%%
67
68 \ExplSyntaxOn
69
70 \tl_if_exist:NF \l__tma_style_tl { \tl_new:N \l__tma_style_tl }
71 \tl_if_exist:NF \l__tma_label_style_tl { \tl_new:N \l__tma_label_style_tl }
72
73 \keys_define:nn { tma }
74 {
75     style .choice:,
76     style / to .code:n = { \tl_set:Nn \l__tma_style_tl { to } },
77     style / bracket .code:n = { \tl_set:Nn \l__tma_style_tl { bracket } },
78     style .initial:n = to,
79
80     labels .choice:,
81     labels / words .code:n = { \tl_set:Nn \l__tma_label_style_tl { words } },
82     labels / long .code:n = { \tl_set:Nn \l__tma_label_style_tl { long } },
83     labels / abbr .code:n = { \tl_set:Nn \l__tma_label_style_tl { abbr } },
84     labels / short .code:n = { \tl_set:Nn \l__tma_label_style_tl { abbr } },
85     labels / dp-sf .code:n = { \tl_set:Nn \l__tma_label_style_tl { abbr } },
86     labels .initial:n = abbr,
87 }
88
89 %% Public commands
```

Parameters for `\tmadp[⟨keyval⟩]{⟨data⟩}[⟨units⟩]` and `\tmASF[⟨keyval⟩]{⟨data⟩}[⟨units⟩]`:

- keyval: keyval options like `[style=bracket]`
- data: data (e.g. `{1.2, 3.4, 2}`)
- units: optional units (e.g. `[\gram]`)
- mode added to `\tma_format:nnnn` routine: mode (`dp` or `sf`)

```

90 \NewDocumentCommand{\tmadp}{O{}m0{}}
91 \NewDocumentCommand{\tmasf}{O{}m0{}}
92
93 % Entry point: parse style and data
94 \cs_new_protected:Nn \tma_format:nnnn
95 {
96     \keys_set:nn { tma } {#1}
97     \tma_parse:nnn {#2}{#3}{#4}
98 }
99
100 % Parse 2- or 3-item list
101 \cs_new_protected:Nn \tma_parse:nnn
102 {
103     \clist_set:Nn \l_tmpa_clist {#1}
104     \int_case:nnF { \clist_count:N \l_tmpa_clist }
105     {
106         {2}%
107             \tma_format_single:nnnn
108             { \clist_item:Nn \l_tmpa_clist {1} }
109             { \clist_item:Nn \l_tmpa_clist {2} }
110             {#2} % unit
111             {#3} % mode
112     }
113     {3}%
114         \tma_format_range:nnnn
115         { \clist_item:Nn \l_tmpa_clist {1} }
116         { \clist_item:Nn \l_tmpa_clist {2} }
117         { \clist_item:Nn \l_tmpa_clist {3} }
118         {#2} % unit
119         {#3} % mode
120     }
121 }
122 { \textbf{Error: expected 2 or 3 comma-separated values.} }
123 }
124
125 % Single number (optional unit)
126 \cs_new_protected:Nn \tma_format_single:nnnn
127 {
128     \tma_with_rounding:nnn {#4}{#2}
129     {
130         \tl_if_blank:nTF {#3}
131         { \num{#1} }
132         { \qty{#1}{#3} }
133         \text{~(to~\tma_mode_label:nn {#4}{\l__tma_label_style_t1})}
134     }
135 }
136
137 % Range (optional unit) with style switch
138 \cs_new_protected:Nn \tma_format_range:nnnnn
139 {
140     % no unit
141     \tl_if_blank:nTF {#4}
142     {
143         \tl_if_eq:NnTF \l__tma_style_t1 { bracket }
144         { \tma_output_bracketed_range:nnnnn {#1}{#2}{#3}{#4}{#5} }
145     }

```

```

146          \tma_with_rounding:nnn {#5}{#3}
147          { \num{#1}\text{~to~}\num{#2} }
148      }
149  }
150  { % with unit
151      \tl_if_eq:NnTF \l__tma_style_tl { bracket }
152      { \tma_output_bracketed_range:nnnnn {#1}{#2}{#3}{#4}{#5} }
153      {
154          \tma_with_rounding:nnn {#5}{#3}
155          { \SIrange{#1}{#2}{#4} }
156      }
157  }
158 }
159
160 % Core: locally apply siunitx rounding then typeset #3
161 % #1 = mode code dp/sf/off, #2 = precision, #3 = content
162 \cs_new_protected:Nn \tma_with_rounding:nnn
163 {
164     \group_begin:
165     \exp_args:Nx \sisetup
166     { round-mode=\tma_mode_map:n {#1}, round-precision=\int_eval:n {#2} }
167     #3
168     \group_end:
169 }
170
171 % Bracketed style output; handles math/text mode parens
172 \cs_new_protected:Nn \tma_output_bracketed_range:nnnnn
173 {
174     \tma_with_rounding:nnn {#5}{#3}
175     {
176         \mode_if_math:TF
177         {
178             ( \qty{#1}{#4},~\qty{#2}{#4} )
179             \text{~(to~}#3\text{~}\tma_mode_label:nn {#5}{\l__tma_label_style_tl})\text{)}
180         }
181         {
182             \text{~(\text{~}\qty{#1}{#4},~\qty{#2}{#4}\text{~}\text{)}}\text{)}
183             \text{~(to~}#3\text{~}\tma_mode_label:nn {#5}{\l__tma_label_style_tl})\text{)}
184         }
185     }
186 }
187
188 % Mapping + label text
189 \cs_new:Npn \tma_mode_map:n #1
190 {
191     \str_case:nnF {#1}
192     { {dp}{places} {sf}{figures} {off}{off} }
193     { places }
194 }
195
196 \cs_new:Npn \tma_mode_label:nn #1#2
197 {
198     \str_case:nnF {#2}
199     {
200         {words}{ \tma_label_words:n {#1} }
201         {long} { \tma_label_long:n {#1} }

```

```

202      {abbr} { \tma_label_abbr:n  {#1} }
203    }
204    { \tma_label_abbr:n {#1} }
205 }
206
207 \cs_new:Npn \tma_label_words:n #1
208 {
209   \str_case:nnF {#1} { {dp}{places} {sf}{figures} {off}{off} } {places}
210 }
211
212 \cs_new:Npn \tma_label_long:n #1
213 {
214   \str_case:nnF {#1}
215   { {dp}{decimal~places} {sf}{significant~figures} {off}{off} }
216   { decimal~places }
217 }
218
219 \cs_new:Npn \tma_label_abbr:n #1
220 {
221   \str_case:nnF {#1} { {dp}{dp} {sf}{sf} {off}{off} } { dp }
222 }
223
224 \ExplSyntaxOff

```

5.7 Pound Sterling printing

```

225 %%%%%%%%%%%%%%
226 %% Pound Sterling value
227 %%%%%%%%%%%%%%
228
229 \NewDocumentCommand{\Pounds}{m}{%
230   \pounds, \num[round-precision=2,round-mode=places,round-integer-to-decimal]{#1}%
231 }

```

5.8 Five value statistics summary

```

232 %%%%%%%%%%%%%%
233 %% Five value statistical summary diagram
234 %%%%%%%%%%%%%%

```

`\FiveStats[$\langle n \rangle$]{ $\langle min_n \rangle$ }{ $\langle max_n \rangle$ }{ $\langle median_n \rangle$ }{ $\langle Q1 \rangle$ }{ $\langle Q3 \rangle$ }` Print the five stats ‘square’ with the provided values:

n : (Optional) number of samples

min_n : Extreme minimum value

max_n : Extreme Maximum value

$median_n$: Median average

$Q1$: First quartile value

$Q3$: Third quartile value

```

235 \NewDocumentCommand{\FiveStats}{o mmmmm}{%
236     \begingroup
237     \tikzset{%
238         every node/.style   = {font=\footnotesize,inner sep=0pt},
239         number/.style       = {text depth=0pt},           % tidy baselines
240     }
241     %--- global layout knobs you might like to tweak -----
242     \def\Pad{3pt}          % white-space between numbers and walls
243     \def\XGap{25mm}        % distance between the L & R interior columns
244     \def\Row{1.7em}         % vertical separation between rows
245     %-----
246     \begin{tikzpicture}[baseline=(med.base)]
247         % reference x-coordinates for the two interior columns
248         \coordinate (IL) at (0,0);                 % interior-left column
249         \coordinate (IR) at (\XGap,0);             % interior-right column
250         %----- Numbers -----
251         \node[number] (med) at ($ (IL)!0.5!(IR) $) {#4};
252         \node[number,anchor=west] (q1) at ($ (IL)+(0,-\Row)$)      {#5};
253         \node[number,anchor=west] (min) at ($ (IL)+(0,-2*\Row)$) {#2};
254         \node[number,anchor=east] (q3) at ($ (IR)+(0,-\Row)$)      {#6};
255         \node[number,anchor=east] (max) at ($ (IR)+(0,-2*\Row)$) {#3};
256         \IfNoValueF{#1}{%
257             % sample size
258             \node[number,anchor=east] (n) at ($ (IL)+(-2*\Pad,-\Row)$) {$n = #1$};
259         }
260         %----- Frame -----
261         \coordinate (TL) at ($ (q1.west |- med.north) + (-\Pad,\Pad)$);
262         \coordinate (TR) at ($ (q3.east |- med.north) + (\Pad,\Pad)$);
263         \coordinate (BL) at ($ (q1.west |- min.south) + (-\Pad,-\Pad)$);
264         \coordinate (BR) at ($ (q3.east |- min.south) + (\Pad,-\Pad)$);
265         % draw: top, right, and left edges
266         \draw[cyan, line width=.4pt] (BL) -- (TL) -- (TR) -- (BR);
267     \end{tikzpicture}%
268 \endgroup
269 }

```

5.9 Probability expression

Maths mode only.

\prob \prob{*<text>*} typesets a probability statement. It allows the use of \and, \or, \bar and \not within the definition so that expressions like $\$\\prob{(Journey A \\or Journey B) \\and Bus}\\$$ may be set:
 $P((Journey A \ or \ Journey B) \ and \ Bus).$

```

270 % %%%%%%%%%%%%%%
271 %% Probabilty expression
272 % %%%%%%%%%%%%%%
273 \ExplSyntaxOn
274
275 % Main \prob command
276 \NewDocumentCommand{\prob}{m}
277 {
278     \prob_prob:n { #1 }

```

```

279 }
280
281 % Internal implementation with local keyword overrides
282 \cs_new_protected:Nn \prob_prob:n
283 {
284     \mathrm{P}\left(
285     \group_begin:
286     % Locally redefine LaTeX primitives - safely!
287     \cs_set_eq:NN \oldand \and
288     \cs_set_eq:NN \oldor \or
289     \cs_set_eq:NN \oldbar \bar
290     \cs_set_eq:NN \oldnot \not
291
292     \cs_set:Npn \and { \textit{and} }
293     \cs_set:Npn \or { \textit{or} }
294     \cs_set:Npn \bar { \mid }
295     \cs_set:Npn \not { \textit{not} }
296
297     \textit{#1}
298     \group_end:
299     \right)
300 }
301
302 \ExplSyntaxOff

```

5.10 Extra macros

```

303 %
304 %% Extra macros
305 %
306 \NewDocumentCommand{\pflag}{+}{\ensuremath{[+]}}
307 \NewDocumentCommand{\nflag}{-}{\ensuremath{[-]}}
308 \NewDocumentCommand{\ld}{\lambda}{\lambda}
309 %
310 %
311 %% End of Package ou-tma-sup
312 %
313
314 \endinput

```

6 Implementation of doc-changes

This is a ‘bonus’ file developed for looking after multiple change log files within the same package. Use at your own risk.

```

1 %% doc-changes.sty
2 %% Copyright 2025 G. I. Riley <geoffr@adaso.com>
3 %
4 % This work may be distributed and/or modified under the
5 % conditions of the LaTeX Project Public License, either version 1.3
6 % of this license or (at your option) any later version.
7 % The latest version of this license is in

```

```

8 %   http://www.latex-project.org/lppl.txt
9 % and version 1.3 or later is part of all distributions of LaTeX
10 % version 2005-12-01 or later.
11 %
12 % This work has the LPPL maintenance status 'maintained.'
13 %
14 % The Current Maintainer of this work is Geoff Riley.
15 %
16 %% This package may be freely used, especially by, but not limited to,
17 %% students, lecturers and staff of the Open University. No acknowledgement
18 %% is _required_ for using this package within the production of a _Tutor
19 %% Marked Assessment._

20 \RequirePackage{expl3}
21 \RequirePackage{doc}
22 \SetupDoc{reportchangedates}
23 \ExplSyntaxOn
24
25 %% Store State
26 \tl_new:N \g__doc_changes_target_tl
27 \seq_new:N \g__doc_changes_stack_seq
28 \prop_new:N \g__doc_changes_stream_prop
29 \bool_new:N \g__doc_changes_setup_bool
30
31 %% Remember original \glossary and install dispatcher (once)
32 \cs_new_protected:Npn \doc_changes_setup:
33 {
34     \bool_if:NF \g__doc_changes_setup_bool
35     {
36         \cs_set_eq:NN \doc_changes_glossary_orig: \glossary
37         \cs_set_protected:Npn \glossary ##1 { \doc_changes_glossary:n {##1} }
38         \bool_gset_true:N \g__doc_changes_setup_bool
39     }
40 }
41 \cs_new_eq:NN \doc_changes_glossary_orig: \scan_stop:
42
43 %% Ensure a stream exists & is open: name -> iow csname
44 \cs_new_protected:Npn \doc_changes_stream_ensure_open:n #1
45 {
46     \prop_if_in:NnF \g__doc_changes_stream_prop {#1}
47     {
48         \iow_new:c { g__doc_changes_iow_#1 }
49         \exp_args:Nc \iow_open:Nn { g__doc_changes_iow_#1 } { \jobname-#1.glo }
50         \prop_put:Nnx \g__doc_changes_stream_prop {#1} { g__doc_changes_iow_#1 }
51     }
52 }
53
54 %% Current target (no stack)
55 \cs_new_protected:Npn \doc_changes_set_target:n #1
56 {
57     \doc_changes_setup:
58     \doc_changes_stream_ensure_open:n {#1}
59     \tl_gset:Nn \g__doc_changes_target_tl {#1}
60 }
61 \cs_new_protected:Npn \doc_changes_clear_target:
62 { \tl_gclear:N \g__doc_changes_target_tl }

```

```

63
64 %% Push / Pop targets
65 \cs_new_protected:Npn \doc_changes_push_target:n #1
66 {
67     \seq_gpush:NV \g__doc_changes_stack_seq \g__doc_changes_target_tl
68     \doc_changes_set_target:n {#1}
69 }
70 \cs_new_protected:Npn \doc_changes_pop_target:
71 {
72     \seq_gpop>NN \g__doc_changes_stack_seq \l_tmpa_tl
73     \tl_if_blank:VTF \l_tmpa_tl
74     { \doc_changes_clear_target: }
75     { \tl_gset:NV \g__doc_changes_target_tl \l_tmpa_tl }
76 }
77
78 %% Declare (open) a list of streams now
79 \cs_new_protected:Npn \doc_changes_declare_streams:n #1
80 { \clist_map_inline:nn {#1} { \doc_changes_stream_ensure_open:n {##1} } }
81
82 %% Dispatcher replacing \glossary
83 \cs_new_protected:Npn \doc_changes_glossary:n #1
84 {
85     \tl_if_blank:VTF \g__doc_changes_target_tl
86     { % No active target -> pass through to original doc \glossary
87         \doc_changes_glossary_orig:{#1}
88     }
89     {
90         % Lookup iow for current target
91         \prop_get:NVN \g__doc_changes_stream_prop \g__doc_changes_target_tl \l_tmpa_tl
92         % Freeze page number now
93         \tl_set:Nx \l_tmpb_tl { \thepage }
94         % Mirror doc.sty: \protected@write<stream>{}{\string\glossaryentry{#1}{<page>}}
95         \exp_args:Nc \protected@write { \l_tmpa_tl } {} {%
96             \string\glossaryentry{#1}{\l_tmpb_tl}%
97         }%
98     }
99 }
100
101 %% Close all streams at end of document
102 \cs_new_protected:Npn \doc_changes_close_all:
103 {
104     \prop_map_inline:Nn \g__doc_changes_stream_prop
105     { \exp_args:Nc \iow_close:N {##2} }
106 }
107 \AtEndDocument{ \doc_changes_close_all: }
```

6.1 Single-column printing support for theglossary

```

108 \int_new:N \g__doc_changes_sc_depth_int
109 \cs_new_eq:NN \doc_changes_orig_theglossary_begin: \scan_stop:
110 \cs_new_eq:NN \doc_changes_orig_theglossary_end: \scan_stop:
111
112 \cs_new_protected:Npn \doc_changes_singlecolumn_begin:
113 {
114     \int_compare:nNnTF { \g__doc_changes_sc_depth_int } = { 0 }
```

```

115  {
116      % First activation: capture originals
117      \cs_if_exist:NT \theglossary { \cs_set_eq:NN \doc_changes_orig_theglossary_beg
118      \cs_if_exist:NT \endtheglossary{ \cs_set_eq:NN \doc_changes_orig_theglossary_end
119      % Install single-column 'theglossary'
120      \cs_set_protected:Npn \theglossary
121      {
122          % Minimal single-column list layout compatible with gglo.ist entries
123          \par\bigskip
124          \begingroup
125          \parindent\z@ \parskip\z@ \relax
126          % Basic index-style paragraph items:
127          \providecommand\indexspace{\par \vskip 10pt plus 2pt minus 2pt\relax}
128          \providecommand@\idxitem{\par\hangindent 40\p@}
129          \providecommand\subitem{\@idxitem\hspace*{20\p@}}
130          \providecommand\subsubitem{\@idxitem\hspace*{30\p@}}
131          \let\item@\idxitem
132      }
133      \cs_set_protected:Npn \endtheglossary
134      { \par \endgroup }
135  }
136  { } % nested activation: keep our replacement
137  \int_gincr:N \g__doc_changes_sc_depth_int
138 }
139
140 \cs_new_protected:Npn \doc_changes_singlecolumn_end:
141 {
142     \int_gdecr:N \g__doc_changes_sc_depth_int
143     \int_compare:nNnT { \g__doc_changes_sc_depth_int } = { 0 }
144     {
145         % Restore originals when last guard unwinds
146         \cs_if_eq:NNF \doc_changes_orig_theglossary_begin: \scan_stop:
147         { \cs_set_eq:NN \theglossary \doc_changes_orig_theglossary_begin: }
148         \cs_if_eq:NNF \doc_changes_orig_theglossary_end: \scan_stop:
149         { \cs_set_eq:NN \endtheglossary \doc_changes_orig_theglossary_end: }
150     }
151 }
```

6.2 Public API (document commands)

\DocChangeDeclareStream[]\DocChangeDeclareStreams: {\langle change sets\rangle} Comman separated list of change sets required.

\DocChangeSet []\DocChangeSet: {\langle change set\rangle} Set the active change set.

\DocChangeClear []\DocChangeClear: Save the current change set.

\DocChangePush []\DocChangePush: {\langle change set\rangle} Switch to the indicated change set, but remember which was active before.

\DocChangePop []\DocChangePop: Restore the previously active change set.

\DocChangeSingleColumn[]\DocChangeSingleColumnOn: Set single column glossary printing.

[]

\DocChangeSingleColumnOff[]\DocChangeSingleColumnOff: Set double column glossary printing.

[]

\DocChangePrint [] \DocChangePrint: [*title*] {*change set*} Print the change set as a glossary using the provided title.

```
152 \NewDocumentCommand \DocChangeDeclareStreams { m }
153 { \doc_changes_declare_streams:n {#1} }
154
155 \NewDocumentCommand \DocChangeSet { m } { \doc_changes_set_target:n {#1} }
156 \NewDocumentCommand \DocChangeClear { } { \doc_changes_clear_target: }
157 \NewDocumentCommand \DocChangePush { m } { \doc_changes_push_target:n {#1} }
158 \NewDocumentCommand \DocChangePop { } { \doc_changes_pop_target: }
159
160 %% Convenience: globally enable/disable single-column glossary layout
161 \NewDocumentCommand \DocChangeSingleColumnOn { } { \doc_changes_singlecolumn_begin: }
162 \NewDocumentCommand \DocChangeSingleColumnOff { } { \doc_changes_singlecolumn_end: }
163
164 %% Print helper (single-column during print)
165 \NewDocumentCommand \DocChangePrint { O{} m }
166 {
167     \par\bigskip
168     \tl_if_blank:nF {#1} { \section*{#1} }
169     \doc_changes_singlecolumn_begin:
170     \InputIfFileExists{ \jobname-#2.gls }{}{ \emph{No~changes~recorded.} }
171     \doc_changes_singlecolumn_end:
172 }
173
174 \ExplSyntaxOff
```

Changes for **ou-tma**

v1.12 – 2024-11-08

General: Standardized package name to 'tma' to make it compatible with CTAN.
 Avoided redefining standard L^AT_EX commands. Consolidated geometry settings. Adjusted loading order of packages. Improved code readability and comments. Added 'legacy' option to allow old definitions of \vec and \C. 10

v1.13 – 2024-11-16

General: Arranged for \qsubpart to go on the same line as the \qpart when there is no intervening text \qsubpart indents further than \qpart. 10

v1.14 – 2024-11-17

General: Allow replacement of Question marker tag using \setquestionstring.
 References with cleveref not working. Replaced my attempts at keeping \qpart and \qsubpart on the same line with Steve Mayers contribution. 10

v1.15 – 2024-11-21

General: Define \setdate and \thedate to allow the header date to be used within the document, eg header and footer. 10

v1.16 – 2024-11-22

General: Added File Properties to pdf files using the hyperref setup system when in pdfbookmark mode. 10

v1.17 – 2025-02-13

General: Rewritten with L^AT_EX3 syntax from the 'xpars' package to make commands less fragile. Finally, I got the alignment of part and subpart numbering to line up correctly. 10

v1.18 – 2025-02-16

General: PDF metadata doesn't set correctly so I have removed it: the cause is an incompatibility between L^AT_EX unicode and the PDF restricted character allowance. 10

v1.19 – 2025-02-18

General: PDF metadata (apparently) was solved with help from Steve Mayers; all down to the use of commands as string containers. New (L^AT_EX3) commands are robust and fail to expand within the context of the metadata and bookmarks; old (L^AT_EX2e) commands are fragile and correctly expanded. I have a mix of old commands and new variables now. 10

v1.20 – 2025-04-07

General: Package name changed from 'tma' to 'ou-tma' to become a little more descriptive and to abide by the minimum package name length suggested by CTAN. 10

v1.21 – 2025-09-30

General: Documentation error spotted and corrected in very first example. A couple of other occurrences also corrected in less conspicuous places. . . . 3

v1.21.1 – 2025-10-10

General: Adjustment of kerning in \perm suggested by Peter Osment . . . 19
 Typo notified just after previous errors corrected. Minor error in \setquestionstring instead of \setquestionstring. 4

v1.21.2 – 2025-10-28

General: Added alignment variation for question string, suggested by Bruce

Ramsey.	4, 12, 18
v1.21.3 – 2025-11-12	
General: Experimental extention to theorem code allowing a name to override the given number, and for an automatic label to be applied using the name.	20

Changes for **ou-tma-sup**

v0.12 – 2025-10-28

General: Added \FiveStats for setting statistic summaries	29
Added \Pounds for setting Pound Sterling	29
Added \prob for setting probability texts	30
Added \qsubparte to allow a suffix on a question subpart	25
Added \tmadp and \tmasf for setting d.p. and s.f. texts	26
Added TikZ styles for solid and hollow dots used in inclusive and exclusive number lines	24
Added shortcut \ld for \lambda.	31
Added shortcuts for plus and minus flags used in sign tables.	31

Changes for **doc-changes**

0.3 – 2025-11-13

General: Documenting Public API	34
---	----

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