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

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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.

Contents

*This document corresponds to ou-tma v1.21.5, dated 2025-11-19, and ou-tma-sup v0.13, dated 2025-11-19.

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 (extract the `.sty` files):

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/ou-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 LATEX document:

```
\documentclass[a4paper,11pt]{article}
\usepackage[⟨options⟩]{ou-tma}
```

```
\usepackage{ou-tma-sup}     % if required
⋮
\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*) [package options]
: `alph:` (default) question numbering as 1(b)(iii);

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

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

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

`legacy` (*Opt*) [package options]
: `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.

`\myname` [header]
: The most essential part of an assignment is to identify who it has been written by 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 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.

`\mypin` [header]

Once the personal identification has been done, the module being worked needs to
\mycourse [header] be declared, the course code of your module should be given with the \mycourse
\mytma [header] macro and the number of the assignment using the \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
\setdate [header] be displayed on the compiled document title page; you may 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.*) [question] 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 [question] \setquestionstring[⟨*alignment*⟩]{⟨*required question number introduction*⟩}. By setting *alignment* to 'l' 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 [question] 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 [question] 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.

Infrequetly, there may arise the need for alternative questioning paths. This is most frequetly 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 with be a question line '1' and a question
\qsubparte [question] line '2', to accomodate these the \qsubparte 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, \qsubpart and \qsubparte are all macros that lay down markers in the margin, and are designed to be used within the question environment 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 \e \ii **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 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.

Note

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

*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.

Example 1: Differential

Code:

```
In display mode, compare \dd\ with $d$:
\[
\frac{\dd^2 y}{\dd x^2} + x\frac{\dd y}{\dd x} + y = 2\sin(x)\\
\]
and in line mode $\e^{\ii x} = \cos(x) + \ii\sin(x)$
```

Result:

In display mode, compare d with d:

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

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:` $\mathbb{N}$ represents all natural numbers;

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

\vect \ve **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
$\vect{AB}$ has a gradient of $\frac{8-3}{-4-6} =
\frac{5}{-10} = -\frac{1}{2}$
The standard unit vectors are \ve{i} and \ve{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 $\overrightarrow{AB}$ 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 \nd \rd \nth **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.

So the standard four English ordinals are provided `\st`, `\nd`, `\rd`, and `\nth`, e.g. 1^{st}, 2^{nd}, 3^{rd}, and 4^{th}.

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).

Combinatoral notations There are two combinatoral 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 were order matters.

\comb `\comb: {⟨n⟩}{⟨r⟩}`. This is equivelent to

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

\perm `\perm: {⟨n⟩}{⟨r⟩}`. This is equivalent to

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

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:` $\mapsto \operatorname{Ker}$

\Orb `\Orb:` $\mapsto \operatorname{Orb}$

\Stab `\Stab:` $\mapsto \operatorname{Stab}$

\Fix `\Fix:` $\mapsto \operatorname{Fix}$

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

\deriv `\deriv: {⟨y⟩}{⟨x⟩}` $\mapsto \frac{\mathrm{d}y}{\mathrm{d}x}$

\pderiv `\pderiv: {⟨y⟩}{⟨x⟩}` $\mapsto \frac{\partial y}{\partial x}$

\psderiv `\psderiv: {⟨y⟩}{⟨x⟩}{⟨z⟩}` $\mapsto \frac{\partial^2 y}{\partial x \partial z}$

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

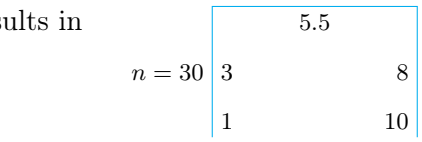
\rect `\rect:` `\rect`, $\square$, is defined particularly for the use of M208 people although others may find it useful.

\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. *This is an ou-tma-sup macro.*

\Pounds `\Pounds: {⟨value⟩}` `\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. *This is an ou-tma-sup macro.*

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

`\FiveStats` `[`⟨*n*⟩`]{`⟨*min*⟩`}{`⟨*max*⟩`}{`⟨*median*⟩`}{`⟨*Q1*⟩`}{`⟨*Q3*⟩`}` `\FiveStats` uses Ti*k*Z to 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` [legacy] `\C:` is the original version of `\Complex`

`\vec` [legacy] `\vec:` is the original version of `\vect`

Theorem and Lemma When setting Theorem and Lemma it is normal to number them for referencing. However, there are also occasions that require 'named' statements.

`Theorem` (*env.*) `Theorem:` `[`⟨*title*⟩`]` If no title is provided then an automatically incrementing counter will be added after the word `Theorem`, however, if a title is provided then that will be inserted after the word `Theorem` when output and a reference label automatically generated in the form `thm:`⟨`title`⟩.

Theorem 1. *Without a title, a theory is just numbered. If a reference label is required, then it must be applied using the normal* `\label` *tag.*

Theorem with a title. *With a title, a theory becomes multi-talented. It is viewed as something special, so it automatcially gets a label created, in this case it would be* `thm:with-a-title`*.*

Theorem 2. *A further theorem can easily reference back to a previous labelled theorem with 'see Theorem with a title on page 9'.*

`Lemma` (*env.*) `Lemma:` `[`⟨*title*⟩`]` In exactly the same way as the `Theorem` environment above is used, so is the `Lemma` environment.

Similar environments may be created by using the command

`NewTheoremWithAutoLabel` `\NewTheoremWithAutoLabel{`⟨*class*⟩`}{`⟨*base*⟩`}[`⟨*wrapper*⟩`][`⟨*prefix*⟩`]`

Where:

`class` (*Arg*) [newtheorem] `class`: The name of the class of entities this will be used as the main title of the output

`base` (*Arg*) [newtheorem] `base`: The base name of the underlying amsthm counter. If two or more classes share the same base, they will also share the same counter.

`wrapper` (*Arg*) [newtheorem] `wrapper`: Optional. The wrapper is the name of the outer environment that will provide the first part of the count number. The default value is `section`,

but it could be `chapter` or even blank if the requirement is for a single value counter.

`prefix` (*Arg*) [newtheorem]

`prefix`: The prefix is a short character sequence used when creating the automatic labels for titled environments. It is usually a three or four character string. For example, the `Theory` environment uses 'thm' and the `Lemma` environment uses 'lem'.

Example:
`\NewTheoremWithAutoLabel{Corollary}{corollary}[][cor]`

Corollary 1. *A Corollary!*

4 Implementation of ou-tma

<@@=tma>

```
%% ou-tma.sty
%% Copyright 2025 G. I. Riley <geoffr@adaso.com>
%
% This work may be distributed and/or modified under the
% conditions of the LaTeX Project Public License, either version 1.3
% of this license or (at your option) any later version.
% The latest version of this license is in
%   http://www.latex-project.org/lppl.txt
% and version 1.3 or later is part of all distributions of LaTeX
% version 2005-12-01 or later.
%
% This work has the LPPL maintenance status 'maintained.'
%
% The Current Maintainer of this work is Geoff Riley.
%
%% This package may be freely used, especially by, but not limited to,
%% students, lecturers and staff of the Open University. It was created
%% by the efforts of many who are now or have been connected with the
%% Open University Students Association. No acknowledgement is
%% _required_ for using this package within the production of a _Tutor
%% 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 LaTeX3 extensions are loaded. Most modern versions of the LaTeX core have this rolled in as standard, but as a belt and braces approach, inclusion here does no harm.

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

4.1 Package Initialisation

We are starting off using the `\ExplSyntaxOn` command to enable the LaTeX3 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_@@_constant_name` (*Var*)
`g_@@_constant_name:` holds the students personal name

`g_@@_constant_tma` (*Var*)
`g_@@_constant_tma:` holds the number of the TMA being answered

`g_@@_constant_course` (*Var*)
`g_@@_constant_course:` holds the OU course code for the module being studied

`g_@@_constant_pin` (*Var*)
`g_@@_constant_pin:` holds the students personal identification number

`g_@@_constant_thedate` (*Var*)
`g_@@_constant_thedate:` holds the date to be printed on the front page of the TMA

```
% %%%%%%%%%%%%%%%%%%%%%%%%%%%
%% Package Initialization
% %%%%%%%%%%%%%%%%%%%%%%%%%%%
\ExplSyntaxOn
\tl_new:N \g_@@_constant_name
\tl_new:N \g_@@_constant_tma
\tl_new:N \g_@@_constant_course
\tl_new:N \g_@@_constant_pin
\tl_new:N \g_@@_constant_thedate
```

These 'constants' are given initial generic values.

```
\tl_gset:Nn \g_@@_constant_name {name}
\tl_gset:Nn \g_@@_constant_tma {tma}
\tl_gset:Nn \g_@@_constant_course {course}
\tl_gset:Nn \g_@@_constant_pin {pin}
\tl_gset:Nn \g_@@_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

```
\newcommand{\name}{\g_@@_constant_name}
\newcommand{\tma}{\g_@@_constant_tma}
\newcommand{\course}{\g_@@_constant_course}
\newcommand{\pin}{\g_@@_constant_pin}
\newcommand{\thedate}{\g_@@_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 unpredicable.

`\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

```
\NewDocumentCommand{\myname}{m}{%
 \tl_gset:Nn \g_@@_constant_name{#1}}
\NewDocumentCommand{\mytma}{m}{%
 \tl_gset:Nn \g_@@_constant_tma{#1}}
\NewDocumentCommand{\mycourse}{m}{%
 \tl_gset:Nn \g_@@_constant_course{#1}}
\NewDocumentCommand{\mypin}{m}{%
 \tl_gset:Nn \g_@@_constant_pin{#1}}
\NewDocumentCommand{\setdate}{m}{%
 \date{#1}\tl_gset:Nn \g_@@_constant_thedate{#1}}
```

That's the end of the LaTeX3 extensions requiring the extension switch, so it can be turned off.

```
\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.

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

In order to allow the question introduction string to be modified, a general LaTeX 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

```
\NewDocumentCommand{\tma@questionalignment}{}{r}
\NewDocumentCommand{\tma@questionstring}{}{\relax}
\NewDocumentCommand{\setquestionstring}{O{r} m}{%
    \RenewDocumentCommand{\tma@questionalignment}{}{#1}%
    \RenewDocumentCommand{\tma@questionstring}{}{#2}%
}
```

Set the default date to 'today'.

```
\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.

```
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% Package Loading
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

\RequirePackage{amsmath}
\RequirePackage{amssymb}
\RequirePackage{amsthm}
\RequirePackage{wasysym}
\RequirePackage{bm}
\RequirePackage{upgreek}
\RequirePackage{graphicx}
\RequirePackage{lastpage}
\RequirePackage{xifthen}
\RequirePackage{verbatim}
\RequirePackage{fancyhdr}
\RequirePackage{geometry}
\RequirePackage{calc}
\RequirePackage{etoolbox}
\RequirePackage[UKenglish]{isodate} % use UK format for date
\cleanlookdateon % remove th,st, rd from date

```

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.

```
% ################################
%% Geometry Settings
% ################################

\geometry{
  headheight=10mm,
  headsep=5mm,
  bottom=25mm,
  footskip=15mm,
  left=30mm,
  right=30mm,
  marginparwidth=0mm,
  marginparsep=0mm,
  includemp
}
```

4.4 Margin Notes

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

`\marginnotes`
`\marginnote`

```
% ################################
%% Margin Notes
% ################################

\NewDocumentCommand{\marginnote}{m}{\marginpar{#1}}
\NewDocumentCommand{\marginnotes}{}{
  \geometry{
    marginparwidth=40mm,
    marginparsep=5mm,
    left=20mm,
    right=15mm
  }
}
```

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.

```
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% Question Numbering
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%

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

The question number is set to print as arabic digits,

```
\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 (*bool*) **tma@usepdfbookmark:** 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`.

```
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% Option Handling
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Define boolean flags
\newif\iftma@roman
\newif\iftma@usecleveref
\newif\iftma@usepdfbookmark
\newif\iftma@legacy

% Set default options
\tma@romanfalse          % Default numbering is 'alph'
\tma@usecleverefffalse   % Default is not to use cleveref
\tma@usepdfbookmarkfalse % Default is not to use pdfbookmark
\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.

```
% Define commands with default values
\renewcommand{\theqpart}{\alph{qpart}}
\renewcommand{\theqsubpart}{\roman{qsubpart}}
\NewDocumentCommand{\tma@crefname}{mmm}{\relax}
\NewDocumentCommand{\tma@stepcounter}{m}{\stepcounter{#1}}
\NewDocumentCommand{\tma@bookmark}{O{0}mm}{\relax}
\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.

```
% Declare options
\DeclareOption{roman}{%
 \tma@romantrue%
}
\DeclareOption{alph}{%
 \tma@romanfalse%
}
\DeclareOption{cleveref}{%
 \tma@usecleverefttrue%
}
\DeclareOption{pdfbookmark}{%
 \tma@usepdfbookmarktrue%
}
\DeclareOption{legacy}{%
 \tma@legacytrue%
}
\DeclareOption*{%
 \PackageWarning{ou-tma}{Unknown option ‘\CurrentOption’}%
}
```

Go ahead, process those options!

```
% Process options
\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.

```
\typeout{********** OPTION RESULTS **********}
\iftma@usepdfbookmark
\typeout{pdfbookmark is TRUE}
\else
\typeout{pdfbookmark is FALSE}
\fi
\iftma@roman
\typeout{roman is TRUE}
\else
\typeout{roman is FALSE}
\fi
\iftma@usecleveref
\typeout{cleveref is TRUE}
\else
\typeout{cleveref is FALSE}
\fi
\iftma@legacy
\typeout{legacy is TRUE}
\else
\typeout{legacy is FALSE}
\fi
\typeout{********** END OPTION RESULTS **********}
```

4.8 Package adjustments based on Options

```
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% Set Up Package Based on Options
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%

% Set question numbering
\iftma@roman
\renewcommand{\theqpart}{\roman{qpart}}
\renewcommand{\theqsubpart}{\alph{qsubpart}}
\else
\renewcommand{\theqpart}{\alph{qpart}}
\renewcommand{\theqsubpart}{\roman{qsubpart}}
\fi
% Load hyperref if necessary
\iftma@usepdfbookmark
\AtBeginDocument{%
 \hypersetup{%
  colorlinks=true,%
  linkcolor=blue,%
  urlcolor=blue,%
  pdfstartview=FitH,%
  pdftitle={TMA~\tma}, %
  pdfauthor={\name~\textemdash~\pin}, %
  pdfkeywords={OUCU:~\pin, TMA~\tma}, %
  pdfsubject=\course%
```

```
 }%
}
\RequirePackage[hyperindex=false,pdfencoding=unicode,psdextra]{hyperref}
\fi

% Load cleveref if necessary
\iftma@usecleveref
% Ensure hyperref is loaded before cleveref
\@ifpackageloaded{hyperref}%
{}%
{\RequirePackage[hyperindex=false,pdfencoding=unicode,psdextra]{hyperref}}
\RequirePackage{cleveref}
% Redefine commands for cleveref
\RenewDocumentCommand{\tma@crefname}{mmm}{\crefname{#1}{#2}{#3}}
\RenewDocumentCommand{\tma@stepcounter}{m}{\refstepcounter{#1}}
\fi

% Redefine commands for pdfbookmark
\iftma@usepdfbookmark
\RenewDocumentCommand{\tma@pageref}{m}{\pageref*{#1}}
\RenewDocumentCommand{\tma@bookmark}{O{0} +m +m}{%
 \pdfbookmark[#1]{#2}{#3}%
}
\fi

\setquestionstring{Q}
```

4.9 Question Environment

```
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% Question Environment
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%

% Set up cref names if cleveref is used
\iftma@usecleveref
\tma@crefname{question}{question}{questions}
\tma@crefname{qpart}{part}{parts}
\tma@crefname{qsubpart}{section}{sections}
\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.

```
\NewDocumentEnvironment{question}{O{0}}{%
 \ifthenelse{#1>0}{\setcounter{question}{#1-1}}{\relax}%
 \tma@stepcounter{question}%
 \tma@bookmark{Question \thequestion}%
  {question\thequestion}%
 \makebox[0em][\tma@questionalignment]{\large{\tma@questionstring~\thequestion%
        \hspace{0.3em}}}\par%
}{%
 \par \vspace{3em}%
}

```

```
\NewDocumentCommand{\qpart}{O{0}}{%
 \ifthenelse{#1>0}{\setcounter{qpart}{#1-1}}{\relax}%
 \tma@stepcounter{qpart}%
 \tma@bookmark[1]{\thequestion.\theqpart}%
  {qpart.\thequestion.\theqpart}%
 \par%
 \makebox[0pt][r]{\large{(\theqpart)\hspace{1.5em} }}%
}

\NewDocumentCommand{\qsubpart}{O{0}}{%
 \ifthenelse{#1>0}{\setcounter{qsubpart}{#1-1}}{\relax}%
 \tma@stepcounter{qsubpart}%
 \tma@bookmark[2]{\thequestion.\theqpart.\theqsubpart}%
  {qsubpart.\thequestion.\theqpart.\theqsubpart}%
 \ifthenelse{\value{qsubpart}>1}%
 {\par}{}%
 \hspace{-2em}\makebox[2em][l]{\large{(\theqsubpart)}}%
}
```

4.10 Mathematical commands

```
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% Mathematical Commands
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%

%% Differential Operators
\NewDocumentCommand{\dd}{}{\ensuremath{\mathop{}\!\mathrm{d}}}
\NewDocumentCommand{\e}{}{\ensuremath{\mathrm{e}}}
\NewDocumentCommand{\ii}{}{\ensuremath{\mathrm{i}}}

%% Number Sets
\NewDocumentCommand{\N}{}{\ensuremath{\mathbb{N}}}
\NewDocumentCommand{\Z}{}{\ensuremath{\mathbb{Z}}}
\NewDocumentCommand{\Q}{}{\ensuremath{\mathbb{Q}}}
\NewDocumentCommand{\R}{}{\ensuremath{\mathbb{R}}}
\NewDocumentCommand{\Complex}{}{%
 \ensuremath{\mathbb{C}}} % Changed from \C to \Complex
\NewDocumentCommand{\Rr}{}{\ensuremath{\mathcal{R}}}

%% Vector Notation
\NewDocumentCommand{\vect}{m}{%
 \ensuremath{\overrightarrow{#1}}} % Changed from \vec to \vect
\NewDocumentCommand{\ve}{m}{\ensuremath{\textbf{#1}}}

%% Ordinal Indicators
\NewDocumentCommand{\st}{}{\textsuperscript{st}}
\NewDocumentCommand{\nd}{}{\textsuperscript{nd}}
\NewDocumentCommand{\rd}{}{\textsuperscript{rd}}
\NewDocumentCommand{\nth}{}{\textsuperscript{th}}

%% Additional Symbols
\NewDocumentCommand{\rect}{}{\ensuremath{\sqsubset\!\!\sqsupset}}

%% Combinatorial Notations
\NewDocumentCommand{\comb}{mm}{\ensuremath{{}^{#1}C_{#2}}}
```

```
\NewDocumentCommand{\perm}{mm}{\ensuremath{{}^{#1}\!P_{#2}}}

%% Mathematical Operators
\DeclareMathOperator{\re}{Re}
\DeclareMathOperator{\im}{Im}
\DeclareMathOperator{\Log}{Log}
\DeclareMathOperator{\Arg}{Arg}
\DeclareMathOperator{\Wnd}{Wnd}
\DeclareMathOperator{\Res}{Res}
\DeclareMathOperator{\Ker}{Ker}
\DeclareMathOperator{\Orb}{Orb}
\DeclareMathOperator{\Stab}{Stab}
\DeclareMathOperator{\Fix}{Fix}

%% Derivatives
\NewDocumentCommand{\deriv}{mm}{%
 \frac{\dd{}#1}{\dd{}#2}}
\NewDocumentCommand{\pderiv}{mm}{%
 \frac{\partial #1}{\partial #2}}
\NewDocumentCommand{\psderiv}{mmm}{%
 \frac{\partial^2 #1}{\partial #2 \partial #3}}

% Legacy Definitions
\iftma@legacy
% Redefine \vec to old definition
\RenewDocumentCommand{\vec}{m}{\ensuremath{\overrightarrow{#1}}}
% Redefine \C to old definition
\ProvideDocumentCommand{\C}{}{\ensuremath{\mathbb{C}}}
\RenewDocumentCommand{\C}{}{\ensuremath{\mathbb{C}}}
\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`.

```
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% Theorem Environment
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%
\@ifpackageloaded{hyperref}%
{}%
{\RequirePackage[hyperindex=false,pdfencoding=unicode,psdextra]{hyperref}}
\RequirePackage{cleveref}
\ExplSyntaxOn
% Declare global variables to store the sanitised tag
\tl_new:N \g_sanitise_tag_tl
\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-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*) [NewTheoremAL]
`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*) [NewTheoremAL]
`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*) [NewTheoremAL]
`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*) [NewTheoremAL]
`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]
```

```
% Theorem factory
\NewDocumentCommand{\NewTheoremWithAutoLabel}{m m O{section} O{#2}}
{
    \newtheorem{#2}{#1}[#3]
    % Define the wrapper environment
    \NewDocumentEnvironment{#1}{O{\NOTAG}}{
        % Save the original version of \the<counter>
        \expandafter\let\csname tma@orig@the#2\expandafter\endcsname
            \csname the#2\endcsname
        \ifstrequal{##1}{\NOTAG}{
            % No tag: use standard numbering
            \csname #2\endcsname%
        }{
            % Tag provided: use the tag and suppress numbering
            \addtocounter{#2}{-1}
            \expandafter\renewcommand\csname the#2\endcsname{##1}
            \SanitiseTag{##1}
            \edef\@auto@label{\ConcatSanitisedTag{#4}}
            \csname #2\endcsname%
            \label{\@auto@label}
        }
    }{
    }
}
\NewTheoremWithAutoLabel{Lemma}{lemma}[][lem]
\NewTheoremWithAutoLabel{Theorem}{theorem}[][thm]
% Define \blacksmiley without loading wasysym
\ProvideDocumentCommand{\blacksmiley}{}{%
 \ensuremath{\unicode{263B}}} % Unicode for blacksmiley emoji
\RenewDocumentCommand{\qedsymbol}{}{\blacksmiley}
```

4.12 Miscellaneous Settings

```
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% Miscellaneous Settings
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%

\RenewDocumentCommand{\thefootnote}{}{\fnsymbol{footnote}}
\numberwithin{equation}{question}
\setlength{\parindent}{0pt}
\setlength{\parskip}{2ex plus 0.3ex minus 0.2ex}
```

4.13 Header and Footer Settings

```
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% Header and Footer Settings
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%

\pagestyle{fancy}
\fancyhf{} % Clear all headers and footers
\fancyhead[L]{\textrm{\name\ \pin}}
\fancyhead[C]{\textrm{\course\ TMA-\tma}}
```

```
\fancyhead[R]{\textrm{Page \thepage\ of \tma@pageref{LastPage}}}
\RenewDocumentCommand{\headrulewidth}{}{0pt} % Remove header rule

% %%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% End of Package ou-tma
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%
%\endinput
```

<@@=tmasup>

5 Implementation of ou-tma-sup

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

This is the OU TMA supplementary file. It's 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.

```
% \RequirePackage{expl3} % Automatically loaded with the \ProvidesExplPackage
\RequirePackage{ou-tma} % main ou-tma package
\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*) [rounding] : 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*) [rounding] : 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 {`⟨*amount*⟩`}`: 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 Ti*k*Z.

`n` (*Arg*) [fivestats] `n:` : (Optional) number of samples

`min` (*Arg*) [fivestats] `min:` : Extreme minimum value

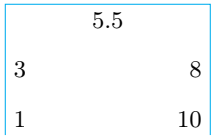
`max` (*Arg*) [fivestats] `max:` : Extreme Maximum value

`median` (*Arg*) [fivestats] `median:` : Median average

`Q1` (*Arg*) [fivestats] `Q1:` : First quartile value

`Q3` (*Arg*) [fivestats] `Q3:` : Third quartile value

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



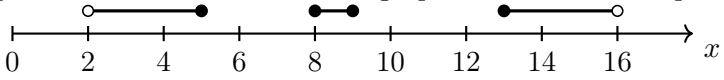
5.3 Package Initialisation

```
\ExplSyntaxOff
\RequirePackage{amsmath}
\RequirePackage{ifthen}

\RequirePackage{siunitx}
\sisetup{per-mode = symbol}
\sisetup{uncertainty-mode = separate}

\RequirePackage{tikz}
\RequirePackage{pgfplots}
\pgfplotsset{compat=1.18}
\usepgfplotslibrary[units]
\usetikzlibrary{angles,
    quotes,
    calc,
    arrows.meta,
    positioning,
    decorations.markings}
```

5.4 TikZ styles for solid and hollow dots

```
% ##############################
%% TikZ styles for solid and hollow dots
% ##############################
```

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




```
\tikzset{
    soliddot/.style={
        fill=black,
        draw=black,
        circle,
        minimum size=4pt,
        inner sep=0pt,
    },
    hollowdot/.style={
        fill=white,
        draw=black,
        circle,
        line width=0.6pt,
        minimum size=4pt,
        inner sep=0pt,
    },
}
```

5.5 Question subpart with extention

```
% ##############################
%% Question subpart with extention
% ##############################
```

Make a question subpart with an extension, eg: Q1.a.i-1
Usage:
`\qsubparte[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.

```
\NewDocumentCommand{\qsubparte}{O{0}m}{
    {
        \iftma@roman
            \renewcommand{\theqsubpart}{\alph{qsubpart}-#2}
        \else
            \renewcommand{\theqsubpart}{\roman{qsubpart}-#2}
        \fi
        \qsubpart[#1]
```

```
    }
}
```

`\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

```
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% Decimal places and significant figures
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%

\ExplSyntaxOn

\tl_if_exist:NF \l__@@_style_tl { \tl_new:N \l__@@_style_tl }
\tl_if_exist:NF \l__@@_label_style_tl { \tl_new:N \l__@@_label_style_tl }

\keys_define:nn { tma }
{
    style .choice:,
    style / to      .code:n = { \tl_set:Nn \l__@@_style_tl { to } },
    style / bracket .code:n = { \tl_set:Nn \l__@@_style_tl { bracket } },
    style           .initial:n = to,

    labels .choice:,
    labels / words  .code:n = { \tl_set:Nn \l__@@_label_style_tl { words } },
    labels / long   .code:n = { \tl_set:Nn \l__@@_label_style_tl { long } },
    labels / abbr   .code:n = { \tl_set:Nn \l__@@_label_style_tl { abbr } },
    labels / short  .code:n = { \tl_set:Nn \l__@@_label_style_tl { abbr } },
    labels / dp-sf  .code:n = { \tl_set:Nn \l__@@_label_style_tl { abbr } },
    labels          .initial:n = abbr,
}
```

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 `\@@_format:nnnn` routine: mode (`dp` or `sf`)

```
%% Public commands
\NewDocumentCommand{\tmadp}{O{}mO{}}{ \@@_format:nnnn {#1}{#2}{#3}{dp} }
\NewDocumentCommand{\tmasf}{O{}mO{}}{ \@@_format:nnnn {#1}{#2}{#3}{sf} }
% Entry point: parse style and data
\cs_new_protected:Nn \@@_format:nnnn
{
    \keys_set:nn { tma } {#1}
    \@@_parse:nnn {#2}{#3}{#4}
}
% Parse 2- or 3-item list
\cs_new_protected:Nn \@@_parse:nnn
{
    \clist_set:Nn \l_tmpa_clist {#1}
    \int_case:nnF { \clist_count:N \l_tmpa_clist }
    {
        {2}{
            \@@_format_single:nnnn
            { \clist_item:Nn \l_tmpa_clist {1} }
            { \clist_item:Nn \l_tmpa_clist {2} }
            {#2} % unit
            {#3} % mode
        }
        {3}{
            \@@_format_range:nnnnn
            { \clist_item:Nn \l_tmpa_clist {1} }
            { \clist_item:Nn \l_tmpa_clist {2} }
            { \clist_item:Nn \l_tmpa_clist {3} }
            {#2} % unit
            {#3} % mode
        }
    }
    { \textbf{Error: expected 2 or 3 comma-separated values.} }
}
% Single number (optional unit)
\cs_new_protected:Nn \@@_format_single:nnnn
{
    \@@_with_rounding:nnn {#4}{#2}
    {
        \tl_if_blank:nTF {#3}
        { \num{#1} }
        { \qty{#1}{#3} }
        \text{~(to~#2~\@@_mode_label:nn {#4}{\l__@@_label_style_tl})}
    }
}
% Range (optional unit) with style switch
\cs_new_protected:Nn \@@_format_range:nnnnn
{
    % no unit
    \tl_if_blank:nTF {#4}
    {
        \tl_if_eq:NnTF \l__@@_style_tl { bracket }
        { \@@_output_bracketed_range:nnnnn {#1}{#2}{#3}{#4}{#5} }
        {
            \@@_with_rounding:nnn {#5}{#3}
            { \num{#1}\text{~to~}\num{#2} }
        }
```

```
    }
    { % with unit
        \tl_if_eq:NnTF \l__@@_style_tl { bracket }
        { \@@_output_bracketed_range:nnnnn {#1}{#2}{#3}{#4}{#5} }
        {
            \@@_with_rounding:nnn {#5}{#3}
            { \SIrange{#1}{#2}{#4} }
        }
    }
}
% Core: locally apply siunitx rounding then typeset #3
%   #1 = mode code dp/sf/off, #2 = precision, #3 = content
\cs_new_protected:Nn \@@_with_rounding:nnn
{
    \group_begin:
    \exp_args:Nx \sisetup
    { round-mode=\@@_mode_map:n {#1}, round-precision=\int_eval:n {#2} }
    #3
    \group_end:
}
% Bracketed style output; handles math/text mode parens
\cs_new_protected:Nn \@@_output_bracketed_range:nnnnn
{
    \@@_with_rounding:nnn {#5}{#3}
    {
        \mode_if_math:TF
        {
            ( \qty{#1}{#4},~\qty{#2}{#4} )
            \text{~(to~#3~\@@_mode_label:nn {#5}{\l__@@_label_style_tl})}
        }
        {
            \text{(}\qty{#1}{#4},~\qty{#2}{#4}\text{)}
            \text{~(to~#3~\@@_mode_label:nn {#5}{\l__@@_label_style_tl})}
        }
    }
}
% Mapping + label text
\cs_new:Npn \@@_mode_map:n #1
{
    \str_case:nnF {#1}
    { {dp}{places} {sf}{figures} {off}{off} }
    { places }
}
\cs_new:Npn \@@_mode_label:nn #1#2
{
    \str_case:nnF {#2}
    {
        {words}{ \@@_label_words:n {#1} }
        {long} { \@@_label_long:n  {#1} }
        {abbr} { \@@_label_abbr:n  {#1} }
    }
    { \@@_label_abbr:n {#1} }
}
\cs_new:Npn \@@_label_words:n #1
{
    \str_case:nnF {#1} { {dp}{places} {sf}{figures} {off}{off} } {places}
```

```
}

\cs_new:Npn \@@_label_long:n #1
{
    \str_case:nnF {#1}
    { {dp}{decimal~places} {sf}{significant~figures} {off}{off} }
    { decimal~places }
}
\cs_new:Npn \@@_label_abbr:n #1
{
    \str_case:nnF {#1} { {dp}{dp} {sf}{sf} {off}{off} } { dp }
}
\ExplSyntaxOff
```

5.7 Pound Sterling printing

```
% ********************************
%% Pound Sterling value
% ********************************

\NewDocumentCommand{\Pounds}{m}{%
    \pounds\,\num[round-precision=2,round-mode=places]{#1}%
}
```

5.8 Five value statistics summary

```
% ********************************
%% Five value statistical summary diagram
% ********************************
```

`\FiveStats[`⟨n⟩`]{`⟨min_n⟩`}{`⟨max_n⟩`}{`⟨$median_n$⟩`}{`⟨$Q1$⟩`}{`⟨$Q3$⟩`}` 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

```
\NewDocumentCommand{\FiveStats}{o mmmmm}{%
    \begingroup
    \tikzset{
        every node/.style   = {font=\footnotesize,inner sep=0pt},
        number/.style       = {text depth=0pt},      % tidy baselines
    }
    %--- global layout knobs you might like to tweak --------
    \def\Pad   {3pt}        % white-space between numbers and walls
```

```
    \def\XGap  {25mm}       % distance between the L & R interior columns
    \def\Row   {1.7em}      % vertical separation between rows
    %-------------------------------------------------------
    \begin{tikzpicture}[baseline=(med.base)]
        % reference x-coordinates for the two interior columns
        \coordinate (IL) at (0,0);          % interior-left column
        \coordinate (IR) at (\XGap,0);      % interior-right column
        %---------------- Numbers -----------------
        \node[number] (med)  at ($ (IL)!0.5!(IR) $) {#4};
        \node[number,anchor=west] (q1)  at ($(IL)+(0,-\Row)$)       {#5};
        \node[number,anchor=west] (min) at ($(IL)+(0,-2*\Row)$)     {#2};
        \node[number,anchor=east] (q3)  at ($(IR)+(0,-\Row)$)       {#6};
        \node[number,anchor=east] (max) at ($(IR)+(0,-2*\Row)$)     {#3};
        \IfNoValueF{#1}{
            % sample size
            \node[number,anchor=east] (n) at ($(IL)+(-2*\Pad,-\Row)$) {$n = #1$};
        }
        %---------------- Frame -------------------
        \coordinate (TL) at ($(q1.west |- med.north)  + (-\Pad,\Pad)$);
        \coordinate (TR) at ($(q3.east |- med.north)  + ( \Pad,\Pad)$);
        \coordinate (BL) at ($(q1.west |- min.south) + (-\Pad,-\Pad)$);
        \coordinate (BR) at ($(q3.east |- min.south) + ( \Pad,-\Pad)$);
        % draw: top, right, and left edges
        \draw[cyan, line width=.4pt] (BL) -- (TL) -- (TR) -- (BR);
    \end{tikzpicture}%
    \endgroup
}
```

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).

```
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% Probabilty expression
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%
\ExplSyntaxOn

% Main \prob command
\NewDocumentCommand{\prob}{m}
{
    \prob_prob:n { #1 }
}

% Internal implementation with local keyword overrides
\cs_new_protected:Nn \prob_prob:n
{
    \mathrm{P}\left(
    \group_begin:
    % Locally redefine LaTeX primitives - safely!
```

```
    \cs_set_eq:NN \oldand \and
    \cs_set_eq:NN \oldor \or
    \cs_set_eq:NN \oldbar \bar
    \cs_set_eq:NN \oldnot \not

    \cs_set:Npn \and { \;\textit{and}\; }
    \cs_set:Npn \or  { \;\textit{or}\; }
    \cs_set:Npn \bar { \mid }
    \cs_set:Npn \not { \textit{not}\; }

    \text{#1}
    \group_end:
    \right)
}

\ExplSyntaxOff
```

5.10 Extra macros

```
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% Extra macros
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
\NewDocumentCommand{\pflag}{}{\ensuremath{[+]}}
\NewDocumentCommand{\nflag}{}{\ensuremath{[-]}}
\NewDocumentCommand{\ld}{}{\ensuremath{\lambda}}

% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% End of Package ou-tma-sup
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

%\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.

<@@=dchg>

```
%% doc-changes.sty
%% Copyright 2025 G. I. Riley <geoffr@adaso.com>
%
% This work may be distributed and/or modified under the
% conditions of the LaTeX Project Public License, either version 1.3
% of this license or (at your option) any later version.
% The latest version of this license is in
%   http://www.latex-project.org/lppl.txt
% and version 1.3 or later is part of all distributions of LaTeX
% version 2005-12-01 or later.
%
% This work has the LPPL maintenance status 'maintained.'
%
% The Current Maintainer of this work is Geoff Riley.
```

```
%
%% This package may be freely used, especially by, but not limited to,
%% students, lecturers and staff of the Open University. No acknowledgement
%% is _required_ for using this package within the production of a _Tutor
%% Marked Assessment._

\RequirePackage{expl3}
\RequirePackage{doc}
\SetupDoc{reportchangedates}
\ExplSyntaxOn

%% Store State
\tl_new:N   \g__@@_target_tl
\seq_new:N  \g__@@_stack_seq
\prop_new:N \g__@@_stream_prop
\bool_new:N \g__@@_setup_bool

%% Remember original \glossary and install dispatcher (once)
\cs_new_protected:Npn \@@_setup:
{
    \bool_if:NF \g__@@_setup_bool
    {
        \cs_set_eq:NN \@@_glossary_orig: \glossary
        \cs_set_protected:Npn \glossary ##1 { \@@_glossary:n {##1} }
        \bool_gset_true:N \g__@@_setup_bool
    }
}
\cs_new_eq:NN \@@_glossary_orig: \scan_stop:

%% Ensure a stream exists & is open: name -> iow csname
\cs_new_protected:Npn \@@_stream_ensure_open:n #1
{
    \prop_if_in:NnF \g__@@_stream_prop {#1}
    {
        \iow_new:c { g__@@_iow_#1 }
        \exp_args:Nc \iow_open:Nn { g__@@_iow_#1 } { \jobname-#1.glo }
        \prop_put:Nnx \g__@@_stream_prop {#1} { g__@@_iow_#1 }
    }
}

%% Current target (no stack)
\cs_new_protected:Npn \@@_set_target:n #1
{
    \@@_setup:
    \@@_stream_ensure_open:n {#1}
    \tl_gset:Nn \g__@@_target_tl {#1}
}
\cs_new_protected:Npn \@@_clear_target:
{ \tl_gclear:N \g__@@_target_tl }

%% Push / Pop targets
\cs_new_protected:Npn \@@_push_target:n #1
{
    \seq_gpush:NV \g__@@_stack_seq \g__@@_target_tl
    \@@_set_target:n {#1}
}
```

```
\cs_new_protected:Npn \@@_pop_target:
{
    \seq_gpop:NN \g__@@_stack_seq \l_tmpa_tl
    \tl_if_blank:VTF \l_tmpa_tl
    { \@@_clear_target: }
    { \tl_gset:NV \g__@@_target_tl \l_tmpa_tl }
}

%% Declare (open) a list of streams now
\cs_new_protected:Npn \@@_declare_streams:n #1
{ \clist_map_inline:nn {#1} { \@@_stream_ensure_open:n {##1} } }

%% Dispatcher replacing \glossary
\cs_new_protected:Npn \@@_glossary:n #1
{
    \tl_if_blank:VTF \g__@@_target_tl
    { % No active target -> pass through to original doc \glossary
        \@@_glossary_orig:{#1}
    }
    {
        % Lookup iow for current target
        \prop_get:NVN \g__@@_stream_prop \g__@@_target_tl \l_tmpa_tl
        % Freeze page number now
        \tl_set:Nx \l_tmpb_tl { \thepage }
        % Mirror doc.sty: \protected@write<stream>{}{\string\glossaryentry{#1}{<page>}}
        \exp_args:Nc \protected@write { \l_tmpa_tl } {} {%
          \string\glossaryentry{#1}{\l_tmpb_tl}%
        }%
    }
}

%% Close all streams at end of document
\cs_new_protected:Npn \@@_close_all:
{
    \prop_map_inline:Nn \g__@@_stream_prop
    { \exp_args:Nc \iow_close:N {##2} }
}
\AtEndDocument{ \@@_close_all: }
```

6.1 Single-column printing support for theglossary

```
\int_new:N \g__@@_sc_depth_int
\cs_new_eq:NN \@@_orig_theglossary_begin: \scan_stop:
\cs_new_eq:NN \@@_orig_theglossary_end:   \scan_stop:

\cs_new_protected:Npn \@@_singlecolumn_begin:
{
    \int_compare:nNnTF { \g__@@_sc_depth_int } = { 0 }
    {
        % First activation: capture originals
        \cs_if_exist:NT \theglossary   { \cs_set_eq:NN \@@_orig_theglossary_begin: \theg
        \cs_if_exist:NT \endtheglossary{ \cs_set_eq:NN \@@_orig_theglossary_end:   \endt
        % Install single-column 'theglossary'
        \cs_set_protected:Npn \theglossary
        {
```

```
            % Minimal single-column list layout compatible with gglo.ist entries
            \par\bigskip
            \begingroup
            \parindent\z@ \parskip\z@ \relax
            % Basic index-style paragraph items:
            \providecommand\indexspace{\par \vskip 10pt plus 2pt minus 2pt\relax}
            \providecommand\@idxitem{\par\hangindent 40\p@}
            \providecommand\subitem{\@idxitem\hspace*{20\p@}}
            \providecommand\subsubitem{\@idxitem\hspace*{30\p@}}
            \let\item\@idxitem
        }
        \cs_set_protected:Npn \endtheglossary
        { \par \endgroup }
    }
    { } % nested activation: keep our replacement
    \int_gincr:N \g__@@_sc_depth_int
}

\cs_new_protected:Npn \@@_singlecolumn_end:
{
    \int_gdecr:N \g__@@_sc_depth_int
    \int_compare:nNnT { \g__@@_sc_depth_int } = { 0 }
    {
        % Restore originals when last guard unwinds
        \cs_if_eq:NNF \@@_orig_theglossary_begin: \scan_stop:
        { \cs_set_eq:NN \theglossary   \@@_orig_theglossary_begin: }
        \cs_if_eq:NNF \@@_orig_theglossary_end:   \scan_stop:
        { \cs_set_eq:NN \endtheglossary \@@_orig_theglossary_end: }
    }
}
```

6.2 Public API (document commands)

\DocChangeDeclareStreams [changes]

`\DocChangeDeclareStreams: {`⟨*change sets*⟩`}` Comman separated list of change sets required.

\DocChangeSet [changes]

`\DocChangeSet: {`⟨*change set*⟩`}` Set the active change set.

\DocChangeClear [changes]

`\DocChangeClear:` Save the current change set.

\DocChangePush [changes]

`\DocChangePush: {`⟨*change set*⟩`}` Switch to the indicated change set, but remember which was active before.

\DocChangePop [changes]

`\DocChangePop:` Restore the previously active change set.

\DocChangeSingleColumnOn [changes]

`\DocChangeSingleColumnOn:` Set single column glossary printing.

\DocChangeSingleColumnOff [changes]

`\DocChangeSingleColumnOff:` Set double column glossary printing.

\DocChangePrint [changes]

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

```
\NewDocumentCommand \DocChangeDeclareStreams { m }
{ \@@_declare_streams:n {#1} }
```

```
154
155 \NewDocumentCommand \DocChangeSet   { m } { \@@_set_target:n  {#1} }
156 \NewDocumentCommand \DocChangeClear {   } { \@@_clear_target:      }
157 \NewDocumentCommand \DocChangePush  { m } { \@@_push_target:n {#1} }
158 \NewDocumentCommand \DocChangePop   {   } { \@@_pop_target:        }
159
160 %% Convenience: globally enable/disable single-column glossary layout
161 \NewDocumentCommand \DocChangeSingleColumnOn  { } { \@@_singlecolumn_begin: }
162 \NewDocumentCommand \DocChangeSingleColumnOff { } { \@@_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     \@@_singlecolumn_begin:
170     \InputIfFileExists{ \jobname-#2.gls }{}{ \emph{No~changes~recorded.} }
171     \@@_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 LaTeX 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`. 11
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`. 11
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. 11
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. 11
v1.16 – 2024-11-22
General: Added File Properties to pdf files using the hyperref setup system when in pdfbookmark mode. 11
v1.17 – 2025-02-13
General: Rewritten with LaTeX3 syntax from the 'xparse' package to make commands less fragile. Finally, I got the alignment of part and subpart numbering to line up correctly. 11
v1.18 – 2025-02-16
General: PDF metadata doesn't set correctly so I have removed it: the cause is an incompatibility between LaTeX unicode and the PDF restricted character allowance. 11
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 (LaTeX3) commands are robust and fail to expand within the context of the metadata and bookmarks; old (LaTeX2e) commands are fragile and correctly expanded. I have a mix of old commands and new variables now. 11
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. 11
v1.21 – 2025-09-30
General: Documentation error spotted and corrected in very first example. A couple of other occurances 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 `\setquestionstrimg` instead of `\setquestionstring`. 4
v1.21.2 – 2025-10-28
General: Added alignment variation for question string, suggested by Bruce

Changes for ou-tma-sup

Changes for doc-changes

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Numbers written in italic refer to the page where the corresponding entry is described; numbers underlined refer to the code line of the definition; numbers in roman refer to the code lines where the entry is used.

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