Actuarial angle symbol for life contingencies and financial mathematics [*]

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Abstract

Package actuarialangle provides commands to typeset the "angle" symbol denoting a duration n in actuarial notation, as in $\overline{n|}$, and an overhead angle bracket, as in $\overline{xy}$.

1 Introduction

This package defines commands to typeset two symbols used in actuarial notation for life contingencies and financial mathematics. The first is the "angle" denoting a duration in the present value of an insurance or annuity: $\overline{n|}$. The second is an overhead angle bracket (or "roof") used to emphasize joint status when ambiguity is possible: $\overline{xy}$. The bracket is normally used with a precedence number above. Facilities to position such numbers are provided by package actuarialsymbol (Beauchemin and Goulet, 2017).

For additional details on actuarial notation for life contingencies, see Bowers et al. (1997).

2 Package options

The package offers the following options:

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[*]This document corresponds to actuarialangle v2.0, dated 2017/04/10.
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thinspace insert a thin space of 1mu between the material under the angle and the right descender; this is the default starting with version 2.0 of the package;

thickspace insert a thicker space of 2mu between the material under the angle and the right descender; this was the value used in versions of the package prior to 2.0;

nobracket do not define command `\overanglebracket`; this option also prevents loading of package pict2e.

We provide option `nobracket` in case the bracket symbol is not needed and pict2e (Gäßlein et al., 2016) interferes with other packages. Loading the package with

```
\usepackage[thickspace,nobracket]{actuarialangle}
```

yields the behaviour of versions prior to 2.0, but for the defunct features mentioned in section 4.

3   Package features

`\actuarialangle`   In math mode, the command

$$\actuarialangle\{\langle duration\rangle\}$$

composes an angle symbol around $\langle duration\rangle$. This is the "raw" command that does not insert any space between $\langle duration\rangle$ and the right descender of the angle. The symbol scales gracefully if the command is ever used outside of a first-level subscript.

`\actuarialangle{n} \quad` `a_{\actuarialangle{n}}`	$\overline{n}\rvert \quad a_{\overline{n}\rvert}$

`\angl`   Users are expected to typeset angle symbols with the command
`\angln`
`\anglr` $\angl\{\langle duration\rangle\}$
`\anglk`
In contrast to `\actuarialangle`, this command inserts some thin space (by default or with package option `thinspace`) or thick space (with package option `thinkspace`) between $\{\langle duration\rangle\}$ and the right descender.

```% with option thinspace:``` ```\angl{n} \quad a_{\angl{n}}```	$\overline{n}\vert \quad a_{\overline{n}\vert}$
```% with option thickspace``` ```\angl{n} \quad a_{\angl{n}}```	$\overline{n}\vert \quad a_{\overline{n}\vert}$

Commands \angln, \anglr and \anglk are shortcuts for the common cases \angl{n}, \angl{r} and \angl{k}, respectively.

\overanglebracket
\group
    The command

$$\overanglebracket\{\langle statuses\rangle\}$$

composes an angle bracket ("roof") above ⟨*statuses*⟩. The rule thickness and spacing relative to the statuses match those of the angle symbol. Command \group is a convenient alias for \overanglebracket.

```\group{xy} \quad``` ```A_{\group{xy}:\angln}```	$\overarc{xy} \quad A_{\overarc{xy}:\overline{n}\vert}$

4 Defunct features

Versions prior to 2.0 of the package included the undocumented commands

    \topprecedence (with alias \lift)
    \vartopprecedence
    \bottomprecedence
    \varbottomprecedence

to typeset precedence numbers above and below statuses in subscript of an actuarial symbol. These features have been moved — and improved on the way — to package actuarialsymbol (Beauchemin and Goulet, 2017).

A Implementation

This appendix contains the annotated source code of the package. Most readers can stop reading here.

A.1 Package options

\ifacta@thinspace
\ifacta@nobracket
Two flags are defined to keep track of the spacing between the material under the angle and right descender, and whether or not the package should define the command \overanglebracket and load package pict2e.

```
1 \newif\ifacta@thinspace \acta@thinspacetrue
2 \newif\ifacta@bracket   \acta@brackettrue
```

\DeclareOption Declaration of the package options and processing. Defaults are thinspace and to define the bracket.

```
3 \DeclareOption{thinspace}{\acta@thinspacetrue}
4 \DeclareOption{thickspace}{\acta@thinspacefalse}
5 \DeclareOption{nobracket}{\acta@bracketfalse}
6 \ProcessOptions
```

A.2   Actuarial angle

The original author of macros \actuarialangle and \acta@angle is unknown. Some of the comments below are his or hers.

\actuarialangle We first define the "raw" user level command.

```
7 \DeclareRobustCommand{\actuarialangle}{\mathpalette\acta@angle}
```

The operation of \mathpalette ensures that proper sizing the command is ever used outside of a first-level subscript.

\acta@angle Next we define the real workhorse.

```
8 \def\acta@angle#1#2{%
9   \mathord{%
```

Add a bit of preceding space.

```
10    \mkern1mu
```

We need many nested boxes here: first a vbox to stack the horizontal rule of the angle and the symbol; second an hbox position the symbol and the right descender of the angle side-to-side; third a vbox to insert spacing between the horizontal rule and the symbol.

```
11    \vbox{\hrule \hbox{%
12        \vbox{%
```

The amount of vertical space below is the normal space for \overline in a subscript.

```
13          \kern3\fontdimen8\scriptfont\thr@@
14          \hbox{$#1#2\m@th$}}%
```

Make the right-hand rule extend down to the depth of a parenthesis even if the symbol under the angle does not have a descender.

```
15        \setbox\z@\hbox{$#1()$}\vrule depth\dp\z@}}%
```

Finishing touch is a bit of following space.

```
16      \mkern1mu}}
```

4

\angl	Finally, we define the main user level function \angl and shortcuts for
\angln	common cases.
\anglr	17 \ifacta@thinspace
\anglk	18 \def\angl#1{{\actuarialangle{{#1}\mkern1mu}}}
	19 \else
	20 \def\angl#1{{\actuarialangle{{#1}\mkern2mu}}}
	21 \fi
	22 \def\angln{{\angl n}}
	23 \def\anglr{{\angl r}}
	24 \def\anglk{{\angl k}}

B   Over angle bracket

The code of this section is executed only if \acta@bracket is true, that is
when the package is *not* loaded with option nobracket.

25 \ifacta@bracket

Drawing the angle bracket requires package pict2e (Gäßlein et al., 2016) to
get arbitrary slopes and neat line joins in paths.

26   \RequirePackage{pict2e}

\overanglebracket   Here is the user level command.

27   \DeclareRobustCommand{\overanglebracket}{%
28   \mathpalette\acta@anglebracket}

We use \mathpalette as above.

\acta@anglebracket   The workhorse is \acta@anglebracket. It builds the bracket symbol with
path lines.

29   \def\acta@anglebracket#1#2{%

Box zero contains the material under the bracket. The width of this box
will determine the width of the flat part of the bracket and the height, the
length of the descenders. Hence we store these values.

30   \setbox\z@\hbox{$\m@th#1#2$}
31   \dimen0\wd\z@ \dimen1\ht\z@

Box two contains the bracket itself. It is drawn in three parts stitched
together; the first and third parts are expressed in a dimension relative
\dimen1, above, whereas the central part is expressed relative \dimen0.

32   \setbox\tw@\hbox{%
33   \setlength{\unitlength}{\dimen1}%
34   \begin{picture}(0.4,0)
35   \polyline(0.4001,0)(0.4,0)(0,-0.8)

```
36        \end{picture}%
37        \setlength{\unitlength}{\dimen0}%
38        \begin{picture}(1,0)
39          \put(0,0){\line(1,0){1}}
40        \end{picture}%
41        \setlength{\unitlength}{\dimen1}%
42        \begin{picture}(0.4,0)
43          \polyline(-0.0001,0)(0,0)(0.4,-0.8)
44        \end{picture}}
```

We store the width of the total width of the backet to center the material under it, below.

```
45        \dimen@\wd\tw@
```

Box containing the whole symbol. The lineskip between the bracket and the statuses is the same as in \acta@angle, plus half the default rule thickness.

```
46        \vbox to\dimen1{%
47          \baselineskip\z@
48          \lineskip3\fontdimen8\scriptfont\thr@@
49          \advance\lineskip by 0.2pt
50          \lineskiplimit\lineskip
51          \vss
52          \box\tw@%
53          \hbox to\dimen@{\hss\unhbox\z@\hss}
54        }
55      }
```

\group   Alias for \overanglebracket.

```
56    \let\group\overanglebracket
57  \fi
```

References

D. Beauchemin and V. Goulet. *Actuarial symbols of life contingencies and financial mathematics*, 2017. URL http://www.ctan.org/pkg/actuarialsymbol/.

N. L. Bowers, H. U. Gerber, J. C. Hickman, D. A. Jones, and C. J. Nesbitt. *Actuarial Mathematics*. Society of Actuaries, Shaumburg, IL, second edition, 1997. ISBN 0-9389594-6-8.

H. Gäßlein, R. Niepraschk, and J. Tkadlec. *The pict2e package*, 2016. URL http://www.ctan.org/pkg/pict2e/.

Version history