

gradbars

Inline data graphics for L^AT_EX

Declare columns. Supply data. Build visual tables.

One source: rendered table and calling code

Method	Score	Mix	Trend	Heat
Baseline	62	62.0	62.0	62
Model A	78	78.0	78.0	78
Model B	86	86.0	86.0	86
Proposed	94	94.0	94.0	94

```
\begin{center}
\begin{gradtable}[align=c,header align=c,width=\linewidth,column sep=4pt,row stretch=1.5,label width=7mm]
\gradcolumn[align=c,header align=c]{name}{Method}
\gradcolumn[type=bar,options={max=100,precision=0}]{score}{Score}
\gradcolumn[type=stack,options={max=100,label=none}]{mix}{Mix}
\gradcolumn[type=spark,options={spark range=fixed,
min=0,max=100,label=none}]{trend}{Trend}
\gradcolumn[type=heat,options={min=0,max=100,precision=0}]{heat}{Heat}
\gradrow{Baseline,62,{20,25,17},{30,45,40,62},62}
\gradrow{Model A,78,{28,30,20},{40,52,68,78},78}
\gradrow{Model B,86,{30,32,24},{48,65,72,86},86}
\gradrow{Proposed,94,{34,35,25},{55,70,83,94},94}
\end{gradtable}
\end{center}
```

[Data bars](#) / [composition](#) / [trends](#) / [heat cells](#)

[PGF/TikZ](#) / [CSV](#) / [Tagged PDF](#)

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Reading this manual. Start with data semantics, then choose a graphic. Appearance and evaluation rules precede the dedicated table interface; complete examples and the reference follow. Rendered examples use the source shown beside or below them. All data are illustrative. The English and Chinese manuals cover the same interfaces; their section and example numbers are independent.

Part I

Quick start and data semantics

1 Installation and engine requirements

The supported baseline is LaTeX 2025-11-01+, expl3 2025-12-29+ and PGF/TikZ 3.1.11a+. Update older distributions before installing this release. `gradbars` is available on [CTAN](#) and included in TeX Live as `gradbars`. For TeX Live installations managed by `tlmgr` (including MacTeX), install it from a terminal:

```
tlmgr install gradbars
```

Update an installed copy or inspect package information with:

```
tlmgr update gradbars
tlmgr info gradbars
```

Load `\usepackage {gradbars}` in the preamble; no project-local `sty` copy is needed. The configured TeX Live repository may not yet contain a new CTAN release. Check the installed version before using new manual features. For a release not yet synchronized, place all matching `.sty` files from `sty/` beside your source, or use a local TEXMF tree under `tex/latex/gradbars`. Include `tblrlibgradbars.sty` for the optional `tabularray` adapter. A project-local copy takes precedence over the system installation. See the [TeX Live package manager documentation](#). Dependencies include TikZ/PGF, `xparse`, `expl3`, `colcell`, `array`, `booktabs`, `colortbl` and `longtable`. No shell escape or external data-conversion program is required.

The package has no inherent XeLaTeX requirement. PDF output with pdfLaTeX, XeLaTeX and LuaLaTeX is tested, including CSV input. The Chinese manual uses XeLaTeX with `ctex` and Fandol fonts. This English manual can be compiled with pdfLaTeX. The package itself does not load `fontspec` or `ctex`. Use an appropriate font and encoding setup for non-ASCII text in your own documents.

1.1 Loading selected libraries

Select feature libraries in the preamble with the `libraries` option:

```
\usepackage[libraries={stack,spark,heat,csv,table}]{gradbars}
```

This explicitly loads all five feature libraries and is equivalent to the default `\usepackage {gradbars}`. Use a shorter list when fewer features are needed:

```
\usepackage[libraries={stack,spark,heat}]{gradbars}
```

The `table` library automatically loads `stack`, `spark`, `heat` and `csv`. Select `libraries=none` for the shared engine and public API only. Load libraries in the preamble; see the `libraries` chapter for details.

1.2 A complete example

```
\documentclass{article}
\usepackage{booktabs,gradbars}
\begin{document}
\gradbarssetup{width=30mm,max=100,precision=1}
\begin{center}
\begin{tabular}{cc}
\toprule
\multicolumn{1}{c}{Model} & \multicolumn{1}{c}{Accuracy (\%)} \\
\midrule
Baseline & \gradbar{72.4} \\
Proposed & \gradbar{92.7} \\
\bottomrule
\end{tabular}
\end{center}
\end{document}
```

No `tikzpicture` wrapper is needed. Commands may also be used inside an existing TikZ picture. Settings and named styles follow ordinary TeX grouping. Options are applied left to right: put a theme or preset before individual overrides.

2 Libraries and public extension interfaces

2.1 Full loading or the minimal mode

`\usepackage {gradbars}` retains full loading and previous public commands. Alternatively, list all feature libraries explicitly:

```
\usepackage[libraries={stack,spark,heat,csv,table}]{gradbars}
```

This is equivalent to default full loading; shorten the list to select fewer libraries. Select only the shared engine, then load features in the preamble:

```
\usepackage[libraries=none]{gradbars}
\usegradbarslibrary{stack,spark}
```

The package option `libraries={heat,spark}` is also available. Core contains ordinary bars, comparisons/ranges, references, quality controls and legends. `stack`, `spark`, `heat` and `csv` add their respective engines; `table` adds native visual tables and all four dependencies. Repeated loading is safe. Unknown libraries, missing files, cycles and unloaded frontends produce clear errors. Load libraries in the preamble; `siunitx v3` remains explicitly optional.

2.2 Complete list of built-in libraries

Version 1.0.0 registers six built-in library names. Core is always loaded; the other five provide optional features:

core Basic bars, comparisons, dumbbells, ranges, reference marks, quality controls and legends, plus number handling, settings and accessibility tagging. Always loaded automatically; no explicit selection is needed.

stack Signed stacked bars, segment labels and stacked legends. The main command is `\gradstack` ; depends on core.

spark Miniature line, bar and win-loss series. The main command is `\gradspark` ; depends on core.

heat Sequential and diverging heat cells with a configurable center. The main command is `\gradheat` ; depends on core.

csv CSV import, cell access, CSV tables and collected columns in existing tables. Main commands include `\gradbarsloadcsv` and `\gradbarscolumn` ; depends on core.

table Native `gradtable` tables with columns, groups, summaries, shared scales, ranking, styles and pagination. Automatically loads core, `stack`, `spark`, `heat` and `csv`.

List all six names as follows. Explicitly selecting core is valid but unnecessary:

```
\usepackage[libraries={core,stack,spark,heat,csv,table}]{gradbars}
```

Alternatively, start in minimal mode and load the libraries in the preamble:

```
\usepackage[libraries=none]{gradbars}
\usegradbarslibrary{core,stack,spark,heat,csv,table}
```

The values `all` and `none` are modes of the package option `libraries`, not library names. Select `libraries=table` for native tables; the loader supplies all dependencies. The files named `keys`, `numbers`, `render-tikz`, `tagging`, `api`, `table-data` and `table-layout`, as well as `model`, are internal modules, not separately loadable public libraries. Register contributed libraries with `\gradbarsdeclarelibrary` first. The `demo` library in this chapter is a companion example, not built in.

2.3 Unified settings

`\gradbarsset` and `\gradbarssetup` share options, grouping and precedence. Local settings and per-graphic overrides retain their previous scope.

Settings with a local override



```
\gradbarsset{max=100,precision=2}
\gradbar{72.125}
{\gradbarsset{color=teal}\gradbar{50}}
```

2.4 Stable registration callbacks

These public interfaces follow the version 1 stability contract:

- Graphics: `\gradbarsdeclaretype` and `\gradgraphic` .
- Formatting: `\gradbarsdeclareformatter` and `\gradbarsformatnumber` .
- Libraries: `\gradbarsdeclarelibrary` .

A scalar callback receives one validated value or NA and should delegate to public graphics. A formatter receives display value, precision and number-format mode; return just the number, with the engine adding unit/percent suffixes. Registration is global and duplicate names are errors. Names start with a lower-case letter and use letters, digits and hyphens.

```
\gradbarsdeclaretype{score}{\gradbar[color=teal]{#1}}
\gradbarsdeclareformatter{boxed}{%
  \fbox{\gradbarsformatnumber[precision=#2,number format=#3]{#1}}}
\gradgraphic{score}{72.125}
\gradbar[formatter=boxed]{72.125}
```

Custom scalar types do not add new native `gradcolumn` types. Custom formatters work in graphics and ordinary number columns, but do not support `number align=decimal`. Data calculations never consume formatted strings.

2.5 A public-only contributed library

The companion `docs/libraries/gradbars-contrib-demo.sty` registers a renderer, formatter and table style. Register its dependencies and load it in the preamble:

```
\gradbarsdeclarelibrary{demo}{table}{docs/libraries/gradbars-contrib-demo.sty}
\usegradbarslibrary{demo}
```

Renderer, formatter and reusable table style



Method	Score
A	72.0
B	90.0
Mean	81.0

```
\gradgraphic{demo-score}{72.125}\par
\gradbar[formatter=demo-boxed]{72.125}\par
\begin{center}
\begin{gradtable}[align=c,header align=c,style=demo-report,width=\linewidth]
  \gradcolumn{name}{Method}
  \gradcolumn[type=number,formatter=demo-boxed,aggregate=mean]{value}{Score}
  \gradrow{A,72}\gradrow{B,90}\gradsummary{Mean}
\end{gradtable}
\end{center}
```

The example uses no private variables. See `docs/developer.md` and `docs/migration-v1.0.0.md` for callback limits, dependencies and migration.

2.6 Install the complete release

Install all matching `.sty` files from `sty/` together, including `tblrllibgradbars.sty`; replacing only the entry file is insufficient. Native versions must match. Use `l3build check`, `l3build doc`, `l3build ctan` and the detailed `texlua scripts/check.lua` regressions.

2.7 Version 1 compatibility contract

The documented public commands, keys, defaults and dependency rules are stable. Compatible additions use a minor release; removals or changes to defaults/data semantics require a major release. Deprecated interfaces remain available throughout version 1. Internal module files and private variables are excluded. See `docs/stability.md` for scope, precedence and callback restrictions. The supported baseline is LaTeX 2025-11-01, expl3 2025-12-29 and PGF/TikZ 3.1.11a or newer. Install all twenty-two matching runtime files, including optional feature libraries and adapters, together. The generated `gradbars.dtx` and `gradbars.ins` reproduce those modules using docstrip; `texlua scripts/source.lua -check` verifies consistency. The `l3doc` source guide complements the illustrated manuals.

3 Third-party libraries and backend providers

The independent starter lives in `docs/libraries/starter/`. It contains a public-only library, an example, a three-engine checker and compatibility guidance.

```
\usepackage[libraries=none]{gradbars}
\gradbarsdeclarelibrary{starter}{table}{gradbars-contrib-starter.sty}
\usegradbarslibrary{starter}
```

Keep the contributed file on the TeX search path. Rename starter package/type/ formatter/style/backend names when making your own library. Declare dependencies in the registry and check them in the library. `\gradbarsversion` reports the package version; `\gradbarsrequireversion {1.1.0}` checks a minimum semantic version. Run the standalone checker with `texlua` and the installed TeX engines:

```
texlua docs/libraries/starter/check-starter.lua --gradbars-root .
```

3.1 Public scalar backend contract

`\gradbarsbackendversion` is schema 1. It provides a scoped read-only record for bar and Heat callbacks while keeping private model storage private.

```
\gradbarsdeclarebackend{my-backend}
{bar,heat,missing,signed,gradient,print,labels,units,clip,
 decorations,embedded,tagging,artifact}
{\gradbarsbackenddefault}
\gradbar[backend=my-backend]{72.125}
```

The callback receives bar or heat as its first argument. Declare only implemented or delegated capabilities. `\gradbarsbackendvalue {field}` exposes canonical values, normalized positions, physical dimensions, options and descriptions during the callback. `\gradbarsbackendlabel` typesets the existing formatted label. `\gradbarsbackenddefault` draws the captured native continuation once. `\gradbarsifbackendcapable {name}{feature}{yes}{no}` queries a declaration. Unknown backends, missing capabilities, recursive callbacks and out-of-scope record reads are diagnosed. Unsupported compound/legend kinds require explicit `backend fallback=tikz`; default error prevents silent changes. Default rendering still uses TikZ. This contract does not supply a second renderer. Callbacks may run during discarded table measurements: avoid external writes, respect suspended tagging and preserve raw data, units, clipping and baselines. The complete field and capability contract is in `docs/backends.md`.

4 Choosing a graphic

Question	Interface
How large is a value?	<code>\gradbar {value}</code> ; use a negative min for signed values.
How do two values compare?	<code>\gradcompare {reference}{current}</code> for layered bars; <code>\graddumbbell {reference}{current}</code> for connected points.
What are the bounds?	<code>\gradrange {lower}{upper}</code> for supplied endpoints.
What makes up the total?	<code>\gradstack {list}</code> for additive, common-unit contributions.
How does a series change?	<code>\gradspark {list}</code> for equally spaced observations.
What is the uncertainty?	<code>error minus</code> and <code>error plus</code> on a point estimate.

5 Values, scales, labels and missing observations

Defaults are `min=0` and `max=100`. Drawing ranges require `min<max`; include zero when comparing magnitudes through bar lengths. Decimal/scientific literals and macros expanding to them are accepted; expressions, thousands separators and units inside input are not. Scientific notation is available as an output format.

Keep `min`, `max` and `width` identical within each comparison column. Zero is not missing. Empty input or uppercase NA denotes missing data for a single observation; missing stack segments are rejected. Overflow warns and clips geometry while preserving the original label. Use `overflow=error` for strict checking.

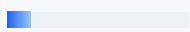
Raw values, calculated percentages and missing values	
	50.0
	25.0%
	50.0 ms
	0.0
	N/A
<code>\gradbar[max=200]{50}</code>	
<code>\gradbar[max=200,value format=percent]{50}</code>	
<code>\gradbar[max=200,unit={\,ms}]{50}</code>	
<code>\gradbar{0}</code>	
<code>\gradbar[missing text={N/A}]{NA}</code>	

`unit` appends text. `value format=percent` computes $100v/\text{max}$, ignores unit, and requires `min=0`. For values already expressed as percentages, use `unit={\%}`. `text` overrides the complete label without changing geometry. `precision` accepts integers from 0 to 6. `number format` is fixed, grouped or scientific. Missing labels do not acquire a unit or percent suffix.

5.1 Scientific input and finite precision

Decimal and e/E scientific literals share graphics, CSV, selection, ranks, statistics and range calculations. Zero is valid; nonzero magnitudes must lie between 10^{-100} and 10^{100} , including explicit ranges and displayed statistics. Each decimal side accepts up to 101 digits; the exponent accepts up to three digits. Internal arithmetic has about 16 significant digits, so additional digits do not guarantee distinct values. Locale separators, expressions, input units, NaN and infinity are errors. Display precision does not alter calculations or ranks.

Scientific input preserves the raw value

 1.25 · 10⁻³

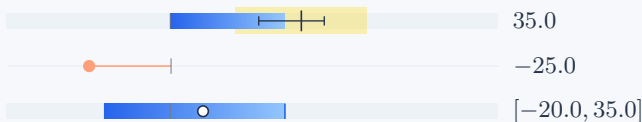
```
\gradbar[min=0,max=1e-2,number format=scientific,precision=2]{1.25E-3}
```

Part II

Graphics and comparisons

6 Signed bars, targets, intervals and uncertainty

A signed point estimate and asymmetric uncertainty



```
\gradbar [min=-50,max=100,width=65mm,
  target=40,band={20,60},error minus=8,error plus=12]{35}

\gradbar [min=-50,max=100,width=65mm,shape=lollipop]{-25}

\gradrange [min=-50,max=100,width=65mm,range point=10]{-20}{35}
```

Error magnitudes are nonnegative distances from the observation, not absolute endpoints. Explain whether they represent standard deviation, standard error or confidence intervals in the table caption. Targets and bands are references, not automatically estimated uncertainty. A band must have ordered endpoints within the scale; invalid reference bands and targets cause errors.

Floating intervals require $\text{lower} \leq \text{upper}$; equal endpoints draw a cap, not an inflated bar. Both endpoints must be present or both missing. A range point must lie inside the original endpoints. Intervals reject error whiskers and quality thresholds. Default labels show the supplied endpoints. Lollipops show a point for zero, but no point for missing input.

Negative bars are solid by default. To give the negative side its own gradient, set its two endpoints explicitly:

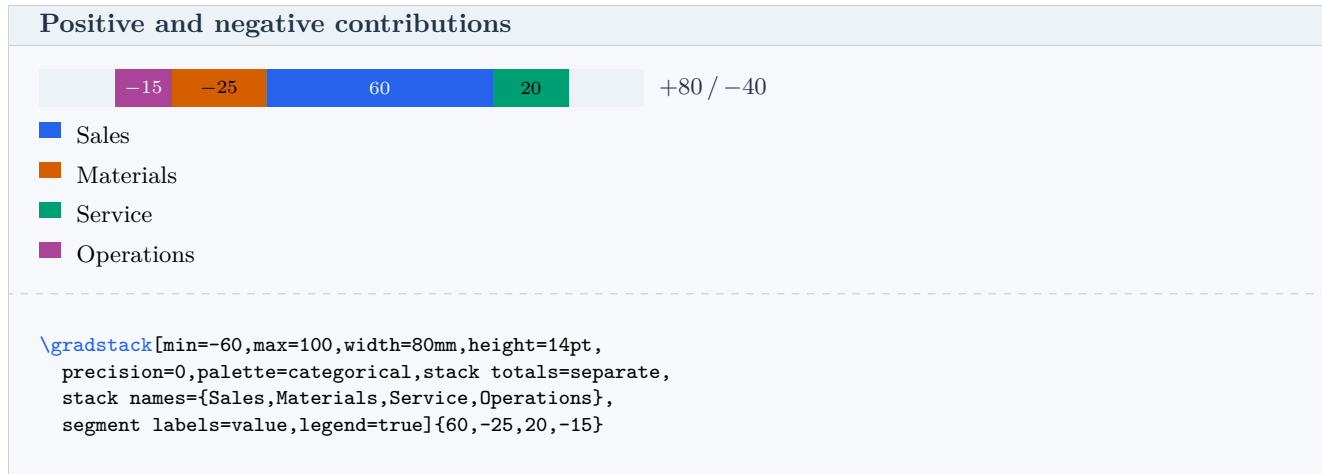
Independent negative gradient



```
\gradbar [min=-100,max=100,width=50mm,
  left color=teal,right color=teal!25,
  negative fill=gradient,
  negative left color=magenta!25,
  negative right color=magenta]{-60}
```

The negative left endpoint is the outer side of the bar and the right endpoint is the side next to zero. ‘negative color’ remains the fallback solid color; threshold and print modes continue to override the gradient.

7 Stacked contributions and segment labels



Positive and negative contributions accumulate independently from zero. Within each side, segment order follows input order. Negative segments require a negative min. Positive and negative subtotals are checked separately against the scale. The default total is the algebraic sum; `stack totals=separate` shows positive and negative subtotals. A zero net does not erase nonzero contributions.

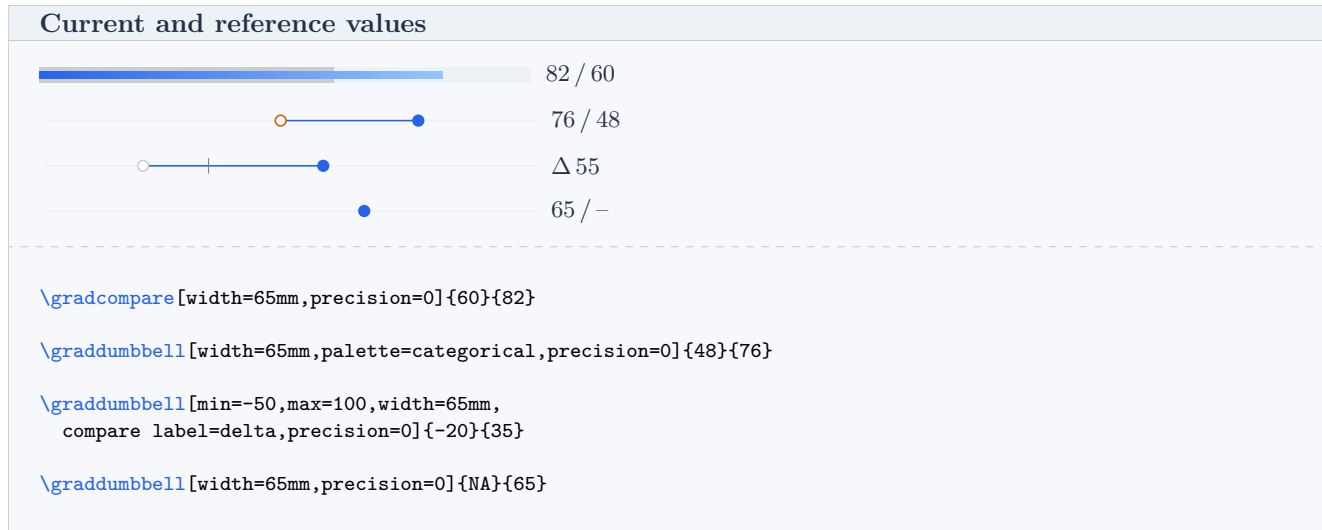
Segment labels can be none, value, percent, name, name value or name percent. The percentage of segment i is

$$p_i = \frac{100|v_i|}{\sum_j |v_j|},$$

where v_i is the original signed value of segment i , and v_j is the original signed value of segment j . The sum runs over all input segments, including contributions clipped by the display range. These percentages represent shares of absolute activity, not shares of a potentially zero net. All-zero stacks do not calculate percentages. Stacks are not normalized to full width. Missing segments, empty lists, quality thresholds and error whiskers are rejected.

Provide one stack name per segment for named labels or automatic legends. Small labels move outside with leader lines; automatic black/white text follows the fill. Zero segments retain their palette and legend positions. Use a shared `\gradbarslegend` outside a table to avoid repeating the legend for every row.

8 Layered and dumbbell comparisons

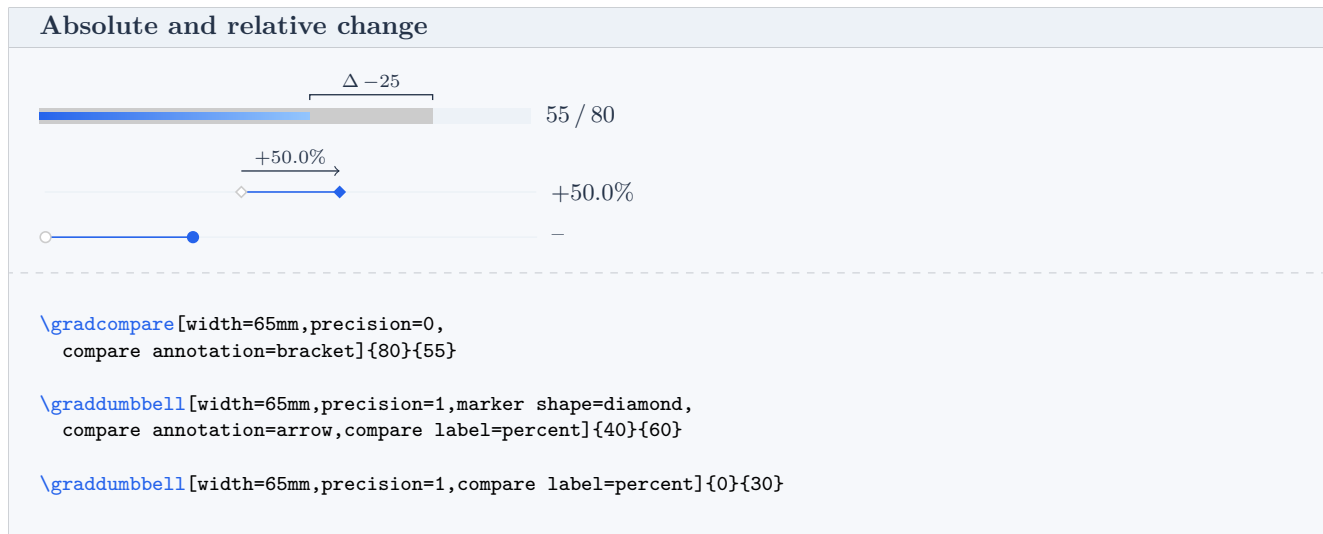


Layered bars use a wide reference and a centered current layer. The `compare ratio` defaults to .45 and must be strictly between zero and one. Both lengths start from the common zero; they are not added or divided.

Dumbbells use a hollow reference point and a current point joined by a line. The default label is current / reference; delta means current minus reference. A missing endpoint suppresses the connector; delta is missing if either endpoint is missing. Equal endpoints overlap. Error whiskers refer to the current value. `compare color`, `marker size` and `stem width` control appearance. Dedicated comparison and spark commands retain their shape when applying presets.

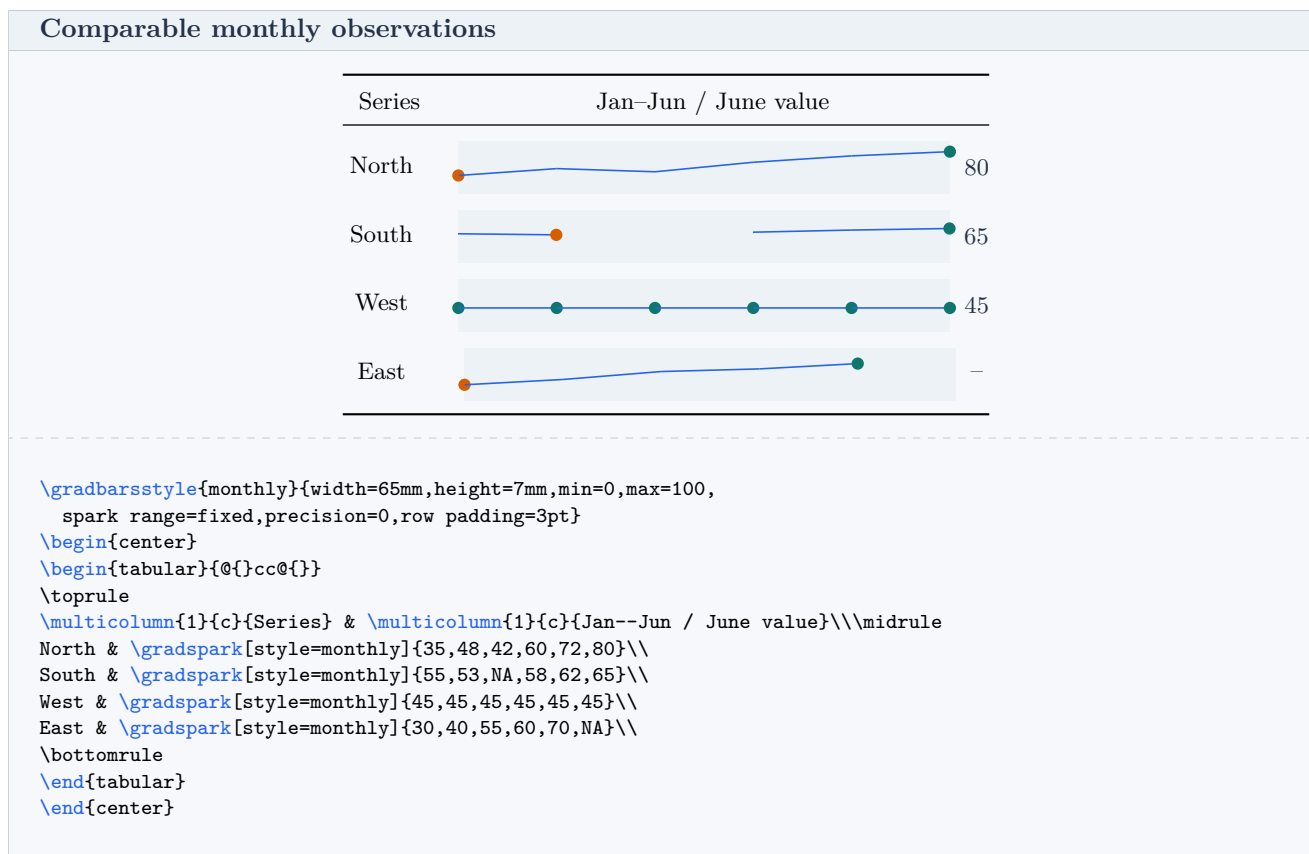
9 Change annotations and relative differences

`compare annotation=none|arrow|bracket` adds a directional arrow or a difference bracket above a layered comparison or dumbbell. None is the default. Arrows point from reference to current; equal values omit the arrow. Missing either endpoint suppresses the annotation.



Relative change is $100(c - r)/|r|$ percent, where r is the reference and c is the current value. A zero reference or missing endpoint gives a missing label, not infinity. This differs from `value format=percent`, which uses the scale maximum. Positive changes carry a plus sign. Annotation text follows percent mode; other modes annotate the raw-unit difference. Reference names and change annotations share the upper area, so avoid crowding both into a narrow graphic.

10 Spark graphics: line, bar and win-loss



Observations are equally spaced. Empty fields and NA keep their horizontal position and break connections. The last label is the last position, not the last nonmissing observation. Default height is 4ex.

spark range=auto uses each row's extrema; compare shapes only with this mode. Use fixed with shared min, max, width and height to compare magnitudes across rows. Constant auto series are centered vertically; a singleton is centered horizontally. All-missing series show only a track and missing label. Fixed ranges use normal overflow rules. Auto ranges do not support computed-percent labels.

spark points can be extrema (default), all, last or none. Extrema mode marks all tied extrema and the last position if present. Low and high colors default to gradbarsOrange and gradbarsTeal. A constant series uses the high color; a non-extreme last point uses the line color. Point colors indicate position, not quality. Use color, stem width and marker size to style the line and points. Sparklines do not parse dates and do not use bar targets, error whiskers, bands or thresholds. Labels stay outside. Use a common observation grid for irregular dates.

10.1 Bar sparks preserve magnitudes

`spark type=bar` draws signed bars in equally sized observation slots. Automatic ranges include zero; fixed ranges use min/max and normal overflow rules. Keep ranges shared when comparing rows.



`spark bar width` defaults to .7 of a slot and must be in (0,1]. Positive bars use the regular fill; negative bars use negative color. Zero draws a short baseline stroke; missing leaves a gap. All-zero/all-missing auto bars use [0,1].

10.2 Win-loss sparks show signs only

`spark type=winloss` maps positives to wins, negatives to losses and zero to ties. Fixed category heights do not express magnitudes; min/max and spark range do not affect the classification. Use `spark win color`, `spark loss color` and `spark zero color` to style categories and the baseline. Both discrete modes retain every position and the raw last-value label; a missing last position retains its missing label. Win-loss rejects computed-percent labels. Print uses grayscale. Spark points and extrema marker colors apply only to line mode. In `gradtable`, use `type=spark` with `spark type=bar` or `winloss` in options.

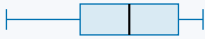
11 Box plots and distribution summaries

Load the optional `distribution` library in the preamble:

```
\usegradbarslibrary{distribution}
```

Samples are comma-separated. Empty fields and NA are missing; zero is retained. Statistics use unsorted, unrounded observations, then sort internally. Quartiles use type-7 linear interpolation: for sorted $x_1, \dots, x_n$, let $h = 1 + (n-1)p$, $j = \lfloor h \rfloor$ and $g = h - j$; then $Q(p) = (1-g)x_j + gx_{j+1}$, taking x_n at $h = n$. Use $p = 0.25, 0.5, 0.75$ for Q1, median and Q3. Whiskers are the extreme actual observations inside $[Q1 - 1.5 IQR, Q3 + 1.5 IQR]$, inclusive. Hollow points are observations outside this interval, not data automatically excluded from analysis.

One record, two input paths



```
\gradboxplot[width=52mm,height=5ex,palette=accessible]{0,2,3,4,5,6,7,8,16}
\quad
\gradboxsummary[width=52mm,height=5ex]{n=9,q1=3,median=5,q3=7,
  low=0,high=8,outliers={16}}
```

The example keeps the box, whiskers, median and outlier distinguishable, with `height=5ex` for readability. With `0,1,2,3,100`, the outlier at 100 compresses the main 0–3 range to about 3% of the total width. Increasing width alone does not resolve this linear-scale effect. Report extreme outliers separately with an explicit explanation when needed; never silently remove them or change their positions. The default `box range=auto` includes outliers; a constant range expands only for drawing. Use `box range=fixed,min=...,max=...` or a named scale for comparisons. `n=0` displays missing; `n=1` is constant; `n=2` follows the same formula. Coincident outliers overlap but keep their count in alternative text. Box whiskers are not confidence intervals. Percent formatting is rejected.

Readable statistics and native columns

`n=9; median=5; outliers=1`

Method	Distribution
Alpha	
Beta	
Missing	—

```
\gradcomputesummary{0,2,3,4,5,6,7,8,16}{%
  n=\gradstat{n}; median=\gradstat{median};
  outliers=\gradstat{outlier count}}
\par\medskip
\begin{center}
\gradtable[align=c,header align=c,style=distribution,width=\linewidth,scale=column]
\gradcolumn{name}{Method}
\gradcolumn[type=boxplot,options={height=5ex,palette=accessible}]{samples}{Distribution}
\gradrow{Alpha,{0,2,3,4,5,6,7,8,16}}
\gradrow{Beta,{-3,0,2,5,9,12,14}}
\gradrow{Missing,NA}
\end{gradtable}
\end{center}
```

`\gradstat` is available within the callback of `\gradcomputesummary`. Fields include `n`, `missing`, `min`, `max`, `mean`, `q1`, `median`, `q3`, `iqr`, `low`, `high`, `outliers`, `outlier count` and `method`. `\gradsummarytext` prints the main statistics. Precomputed records require `n`, `q1`, `median`, `q3`, `low` and `high`; unknown missing/outlier counts remain unknown. No algorithm can be verified without the samples. Optional extrema, mean and outliers are checked for consistency. Raw samples are not silently pooled across rows or groups.

12 Multiple references, bullet charts and grouped intervals

`references` takes records in the form `value/color/line style/name`. Enclose each record in braces. Styles are solid, dashed and dotted. Values must lie within min/max. Leave a name empty by retaining the final slash. Names use alternating heights, but long or closely spaced names may still overlap.

Several named references



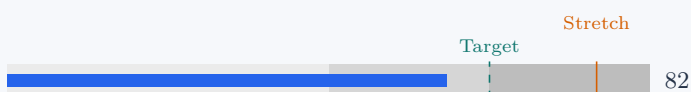
```
\gradbar [width=85mm,height=9pt,precision=0,
  references={{40/gray/dotted/Baseline},
    {75/gradbarsTeal/dashed/Target},
    {95/gradbarsOrange/solid/Limit}}]{68}
```

`references={}` clears inherited references. They may coexist with `target`. References apply to bars, stacks, comparisons and intervals, not sparklines. Avoid slashes in names; compact tables can explain unnamed reference lines in a heading.

12.1 Bullet charts

`\gradbullet {value}` draws an actual value over explicit background grades. Provide `bullet bands` as upper-bound/color records. Bounds must strictly increase; the first band starts at min and the final bound must equal max. The default height is 12pt, with the actual bar occupying 40% of that height.

Actual performance, reference grades and targets

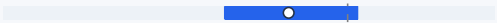
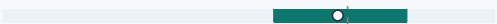
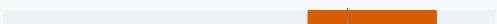


```
\gradbullet [width=85mm,max=120,precision=0,color=gradbarsBlue,
  bullet bands={{60/black!8},{90/black!16},{120/black!26}},
  references={{90/gradbarsTeal/dashed/Target},
    {110/gradbarsOrange/solid/Stretch}}]{82}
```

Grades do not classify performance automatically. Supply quality thresholds separately when needed. Explain the grades in a caption; use explicit gray shades for monochrome output. NA and zero retain their different meanings.

12.2 Several intervals in one cell

`\gradintervals {records}` accepts `name/lower/point/upper/color` records. Each record uses the same scale and graphic width; names align to the longest name. Use NA for an absent point, or NA for all three numbers for a missing record.

Comparable uncertainty intervals		
Method A		[45, 72]
Method B		[55, 82]
Method C		[62, 88]

```

\gradintervals[width=65mm,min=0,max=100,height=5pt,
precision=0,row padding=4pt,references={{70/gray/dashed/}}]{
  {Method A/45/58/72/gradbarsBlue},
  {Method B/55/68/82/gradbarsTeal},
  {Method C/62/NA/88/gradbarsOrange}}

```

Points are supplied, never inferred. Lower must not exceed upper and a point must lie inside the original interval. Explain the confidence level if relevant. This command creates an indivisible inner table: names and endpoint labels add to its width, and records do not break across pages. Reference names repeat per record.

13 Heat cells and continuous color scales

Heat encodes one scalar through fill color and retains its formatted value inside the rectangle. Use `\gradheat[options]{value}` in text, ordinary tables or existing TikZ pictures. Color is interpolated linearly over min/max.

Continuous colors and a neutral missing cell

0.0	50.0	100.0	—
-----	------	-------	---

```
\gradheat[min=0,max=100]{0}\quad
\gradheat[min=0,max=100]{50}\quad
\gradheat[min=0,max=100]{100}\quad
\gradheat{NA}
```

13.1 Colors, text and missing observations

`heat low color` and `heat high color` specify the endpoint colors; `better=lower` reverses their direction. `heat text color=auto` chooses black or white by contrast, or accepts an explicit color. `heat missing color` provides a neutral missing fill, distinct from zero. Precision, units, number formatting, custom text, rounded corners, print grayscale and alternative text work. Labels are inside; `label=none` hides a standalone cell's label. Bar targets, errors, patterns and threshold bins are not drawn.

13.2 Diverging colors and a center value

`heat palette=diverging` selects orange/white/teal. Heat center defaults to 0 and heat center color to white; the center may instead be a target value. It must lie within min/max, including their boundaries.

Zero and target centers in asymmetric ranges

−25.0	0.0	50.0
35.0	50.0	65.0

```
\gradheat[heat palette=diverging,
  min=-50,max=100,heat center=0]{-25}\quad
\gradheat[heat palette=diverging,
  min=-50,max=100,heat center=0]{0}\quad
\gradheat[heat palette=diverging,
  min=-50,max=100,heat center=0]{50}

\gradheat[heat palette=diverging,
  min=20,max=80,heat center=50]{35}\quad
\gradheat[heat palette=diverging,
  min=20,max=80,heat center=50]{50}\quad
\gradheat[heat palette=diverging,
  min=20,max=80,heat center=50]{65}
```

Each side interpolates independently, so the center stays neutral in asymmetric ranges. `Better=lower` swaps endpoints, retaining the center color. Print uses gray endpoints and a white center. Place custom heat low/center/high color keys after the palette; `heat palette=sequential` retains the earlier blue scale. Automatic ranges do not expand to include a center outside the data range. Keep `include zero=true` for a zero center, or set appropriate fixed limits. Missing retains its separate fill; raw labels remain unchanged and alternative text also describes the center.

13.3 Declaring a heat column in gradtable

Use `type=heat` with one scalar or NA per cell. Fill covers content width, retaining column spacing. Best/second-best marking uses `mark=best|both`. This example uses a fixed range; see Section 22 for automatic scales and Section 32 for CSV data sources.

A fixed-scale heat column

Method	Score
A	70
B	90
Pending	–

```

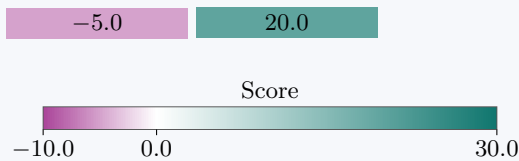
\begin{center}
\begin{gradtable}[align=c,header align=c,width=\linewidth]
  \gradcolumn{name}{Method}
  \gradcolumn[type=heat,mark=both,
    options={min=0,max=100,precision=0}]{score}{Score}
  \gradrow{A,70}
  \gradrow{B,90}
  \gradrow{Pending,NA}
\end{gradtable}
\end{center}

```

14 Continuous and shared legends

Load `legend` in the preamble; it depends on `Heat`. Unlike category swatches, a continuous legend describes a numeric scale and uses the same color interpolation.

Two values sharing a frozen scale and legend



```
\begingroup
\gradscale{legend-score}{min=-10,max=30}
\gradlegenddefine{legend-score}{scale group=legend-score,
  heat palette=purple-teal,
  heat center=0,legend title={Score}}
\gradheat[legend group=legend-score]{-5}
\gradheat[legend group=legend-score]{20}
\par\medskip
\gradlegenduse[width=60mm,height=3mm,legend missing=false]{legend-score}
\endgroup
```

`\gradheatlegend` accepts ordinary graphic keys plus `legend title`, `legend ticks`.

`legend missing=false` hides the missing-value item and its automatic description; `true` is the default. Both legend commands accept this switch.

Set `legend orientation` to `horizontal` or `vertical`. Width is ramp length; height is thickness. Endpoints and an interior neutral center are default ticks; custom ticks must increase within the range. The smooth ramp uses 256 vector strips. Increase precision or spacing if tick text overlaps. `\gradlegenddefine` freezes scale, direction, unit and color roles in the current group. Use `legend group=name` in standalone graphics or column options. Unknown names, duplicate declarations and contradictory scale/color/unit settings are errors. `\gradlegenduse` only accepts layout, tick formatting, font and accessibility overrides, leaving subsequent graphics unchanged.

Reference symbols have different statistical meanings

- | Declared target
- | Reference value
- Reference range
- ├─┤ Error distances
- ▣▣▣ Quartiles and observed whiskers

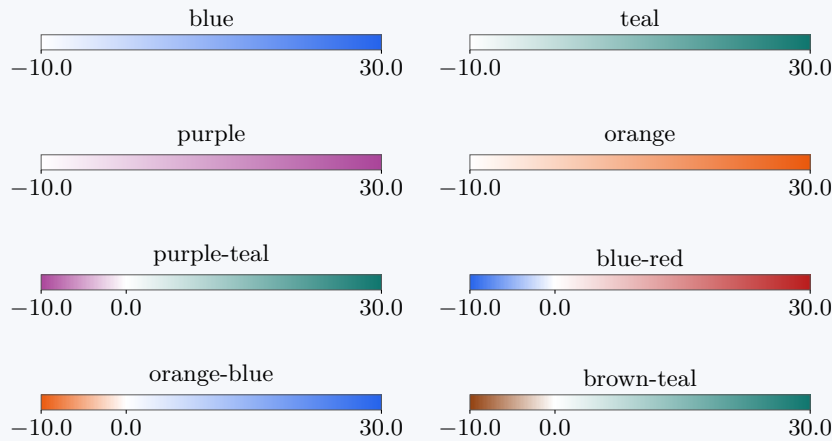
```
\gradreferencelegend{target/Declared target,
  reference/Reference value,band/Reference range,
  error/Error distances,box/Quartiles and observed whiskers}
```

Reference descriptions declare their actual meaning; neither error distances nor box whiskers automatically denote confidence intervals. For shared category or reference legends, set `legend kind=categorical|reference` and `legend names`. Repeated decoration may use `accessibility=artifact`.

14.1 Built-in Heat palettes

One `heat palette=name` selects endpoint colors, a white center and the interpolation mode. Sequential palettes `blue`, `teal`, `purple` and `orange` run from white to that color. Diverging palettes `purple-teal`, `blue-red`, `orange-blue` and `brown-teal` run from the first color through white to the second; `heat center` still sets the numeric center. These are color shortcuts, not accessibility certifications; existing accessible palettes remain available. Explicit low, center and high colors placed after the preset still override it.

Built-in continuous palettes



```
\gradheatlegend[width=45mm,height=2mm,min=-10,max=30,heat center=0,
  heat palette=blue,legend title={blue},legend missing=false]\quad
\gradheatlegend[width=45mm,height=2mm,min=-10,max=30,heat center=0,
  heat palette=teal,legend title={teal},legend missing=false]\par\medskip
\gradheatlegend[width=45mm,height=2mm,min=-10,max=30,heat center=0,
  heat palette=purple,legend title={purple},legend missing=false]\quad
\gradheatlegend[width=45mm,height=2mm,min=-10,max=30,heat center=0,
  heat palette=orange,legend title={orange},legend missing=false]\par\medskip
\gradheatlegend[width=45mm,height=2mm,min=-10,max=30,heat center=0,
  heat palette=purple-teal,legend title={purple-teal},legend missing=false]\quad
\gradheatlegend[width=45mm,height=2mm,min=-10,max=30,heat center=0,
  heat palette=blue-red,legend title={blue-red},legend missing=false]\par\medskip
\gradheatlegend[width=45mm,height=2mm,min=-10,max=30,heat center=0,
  heat palette=orange-blue,legend title={orange-blue},legend missing=false]\quad
\gradheatlegend[width=45mm,height=2mm,min=-10,max=30,heat center=0,
  heat palette=brown-teal,legend title={brown-teal},legend missing=false]
```

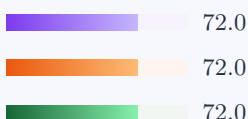
Part III

Appearance, labels and evaluation

15 Appearance, reusable styles and palettes

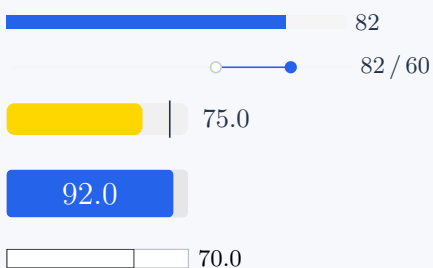
Ten themes are available: blue, teal, solid, gray, lbyellow, vibblue, cyblu, violet, orange and forest. The three new themes pair violet, warm-orange or forest-green gradients with matching pale tracks and dark value labels. Nine predefined solid colors are `lightgreen` (■), `lightyellow` (■), `lightblue` (■), `lightred` (■), `rose` (■), `skyblue` (■), `gold` (■), `lavender` (■) and `peach` (■). Use `color` for solid fill and `left color/right color` for a gradient. Standard xcolor expressions work.

Violet, warm orange and forest green themes



```
\gradbar[theme=violet]{72}
\gradbar[theme=orange]{72}
\gradbar[theme=forest]{72}
```

A reusable layout style



```
\gradbarsstyle{paperrow}{preset=paper,width=45mm,max=100,precision=0}
\gradbar[style=paperrow]{82}

\graddumbbell[style=paperrow]{60}{82}

\gradbar[preset=report,target=90,thresholds={60,80}]{75}

\gradbar[preset=presentation]{92}

\gradbar[preset=outline]{70}
```

The paper preset uses thin solid bars, a faint track and outside values. Report uses thicker rounded bars; supply actual target and threshold values yourself. Presentation uses larger type and automatic inside placement. Outline uses hollow shapes with fine strokes. Presets do not invent data or scale limits.

Group palettes are categorical (six distinct colors), sequential (five blue levels), diverging (orange through neutral to teal), and mono (gray with textures). These palettes select by segment position, not by value; short lists cycle. Named categories instead preserve identity across reordered or subsetted data:

Stable category identity and a shared legend

 90.0

 90.0

 Compute

 Storage

```
\gradbarcategory{Compute}{gradbarsBlue}{diagonal}
\gradbarcategory{Storage}{gradbarsOrange}{dots}
\gradstack[stack names={Compute,Storage}]{60,30}

\gradstack[stack names={Storage,Compute}]{30,60}

\gradbarslegend[width=50mm]{Compute,Storage}
```

Registered names override positional colors and patterns; unregistered names fall back to the current palette. Definitions are scoped. In print/mono mode, category colors use gray while registered patterns remain. Legends use the same mapping. Patterns are none, diagonal, reverse, dots, crosshatch, horizontal and vertical. Use names or textures alongside color when category distinctions matter.

15.1 Color roles with redundant cues

`palette=accessible` supplies seven Okabe–Ito color roles with cyclic stack textures; `theme=accessible` selects its solid-bar roles. Heat provides `heat palette` (`accessible-sequential`, `accessible-diverging`). Native tables accept `theme=accessible` and `style=accessible`. Existing defaults remain.

Colors, text, texture and monochrome output

 100.0

 100.0

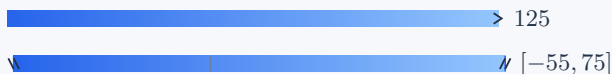
```
\gradstack[palette=accessible,width=45mm,height=16pt,
  stack names={A,B,C},segment labels=name]{30,20,50}
\par\medskip
\gradstack[palette=accessible,print,width=45mm,height=16pt,
  stack names={A,B,C},segment labels=name]{30,20,50}
```

Colors and textures cycle; keep category text, especially beyond seven categories. For gradients, center-based automatic contrast is only an estimate; use solid fills, an external label or a white label background if needed. Heat computes black/white contrast for the actual cell fill. Missing markers, hollow outlier circles and printed patterns carry meaning without relying on color alone. Alternative text retains raw data and explicit units; deliberate `alt` can replace a long description while adjacent text provides the full data.

16 Overflow indicators and marker shapes

`overflow mark=none|arrow|slash` indicates clipped values at scale boundaries. The default is `none` for individual graphics and `arrow` in `gradtable`. Exact boundary values do not produce a mark. `overflow=error` still rejects out-of-range data.

Clipping without hiding the original value



```
\gradbar[max=100,width=65mm,precision=0,overflow mark=arrow]{125}
```

```
\gradrange[min=-40,max=60,width=65mm,precision=0,
overflow mark=slash]{-55}{75}
```

Checks use raw values, interval and error endpoints, both comparison values and separate signed stack subtotals. Fixed-range sparklines check all present points. The mark indicates overflow, not quality or the amount beyond the boundary.

`marker shape` supports circle, square, diamond and triangle; `marker fill` supports solid and hollow. Dumbbell reference markers and interval estimates remain hollow to preserve their meaning. Marker size is the distance from the center to its boundary.

Shapes that remain distinguishable in monochrome



```
\gradbar[shape=lollipop,marker shape=square]{72}
```

```
\graddumbbell[marker shape=diamond]{48}{72}
```

```
\gradbar[shape=lollipop,marker shape=triangle,marker fill=hollow]{72}
```

17 Quality: higher, lower, target or interval

Higher and lower modes classify the raw value using two increasing thresholds. Lower reverses the quality colors without reversing geometry. Threshold colors are always ordered bad, intermediate, good.



Target mode evaluates $d = |v - t|$. Interval mode evaluates $d = \max(0, a - v, v - b)$ for an ordered closed interval $[a, b]$. These modes require two nonnegative increasing distance thresholds: $d \leq t_1$ is good, $t_1 < d \leq t_2$ intermediate, and $d > t_2$ bad. Thus thresholds of 0 and 10 classify values inside the interval, including its endpoints, as good. Quality target/range evaluate data; target/band draw optional references. Set them separately. Quality changes color, never positions or labels. It is not applied to stacks, floating intervals or sparklines.

18 Label placement, printing and practical limits

Labels support `outside`, `left`, `inside`, `end`, `auto` and `none`. `auto` moves a label outside when it does not fit. `end` places it above the endpoint. Comparisons, lollipops, outlined bars and intervals with a range point move internal labels outside. Sparklines always use outside labels. `text color=auto` chooses black or white. `label width` reserves an outside slot; use the same sufficiently wide slot throughout a column. Long labels may require a wider column or a custom short text.

Left labels and inline baselines

92.7% 

```
\gradbar[label=left,unit={\%},baseline=text]{92.7}
\qqquad
\gradbar[label=left,baseline=bottom]{NA}
```

`label=left` places the formatted label immediately before the track and right-aligns it within `label width`. It is intended for compact table columns where the value should read before the visual bar. `baseline=text` uses the current label font metrics; `baseline=center` and `baseline=bottom` are useful when a table row deliberately aligns graphics by their visual center or lower edge. A positive `baseline shift` moves the picture upward.

`row padding` reserves extra height above and below a graphic; it does not change the document's global row spacing. Use `arraystretch` or table row spacing when appropriate. Marker shapes reserve space consistently even when the first or last observation does not have a marker.

`print` applies gray fills, textures and white label backgrounds. Mono is a group palette using those settings. Provide textual category names and real values as well as visual distinctions. Outlined bars and legends are available through `outline=true` or the outline preset; `print` clears outline mode.

All collision handling is local to a graphic, not to the whole table. Complex axes, date parsing and large general-purpose plots are outside this package's scope. Automatic alternative descriptions are available when PDF tagging is enabled; see the tagging notes in the interface reference.

Part IV

Visual tables and data interfaces

19 Dedicated visual tables: gradtable

Declare columns, then supply data rows. No alignment separators or row-ending commands are needed.

`\gradcolumn [options]{id}{title}` requires a unique id; `\gradrow {cells}` provides comma-separated cells in declaration order. Protect text containing commas with braces. Use explicit NA for missing numbers.

Text, numbers and bars in one table

Method	Samples	Score
Method A	120	82.4
Method B	12 500	91.2
Method C	—	—

```
\begin{center}
\begin{gradtable}[align=c,header align=c,preset=paper,graphic width=48mm,
text width=24mm,label width=14mm]
\gradcolumn{method}{Method}
\gradcolumn[type=number,options={precision=0}]{n}{Samples}
\gradcolumn[type=bar,options={max=100,precision=1}]{score}{Score}
\gradrow{Method A,120,82.4}
\gradrow{Method B,12500,91.2}
\gradrow{Method C,NA,NA}
\end{gradtable}
\end{center}
```

Column `options={...}` accepts drawing options such as min, max, precision, unit, theme, target and references. All rows share those options. Number columns format values without clipping them to a drawing scale.

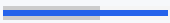
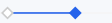
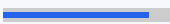
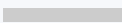
All outside labels in a column are measured before rendering. The label slot is the greater of label width and the widest actual label, and aligns values right. Wider labels do not change the graphic scale. Equal fixed precision naturally can align decimal points; use number `align=decimal` for explicit sign/exponent-aware alignment. Defaults are `graphic width=32mm`, `text width=22mm` and `label width=18mm`.

Declare every column before any group or data row. Every row must contain exactly one cell per column. Do not omit a missing field. Validation identifies the row and column id. Text wraps in text columns. By default the table uses its natural width; an explicit total width enables allocation as described below.

20 Comparison, composition and trend columns

Available types are text, number, bar, bullet, interval, compare, dumbbell, stack spark and heat. Compare and dumbbell cells use reference/current order; default labels display current/reference, while delta displays current minus reference. NA means both missing; 40/NA and NA/60 represent one missing endpoint.

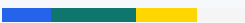
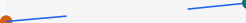
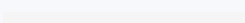
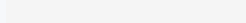
Two views of the same comparison

Method	Values	Change
A	 68 / 40	 Δ 28
B	 60 / 75	 Δ -15
C	 - / 50	 -

```
\begin{center}
\begin{gradtable}[align=c,header align=c,text width=22mm,graphic width=32mm,
  label width=12mm,column sep=6pt,row stretch=1.8]
\gradcolumn{name}{Method}
\gradcolumn[type=compare,options={max=100,precision=0}]{bars}{Values}
\gradcolumn[type=dumbbell,options={max=100,precision=0,
  compare label=delta,marker shape=diamond}]{change}{Change}
\gradrow{A,40/68,40/68}
\gradrow{B,75/60,75/60}
\gradrow{C,50/NA,50/NA}
\end{gradtable}
\end{center}
```

Stack and spark cells contain lists, so enclose each cell's list in braces. Whole-cell NA is supported. Missing individual stack contributions are not zero and must not be included in a total. A spark's missing last position retains a missing label rather than borrowing an earlier observation.

Composition and a common-scale trend

Project	Composition	Five periods
A	 80	 80
B	 65	 -
C	 -	 -

```
\begin{center}
\begin{gradtable}[align=c,header align=c,text width=22mm,graphic width=32mm,
  label width=12mm,column sep=6pt,row stretch=1.8]
\gradcolumn{name}{Project}
\gradcolumn[type=stack,options={max=100,precision=0,
  stack colors={gradbarsBlue,gradbarsTeal,gold}}]{mix}{Composition}
\gradcolumn[type=spark,options={spark range=fixed,
  min=0,max=100,precision=0}]{trend}{Five periods}
\gradrow{A,{20,35,25},{35,48,NA,65,80}}
\gradrow{B,{30,20,15},{80,70,65,NA,NA}}
\gradrow{C,NA,NA}
\end{gradtable}
\end{center}
```

Keep stack categories in a consistent order or register named categories. Use a negative min for negative contributions. Use fixed spark ranges to compare magnitudes; auto scales each cell separately and only supports shape comparison.

21 Alignment, rules and spacing

Headers follow the corresponding column unless overridden. With `align=auto`, text and graphic columns align left and number columns align right. Column settings override table settings. Use `header align=c` for centered headings.

Horizontal alignment and vertically centered text

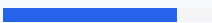
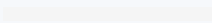
Column A	Column B	Column C	Count
Method A	Method A	Method A	120
A longer name wraps within the text column	Short	Short	5

```
\begin{center}
\begin{gradtable}[align=c,header align=c,rules=grid,valign=c,
  text width=30mm,column sep=5pt,row padding=3pt,
  header color=gradbarsBlue!8,rule color=gradbarsBlue!60!black]
\gradcolumn[align=c]{left}{Column A}
\gradcolumn[align=c]{center}{Column B}
\gradcolumn[align=c]{right}{Column C}
\gradcolumn[type=number,align=c,width=20mm,
  options={precision=0}]{number}{Count}
\gradrow{Method A,Method A,Method A,120}
\gradrow{A longer name wraps within the text column,Short,Short,5}
\end{gradtable}
\end{center}
```

`valign=t|c|b` affects text columns only, using array's p/m/b paragraph boxes. Use `align=l`, `valign=c` for left-aligned, vertically centered text.

In natural-width mode, column width fixes text wrapping but is a minimum for number and graphic cells. Graphic width controls the plot, label width controls the numeric slot, and column width controls the cell. Graphic alignment moves the complete plot-plus-label cell; numeric labels remain right-aligned internally.

A centered score heading and graphic cell

Method	Score
A	 82
B	 —

```
\begin{center}
\begin{gradtable}[align=c,header align=c,rules=rows,graphic width=28mm,label width=12mm,column sep=8pt,row
  stretch=1.4]
\gradcolumn[width=24mm,header align=c]{method}{Method}
\gradcolumn[type=bar,align=c,width=75mm,
  options={max=100,precision=0}]{score}{Score}
\gradrow{A,82}
\gradrow{B,NA}
\end{gradtable}
\end{center}
```

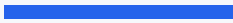
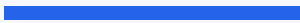
Option	Meaning
<code>rules=booktabs</code>	Default: top, header separator and bottom rules.
<code>rules=rows</code>	Also separates data rows horizontally.
<code>rules=grid</code>	Full horizontal/vertical grid and outer border.
<code>rules=none</code>	No table rules.
<code>column sep</code>	Horizontal padding per side of a column; default 6pt.
<code>row stretch</code>	Positive base row-height multiplier: paper/mono 1.2, report 1.5.
<code>row padding</code>	Extra height, default 0pt; does not scale graphics.
<code>header color</code>	Report defaults to <code>gradbarsTrack</code> ; empty clears the fill.
<code>rule color</code>	Default black; local to this table.

Spacing and widths must be nonnegative. Cell alignment does not position the whole table: use an enclosing group with centering, `raggedright` or `raggedleft`.

22 Automatic column scales and zero baselines

Column width controls available space; the numerical scale controls where values appear within that space. Table and column keys `scale=fixed|column` and `include zero=true|false` control ranges independently of width. Fixed is the default and retains min/max in drawing options. Column mode scans every row before layout and overrides those limits. Column settings override table settings; text columns ignore scaling. Manual and CSV rows use the same rules, with consistent ranges across pages. CSV selection defaults to full-data ranges; `scale=visible` selects the displayed rows instead.

Shared ranges with per-column zero settings

Method	Score	Time
A		70.0
B		90.0
Pending	—	—

```
\begin{center}
\begin{gradtable}[align=c,header align=c,width=\linewidth,scale=column,include zero=false]
  \gradcolumn{name}{Method}
  \gradcolumn[type=bar,include zero=true]{score}{Score}
  \gradcolumn[type=bar]{time}{Time}
  \gradrow{A,70,70}
  \gradrow{B,90,90}
  \gradrow{Pending,NA,NA}
\end{gradtable}
\end{center}
```

Score uses [0,90]; Time uses [70,90].

22.1 Including zero or retaining a fixed range

Missing values are ignored; zero remains an observation and is included by default. Without zero, positive-only and negative-only ranges are valid; a bar's zero baseline is clipped to the nearest range border. Keep zero when lengths must describe magnitudes from zero. Percent labels still require `min=0` and `max>0`. Use `scale=fixed` with the same limits when comparing different datasets. Targets, references and error magnitudes are not observations used for scaling; choose a fixed range when those annotations need additional space.

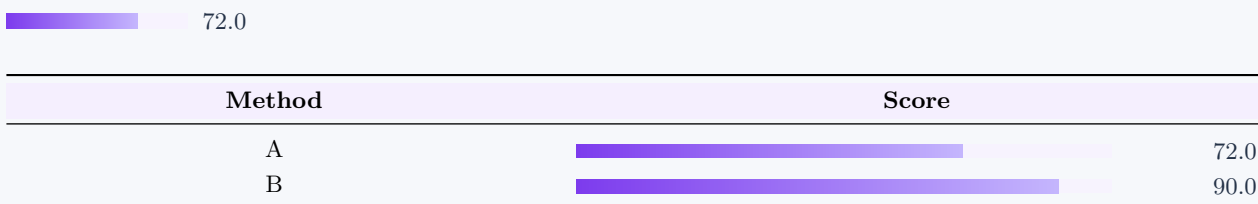
22.2 Missing, constant and compound data

All-missing or header-only columns use [0,1]; zero-inclusive all-zero columns also use [0,1]. A constant column without zero uses [value-0.5,value+0.5]. Number, bar, bullet and heat columns use scalar extrema. Pair and interval columns use endpoints and point estimates; spark columns share every observation and select a fixed range; stacks use signed cumulative totals with zero baselines.

22.3 Shared named scales across tables

`\gradscale {name}{min=lo,max=hi}` declares explicit limits with `min<max`. Scale group references work in standalone graphics or table columns. Definitions follow TeX grouping; redefinition replaces the current scope's value. Groups override drawing min/max options and do not depend on table order.

A graphic and table sharing an accuracy scale



```
\gradscale{accuracy}{min=0,max=100}
\gradbar[scale group=accuracy,theme=violet]{72}

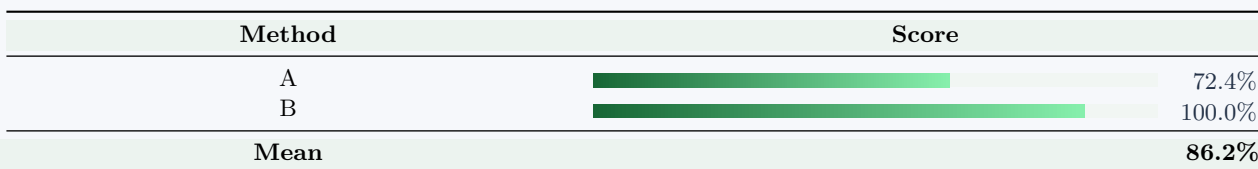
\begin{center}
\begin{gradtable}[align=c,header align=c,style=academic,theme=violet,width=\linewidth]
\gradcolumn{name}{Method}
\gradcolumn[type=bar,scale group=accuracy]{score}{Score}
\gradrow{A,72}\gradrow{B,90}
\end{gradtable}
\end{center}
```

Table/column groups require `scale=fixed`; `scale=column` is a conflict. Columns inherit table groups and can clear them with an empty scale group. Ordinary sparks select fixed group ranges; win-loss retains sign categories. Unknown groups are errors. This release does not automatically collect future tables.

22.4 Padding, nice bounds and percent denominators

Scale padding and scale nice apply only to automatic column ranges and default to 0 and false. Padding is a percentage of the original span at each nonzero endpoint, retaining zero anchors. Nice bounds round outward to a 1/2/5 step, targeting about five intervals. Column settings override table settings; fixed or named limits are unchanged.

Expanded drawing limits with the original percent basis



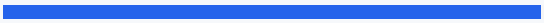
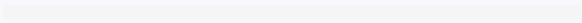
```
\begin{center}
\begin{gradtable}[align=c,header align=c,style=compact,theme=forest,width=\linewidth,
scale=column,scale padding=10,scale nice=true]
\gradcolumn{name}{Method}
\gradcolumn[type=bar,aggregate=mean,
options={value format=percent}]{score}{Score}
\gradrow{A,63}\gradrow{B,87}
\gradsummary{Mean}
\end{gradtable}
\end{center}
```

The range starts at [0,87], expands to [0,95.7] and rounds to [0,100]. Percent labels still use 87, so the old maximum stays 100%. Drawing key percent base can explicitly select another positive denominator. Without adjustment the existing max-based behavior remains. Graphic percent formatting requires `min=0`. Ranks and aggregates use raw values; heat centers must remain inside the range.

23 Allocating a total table width

`width=\linewidth` allocates the available width without scaling text. Labels, fixed columns, padding and rules are reserved first; text columns and graphic areas share the remaining space. Values keep their original scale.

A fixed number column and flexible text and graphics

Setup	Evaluation		
Method name	Score	Samples	
An improved method with a longer name		92.8	12 500
Baseline		84.6	320
Pending		–	80

```

\begin{center}
\begin{gradtable}[align=c,header align=c,width=\linewidth,label width=12mm,column sep=6pt,row padding=2pt,
min text width=18mm,min graphic width=15mm]
\gradcolumn[weight=1]{method}{Method name}
\gradcolumn[type=bar,weight=2,mark=both,
options={max=100,precision=1}]{score}{Score}
\gradcolumn[type=number,width=18mm,
options={precision=0}]{count}{Samples}
\gradheader{\gradspan{1}{Setup}\gradspan{2}{Evaluation}}
\gradrow{An improved method with a longer name,92.8,12500}
\gradrow{Baseline,84.6,320}
\gradrow{Pending,NA,80}
\end{gradtable}
\end{center}

```

Default `width=0pt` retains natural sizing. A positive column weight (default 1) shares space left after minimum widths, so `weight=2` does not mean exactly twice the final column width. Min text width and min graphic width default to 12mm; the latter excludes the label slot. Number columns do not stretch.

In total-width mode a column width fixes a text or graphic cell; number columns still grow to fit their labels. The allocated plot width overrides graphic width and any width in drawing options. Every row shares that allocated width. Headers and group titles may wrap; unbreakable words still need break points. An insufficient budget causes an error: increase the width, reduce padding or minimum widths, shorten units, or use fewer columns. Keep at least one flexible column when fixed columns leave unused space.

24 Multilevel headers and spanning titles

`\gradheader {...}` adds a header layer. Within it, `\gradspan {count}{title}` spans consecutive columns. Declare all columns first, then header layers, then groups and rows. Each layer must span exactly the total number of columns. Column titles form the bottom header layer.

Three header levels

Model evaluation			
Setup	Prediction quality		Latency
Method	Accuracy	F1	ms
A	91.4	89.7	24
B	93.2	91.5	31

```

\begin{center}
\begin{gradtable}[align=c,header align=c,rules=grid,header color=gradbarsBlue!8,text width=28mm,
column sep=8pt,row padding=3pt]
\gradcolumn[method]{Method}
\gradcolumn[type=number,width=24mm,
options={precision=1}]{accuracy}{Accuracy}
\gradcolumn[type=number,width=24mm,
options={precision=1}]{fscore}{F1}
\gradcolumn[type=number,width=24mm,
options={precision=0}]{latency}{ms}
\gradheader{\gradspan{4}{Model evaluation}}
\gradheader{\gradspan{1}{Setup}\gradspan{2}{Prediction quality}
\gradspan{1}{Latency}}
\gradrow{A,91.4,89.7,24}
\gradrow{B,93.2,91.5,31}
\end{gradtable}
\end{center}

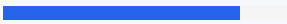
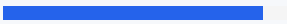
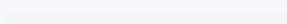
```

Spanning titles are centered, follow header color and use the chosen rules. An empty title still occupies its declared span. Layers merge horizontally, not vertically. Schemas may include headers, but no columns may follow a header.

25 Grouped rows and best-value marking

`\gradgroup {title}` inserts a full-width group heading. Each group needs at least one data row. Groups do not alter scales or participate in ranking. Group color defaults to `gradbarsTrack`; an empty value removes it. Group sep defaults to 4pt. All rule styles support groups.

Ties, second-best values and lower-is-better metrics

Method	Score	Time / s
Baselines		
A		82.4
B		90.2
Improved methods		
C		90.2
D		<u>86.7</u>
E		—

```

\begin{center}
\begin{gradtable}[align=c,header align=c,text width=30mm,
  graphic width=38mm,label width=12mm,group sep=4pt]
  \gradcolumn[method]{Method}
  \gradcolumn[type=bar,mark=both,
    options={max=100,precision=1}]{score}{Score}
  \gradcolumn[type=number,mark=both,width=24mm,
    options={better=lower,precision=1}]{time}{Time / s}
  \gradgroup{Baselines}
  \gradrow{A,82.4,12.8}
  \gradrow{B,90.2,10.5}
  \gradgroup{Improved methods}
  \gradrow{C,90.2,9.6}
  \gradrow{D,86.7,9.6}
  \gradrow{E,NA,NA}
\end{gradtable}
\end{center}

```

Best values are bold and second-best values are underlined. Mark can be none (default), best or both, for number, bar and bullet columns. Ranking covers the whole table, across groups and pages. Use **better=higher** or **better=lower** inside column options; target-distance and interval-quality ranking are not supported.

Ranking uses raw values before rounding. Equal numbers (including 2 and 2.0) tie; second best is the next distinct value. NA is excluded and zero participates. An all-missing column has no marks; an all-equal column has no second best. Increase precision if rounding hides a distinction. For stacks or trends, add a separate number column defining the metric to rank. Explain the marking in a caption.

25.1 Automatic CSV groups and within-group ranks

`group by=family` references a declared text column ID, not a CSV header. Groups follow first occurrence in the CSV and omit groups with no displayed rows. Within each group, rows retain their global-sort order. Empty text forms a real group named (ungrouped); group missing label customizes its title. Literal text NA and configured missing tokens remain separate names. Automatic groups cannot be combined with manual `gradgroup` declarations. `rank scope=group` ranks displayed observations independently in each group; the default table retains whole-table ranking. Missing numbers are skipped, zero participates, and ties/second distinct values follow the existing rules. Manual groups also support group statistics: repeated titles remain separate groups, and rows preceding the first heading form an implicit unnamed group.

Complete example: algorithm-family comparisons

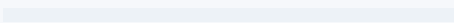
Method	Family	Score	Time / ms
Classic			
Fast	Classic		84.0
Stable	Classic		84.0
Reference	Classic		78.0
Summary			82.0
Neural			
Compact	Neural		91.0
Wide	Neural		91.0
Pending	Neural		—
Summary			91.0
All visible			85.6

```
\gradbarsloadcsv{families}{docs/data/families.csv}
\begin{center}
\begin{gradtable}[align=c,header align=c,data=families,width=\linewidth,style=academic,theme=teal,
  scale=column,group by=family,rank scope=group,group summary=true,
  sort keys={score/descending,time/ascending}]
  \gradcolumn[source=Method]{method}{Method}
  \gradcolumn[source=Family]{family}{Family}
  \gradcolumn[type=bar,source=Score,mark=both,aggregate=mean]{score}{Score}
  \gradcolumn[type=number,source=Time,mark=both,aggregate=min,
    options={better=lower,precision=0}]{time}{Time / ms}
  \gradsummary{All visible}
\end{gradtable}
\end{center}
```

Classic and Neural have mean scores of 82 and 91, with minimum times of 8 and 12. Group headings stay with the first data row; group summaries appear once with the final group row. Continued pages do not repeat group headings. Column or explicitly shared scales span all groups to preserve comparisons.

26 Summary rows and statistical scope

Set aggregate on scalar number, bar, bullet or heat columns and declare one `gradsummary` in the table. Aggregate accepts none (default), count, sum, mean, min or max. Summary cells display numbers rather than graphics, so a total outside the drawing range is not clipped.

A valid-observation mean and total latency			
Method	Score	Time	
A		72.0	20 ms
B		90.0	30 ms
Missing		–	0 ms
Summary		81.0	50 ms

```

\begin{center}
\begin{gradtable}[align=c,header align=c,style=academic,theme=teal,width=\linewidth]
  \gradcolumn{name}{Method}
  \gradcolumn[type=bar,aggregate=mean,mark=both,
    options={max=100}]{score}{Score}
  \gradcolumn[type=number,aggregate=sum,
    options={precision=0,unit={\,ms}}]{time}{Time}
  \gradrow{A,72,20}\gradrow{B,90,30}\gradrow{Missing,NA,0}
  \gradsummary{Summary}
\end{gradtable}
\end{center}

```

The score mean is 81 and latency sum is 50. Count counts valid numeric observations and displays an integer with no unit or computed percent. Missing is skipped; zero is retained. Empty/all-missing count and sum are 0; mean/min/max are missing.

26.1 Displayed rows or the full dataset

`\gradsummary [scope=visible|data]{label}` defaults to visible, after CSV filtering, sorting and limit. Data uses all imported rows; both scopes coincide for manual tables. The label occupies the first text column; use an empty label for an all-numeric table. Text/compound columns cannot be aggregated and columns without an aggregate leave empty summary cells.

Display two rows, summarize all imported observations			
Method	Score	Latency	
Model "Plus"	92.7	61.0	
Compact, tuned	81.6	88.0	
All data	61.7	4	

```

\gradbarsloadcsv{results}{docs/data/results.csv}
\begin{center}
\begin{gradtable}[align=c,header align=c,style=compact,data=results,width=\linewidth,
  sort=score,order=descending,limit=2]
  \gradcolumn[source=Model]{name}{Method}
  \gradcolumn[type=number,source=Score,aggregate=mean]{score}{Score}
  \gradcolumn[type=number,width=18mm,source=Latency,aggregate=count]{n}{Latency}
  \gradsummary[scope=data]{All data}
\end{gradtable}
\end{center}

```

The full score mean is 61.675; valid latency count is 4. Summaries do not affect ranking, ranges or source-row counts. Number columns retain their alignment, bar/bullet summaries align right and heat summaries center. Precision, units and number format are inherited and measured before width allocation. Long tables show the

summary once with their last data row. Summary color=auto follows the table theme; an empty color disables fill. Summary font defaults to bold text and math.

26.2 Group summaries and independent statistical scopes

`group summary=true` adds one numeric row per displayed group using the existing column aggregates, even without an overall `gradsummary`. Group summary label defaults to Summary in the first text column. `group summary scope=visible|data` defaults to visible; data includes all imported observations of that group, including filtered/limited-out members. Undisplayed groups do not acquire headings or summaries. Manual groups have the same rows in both scopes. Missing, zero and formatting rules match overall summaries. Group and overall scope settings are independent; color/font reuse summary color and summary font. Neither summary participates in sorting, ranks or ranges. The overall summary follows the final group summary on the same page.

Complete example: grouped experiment results			
Run	Batch	Change	Duration
First			
Trial C	First	2.0	10.0
Trial A	First	−4.0	12.0
Pending	First	—	—
Group summary		−1.0	2
Second			
Trial B	Second	6.0	15.0
Trial D	Second	0.0	11.0
Group summary		3.0	2
All visible		1.0	4


```

\gradscale{change}{min=-10,max=10}
\gradbarsloadcsv{experiments}{docs/data/experiments.csv}
\begin{center}
\begin{gradtable}[align=c,header align=c,data=experiments,width=\linewidth,theme=violet,
  group by=batch,group summary=true,group summary label={Group summary},
  sort keys={change/descending,duration/ascending}]
  \gradcolumn[source=Run]{run}{Run}
  \gradcolumn[source=Batch]{batch}{Batch}
  \gradcolumn[type=heat,source=Change,aggregate=mean,scale group=change,
    options={heat palette=diverging,heat center=0}]{change}{Change}
  \gradcolumn[type=number,source=Duration,aggregate=count]{duration}{Duration}
  \gradsummary{All visible}
\end{gradtable}
\end{center}

```

The groups have Change means of −1 and 3. Duration summaries count valid observations: two per group and four overall. The overall Change mean is 1.

27 Report and monochrome table presets

`style=matrix` provides centered cells/headers, row rules, row stretch 1.35, column separation 6pt and row padding 1pt, with an independent color theme.

Matrix style with missing values and a summary

Method	Value
A	−5.0
B	5.0
Pending	–
Mean	0.0

```
\begin{center}
\begin{gradtable}[align=c,header align=c,style=matrix,theme=teal,width=\linewidth]
  \gradcolumn{name}{Method}
  \gradcolumn[type=number,aggregate=mean]{value}{Value}
  \gradrow{A,-5}\gradrow{B,5}\gradrow{Pending,NA}\gradsummary{Mean}
\end{gradtable}
\end{center}
```

The optional `style=reference` uses booktabs rules, centered headers, decimal number alignment, `row stretch=1.25` and `column sep=6pt`. It has no mandatory color theme and leaves existing styles unchanged.

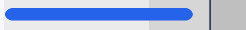
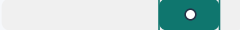
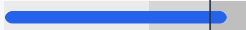
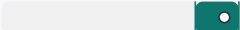
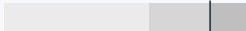
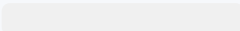
Reference table with aligned numbers

Method	Value
A	−12.125
B	1.250
Pending	–
Mean	−5.438

```
\begin{center}
\begin{gradtable}[align=c,header align=c,style=reference,theme=teal,width=\linewidth]
  \gradcolumn{name}{Method}
  \gradcolumn[type=number,aggregate=mean,options={precision=3}]{value}{Value}
  \gradrow{A,-12.125}\gradrow{B,1.25}\gradrow{Pending,NA}\gradsummary{Mean}
\end{gradtable}
\end{center}
```

Table presets are paper (thin solid bars and compact booktabs rules), report (tinted headings and taller rows) and mono (gray and textures). Column drawing options override the preset. Table presets and individual-graphic presets are separate interfaces.

Bullet and interval columns

Project	Progress	Interval
A		78  [65, 90]
B		92  [80, 98]
C		—  —

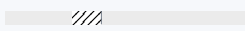
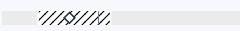
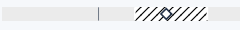
```

\begin{center}
\begin{gradtable}[align=c,header align=c,preset=report,graphic width=32mm,
text width=19mm,label width=19mm]
\gradcolumn{name}{Project}
\gradcolumn[type=bullet,options={max=100,precision=0,
bullet bands={{60/black!8},{85/black!16},{100/black!25}},
target=85}]{actual}{Progress}
\gradcolumn[type=interval,options={max=100,precision=0,
color=gradbarsTeal}]{estimate}{Interval}
\gradrow{A,78,65/78/90}
\gradrow{B,92,80/92/98}
\gradrow{C,NA,NA}
\end{gradtable}
\end{center}

```

Interval cells use lower/point/upper. NA in the point position omits only the point, while whole-cell NA omits the interval. The supplied point must lie inside the original endpoints. Bullet columns require explicit background bands.

Signed observations in monochrome

Group	Change	Interval
A		-12  [-25, 5]
B		28  [15, 45]

```

\begin{center}
\begin{gradtable}[align=c,header align=c,preset=mono,graphic width=32mm,
text width=19mm,label width=19mm]
\gradcolumn{name}{Group}
\gradcolumn[type=bar,options={min=-40,max=60,precision=0}]{change}{Change}
\gradcolumn[type=interval,options={min=-40,max=60,
precision=0,marker shape=diamond}]{range}{Interval}
\gradrow{A,-12,-25/-12/5}
\gradrow{B,28,15/28/45}
\end{gradtable}
\end{center}

```

Default tables are indivisible and can be placed in table, table* or minipage. They do not infer ranges, calculate totals or load files automatically.

27.1 Built-in table styles and independent themes

Style=academic uses paper rules, compact uses smaller text and natural widths, and dashboard uses report spacing and row rules. They use the existing named style registry; place a style before explicit overrides. Table theme accepts none (default), blue, teal, violet, orange, forest or mono. Themes set graphic fills, sequential heat endpoints and automatic header/summary fills. Column drawing options can override colors or select a diverging palette.

Academic with violet

Method	Score
A	72.0
B	90.0
Mean	81.0

```
\begin{center}
\begin{gradtable}[align=c,header align=c,style=academic,theme=violet,width=\linewidth]
  \gradcolumn{name}{Method}
  \gradcolumn[type=bar,aggregate=mean]{score}{Score}
  \gradrow{A,72}\gradrow{B,90}\gradsummary{Mean}
\end{gradtable}
\end{center}
```

Compact with forest green

Method	Score
A	72.0
B	90.0
Mean	81.0

```
\begin{center}
\begin{gradtable}[align=c,header align=c,style=compact,theme=forest,width=\linewidth]
  \gradcolumn{name}{Method}
  \gradcolumn[type=heat,aggregate=mean]{score}{Score}
  \gradrow{A,72}\gradrow{B,90}\gradsummary{Mean}
\end{gradtable}
\end{center}
```

Dashboard with warm orange

Method	Score
A	72.0
B	90.0
Mean	81.0

```
\begin{center}
\begin{gradtable}[align=c,header align=c,style=dashboard,theme=orange,width=\linewidth]
  \gradcolumn{name}{Method}
  \gradcolumn[type=bar,aggregate=mean]{score}{Score}
  \gradrow{A,72}\gradrow{B,90}\gradsummary{Mean}
\end{gradtable}
\end{center}
```

Explicit header/summary colors override auto fills; empty colors disable them. Font controls table text, while column options can style graphic label fonts. Existing paper/report/mono presets remain available. Styles do not change statistical scopes, zero baselines or numerical scales.

27.2 The research table style

Research uses booktabs, centered headers, row stretch 1.3, column separation 5pt, row padding 1pt and group separation 5pt. Number columns default to decimal alignment. No color theme or SI dependency is mandatory; all six existing table themes can be combined. Academic, compact and dashboard retain their defaults. Put explicit overrides after style selection.

Research style with the forest theme	
Method	Value
Experiment	
A	−12.125
B	1.250
Pending	–
Summary	−5.438
Overall	−5.438

```

\begin{center}
\begin{gradtable}[align=c,header align=c,style=research,theme=forest,width=\linewidth,group summary=true]
  \gradcolumn{name}{Method}
  \gradcolumn[type=number,aggregate=mean,mark=both,
    options={precision=3}]{value}{Value}
  \gradgroup{Experiment}\gradrow{A,-12.125}\gradrow{B,1.25}\gradrow{Pending,NA}
  \gradsummary{Overall}
\end{gradtable}
\end{center}

```

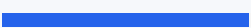
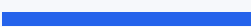
28 Reusable table styles and schemas

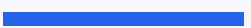
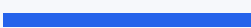
`\gradtablestyle {name}{keys}` saves table appearance.

`\gradtableschema {name}{body}` saves column and header declarations.

Use `style=name` and `\graduseschema {name}`. Definitions may be placed in the preamble. Redefinition replaces an earlier definition and follows TeX grouping.

Shared structure, different rule styles

Method	Score
Validation	
A	 81.5
B	 88.2

Method	Score
Test	
A	 79.6
B	 85.3

```
\gradtablestyle{benchmark}{rules=booktabs,header align=c,
text width=30mm,graphic width=40mm,label width=12mm,
row stretch=1.3,group color=gradbarsBlue!8}
\gradtableschema{benchmark}{
\gradcolumn{method}{Method}
\gradcolumn[type=bar,mark=both,
options={max=100,precision=1}]{score}{Score}
}
\begin{center}
\begin{gradtable}[align=c,header align=c,style=benchmark]
\graduseschema{benchmark}
\gradgroup{Validation}
\gradrow{A,81.5}
\gradrow{B,88.2}
\end{gradtable}
\end{center}

\begin{center}
\begin{gradtable}[align=c,header align=c,style=benchmark,rules=grid]
\graduseschema{benchmark}
\gradgroup{Test}
\gradrow{A,79.6}
\gradrow{B,85.3}
\end{gradtable}
\end{center}
```

Options after style override it. Styles may reference other styles and schemas may compose schemas; cycles cause errors. Ids must remain unique. Apply schemas before any data or group. Each table measures and ranks its own data separately.

29 Domain report presets

Load `\usegradbarslibrary {reports}` in the preamble. It adds correlation, ablation and metric recipes through the existing table and legend libraries. These presets display supplied data; they do not compute statistical estimates.

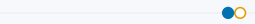
A fixed-scale correlation matrix

Variable	A	B
A	1.00	-0.38
B	-0.38	1.00

```
\begin{center}
\begin{gradtable}[align=c,header align=c,style=correlation]
\gradcolumn{name}{Variable}
\gradcorrelationcolumn{a}{A}
\gradcorrelationcolumn{b}{B}
\gradrow{A,1,-.38}\gradrow{B,-.38,1}
\end{gradtable}
\end{center}
```

Standalone `\gradcorrelation {r}` fixes $[-1,1]$, keeps zero white, uses two decimals and rejects values outside the correlation range. NA is missing. The matrix recipe does not check symmetry, significance or positive semidefiniteness.

Ablation observations: reference/current

Variant	Score change
Without feature	 $\Delta -4.00$
With extra data	 $\Delta 4.00$

```
\begin{center}
\begin{gradtable}[align=c,header align=c,style=ablation]
\gradcolumn{name}{Variant}
\gradablationcolumn{score}{Score change}
\gradrow{Without feature,80/76}
\gradrow{With extra data,80/84}
\end{gradtable}
\end{center}
```

`\gradablation [options]{reference}{current}` draws the same dumbbell alone. Its delta is current minus reference in the supplied units, not a significance test or an inferred percent change. The default range is $[0,100]$.

Metrics with separate directions and units

Model	Accuracy	Latency
A	 92.00	 35.0ms
B	 95.00	 48.0ms
C	 90.00	 28.0ms

```

\begin{center}
\begin{gradtable}[align=c,header align=c,style=metrics,width=\linewidth]
\gradcolumn{name}{Model}
\gradmetriccolumn{acc}{Accuracy}
\gradmetriccolumn[options={style=report-metric,
  better=lower,unit={ ms},precision=1}]{lat}{Latency}
\gradrow{A,92,35}\gradrow{B,95,48}\gradrow{C,90,28}
\end{gradtable}
\end{center}

```

`\gradmetric {value}` is the standalone [0,100] preset. Native metric columns scan their own ranges and mark best/second values; lower-is-better must be stated for costs. No combined score is invented. Column keys override recipe defaults; when replacing options, retain the desired report graphic style. Full examples and limits are in `docs/reports.md` and `docs/examples/domain-reports.tex`.

30 Multipage tables and repeated headers

`long=true` uses `longtable` to break between data rows. Every page repeats the full header, including spanning layers. Widths and ranking are computed for the entire table. A group heading stays with its first row; the remaining group may continue, but its name is not repeated automatically.

Place long tables directly in single-column body text, outside floats, minipages and nonbreakable example boxes. They cannot run in two-column mode. A single row cannot split. Use `caption` for a numbered title, label for referencing (requires `caption`), and `continued text` for continuation notices (default: (continued)). An empty `continued text` suppresses the notice. Compile twice to settle references.

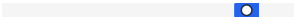
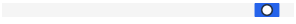
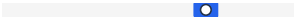
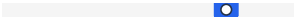
The following table is typeset directly in this manual and can cross a page boundary. Its exact source is printed afterwards. Best values are bold and the next distinct values are underlined across all records.

Table 1: Grouped benchmark

Setup		Shared evaluation set			
Method		Score	Time / s	Interval	
Experiment group A					
Method 01		70.0	8.0		[66, 74]
Method 02		77.2	11.1		[73, 81]
Method 03		84.4	14.2		[80, 88]
Method 04		91.0	17.0		[87, 95]
Method 05		70.2	20.1		[66, 74]
Method 06		77.4	23.2		[73, 81]
Method 07		84.0	9.0		[80, 88]
Method 08		<u>91.2</u>	12.1		[87, 95]
Experiment group B					
Method 09		70.4	15.2		[66, 74]
Method 10		77.0	18.0		[73, 81]
Method 11		84.2	21.1		[80, 88]
Method 12		91.4	24.2		[87, 95]
Method 13		70.0	10.0		[66, 74]
Method 14		77.2	13.1		[73, 81]
Method 15		84.4	16.2		[80, 88]
Method 16		91.0	19.0		[87, 95]
Experiment group C					
Method 17		70.2	22.1		[66, 74]
Method 18		77.4	<u>8.2</u>		[73, 81]

(continued)

Table 1: Grouped benchmark (continued)

Setup		Shared evaluation set			
Method	Score	Time / s		Interval	
Method 19		84.0	11.0		[80, 88]
Method 20		<u>91.2</u>	14.1		[87, 95]
Method 21		70.4	17.2		[66, 74]
Method 22		77.0	20.0		[73, 81]
Method 23		84.2	23.1		[80, 88]
Method 24		<u>91.4</u>	9.2		[87, 95]

Source of the multipage example

```

\begin{center}
\begin{gradtable}[align=c,header align=c,long=true,width=\linewidth,
caption={Grouped benchmark},label={tab:english-long},
continued text={(continued)},label width=12mm,column sep=6pt,row stretch=1.4,row padding=3pt]
\gradcolumn[weight=1]{method}{Method}
\gradcolumn[type=bar,weight=2,mark=both,
options={max=100,precision=1}]{score}{Score}
\gradcolumn[type=number,width=18mm,mark=both,
options={better=lower,precision=1}]{time}{Time / s}
\gradcolumn[type=interval,weight=1.5,
options={max=100,precision=0}]{range}{Interval}
\gradheader{\gradspan{1}{Setup}\gradspan{3}{Shared evaluation set}}
\gradgroup{Experiment group A}
\gradrow{Method 01,70.0,8.0,66/70/74}
\gradrow{Method 02,77.2,11.1,73/77/81}
\gradrow{Method 03,84.4,14.2,80/84/88}
\gradrow{Method 04,91.0,17.0,87/91/95}
\gradrow{Method 05,70.2,20.1,66/70/74}
\gradrow{Method 06,77.4,23.2,73/77/81}
\gradrow{Method 07,84.0,9.0,80/84/88}
\gradrow{Method 08,91.2,12.1,87/91/95}
\gradgroup{Experiment group B}
\gradrow{Method 09,70.4,15.2,66/70/74}
\gradrow{Method 10,77.0,18.0,73/77/81}
\gradrow{Method 11,84.2,21.1,80/84/88}
\gradrow{Method 12,91.4,24.2,87/91/95}
\gradrow{Method 13,70.0,10.0,66/70/74}
\gradrow{Method 14,77.2,13.1,73/77/81}
\gradrow{Method 15,84.4,16.2,80/84/88}
\gradrow{Method 16,91.0,19.0,87/91/95}
\gradgroup{Experiment group C}
\gradrow{Method 17,70.2,22.1,66/70/74}
\gradrow{Method 18,77.4,8.2,73/77/81}
\gradrow{Method 19,84.0,11.0,80/84/88}
\gradrow{Method 20,91.2,14.1,87/91/95}
\gradrow{Method 21,70.4,17.2,66/70/74}
\gradrow{Method 22,77.0,20.0,73/77/81}
\gradrow{Method 23,84.2,23.1,80/84/88}
\gradrow{Method 24,91.4,9.2,87/91/95}
\end{gradtable}
\end{center}

```

31 tabularray integration and cell-centered labels

The optional adapter requires `tabularray 2025C` (2025-11-27) or newer. Load it in the preamble:

```
\usepackage{tabularray}
\usepackage{gradbars}
\UseTblrLibrary{gradbars}
```

The external library is `tblrlibgradbars.sty`, installed with the other files from `sty/`. It loads `Heat` and the `hook/varwidth` support on demand. Repeated loading is harmless. With only `tabularray` loaded, the library also loads a minimal `gradbars` core. Ordinary documents have no `tabularray` dependency.

31.1 Columns and cell commands

`G[options]{width}`, `H[options]{width}`, `N[options]{width}` and `D[options]{width}` provide bars, heat cells, numbers and layered comparisons. `D` accepts `reference/current`; an empty cell or `NA` marks both endpoints as missing. Widths exclude column separation and rules. Protect header text with a pair of braces so it bypasses numeric conversion. Rename existing custom `G/H/N/D` types before loading this library if those names are already used.

Signed data in the `gradtblr` preset

Method	Change	Heat	Number	Before/after
A	0.5	-5.0	1.3	7.0 / -3.0
B	-9.5	5.0	-2.5	- / 4.0
Pending	+	-	-	- / -

```
\begin{group}
\gradtblrsetup{min=-10,max=10,precision=1,height=14pt,
  color=gradbarsTeal!45,negative color=red!35,
  track color=white,text color=black}
\begin{center}
\begin{gradtblr}{columns={halign=c,colspec={c G{23mm} H{23mm} N{23mm} D{35mm}}}}
Method & {Change} & {Heat} & {Number} & {Before/after}\\
A & 0.5 & -5 & 1.25 & -3/7\\
B & -9.5 & 5 & -2.5 & 4/NA\\
Pending & NA & NA & NA & NA/NA\\
\end{gradtblr}
\end{center}
\end{group}
```

The separate `gradtblr` environment adds centered cells, a tinted bold header, thin horizontal rules and spacing, without changing ordinary `tblr` defaults. Headers must still be protected. `\gradtblrsetup` accumulates defaults within the current TeX group. Precedence is graphic settings, adapter initial settings, adapter defaults, per-call options, then allocated dimensions. Adapter initial settings are `baseline=text,label=inside,label align=cell`.

Existing `Q/X` columns can select a helper with the `cmd` key:

```
cmd=\gradbarTblr      % bar
cmd=\gradheatTblr     % Heat
cmd=\gradnumberTblr   % number
cmd=\gradcompareTblr  % layered comparison
```

Each helper accepts optional settings followed by the data argument. The generic cell command has the following syntax:

```
\gradtblrcell[options]{type}{data}
```

Supported types are `bar`, `heat`, `number`, `compare`, `dumbbell` and `range`; the last three accept two slash-separated endpoints (lower/upper for range). Number cells reuse formatting, precision and units without clipping values or producing a Figure description. Load optional `siunitx` explicitly for SI formatting.

31.2 Cell alignment, widths and left labels

With `label=inside` or `label=auto`, `label align=cell` centers labels in the full graphic width regardless of the filled segment or sign. Ordinary graphics default to `label align=graphic`. None, left, outside and end retain their placement semantics. `label overflow=allow` only permits overflow; it does not select an alignment reference.

`cell width=auto` uses the available content width. Natural-column trials start from the configured graphic width and then use the allocated width. Fixed, X and spanning cells are supported. Supply an explicit cell width for standalone calls; it must fit the actual column allocation. Left/outside labels reserve their slot and gap within that total. Enlarge the slot/cell or reduce the font for long text; overflow is an error unless explicitly allowed.

Left labels preserve formatted units

Decade	Frequency
1700	0.05942% 
1710	0.03044% 

```
\begin{group}
\gradtblrsetup{min=0,max=.065,precision=5,unit=\%,
  label=left,label width=16mm,height=8pt}
\begin{center}
\begin{tblr}{columns={halign=c},colspec={c G{45mm}},row{1}={font=\bfseries}}
Decade & {Frequency}\\
1700 & .05942\\
1710 & .03044\\
\end{tblr}
\end{center}
\end{group}
```

31.3 Pagination and accessibility

Use the same columns in `longtblr` with `rowhead=1` for repeated protected text headers. Place it in single-column body text outside indivisible containers:

```
\begin{center}
\begin{longtblr}{columns={halign=c},colspec={c G[min=0,max=100]{40mm}},rowhead=1}
Method & {Score}\\
A & 72\\
B & 94\\
\end{longtblr}
\end{center}
```

Choose `gradtable` for CSV selection, automatic column scales, ranks and summaries; choose this adapter for tabulararray layout and merging. It does not add these data-processing operations to `tblr`. Explicit alt, automatic descriptions and artifact/off retain their graphic meaning. Trial measurement suspends tagging to prevent duplicate descriptions. With the basic adapter alone, repeated headers should contain text. For graphic headers and full table structure, enable the explicit interface below. Graphic descriptions do not establish PDF/UA conformance for a complete table or document.

31.4 Additional graphic columns and explicit table semantics

J/R/V/K/U/B provide dumbbell/range/spark/stack/bullet/boxplot columns with the same optional keys and mandatory width. The matching commands are `\graddumbbellTblr`, `\gradrangeTblr`, `\gradsparkTblr`, `\gradstackTblr`, `\gradbulletTblr` and `\gradboxplotTblr`. The adapter loads `stack`, `spark` and `distribution` in addition to `Heat`. Keep comma-containing series inside a guarded cell and call its helper explicitly. `Spark/stack` suppress the default main label; `bullet` columns require declared bands.

Range and distribution in native tabularray layout

Method	Range	Samples
Alpha	 [10.0, 30.0]	
Beta	—	—

```

\begin{center}
\begin{tblr}{columns={halign=c},colspec={c R{30mm} B{40mm}},hlines}
Method & {Range} & {Samples}\\
Alpha & 10/30 & {\gradboxplotTblr[cell width=40mm]{0,1,2,3,100}}\\
Beta & NA & NA\\
\end{tblr}
\end{center}

```

For a tagged document, `\gradtblrtagging` opts into Table/TR/TH/TD, scoped headers, RowSpan/ColSpan and Caption. The command belongs in a local group before the table. The source document must enable tagging itself.

```

% Before documentclass:
\DocumentMetadata{tagging=on,lang=en-US}
% Inside the document:
{\gradtblrtagging{head rows=1,row headers={1},caption={Scores}}
\begin{center}
\begin{tblr}{columns={halign=c},colspec={c G{30mm}}}}
{Method} & {Score}\\
A & 42\\
\end{tblr}
\end{center}}

```

Short tables support all three engines. Repeated tagged longtblr headers require LuaLaTeX: the first logical header is retained and subsequent copies are artifacts. The explicit `header repeat=describe` mode rebuilds each repeated header with fresh marked content beneath its original logical cells. Header callbacks are re-executed, while data rows remain unique. Explicit multilevel associations use `cell headers`; `header cells` declares irregular header cells. Addresses are 1-based row/column pairs, and references must point to real TH cells; unknown/covered cells and cycles are errors. Ordinary untagged longtblr works on all engines. Nested tagged tables and cross-page spanning cells remain outside the verified scope. Use the tagged caption option instead of native repeated captions for the tested structure. Structural tests are not reader-level certification or a claim of whole-document PDF/UA compliance.

```

\gradtblrtagging{head rows=2,row headers={1},
  header cells={3/3},cell headers={3/2={1/2,2/2,3/1}}}

```

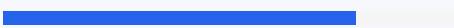
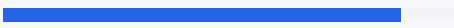
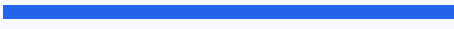
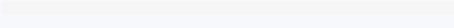
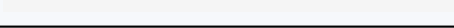
32 CSV input and numeric table columns

CSV files are read as characters, not executed as TeX. UTF-8 BOM, quoted commas, doubled quotes and custom missing tokens are supported. Fields must fit on a single line and the delimiter must be a comma. Headers must be unique and nonempty.

32.1 Binding a native gradtable data source

Load a dataset, then bind it with `data=results`. A column's `source=Score` selects an exact CSV header and defaults to its id. Fields may be reordered or reused. Omit `gradrow` in imported tables; rows follow file order, numeric missing values use the dataset's mapping and text stays literal.

CSV field binding with multiple metrics

Method	Score	Latency
Baseline		72.4
Compact, tuned		81.6
Model "Plus"		92.7
Pending		—
Zero		0.0

```
\gradbarsloadcsv{results}{docs/data/results.csv}
\begin{center}
\begin{gradtable}[align=c,header align=c,data=results,width=\linewidth,scale=column]
\gradcolumn[source=Model]{method}{Method}
\gradcolumn[type=bar,source=Score,mark=both]{score}{Score}
\gradcolumn[type=number,source=Latency,
options={precision=0}]{time}{Latency}
\end{gradtable}
\end{center}
```

Manual `gradrow` data cannot be mixed with an imported dataset. Unknown datasets or fields are errors. Quote list fields containing commas; use NA for missing observations or endpoints within compound fields. Native sources support `long=true`, with shared widths, scales, ranks and repeated headers across pages. See Section 22 for automatic ranges and Section 13 for changing a scalar column to `type=heat`.

32.2 Sorting, filtering and displaying the first rows

Sort names a declared column id; order selects ascending or descending. Numeric sorting uses raw values, places missing last in either direction and retains file order for ties. Filter combines comma-separated conditions with AND. Limit is a nonnegative integer; 0 is unlimited. Processing order is filter, stable sort, then limit.

Filter scores, then select the two lowest latencies

Method	Score	Latency
Model "Plus"	92.7	61
Compact, tuned	81.6	88

```
\gradbarsloadcsv{results}{docs/data/results.csv}
\begin{center}
\begin{gradtable}[align=c,header align=c,data=results,width=\linewidth,scale=column,
  filter={score>=75},sort=time,order=ascending,limit=2]
  \gradcolumn[source=Model]{method}{Method}
  \gradcolumn[type=bar,source=Score]{score}{Score}
  \gradcolumn[type=bar,source=Latency,
    options={better=lower,precision=0}]{time}{Latency}
\end{gradtable}
\end{center}
```

Numeric conditions support `=`, `!=`, `<`, `<=`, `>` and `>=`; for example, `filter={score>=75,time<100}`. Ordinary comparisons, including `!=`, exclude missing values; use `score=NA` or `score!=NA` to test mapped missingness. Text conditions support literal, case-sensitive `=` and `!=`; `method=` matches empty text. Protect a whole condition containing a comma, as in `filter={{method=Compact, tuned}}`. Text sorts in character order, not locale-specific collation, with empty text last. These keys require data and text, number, bar, bullet or heat columns. The loaded dataset remains unchanged; labels are not used to compare values.

32.3 Scale scope and rankings after selection

`scale scope=data` is the default: ranges still cover all imported rows.

Latency above uses `[0,125]`; `scale scope=visible` uses the retained two rows and gives `[0,88]`. Rankings always use displayed rows. An empty visible selection uses `[0,1]`. Long tables paginate after selection and retain shared ranges and rankings.

32.4 Multiple keys and grouping order

`sort keys={score/descending,time/ascending}` sorts by score first and time second. Each key requires its own direction. Nonempty sort and sort keys cannot be combined; order applies only to the old single-key option. Missing stays last at each key; equal/missing keys proceed to the next key and full ties keep CSV order.

Global top-three selection before grouping

Method	Family	Score	Time
Classic			
Fast	Classic	84.0	8.0
Neural			
Compact	Neural	91.0	12.0
Wide	Neural	91.0	20.0

```

\gradbarsloadcsv{families}{docs/data/families.csv}
\begin{center}
\begin{gradtable}[align=c,header align=c,data=families,width=\linewidth,
sort keys={score/descending,time/ascending},limit=3,group by=family]
\gradcolumn[source=Method]{method}{Method}
\gradcolumn[source=Family]{family}{Family}
\gradcolumn[type=number,source=Score]{score}{Score}
\gradcolumn[type=number,source=Time]{time}{Time}
\end{gradtable}
\end{center}

```

Selection runs filter, global stable sort, global limit, then grouping. The selected rows are Compact, Wide and Fast; the original group order displays Classic's Fast first, then Neural's Compact and Wide. Limit is a table-wide data row count, not a per-group quota. Grouping changes whole-table order while preserving relative sort order within each group.

32.5 Legacy CSV access and numeric collection columns

The following source assumes a CSV file with Name and Score columns:

```

\gradbarsloadcsv{results}{results.csv}
\begin{center}
\gradbarscsvtable{results}{Name}{Score}
\end{center}
\gradbarscsvstyle{shared}{results}{Score}
\gradbarscsv[style=shared]{results}{1}{Score}
\gradbarscsvcell{results}{1}{Name}

```

Rows are one-based. CSV range styles include zero and use a positive upper limit even for all-zero, all-negative or all-missing columns. The legacy `gradbarscsvtable` does not paginate; native `gradtable` data sources support `long=true`. A dataset definition follows grouping.

Only numbers in a common-style column

Item	Value
A	72
B	-20
C	0
D	-

```

\gradbarscolumn{G}{width=35mm,min=-50,max=100,precision=0}
\begin{center}
\begin{tabular}{@{}cG@{}}
\toprule
\multicolumn{1}{c}{Item} & \multicolumn{1}{c}{Value} \\ \midrule
A & 72 \\ B & -20 \\ C & 0 \\ D & NA \\ \bottomrule
\end{tabular}
\end{center}

```

Numeric columns use `colcell`. Use `multicolumn` for text headings. They do not calculate a range and are not `siunitx` S columns. Avoid placing complete drawing commands in a numeric collection cell. `tabular` and `longtable` workflows are documented; `tabularray` uses the separate adapter described in its own chapter.

32.6 Compact numeric columns without cell commands

`\gradbarscolumn*{G}{options}` supplies text-baseline, inside labels centered in the whole cell, and blank handling. It belongs to the already loaded `csv` library; no CSV file or user-defined collector is needed. Explicit options override those defaults. `\gradbarshead {text}` makes a centered text heading that bypasses numeric conversion.

One column declaration, numbers in the cells

Method	Precision	Recall
Alpha	1.000	0.968
Beta		0.750
Zero	0.000	—

```
\gradbarscolumn*{G}{max=1,width=14mm,precision=3,
  theme=gray,height=3ex,font=\small}
\begin{center}
\begin{tabular}{@{}cGG@{}}
\toprule
Method & \gradbarshead{Precision} & \gradbarshead{Recall}\\\midrule
Alpha & 1.000 & 0.968\\
Beta & & 0.750\\
Zero & 0 & NA\\\bottomrule
\end{tabular}
\end{center}
```

Literal empty cells stay blank and reserve the configured graphic width; NA remains an explicit missing value and zero is drawn normally. The unstarred interface retains its earlier defaults and missing-value behavior. The starred form rejects existing or reserved column names; choose an unused letter. Use standard `multicolumn` for grouped headings. No automatic range or ranking is added. The complete four-tool Precision/Recall example is in `docs/examples/precision-recall.tex`.

33 Research number columns and semantic units

33.1 Optional siunitx formatting

Formatter=builtin preserves existing output. Load siunitx v3 explicitly and select `formatter=siunitx`; tables and columns also have formatter defaults and overrides, independent of standalone setup. Drawing keys in column options can override them. The adapter maps precision and fixed/grouped/scientific display using public num and unit interfaces, without passing a graphic to an S column. Missing v3 dependencies produce an error. This is a defined subset of siunitx, not support for every formatting option or uncertainty input.

```
\usepackage{siunitx}
\usepackage{gradbars}
\gradbar[formatter=siunitx,precision=3,
  unit code={\milli\second},unit text={milliseconds}]{1.23456e1}
```

Legacy unit remains a literal suffix. Unit code requires the SI formatter and readable unit text; do not combine both unit forms or attach semantic units to computed-percent labels. Missing has no suffix and count summaries suppress units. Automatic descriptions retain raw values and readable unit text rather than unit macros; explicit alt still replaces the complete description.

33.2 Decimal points, signs and exponents

Number `align=decimal` applies only to number columns. A table default leaves text/graphic columns unchanged; explicitly selecting it for a graphic errors. Both sides are measured across displayed data and group/overall summaries before width allocation. Align locates the whole number block. Scientific displays align mantissas and reserve exponent/unit space; `precision=0` aligns integer endpoints and missing labels are centered. Display rounding ties go away from zero while statistics retain raw values. Increase explicitly insufficient column widths. Long tables retain the same anchors across pages.

Complete example: precision and elapsed time

Method	Family	Score	Time
Classic			
Fast	Classic	86.00	8.375 ms
Reference	Classic	<u>81.25</u>	<u>125.000 ms</u>
Summary			83.63 8.375 ms
Neural			
Compact	Neural	91.50	12.000 ms
Wide	Neural	91.50	<u>20.250 ms</u>
Pending	Neural	—	—
Summary			91.50 12.000 ms
Overall			87.56 8.375 ms

```

\gradbarsloadcsv{precision}{docs/data/precision-time.csv}
\begin{center}
\begin{gradtable}[align=c,header align=c,data=precision,width=\linewidth,style=research,theme=teal,
  formatter=siunitx,group by=family,rank scope=group,group summary=true,
  sort keys={score/descending,time/ascending}]
  \gradcolumn[source=Method]{name}{Method}
  \gradcolumn[source=Family]{family}{Family}
  \gradcolumn[type=bar,source=Score,aggregate=mean,mark=both,
    options={precision=2}]{score}{Score}
  \gradcolumn[type=number,source=Time,aggregate=min,mark=both,
    options={precision=3,better=lower,
      unit code={\milli\second},unit text={milliseconds}}]{time}{Time}
  \gradsummary{Overall}
\end{gradtable}
\end{center}

```

Group minimum times are 8.375 and 12 milliseconds. Both Neural scores of 91.5 are group bests, and the missing row acquires no unit.

Complete example: metrics of different magnitudes

Method	Residual	Count	Rate
A	1.25×10^{-4}	1.20×10^6	0.025 s
B	-2.50×10^{-3}	9.75×10^5	1.250 s
C	0.00×10^0	2.00×10^6	12.500 s
Pending	–	–	–
Summary	-7.92×10^{-4}	4.18×10^6	4.592 s

```

\gradbarsloadcsv{magnitudes}{docs/data/magnitudes.csv}
\begin{center}
\begin{gradtable}[align=c,header align=c,data=magnitudes,style=research,theme=violet,
width=0pt,text width=20mm,column sep=6pt,
row stretch=1.15,row padding=1pt]
\gradcolumn[source=Method]{name}{Method}
\gradcolumn[type=number,source=Residual,aggregate=mean,mark=both,
options={precision=2,number format=scientific,better=lower}]{residual}{Residual}
\gradcolumn[type=number,source=Count,aggregate=sum,formatter=siunitx,
options={precision=2,number format=scientific}]{count}{Count}
\gradcolumn[type=number,source=Rate,aggregate=mean,
options={precision=3,unit={\,s}}]{rate}{Rate}
\gradsummary{Summary}
\end{gradtable}
\end{center}

```

The residual mean is approximately -7.9167×10^{-4} and the Count sum is 4.175×10^6 . Display precision changes neither statistic.

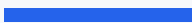
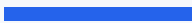
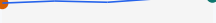
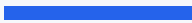
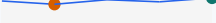
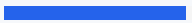
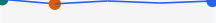
This number-only table uses `width=0pt` for natural sizing, avoiding unused width in the method column.

Part V

Complete layout examples

34 A complete benchmark table

Use shared scales within each column, explicit units and a stated ranking rule. This example combines a score, latency, before/after change and recent history. Best score and lowest latency are bold; missing observations remain missing.

Model comparison with a grouped header						
Setup		Performance		Comparison		
Method		Score	ms	Change	Five periods	
A		82.4	14.8		Δ 14.4	 82.4
B		91.6	18.2		Δ 15.6	 91.6
C		87.3	11.5		Δ 7.3	 87.3
D		78.9	9.6		Δ -4.1	 78.9

```

\begin{center}
\begin{gradtable}[align=c,header align=c,width=\linewidth,label width=8mm,column sep=3pt,min text width=12mm,
min graphic width=15mm,row stretch=1.7]
\gradcolumn[method]{Method}
\gradcolumn[type=bar,mark=best,weight=1.2,
options={max=100,precision=1}]{score}{Score}
\gradcolumn[type=number,width=15mm,mark=best,
options={better=lower,precision=1}]{time}{ms}
\gradcolumn[type=dumbbell,options={max=100,precision=1,
compare label=delta}]{change}{Change}
\gradcolumn[type=spark,options={spark range=fixed,
min=0,max=100,precision=1}]{trend}{Five periods}
\gradheader{\gradspan{1}{Setup}\gradspan{2}{Performance}}
\gradspan{2}{Comparison}}
\gradrow{A,82.4,14.8,68/82.4,{68,74,70,78,82.4}}
\gradrow{B,91.6,18.2,76/91.6,{76,81,78,87,91.6}}
\gradrow{C,87.3,11.5,80/87.3,{80,72,83,78,87.3}}
\gradrow{D,78.9,9.6,83/78.9,{83,72,79,74,78.9}}
\end{gradtable}
\end{center}

```

The dumbbell connects reference and current values, and its label shows their difference. All trends share 0–100 vertically and equal observation spacing. These numbers are demonstrations, not experimental findings.

35 Two-column papers, print and slides

35.1 A narrow paper column

Use `width=\linewidth` in the local column or minipage; reduce horizontal padding and the reserved label slot before reducing font size. A normal `gradtable` can be inside a table float; a wide table* can span both paper columns.

A table fitted to an 80mm column

Method	Score
Baseline	82.4
Proposed	91.6

```
\begin{minipage}{80mm}
\begin{center}
\begin{gradtable}[align=c,header align=c,width=\linewidth,preset=paper,label width=8mm,column sep=3pt,min text
width=12mm,
min graphic width=15mm]
\gradcolumn[method]{Method}
\gradcolumn[type=bar,mark=best,
options={max=100,precision=1}]{score}{Score}
\gradrow{Baseline,82.4}
\gradrow{Proposed,91.6}
\end{gradtable}
\end{center}
\end{minipage}
```

Use the multipage example in the preceding part for long results lists. Long mode must be outside floats and two-column text, rather than shrinking an entire long table.

35.2 Monochrome printing

Use `preset=mono` for tables, print for individual graphics, and registered textures for categories. Keep numeric labels and category names. Explain bold and underline marking. Print a sample at its final scale: very fine textures may disappear.

Category shares with a matching print legend



```
\gradstack[print,width=75mm,height=17pt,
stack names={Train,Validation,Test},
stack patterns={diagonal,dots,crosshatch},
legend=true,segment labels=percent,precision=0]{60,25,15}
```

35.3 Beamer slides

Use fewer rows, larger text and stronger contrast. Individual graphics support `preset=presentation`. The following is a complete source for a separate slide:

```
\documentclass{beamer}
\usepackage{gradbars}
\begin{document}
\begin{frame}{Progress toward the target}
```

```
\gradbarssetup{preset=presentation,width=.6\linewidth,  
  max=100,precision=0,target=90}  
\gradbar{82}  
\end{frame}  
\end{document}
```

Ordinary tables can be placed in a frame. Long mode is not a mechanism for splitting a visual table into slides; choose the rows for each frame explicitly.

Part VI

Questions and interface reference

36 Frequently asked questions

Why does a long label overflow? Outside labels need room in addition to the plot. Increase label width, shorten a unit, or use text to give a shorter label. Gradtable measures the widest label per column; increase the total width or reduce padding if its reserved labels leave insufficient graphic space. Unbreakable text still needs explicit break opportunities.

How do I adjust row height? In gradtable use row stretch and row padding; for a standalone graphic use row padding. In a standard tabular, arraystretch also changes row height. References and change annotations may need additional headroom.

Why do equal values have different lengths? Use the same min, max and graphic width within a comparison column. Spark auto ranges rescale each series; use fixed for magnitude comparisons. Formatting does not change geometry.

Is NA the same as zero? No. Zero is an observed value and participates in ranking. NA is missing. A spark keeps its missing position and breaks the line. A missing stack contribution cannot safely be treated as zero.

Why did a table not break across pages? Normal gradtable is indivisible. Set `long=true` in single-column body text, outside a float or minipage. Individual rows cannot split. A group heading stays with its first row, but its name is not repeated on subsequent pages.

Why are two identical-looking labels ranked differently? Ranking uses raw values, not rounded labels. Increase precision. Ties mark all equal raw values; second best means the next distinct value in the chosen table or group scope.

37 Compact option reference

Option	Default / meaning
width, height	24mm, 1.5ex; sparklines default to 4ex high.
min, max	0, 100; common scale.
precision, number format	1; fixed, grouped or scientific.
unit, text	Empty; suffix or complete custom label.
label, label width	outside, 4.5em; label also accepts left.
baseline, baseline shift	auto, 0pt; text, center or bottom presets.
rounded, row padding	0pt, 0pt; nonnegative lengths.
marker size, stem width	2pt, .6pt; positive lengths.
outline, outline width	false, .4pt; positive width.
compare color, compare ratio	black!20, .45; ratio strictly between 0 and 1.
compare label	values, delta or percent.
stack totals	net or separate.
stack colors	gradbarsBlue, gradbarsTeal, gold; cyclic.
stack names, legend	Empty list; false.
segment labels	none, value, percent, name, name value, name percent.
better	higher, lower, target, interval.
quality target, quality range	Required for their respective modes; no default.
spark range, spark points	auto; extrema.
overflow	clip or error.
negative fill	solid; gradient with negative left color and negative right color.

38 Table and annotation reference

Interface / option	Purpose
<code>\gradcolumn [...]{id}{title}</code>	Declare a unique column before rows.
<code>\gradrow {cells}</code>	Comma-separated cells in column order.
<code>\gradheader {spans}</code>	Add a full header layer before data.
<code>\gradspan {n}{title}</code>	Span n consecutive columns in that layer.
<code>\gradgroup {title}</code>	Full-width heading followed by data.
<code>\gradtablestyle {name}{keys}</code>	Reuse table options with <code>style=name</code> .
<code>\gradtableschema {name}{body}</code>	Reuse declarations with <code>graduseschema</code> .
<code>mark=none best both</code>	Raw-value ranking for number/bar/bullet.
<code>width, weight</code>	Total width and flexible-column allocation.
<code>long=true</code>	Paginate, repeating complete headers.
<code>caption, label</code>	Long-table title and reference; label needs caption.
<code>overflow mark</code>	none, arrow or slash at clipped boundaries.
<code>marker shape</code>	circle, square, diamond or triangle.
<code>compare annotation</code>	none, arrow or bracket.
<code>compare label</code>	values, delta or percent.
<code>references</code>	value/color/style/name records.
<code>bullet bands</code>	Increasing upper-bound/color records ending at max.

Neither table buffering nor the drawing commands infer scientific meaning from your data. Set scales, units, uncertainty interpretation, category identity and quality direction explicitly. Horizontal header spans are supported; vertical cell merging is not supported. Scalar overall and group summaries are supported.

38.1 Tagged PDF and alternative text

On a LaTeX distribution supporting PDF tagging, enable it with `DocumentMetadata` before `documentclass`. Independent graphics generate English alternative text from raw data: values, units, scales, error distances, reference lines, comparison endpoints and differences, stack segments and subtotals, and every spark observation including missing positions. Intervals describe supplied endpoints and estimates; confidence levels are not inferred. Legends describe their category names.

```
\DocumentMetadata{tagging=on,pdfstandard=ua-2,lang=en-US}
\documentclass{article}
\usepackage{gradbars}
\begin{document}
\gradbar{72}
\gradbar[alt={Accuracy: 72 percent, out of 100 percent.}]{72}
\graddumbbell[compare label=delta]{58}{76}
\end{document}
```

Use `alt` to supply context or another language. Empty `alt` restores automatic text; the existing `/tikz/alt` syntax remains supported. Accessibility defaults to `auto`. Use `accessibility=artifact` only when surrounding text fully conveys the graphic's information. `accessibility=off` leaves tagging to the surrounding code. These options do not change visible output when tagging is disabled.

Descriptions use raw values before rounding. The `text` option only changes the visual label; use `alt` to change its semantic description. Table measurement does not produce tags, so each rendered graphic cell has one description. Inside an existing TikZ picture, describe the complete graphic using the outer picture's `alt`. Automatic descriptions do not establish document-wide PDF/UA conformance: validate table headers, reading order, fonts and other content separately.

Contact and maintenance

Author and maintainer: SuFan (Tape5try). Contact 3546236610@qq.com or the [issue tracker](#). Include a minimal source, engine and log. Distributed under the MIT license.