${\tt tabularray} \ and \ {\tt kableExtra}$

Flexible LATEX tables

Table of contents

Why use tabularray?	2
Text styles	4
Colors	4
Precedence: Rows, Columns, Cells	6
Lines: Horizontal and Vertical	6
Width	7
Cell-specific settings	8
Extra tabularray arguments	9
Solved bugs	9
Issue #616	10
Issue #634	11
Issue #636	11
Issue #645	12
Issue #660	12
Issue #701	13
Issue #738	14
Remaining bugs	15
Issue #366	15
Issue #571	17

This vignette requires this kableExtra development branch:

```
remotes::install_github("vincentarelbundock/kableExtra@tabularray")
```

This vignette demonstrates how to harness the capabilities of tabularray and kableExtra for crafting advanced LATEX tables in R. Readers will learn to use the kbl() function for transforming data frames into sophisticated LATEX tables. The integration of kableExtra with tabularray brings a host of benefits, including versatile cell alignment and the ability to create colorful, multirow, and multicolumn tables. The guide covers controlling rows, columns, cells, line manipulation, and table width management, aiming to equip users with the knowledge to create responsive, visually appealing, and well-structured LATEX tables.

Click here to visit the tabularray website and read its documentation.

To create tables with tabularray in kableExtra, users only need to set the tabular argument of the kbl function:

```
library(kableExtra)

df <- data.frame(Car = row.names(mtcars), mtcars[, 1:3])[1:4,]
row.names(df) <- NULL

kbl(df, tabular = "tblr")</pre>
```

Car	mpg	cyl	disp
Mazda RX4	21.0	6	160
Mazda RX4 Wag	21.0	6	160
Datsun 710	22.8	4	108
Hornet 4 Drive	21.4	6	258

Why use tabularray?

kableExtra supports the tabularray package for LaTeX to create tables with advanced formatting options. tabularray offers several benefits:

- Versatile cell alignment
- Multirow and multicolumn support
- Flexible column types
- Advanced line customization
- Colorful table options
- Improved vertical spacing

- Compatibility with LATEX3
- Support for long tables
- Integration with popular LATEX libraries

One of the most important benefits of using tabularray is that code generated by kableExtra is very readable, and much easier to edit manually than when using other LATEX packages. For example, here is the code for a table with colored and bolded rows:

```
kbl(df, tabular = "tblr") |>
    row_spec(2:3, bold = TRUE, background = "pink") |>
    cat()
\begin{tblr}{
colspec={Q[halign=1]Q[halign=r]Q[halign=r]},
rowspec={Q[]Q[]Q[bg=pink, font=\bfseries]Q[bg=pink, font=\bfseries]Q[]Q[]},
}
\hline
Car & mpg & cyl & disp\\
\hline
Mazda RX4 & 21.0 & 6 & 160\\
Mazda RX4 Wag & 21.0 & 6 & 160\\
Datsun 710 & 22.8 & 4 & 108\\
Hornet 4 Drive & 21.4 & 6 & 258\\
\hline
\end{tblr}
```

Here are some of the important things to notice:

- The tabular environment starts with \being{tblr} and ends with \end{tblr}.
- The data and style are completely independent: The tabular content is untouched, and we add colspec and rowspec headers to specify the style.
- Each row and each column gets a Q[] entry, which acts as a styling operator. We can insert arguments in the square brackets to change the style of all the cells in a column or row. The available arguments are described in the tabularray documentation.

In contrast, when using other LATEX packages, each entry of the table must be modified, which arguably makes the code messier and harder to edit:

```
kbl(df, format = "latex") |>
  row_spec(2:3, bold = TRUE, background = "pink") |>
  cat()
```

```
\begin{tabular}[t]{l|r|r|r}
\hline
Car & mpg & cyl & disp\\
\hline
Mazda RX4 & 21.0 & 6 & 160\\
\hline
\cellcolor{pink}{\textbf{Mazda RX4 Wag}} & \cellcolor{pink}{\textbf{21.0}} & \cellcolor{pink}\hline
\cellcolor{pink}{\textbf{Datsun 710}} & \cellcolor{pink}{\textbf{22.8}} & \cellcolor{pink}{\hline
Hornet 4 Drive & 21.4 & 6 & 258\\
\hline
\end{tabular}
```

Text styles

The core functions to modify text styles in kableExtra are cell_spec(), row_spec(), and column_spec(). All the arguments of these functions are supported, except for 3 arguments of the row_spec() function: angle, font_size, and align. Users can achieve a similar effect using the cell_spec() function (see the section below on cell-specific settings).

Here is an example of a table with bold text and strikethroughs:

```
kbl(df, tabular = "tblr") |>
  row_spec(2:3, bold = TRUE) |>
  column_spec(1, strikeout = TRUE)
```

Car	mpg	cyl	disp
Mazda RX4	21.0	6	160
Mazda RX4 Wag	21.0	6	160
Datsun 710	22.8	4	108
Hornet 4 Drive	21.4	6	258

Colors

In tabularray, color names are supported through the integration of the xcolor and ninecolors packages. The xcolor package is a comprehensive solution in LaTeX for color customization, offering a wide range of predefined color names and the ability to define custom colors using various color models like RGB, CMYK, and HTML. This flexibility allows

for precise color specification and is ideal for setting text, table elements, and other document components in LaTeX.

The basic LATEX colors are: black, blue, brown, cyan, darkgray, gray, green, lightgray, lime, magenta, olive, orange, pink, purple, red, teal, violet, white, yellow.

The ninecolors package adds suffix to 9 of those colors to set 1 of 13 different hues: gray, red, brown, yellow, olive, green, teal, cyan, azure, blue, violet, magenta, purple. For all colors, 0 means black, and 10 is white. Two colors with the same numbered suffix have the same luminance (ex: gray3 and olive3). These nine colors are carefully selected to ensure proper color contrast according to the Web Content Accessibility Guidelines (WCAG). This feature is particularly useful for creating documents with high readability and accessibility standards. To get proper WCAG Color Contrast, the ninecolors author recommends choosing two colors with different names, with at least a 5 unit difference in level.

The col_spec(), row_spec(), and cell_spec() functions support these colors out of the box:

```
df |>
  kbl(tabular = "tblr") |>
  column_spec(1, color = "purple3") |>
  row_spec(2:3, background = "azure9")
```

Car	mpg	cyl	disp
Mazda RX4	21.0	6	160
Mazda RX4 Wag	21.0	6	160
Datsun 710	22.8	4	108
Hornet 4 Drive	21.4	6	258

Of course, kableExtra themes are also supported:

```
df |>
  kbl(tabular = "tblr") |>
  kable_styling(latex_options = "striped")
```

Car	mpg	cyl	disp
Mazda RX4	21.0	6	160
Mazda RX4 Wag	21.0	6	160
Datsun 710	22.8	4	108
Hornet 4 Drive	21.4	6	258

Precedence: Rows, Columns, Cells

In some contexts, user-specified settings like cell colors or text styles enter in conflict. In such cases, these two rules are applied:

- 1. cell_spec() settings have the highest precedence.
- 2. The last function call determines if row or column settings have precedence: column_spec() vs row_spec()

In the following example, we define conflicting background colors at the cell, column, and row level. In that case, the cell wins. When there is only a conflict between rows and columns, rows win because row_spec() is called after column_spec().

```
df2 <- df
df2[1, 1] <- cell_spec(df2[1, 1], background = "yellow", format = "tblr")
kbl(df2, tabular = "tblr", escape = FALSE) |>
    column_spec(1:2, background = "pink") |>
    row_spec(1:2, background = "azure8")
```

Car	mpg	cyl	disp
Mazda RX4	21.0	6	160
Mazda RX4 Wag	21.0	6	160
Datsun 710	22.8	4	108
Hornet 4 Drive	21.4	6	258

Lines: Horizontal and Vertical

The tabularray package offers advanced table formatting options in LATEX, especially for vertical and horizontal lines. The syntax to control these lines is slightly different than for other output format in kableExtra, so it deserves some explanation. Consider this example:

```
kbl(df,
    tabular = "tblr",
    toprule = "", midrule = "", bottomrule = "",
    linesep = "hlines={dash=dotted, fg=brown6}",
    vline = "vlines={dash=dashed, fg=green4, wd=2pt}"
)
```

Car	mpg	cyl	disp
Mazda RX4	21.0	6	160
Mazda RX4 Wag	21.0	6	160
Datsun 710	22.8	4	108
Hornet 4 Drive	21.4	6	258

To achieve this result, we began by removing the default horizontal rules (toprule, midrule, bottomrule), otherwise, there would be double horizontal lines in the table. Then, we use the linesep argument to tell tabularray how to format horizontal lines in the table, and the vline argument to control vertical lines.

When vlines and hlines are in plural form, they control all lines in the table. tabularray also supports another syntax for specifying individual lines. For example, we can control the color, width, and type of lines as follows::

```
kbl(df,
    tabular = "tblr",
    toprule = "", midrule = "", bottomrule = "",
    linesep = "hline{1-6}={dash=solid, fg=brown6}",
    vline = "vline{2,3}={dash=dotted, fg=green4}"
)
```

Car	mpg	cyl	disp
Mazda RX4	21.0	6	160
Mazda RX4 Wag	21.0	6	160
Datsun 710	22.8	4	108
Hornet 4 Drive	21.4	6	258

Width

To fix the width of certain columns or expand the table to full page width, kableExtra can use X or Q columns in tabularray. X columns are designed for scenarios where you want the table columns to automatically adjust their widths to fill the entire available space. This feature is particularly useful for creating tables that span the full width of a page or container. When you use X columns, the width of each column is proportionally divided based on the available space, allowing for a responsive and evenly distributed layout. On the other hand, Q columns function like the standard p columns in LATEX, where you manually specify the width of each column. The content in these columns is wrapped to fit within the set width. This

type of column is ideal when precise control over column width is needed, such as in tables with varying content lengths or specific design requirements.

When using the kable_styling() function in R for LATEX output and setting full_width = TRUE, the table automatically employs X columns. This configuration makes the table expand to fill the width of its container, with each column adjusting its width to fit proportionally. This is a key feature for creating full-width tables that need to be responsive and aesthetically balanced in their layout.

This example illustrates how to customize the width of a single columns, while expanding the rest of the table to fill the entire page width:

```
kbl(df,
    tabular = "tblr",
    align = "lccc") |>
    kable_styling(full_width = TRUE) |>
    column_spec(1, width = "8cm")
```

Car	mpg	cyl	disp
Mazda RX4	21.0	6	160
Mazda RX4 Wag	21.0	6	160
Datsun 710	22.8	4	108
Hornet 4 Drive	21.4	6	258

Cell-specific settings

To apply cell-specific settings, we can use the cell_spec() function. In kbl(), it is necessary to use escape=TRUE and tabular="tblr". In cell_spec(), it is necessary to use tabular="tblr":

```
df2 <- df
df2[2, 2] <- cell_spec(
    df2[2, 2],
    background = "pink",
    align = "c",
    color = "azure2",
    font_size = 20,
    angle = 45,
    format = "tblr")</pre>
```

kbl(df2,	tabular	=	"tblr",	escape	=	FALSE)
,	00000		, ,			

Car	mpg	cyl	disp
Mazda RX4	21	6	160
Mazda RX4 Wag	2>	6	160
Datsun 710	22.8	4	108
Hornet 4 Drive	21.4	6	258

Extra tabularray arguments

The tabularray document describes many other arguments which are available to control cells, rows, and columns of a table. For example, the ht argument can control the height of a row.

kableExtra does not have a height argument, but it is possible (and fun) to push through extra (unspecified) tabularray arguments through background argument. To understand how this works, note that when we call background="red", kableExtra simply adds a string to the rowspec header: fg=red. If we extend the background entry, then we can specify height and vertical alignment too. Here, we use f for "foot" (also: h, m) and specify the height in em units (also: cm, pt, in):

```
kbl(df, tabular = "tblr") |>
row_spec(2, background = "pink, ht=3.5em, valign=f")
```

Car	mpg	cyl	disp
Mazda RX4	21.0	6	160
Mazda RX4 Wag	21.0	6	160
Datsun 710	22.8	4	108
Hornet 4 Drive	21.4	6	258

Solved bugs

This section prints several tables which previous included bugs, as reported by kableExtra users on the issue tracker. This illustrates that tabularray solves many longstanding prob-

lems.

```
mtcars %>%
  head(n = 10) %>%
  kbl(tabular = "tblr") %>%
  kable_styling() |>
  row_spec(seq(1, 10, by = 2), background = "gray8, ht=1cm") |>
  row_spec(seq(2, 10, by = 2), background = "white, ht=1cm")
```

	mpg	cyl	disp	hp	drat	wt	qsec	VS	am	gear	carb
Mazda RX4	21.0	6	160.0	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag	21.0	6	160.0	110	3.90	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108.0	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258.0	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout	18.7	8	360.0	175	3.15	3.440	17.02	0	0	3	2
Valiant	18.1	6	225.0	105	2.76	3.460	20.22	1	0	3	1
Duster 360	14.3	8	360.0	245	3.21	3.570	15.84	0	0	3	4
Merc 240D	24.4	4	146.7	62	3.69	3.190	20.00	1	0	4	2
Merc 230	22.8	4	140.8	95	3.92	3.150	22.90	1	0	4	2
Merc 280	19.2	6	167.6	123	3.92	3.440	18.30	1	0	4	4

```
cs_dt <- mtcars[1:10, 1:2]
cs_dt$mpg = cell_spec(cs_dt$mpg, align = "c")
kbl(cs_dt, tabular = "tblr", escape = FALSE) %>%
kable_styling(latex_options = "striped")
```

	mpg	cyl
Mazda RX4	21	6
Mazda RX4 Wag	21	6
Datsun 710	22.8	4
Hornet 4 Drive	21.4	6
Hornet Sportabout	18.7	8
Valiant	18.1	6
Duster 360	14.3	8
Merc 240D	24.4	4
Merc 230	22.8	4
Merc 280	19.2	6

```
set.seed(1024)
paint <- function(x) {
   col <- ifelse(x < 0.5, "yellow", "red")
   sapply(seq_along(x), function(i) cell_spec(
      formatC(x[i], format = "f", digits = 2), background = col[i], format = "tblr")
   )
}
DF <- data.frame(V1 = sample(letters,10,T), V2 = abs(rnorm(10)), V3 = abs(rnorm(10)))
DF[,-1] = lapply(DF[,-1], paint)

kbl(DF, tabular = "tblr", digits = 2, escape = FALSE) |>
   kable_styling(latex_options = "striped")
```

V1	V2	V3
u	1.74	0.38
v	0.11	0.84
u	0.91	0.58
m	1.06	1.45
О	0.02	0.28
x	0.29	1.12
m	0.03	1.32
p	0.73	1.41
g	0.53	0.94
h	0.20	2.28

```
mtcars[1:3, 1:3] |>
  kbl(tabular = "tblr", booktabs = TRUE) |>
  row_spec(0, background = "teal3", bold = TRUE, color = "white")
```

	mpg	cyl	disp
Mazda RX4	21.0	6	160
Mazda RX4 Wag	21.0	6	160
Datsun 710	22.8	4	108

```
kbl(mtcars[1:7, ], align = "c", tabular = "tblr", booktabs = TRUE, linesep = "") %>%
   kable_styling(latex_options = c("striped", "HOLD_position"), full_width = TRUE) %>%
   column_spec(1, width = "4cm")
```

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21.0	6	160	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag	21.0	6	160	110	3.90	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout	18.7	8	360	175	3.15	3.440	17.02	0	0	3	2
Valiant	18.1	6	225	105	2.76	3.460	20.22	1	0	3	1
Duster 360	14.3	8	360	245	3.21	3.570	15.84	0	0	3	4

```
dt <- data.frame(
   title = c(rep("a", 3), rep("b", 3), rep("c", 3), rep("d", 3)),
   value = 1:12
)
kbl(dt, format = "latex", tabular = "tblr") |>
   collapse_rows(1, latex_hline = "none") |>
   pack_rows(index = c('a' = 3, 'b' = 3, 'c' = 3, 'd' = 3)) |>
   row_spec(c(1, 5, 9, 13), background = "gray8")
```

title	value
a a	
	1
a	2
a	3
$b\mathbf{b}$	
	4
b	5
b	6
$c\mathbf{c}$	
	7
\mathbf{c}	8
\mathbf{c}	9
$\mathrm{d}\mathbf{d}$	
	10
d	11
d	12

```
t <- head(cars)
t$dist <- cell_spec(t$dist, background = "red", format = "tblr")
kbl(t, tabular = "tblr", escape = FALSE) |> kable_styling(latex_options = c("striped"))
```

speed	dist
4	2
4	10
7	4
7	22
8	16
9	10

Remaining bugs

The bugs in this section should be easy to fix now.

Ter	rm	uni	adj	uni1	adj1
a					
(Other	Ref	Ref	Ref	Ref
7	White	0.87(0.36, 2.1)	0.63(0.21, 1.9)	$1.1(0.37, 3.2)^{}$	0.73(0.22, 2.5)
I	Black	$1.3(0.62, 2.7)^{}$	0.86(0.40, 1.8)	0.67(0.19, 2.3)	0.47(0.14, 1.6)
b					
	18 to 24	Ref	Ref	Ref	Ref
2	25 to 39	0.65(0.32, 1.3)	$1.5(0.43, 5.1)^{}$	0.38(0.16, 0.89)*	0.88(0.15, 5.2)
4	10 to 59	0.69(0.38, 1.2)	$2.1(0.75, 5.9)^{}$	0.61(0.24, 1.5)	$1.9(0.48, 7.6)^{}$
\mathbf{c}					
1	Married	Ref	Ref	Ref	Ref
1	No longer married	4.5(1.5, 13.5)**^	$2.5(0.73, 8.5)^{}$	$3.5(1.0, 12.5)^{}$	$1.7(0.48, 6.0)^{}$
I	Never married	$3.8(1.6, 9.1)**^{}$	$2.8(0.79, 9.6)^{}$	$2.4(0.84, 7.0)^{}$	$1.8(0.39, 8.0)^{}$
I	Living with partner	$2.7(0.86, 8.3)^{}$	$2.0(0.62, 6.4)^{}$	$1.7(0.34, 8.3)^{}$	$1.2(0.28, 5.5)^{}$
1	Missing	7.1(2.4, 20.7)***	5.9(1.0, 34.4)^	8.0(2.5, 25.4)***	$6.5(0.95, 44.8)^{}$
d					
()-1	Ref	Ref	Ref	Ref
2	2-5	1.9(0.47, 7.3)^	0.99(0.14, 7.1)	1.2(0.23, 6.5)^	0.36(0.06, 2.2)
6	3-10	$2.5(0.89, 6.9)^{}$	0.70(0.16, 3.1)	$2.5(0.81, 7.8)^{}$	0.41(0.09, 1.8)
]	11+	4.1(1.5, 11.6)**^	0.57(0.11, 3.0)	4.1(1.3, 13.3)*^	0.36(0.08, 1.7)
e					
()-1	Ref	Ref	Ref	Ref
2	2-5	4.2(2.2, 7.8)***	3.3(0.87, 12.8)^	4.4(2.1, 9.3)***	3.2(0.45, 23.2)^
6	5+	14.1(2.6, 75.9)***^	4.2(0.85, 20.3)	18.2(2.8, 120.2)***^	4.6(0.55, 38.9)
\mathbf{f}					
()-1	Ref	Ref	Ref	Ref
2	2-5	1.6(0.81, 3.1)^	1.3(0.44, 3.8)^	2.9(0.96, 8.7)^	3.0(0.75, 12.0)^
6	5+	3.7(1.5, 9.2)**^	$2.1(0.47, 9.6)^{}$	6.0(1.9, 18.6)***	3.1(0.54, 18.1)^
\mathbf{g}					
)-1	Ref	Ref	Ref	Ref
6	2-5	$2.8(1.2, 6.3)^{*}$	0.65(0.13, 3.2)	3.8(1.4, 10.4)*^	0.95(0.11, 8.0)
h	3+	16.8(3.1, 92.5)***^	2.6(0.54, 12.5)^	22.5(3.2, 155.8)***^	3.3(0.41, 26.8)^
	Yes	Ref	NA	Ref	NA
	No	0.59(0.28, 1.2)	NA	0.99(0.33, 3.0)	NA

}

Issue #571

Notes:

• Striping does not take groups into account, but at least the indentation works.

```
kbl(mtcars[1:10, 1:6], tabular = "tblr") |>
  pack_rows("Group 1", 4, 7) |>
  pack_rows("Group 2", 8, 10) |>
  kable_styling(latex_options = c("striped"))
```

	mpg	cyl	disp	hp	drat	wt
Mazda RX4	21.0	6	160.0	110	3.90	2.620
Mazda RX4 Wag	21.0	6	160.0	110	3.90	2.875
Datsun 710	22.8	4	108.0	93	3.85	2.320
Group 1						
Hornet 4 Drive	21.4	6	258.0	110	3.08	3.215
Hornet Sportabout	18.7	8	360.0	175	3.15	3.440
Valiant	18.1	6	225.0	105	2.76	3.460
Duster 360	14.3	8	360.0	245	3.21	3.570
Group 2						
Merc 240D	24.4	4	146.7	62	3.69	3.190
Merc 230	22.8	4	140.8	95	3.92	3.150
Merc 280	19.2	6	167.6	123	3.92	3.440