# Using table1 with LaTeX

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## Introduction

A long reqested feature has been the ability to use `table1` within LaTeX documents. Since version 1.4 of `table1`, this is now possible (with some limitations) by converting the output of `table1()` to a `data.frame`, `kableExtra` or `flextable`, using the functions `as.data.frame()`, `t1kable()` and `t1flex()` respectively, as these objects can be rendered to LaTaX (note: `data.frame` (via pandoc) and `flextable` objects can also be rendered to .docx format, while, `kableExtra` cannot).

## Examples

We demonstrate this using a familiar example from the main vignette. First, we can try the `data.frame` approach:

```
x <- table1(~ age + sex + wt | treat, data=dat)
as.data.frame(x)
```

```
##                                 Placebo           Treated           Overall
## 1                                (N=52)            (N=94)           (N=146)
## 2          Age (years)
## 3            Mean (SD)       39.2 (14.2)       40.1 (13.3)       39.8 (13.6)
## 4    Median [Min, Max] 37.5 [18.0, 65.0] 39.5 [18.0, 65.0] 39.0 [18.0, 65.0]
## 5                  Sex
## 6               Female      34.0 (65.4%)      53.0 (56.4%)      87.0 (59.6%)
## 7                 Male      18.0 (34.6%)      41.0 (43.6%)      59.0 (40.4%)
## 8          Weight (kg)
## 9            Mean (SD)       68.1 (16.3)       68.3 (16.7)       68.2 (16.5)
## 10   Median [Min, Max]  66.7 [37.5, 116]  64.9 [40.0, 119]  66.2 [37.5, 119]
## 11             Missing       2.00 (3.8%)       3.00 (3.2%)       5.00 (3.4%)
```

By default, this does not produce a LaTeX table, but the same text output you would see in the R console. If the `printr` package is loaded, however, we do get a LaTeX table by default:

```
library(printr, quietly=TRUE)
as.data.frame(x)
```

| | Placebo | Treated | Overall |
|---|---|---|---|
| | (N=52) | (N=94) | (N=146) |
| Age (years) | | | |
| Mean (SD) | 39.2 (14.2) | 40.1 (13.3) | 39.8 (13.6) |
| Median [Min, Max] | 37.5 [18.0, 65.0] | 39.5 [18.0, 65.0] | 39.0 [18.0, 65.0] |
| Sex | | | |
| Female | 34.0 (65.4%) | 53.0 (56.4%) | 87.0 (59.6%) |
| Male | 18.0 (34.6%) | 41.0 (43.6%) | 59.0 (40.4%) |
| Weight (kg) | | | |
| Mean (SD) | 68.1 (16.3) | 68.3 (16.7) | 68.2 (16.5) |
| Median [Min, Max] | 66.7 [37.5, 116] | 64.9 [40.0, 119] | 66.2 [37.5, 119] |
| Missing | 2.00 (3.8%) | 3.00 (3.2%) | 5.00 (3.4%) |

Alternatively, we can use the `knitr::kable()` function:

```
library(printr, quietly=TRUE)
kable(as.data.frame(x), booktabs=TRUE)
```

| | Placebo | Treated | Overall |
|---|---|---|---|
| | (N=52) | (N=94) | (N=146) |
| Age (years) | | | |
| Mean (SD) | 39.2 (14.2) | 40.1 (13.3) | 39.8 (13.6) |
| Median [Min, Max] | 37.5 [18.0, 65.0] | 39.5 [18.0, 65.0] | 39.0 [18.0, 65.0] |
| Sex | | | |
| Female | 34.0 (65.4%) | 53.0 (56.4%) | 87.0 (59.6%) |
| Male | 18.0 (34.6%) | 41.0 (43.6%) | 59.0 (40.4%) |
| Weight (kg) | | | |
| Mean (SD) | 68.1 (16.3) | 68.3 (16.7) | 68.2 (16.5) |
| Median [Min, Max] | 66.7 [37.5, 116] | 64.9 [40.0, 119] | 66.2 [37.5, 119] |
| Missing | 2.00 (3.8%) | 3.00 (3.2%) | 5.00 (3.4%) |

The output here is a bit nicer because we have specified the `booktabs` option, but because we are talking about a simple `data.frame`, there is no option to specify formatting (like bold text for variable labels, for instance).

Next, we can try the `t1kable()` function, to produce a `kableExtra` object:

```
t1kable(x)
```

| | Placebo | Treated | Overall |
|---|---|---|---|
| | (N=52) | (N=94) | (N=146) |
| **Age (years)** | | | |
| Mean (SD) | 39.2 (14.2) | 40.1 (13.3) | 39.8 (13.6) |
| Median [Min, Max] | 37.5 [18.0, 65.0] | 39.5 [18.0, 65.0] | 39.0 [18.0, 65.0] |
| **Sex** | | | |
| Female | 34.0 (65.4%) | 53.0 (56.4%) | 87.0 (59.6%) |
| Male | 18.0 (34.6%) | 41.0 (43.6%) | 59.0 (40.4%) |
| **Weight (kg)** | | | |
| Mean (SD) | 68.1 (16.3) | 68.3 (16.7) | 68.2 (16.5) |
| Median [Min, Max] | 66.7 [37.5, 116] | 64.9 [40.0, 119] | 66.2 [37.5, 119] |
| Missing | 2.00 (3.8%) | 3.00 (3.2%) | 5.00 (3.4%) |

This looks a bit better: it usese the `booktabs` option by default, and also has bold variable labels. But

| | Placebo (N=52) | Treated (N=94) | Overall (N=146) |
|---|---|---|---|
| **Age (years)** | | | |
| Mean (SD) | 39.2 (14.2) | 40.1 (13.3) | 39.8 (13.6) |
| Median [Min, Max] | 37.5 [18.0, 65.0] | 39.5 [18.0, 65.0] | 39.0 [18.0, 65.0] |
| **Sex** | | | |
| Female | 34.0 (65.4%) | 53.0 (56.4%) | 87.0 (59.6%) |
| Male | 18.0 (34.6%) | 41.0 (43.6%) | 59.0 (40.4%) |
| **Weight (kg)** | | | |
| Mean (SD) | 68.1 (16.3) | 68.3 (16.7) | 68.2 (16.5) |
| Median [Min, Max] | 66.7 [37.5, 116] | 64.9 [40.0, 119] | 66.2 [37.5, 119] |
| Missing | 2.00 (3.8%) | 3.00 (3.2%) | 5.00 (3.4%) |

because of a limitation with multiline headers (i.e. headers that contain line breaks), the `N=XX` for each column is placed in the first row of the table, which is less than ideal.

Finally, we can try using the `t1flex()` function to produce a `flextable` object:

```
t1flex(x)
```

```
## Warning: Warning: fonts used in `flextable` are ignored because the `pdflatex` engine is used and no
## You can avoid this warning by using the `set_flextable_defaults(fonts_ignore=TRUE)` command or use a
## `latex_engine: xelatex` in the YAML header of the R Markdown document.
```

Note that this issues a warning about using the `xelatex` engine instead of `pdflatex`, but we will ignore that here because vignettes don't build with `xelatex`.

The output is less attractive in my opinion, but could still be considered acceptable. It is more spaced out, doesn't have bold labels or line break in the column headers. Also, `flextable` places the table in a float, whereas `kableExtra` leaves it inline. I personally would use `kableExtra` over `flextable` in a LaTeX documents. But a big advantage of `flextable` is that in can render to .docx format (i.e. Microsoft Word), which `kableExtra` cannot.

### Nested groups

Nested groups are supported with `kableExtra` and `flextable`, but not simple `data.frames`. Here, one example with `kableExtra`:

```
x2 <- table1(~ age + wt | treat*sex, data=dat, overall=FALSE)
t1kable(x2)
```

Table 2: Test caption

| | Placebo | Treated | Overall |
|---|---|---|---|
| | (N=52) | (N=94) | (N=146) |
| **Age (years)** | | | |
| Mean (SD) | 39.2 (14.2) | 40.1 (13.3) | 39.8 (13.6) |
| Median [Min, Max] | 37.5 [18.0, 65.0] | 39.5 [18.0, 65.0] | 39.0 [18.0, 65.0] |
| **Sex** | | | |
| Female | 34.0 (65.4%) | 53.0 (56.4%) | 87.0 (59.6%) |
| Male | 18.0 (34.6%) | 41.0 (43.6%) | 59.0 (40.4%) |
| **Weight (kg)** | | | |
| Mean (SD) | 68.1 (16.3) | 68.3 (16.7) | 68.2 (16.5) |
| Median [Min, Max] | 66.7 [37.5, 116] | 64.9 [40.0, 119] | 66.2 [37.5, 119] |
| Missing | 2.00 (3.8%) | 3.00 (3.2%) | 5.00 (3.4%) |

Test footnote

| | Placebo | | Treated | |
|---|---|---|---|---|
| | Female | Male | Female | Male |
| | (N=34) | (N=18) | (N=53) | (N=41) |
| **Age (years)** | | | | |
| Mean (SD) | 40.6 (14.5) | 36.6 (13.6) | 40.1 (13.4) | 40.1 (13.3) |
| Median [Min, Max] | 39.5 [18.0, 65.0] | 33.5 [18.0, 64.0] | 39.0 [18.0, 65.0] | 41.0 [18.0, 65.0] |
| **Weight (kg)** | | | | |
| Mean (SD) | 68.8 (14.8) | 66.8 (19.3) | 65.6 (15.1) | 71.5 (18.0) |
| Median [Min, Max] | 67.2 [45.8, 116] | 66.6 [37.5, 105] | 61.4 [41.9, 103] | 68.3 [40.0, 119] |
| Missing | 1.00 (2.9%) | 1.00 (5.6%) | 3.00 (5.7%) | 0 (0%) |

### Captions and footnotes

Captions and footnotes are supported with both `kableExtra` and `flextable`. An example withh `kableExtra`:

```
x <- table1(~ age + sex + wt | treat, data=dat,
    caption="Test caption", footnote="Test footnote")
t1kable(x)
```

Alternatively, the `kableExtra::footnote()` function can be used to add footnotes to the resulting object (this function also does automatic numbering, which may be considered an advantage). Note that when a caption is used, the table is rendered as a float.

## Closing remarks

As of version 1.4, it is now possible to use `table1` within LaTeX documents. There are some limitations on the formatting, however (it looks fine, but not quite the same as the HTML output and there is less flexibilty to control it).

The actual LaTeX code generation is handled by an external package (i.e., `knitr`, `kableExtra` or `flextable`). The LaTeX generated by `kableExtra` and `flextable` is very different, and in my opinion `kableExtra` produces the better result. Both `kableExtra` and `flextable` have an extensive number of functions that can be applied to the converted object in order to alter the appearance of the table but these will not be described here; refer to each package's documentation for the complete details.