RMarkdown Tables - Data Summary and Presentation

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## Why you want Tables

While you can create simple tables with the table() function in base R, most of the time you will want to present your results in some kind of table format. This could be for any of the following:

* viewing your data in a table format
* presenting summary statistics of the variables in your dataset
* presenting your models or analysis results in a table format
* and even more…

## Get Inspiration

The underlying formatting for making appealing and well organized tables can be sort of an art-form. Getting the code to work along with the formatting for various final formats (like HTML, PDF, DOC, PPT, etc) can be extremely challenging. However, the good new is that this has recently been a hot area of rapid development in the R/RMarkdown world.

In fact, in the past few years there have been contests on the best tables and associated packages and codes for these projects. See:

* [Winners of the 2022 RStudio Tables Contest](https://posit.co/blog/winners-of-the-2022-table-contest/)
* [Winners of the 2021 RStudio Tables contest](https://www.rstudio.com/blog/winners-of-the-2021-table-contest/)
* [Winners of the 2020 RStudio Tables contest](https://www.rstudio.com/blog/winners-of-the-2020-rstudio-table-contest/)

## Let’s try a simple table to get started

Here is an example of basic output to view the “top” of the builtin mtcars dataset, using this code: head(mtcars) .

head(mtcars)

## 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

OK, so this is just text on the page - not really a nice table.

To make this a table, let’s use the kable() function from the knitr package. To set this up, we’ll also use the dplyr package to use the %>% pipe coding approach.

library(knitr)  
library(dplyr)  
mtcars %>%  
 head() %>%  
 knitr::kable()

|  | 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 |

Let’s add a caption for our table.

NOTE: The way the caption shows up will vary depending on whether you “knit” to HTML, DOCX, PDF or other formats…

mtcars %>%  
 head() %>%  
 knitr::kable(caption = "Top 6 rows of the mtcars dataset")

Top 6 rows of the mtcars dataset

|  | 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 |

## Try customization with the gt package

You can add headers, footers and more with the gt package. See <https://gt.rstudio.com/index.html>.

library(gt)  
mtcars %>%  
 head() %>%  
 gt()

| mpg | cyl | disp | hp | drat | wt | qsec | vs | am | gear | carb |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 21.0 | 6 | 160 | 110 | 3.90 | 2.620 | 16.46 | 0 | 1 | 4 | 4 |
| 21.0 | 6 | 160 | 110 | 3.90 | 2.875 | 17.02 | 0 | 1 | 4 | 4 |
| 22.8 | 4 | 108 | 93 | 3.85 | 2.320 | 18.61 | 1 | 1 | 4 | 1 |
| 21.4 | 6 | 258 | 110 | 3.08 | 3.215 | 19.44 | 1 | 0 | 3 | 1 |
| 18.7 | 8 | 360 | 175 | 3.15 | 3.440 | 17.02 | 0 | 0 | 3 | 2 |
| 18.1 | 6 | 225 | 105 | 2.76 | 3.460 | 20.22 | 1 | 0 | 3 | 1 |

Add a header.

mtcars %>%  
 head() %>%  
 gt() %>%  
 tab\_header(  
 title = "The mtcars dataset",  
 subtitle = "The top 6 rows are presented"  
 )

Table 1: The mtcars dataset

The top 6 rows are presented

| mpg | cyl | disp | hp | drat | wt | qsec | vs | am | gear | carb |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 21.0 | 6 | 160 | 110 | 3.90 | 2.620 | 16.46 | 0 | 1 | 4 | 4 |
| 21.0 | 6 | 160 | 110 | 3.90 | 2.875 | 17.02 | 0 | 1 | 4 | 4 |
| 22.8 | 4 | 108 | 93 | 3.85 | 2.320 | 18.61 | 1 | 1 | 4 | 1 |
| 21.4 | 6 | 258 | 110 | 3.08 | 3.215 | 19.44 | 1 | 0 | 3 | 1 |
| 18.7 | 8 | 360 | 175 | 3.15 | 3.440 | 17.02 | 0 | 0 | 3 | 2 |
| 18.1 | 6 | 225 | 105 | 2.76 | 3.460 | 20.22 | 1 | 0 | 3 | 1 |

Add a footer.

mtcars %>%  
 head() %>%  
 gt() %>%  
 tab\_header(  
 title = "The mtcars dataset",  
 subtitle = "The top 6 rows are presented"  
 ) %>%  
 tab\_source\_note(  
 source\_note = "The data was extracted from the 1974 Motor Trend US magazine, and comprises fuel consumption and 10 aspects of automobile design and performance for 32 automobiles (1973–74 models)."  
 )

Table 1: The mtcars dataset

The top 6 rows are presented

| mpg | cyl | disp | hp | drat | wt | qsec | vs | am | gear | carb |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 21.0 | 6 | 160 | 110 | 3.90 | 2.620 | 16.46 | 0 | 1 | 4 | 4 |
| 21.0 | 6 | 160 | 110 | 3.90 | 2.875 | 17.02 | 0 | 1 | 4 | 4 |
| 22.8 | 4 | 108 | 93 | 3.85 | 2.320 | 18.61 | 1 | 1 | 4 | 1 |
| 21.4 | 6 | 258 | 110 | 3.08 | 3.215 | 19.44 | 1 | 0 | 3 | 1 |
| 18.7 | 8 | 360 | 175 | 3.15 | 3.440 | 17.02 | 0 | 0 | 3 | 2 |
| 18.1 | 6 | 225 | 105 | 2.76 | 3.460 | 20.22 | 1 | 0 | 3 | 1 |
| The data was extracted from the 1974 Motor Trend US magazine, and comprises fuel consumption and 10 aspects of automobile design and performance for 32 automobiles (1973–74 models). | | | | | | | | | | |

## What about summary statistics?

A really simple approach is to use the summary() function in case R. But the results, while useful, is less than inspiring.

mtcars %>%  
 summary() %>%  
 knitr::kable()

|  | mpg | cyl | disp | hp | drat | wt | qsec | vs | am | gear | carb |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Min. :10.40 | Min. :4.000 | Min. : 71.1 | Min. : 52.0 | Min. :2.760 | Min. :1.513 | Min. :14.50 | Min. :0.0000 | Min. :0.0000 | Min. :3.000 | Min. :1.000 |
|  | 1st Qu.:15.43 | 1st Qu.:4.000 | 1st Qu.:120.8 | 1st Qu.: 96.5 | 1st Qu.:3.080 | 1st Qu.:2.581 | 1st Qu.:16.89 | 1st Qu.:0.0000 | 1st Qu.:0.0000 | 1st Qu.:3.000 | 1st Qu.:2.000 |
|  | Median :19.20 | Median :6.000 | Median :196.3 | Median :123.0 | Median :3.695 | Median :3.325 | Median :17.71 | Median :0.0000 | Median :0.0000 | Median :4.000 | Median :2.000 |
|  | Mean :20.09 | Mean :6.188 | Mean :230.7 | Mean :146.7 | Mean :3.597 | Mean :3.217 | Mean :17.85 | Mean :0.4375 | Mean :0.4062 | Mean :3.688 | Mean :2.812 |
|  | 3rd Qu.:22.80 | 3rd Qu.:8.000 | 3rd Qu.:326.0 | 3rd Qu.:180.0 | 3rd Qu.:3.920 | 3rd Qu.:3.610 | 3rd Qu.:18.90 | 3rd Qu.:1.0000 | 3rd Qu.:1.0000 | 3rd Qu.:4.000 | 3rd Qu.:4.000 |
|  | Max. :33.90 | Max. :8.000 | Max. :472.0 | Max. :335.0 | Max. :4.930 | Max. :5.424 | Max. :22.90 | Max. :1.0000 | Max. :1.0000 | Max. :5.000 | Max. :8.000 |

## Try the gtsummary package

* Learn more about the gtsummary package at: <https://www.danieldsjoberg.com/gtsummary/index.html>
* Inspiration Gallery, <https://www.danieldsjoberg.com/gtsummary/articles/gallery.html>.

library(gtsummary)  
mtcars %>%  
 tbl\_summary()

| **Characteristic** | **N = 32**1 |
| --- | --- |
| mpg | 19.2 (15.4, 22.8) |
| cyl |  |
| 4 | 11 (34%) |
| 6 | 7 (22%) |
| 8 | 14 (44%) |
| disp | 196 (121, 326) |
| hp | 123 (97, 180) |
| drat | 3.70 (3.08, 3.92) |
| wt | 3.33 (2.58, 3.61) |
| qsec | 17.71 (16.89, 18.90) |
| vs | 14 (44%) |
| am | 13 (41%) |
| gear |  |
| 3 | 15 (47%) |
| 4 | 12 (38%) |
| 5 | 5 (16%) |
| carb |  |
| 1 | 7 (22%) |
| 2 | 10 (31%) |
| 3 | 3 (9.4%) |
| 4 | 10 (31%) |
| 6 | 1 (3.1%) |
| 8 | 1 (3.1%) |
| 1Median (IQR); n (%) | |

Look at statistics by group.

mtcars %>%  
 tbl\_summary(by = cyl)

| **Characteristic** | **4**, N = 111 | **6**, N = 71 | **8**, N = 141 |
| --- | --- | --- | --- |
| mpg | 26.0 (22.8, 30.4) | 19.7 (18.7, 21.0) | 15.2 (14.4, 16.3) |
| disp | 108 (79, 121) | 168 (160, 196) | 351 (302, 390) |
| hp | 91 (66, 96) | 110 (110, 123) | 193 (176, 241) |
| drat | 4.08 (3.81, 4.17) | 3.90 (3.35, 3.91) | 3.12 (3.07, 3.23) |
| wt | 2.20 (1.89, 2.62) | 3.22 (2.82, 3.44) | 3.76 (3.53, 4.01) |
| qsec | 18.90 (18.56, 19.95) | 18.30 (16.74, 19.17) | 17.18 (16.10, 17.56) |
| vs | 10 (91%) | 4 (57%) | 0 (0%) |
| am | 8 (73%) | 3 (43%) | 2 (14%) |
| gear |  |  |  |
| 3 | 1 (9.1%) | 2 (29%) | 12 (86%) |
| 4 | 8 (73%) | 4 (57%) | 0 (0%) |
| 5 | 2 (18%) | 1 (14%) | 2 (14%) |
| carb |  |  |  |
| 1 | 5 (45%) | 2 (29%) | 0 (0%) |
| 2 | 6 (55%) | 0 (0%) | 4 (29%) |
| 3 | 0 (0%) | 0 (0%) | 3 (21%) |
| 4 | 0 (0%) | 4 (57%) | 6 (43%) |
| 6 | 0 (0%) | 1 (14%) | 0 (0%) |
| 8 | 0 (0%) | 0 (0%) | 1 (7.1%) |
| 1Median (IQR); n (%) | | | |

Add statistical comparison tests.

mtcars %>%  
 tbl\_summary(by = cyl) %>%   
 add\_p()

| **Characteristic** | **4**, N = 111 | **6**, N = 71 | **8**, N = 141 | **p-value**2 |
| --- | --- | --- | --- | --- |
| mpg | 26.0 (22.8, 30.4) | 19.7 (18.7, 21.0) | 15.2 (14.4, 16.3) | <0.001 |
| disp | 108 (79, 121) | 168 (160, 196) | 351 (302, 390) | <0.001 |
| hp | 91 (66, 96) | 110 (110, 123) | 193 (176, 241) | <0.001 |
| drat | 4.08 (3.81, 4.17) | 3.90 (3.35, 3.91) | 3.12 (3.07, 3.23) | <0.001 |
| wt | 2.20 (1.89, 2.62) | 3.22 (2.82, 3.44) | 3.76 (3.53, 4.01) | <0.001 |
| qsec | 18.90 (18.56, 19.95) | 18.30 (16.74, 19.17) | 17.18 (16.10, 17.56) | 0.006 |
| vs | 10 (91%) | 4 (57%) | 0 (0%) | <0.001 |
| am | 8 (73%) | 3 (43%) | 2 (14%) | 0.009 |
| gear |  |  |  | <0.001 |
| 3 | 1 (9.1%) | 2 (29%) | 12 (86%) |  |
| 4 | 8 (73%) | 4 (57%) | 0 (0%) |  |
| 5 | 2 (18%) | 1 (14%) | 2 (14%) |  |
| carb |  |  |  | <0.001 |
| 1 | 5 (45%) | 2 (29%) | 0 (0%) |  |
| 2 | 6 (55%) | 0 (0%) | 4 (29%) |  |
| 3 | 0 (0%) | 0 (0%) | 3 (21%) |  |
| 4 | 0 (0%) | 4 (57%) | 6 (43%) |  |
| 6 | 0 (0%) | 1 (14%) | 0 (0%) |  |
| 8 | 0 (0%) | 0 (0%) | 1 (7.1%) |  |
| 1Median (IQR); n (%) | | | | |
| 2Kruskal-Wallis rank sum test; Fisher's exact test | | | | |

## Also try the arsenal package

Learn more about the arsenal package:

* <https://mayoverse.github.io/arsenal/>
* and the tableby() function <https://mayoverse.github.io/arsenal/articles/tableby.html>

This time, let’s look at the penguins dataset from the palmerpenguins package.

We’ll use the tableby() function from the arsenal package to get some summary stats.

**NOTE: IMPORTANT - when using the arsenal package, you need to add results = "asis" in your r-chunk options so that the table looks correct when you “knit” your Rmarkdown file.**

library(palmerpenguins)  
library(arsenal)  
  
tab1 <- tableby(~ bill\_length\_mm + bill\_depth\_mm +  
 flipper\_length\_mm + body\_mass\_g,   
 data = penguins)  
summary(tab1)

|  | Overall (N=344) |
| --- | --- |
| **bill\_length\_mm** |  |
| N-Miss | 2 |
| Mean (SD) | 43.922 (5.460) |
| Range | 32.100 - 59.600 |
| **bill\_depth\_mm** |  |
| N-Miss | 2 |
| Mean (SD) | 17.151 (1.975) |
| Range | 13.100 - 21.500 |
| **flipper\_length\_mm** |  |
| N-Miss | 2 |
| Mean (SD) | 200.915 (14.062) |
| Range | 172.000 - 231.000 |
| **body\_mass\_g** |  |
| N-Miss | 2 |
| Mean (SD) | 4201.754 (801.955) |
| Range | 2700.000 - 6300.000 |

We can also get comparison statistics by group with associated statistical tests. Let’s look at these summary stats by the 3 species of penguins.

tab1 <- tableby(species ~ bill\_length\_mm + bill\_depth\_mm +  
 flipper\_length\_mm + body\_mass\_g,   
 data = penguins)  
summary(tab1)

|  | Adelie (N=152) | Chinstrap (N=68) | Gentoo (N=124) | Total (N=344) | p value |
| --- | --- | --- | --- | --- | --- |
| **bill\_length\_mm** |  |  |  |  | < 0.001 |
| N-Miss | 1 | 0 | 1 | 2 |  |
| Mean (SD) | 38.791 (2.663) | 48.834 (3.339) | 47.505 (3.082) | 43.922 (5.460) |  |
| Range | 32.100 - 46.000 | 40.900 - 58.000 | 40.900 - 59.600 | 32.100 - 59.600 |  |
| **bill\_depth\_mm** |  |  |  |  | < 0.001 |
| N-Miss | 1 | 0 | 1 | 2 |  |
| Mean (SD) | 18.346 (1.217) | 18.421 (1.135) | 14.982 (0.981) | 17.151 (1.975) |  |
| Range | 15.500 - 21.500 | 16.400 - 20.800 | 13.100 - 17.300 | 13.100 - 21.500 |  |
| **flipper\_length\_mm** |  |  |  |  | < 0.001 |
| N-Miss | 1 | 0 | 1 | 2 |  |
| Mean (SD) | 189.954 (6.539) | 195.824 (7.132) | 217.187 (6.485) | 200.915 (14.062) |  |
| Range | 172.000 - 210.000 | 178.000 - 212.000 | 203.000 - 231.000 | 172.000 - 231.000 |  |
| **body\_mass\_g** |  |  |  |  | < 0.001 |
| N-Miss | 1 | 0 | 1 | 2 |  |
| Mean (SD) | 3700.662 (458.566) | 3733.088 (384.335) | 5076.016 (504.116) | 4201.754 (801.955) |  |
| Range | 2850.000 - 4775.000 | 2700.000 - 4800.000 | 3950.000 - 6300.000 | 2700.000 - 6300.000 |  |

## Another COOL package, summarytools

Another really cool package that is useful for getting a quick summary of what is in your dataset along with some quick summary stats and tiny charts.

Learn more at:

* <https://cran.r-project.org/web/packages/summarytools/>
* <https://cran.r-project.org/web/packages/summarytools/vignettes/introduction.html>

Let’s look at the penguins dataset again.

And like the arsenal package, when we use the summarytools package, you need to add results = "asis" to the r-chunk options.

library(summarytools)  
dfSummary(penguins,   
 plain.ascii = FALSE,   
 style = "grid",   
 graph.magnif = 0.75,   
 valid.col = FALSE,  
 tmp.img.dir = "/tmp")

### Data Frame Summary

#### penguins

**Dimensions:** 344 x 8  
**Duplicates:** 0

| No | Variable | Stats / Values | Freqs (% of Valid) | Graph | Missing |
| --- | --- | --- | --- | --- | --- |
| 1 | species [factor] | 1. Adelie 2. Chinstrap 3. Gentoo | 152 (44.2%) 68 (19.8%) 124 (36.0%) |  | 0 (0.0%) |
| 2 | island [factor] | 1. Biscoe 2. Dream 3. Torgersen | 168 (48.8%) 124 (36.0%) 52 (15.1%) |  | 0 (0.0%) |
| 3 | bill\_length\_mm [numeric] | Mean (sd) : 43.9 (5.5) min < med < max: 32.1 < 44.5 < 59.6 IQR (CV) : 9.3 (0.1) | 164 distinct values |  | 2 (0.6%) |
| 4 | bill\_depth\_mm [numeric] | Mean (sd) : 17.2 (2) min < med < max: 13.1 < 17.3 < 21.5 IQR (CV) : 3.1 (0.1) | 80 distinct values |  | 2 (0.6%) |
| 5 | flipper\_length\_mm [integer] | Mean (sd) : 200.9 (14.1) min < med < max: 172 < 197 < 231 IQR (CV) : 23 (0.1) | 55 distinct values |  | 2 (0.6%) |
| 6 | body\_mass\_g [integer] | Mean (sd) : 4201.8 (802) min < med < max: 2700 < 4050 < 6300 IQR (CV) : 1200 (0.2) | 94 distinct values |  | 2 (0.6%) |
| 7 | sex [factor] | 1. female 2. male | 165 (49.5%) 168 (50.5%) |  | 11 (3.2%) |
| 8 | year [integer] | Mean (sd) : 2008 (0.8) min < med < max: 2007 < 2008 < 2009 IQR (CV) : 2 (0) | 2007 : 110 (32.0%) 2008 : 114 (33.1%) 2009 : 120 (34.9%) |  | 0 (0.0%) |

### summarytools::ctable()

Get a nice crosstable for 2 categorical variables using ctable() function. Let’s look at species and sex in the penguins dataset.

**NOTE: At the moment ctable() will only work for HTML output. This does not work for DOC or PDF formats.**

library(magrittr)  
penguins %$% # Acts like with(penguins, ...)  
 ctable(x = species, y = sex,  
 useNA = "no",  
 chisq = TRUE,  
 OR = TRUE,  
 RR = TRUE,  
 headings = FALSE) %>%  
 print(method = "render")

## More fun packages to try out

These can all be fun to play with but with “great power comes great responsibility” - the key is looking for examples to adapt and reading the documentation.

For all of these getting the formatting to work across multiple output formats is really challenging. Typically, the developers get HTML and/or PDF (through LaTeX) working first and MS WORD DOCX formats are the hardest to adapt. Although if all fails (sometimes) you can simply cut and paste HTML output over into a WORD document - see kableExtra short video <http://haozhu233.github.io/kableExtra/kableExtra_and_word.html>.

* reactablefmtr <https://kcuilla.github.io/reactablefmtr/index.html>
* gtExtras
  + <https://jthomasmock.github.io/gtExtras/index.html>
  + <https://themockup.blog/posts/2022-06-13-gtextras-cran/>
* flextable <https://ardata-fr.github.io/flextable-book/> and gallery examples at <https://ardata-fr.github.io/flextable-gallery/gallery/>
* kableExtra for added functionality for knitr::kable(), see <https://cran.r-project.org/web/packages/kableExtra/>

More links:

* <https://towardsdatascience.com/top-7-packages-for-making-beautiful-tables-in-r-7683d054e541>
* [Tables in Clinical Trials with R - online book](https://rconsortium.github.io/rtrs-wg/)
* [Tables for presentation - Ch29 in the The Epidemiologist R Handbook - online book](https://epirhandbook.com/en/tables-for-presentation.html)