Data visualization with R

```
# plot()
# googleVis()
# ggmap()
# ggrepel()
# waterfall()
# rCharts()
# ggvis
# plotly

library(ggplot2)
#install.packages(ggmap)
#install.packages()
# install.packages("kableExtra")
# Tables:
# Call the print.data.frame generic method
# knitr:: kable
# tibble: :print.tbl df
# markdown: :paged_table
# pander::pander())
# gt plot
# Kable + kableExtra
# formattable
# DT
# reactable
# flextable
# huxtable
#  rhandsontable
# pixiedust
```

Introduction

This document contains step by step guide on the common data visualization tools used in *R*.

Tables

Tables are extremely important tool for anyone working with data. Tables helps us display data in cells that are organized into rows and columns.

We are going to look at different ways of presenting and organizing data data in talbes Again, what is covered in this document is not exhaustive, but I will try to cover all types of tables that someone may need for any data related visualization.

Generic Tables in R

One way to display the data in tables is to simply call the data in an R script. This is similar to calling a print function on the data and prints the entire data

```
mtcars # similar to print(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
## Duster 360        14.3   8  360 245 3.21 3.570 15.84  0  0    3    4
```

Notice, this way prints the whole data on the documnt. This is not very informative and is never recommended unless your data is very small. Most of the time you are dealing with very large data sets that have more than a thousand observations. Printing such data set does not make any sense.

Sometimes, you may want see a glimpse of the data, may be see the first or the last few observations of the data. we can use the function `head()` to see the first few observations or `tail()` to see the last few observations.

```
head(mtcars) # first 6 observations, use head(mtcars, n = 10) to see first 10, etc
```

```
##                    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
```

```
tail(mtcars) # last 6 observation, use tail(mtcars, n = 10) to see lastt 10, etc
```

```
##                 mpg cyl  disp  hp drat    wt qsec vs am gear carb
## Porsche 914-2  26.0   4 120.3  91 4.43 2.140 16.7  0  1    5    2
## Lotus Europa   30.4   4  95.1 113 3.77 1.513 16.9  1  1    5    2
## Ford Pantera L 15.8   8 351.0 264 4.22 3.170 14.5  0  1    5    4
## Ferrari Dino   19.7   6 145.0 175 3.62 2.770 15.5  0  1    5    6
## Maserati Bora  15.0   8 301.0 335 3.54 3.570 14.6  0  1    5    8
## Volvo 142E     21.4   4 121.0 109 4.11 2.780 18.6  1  1    4    2
```

if you want to get any range, any any specific columns of the data set, use the indices of those observations and columns. Suppose, you want see observations 10 to 15, or you want to see the 2nd column of the data. The following is how you would do that.

```
mtcars[10:15,] #observations 10 to 15
```

```
##                   mpg cyl  disp  hp drat   wt  qsec vs am gear carb
## Merc 280          19.2   6 167.6 123 3.92 3.44 18.30  1  0    4    4
## Merc 280C         17.8   6 167.6 123 3.92 3.44 18.90  1  0    4    4
## Merc 450SE        16.4   8 275.8 180 3.07 4.07 17.40  0  0    3    3
## Merc 450SL        17.3   8 275.8 180 3.07 3.73 17.60  0  0    3    3
## Merc 450SLC       15.2   8 275.8 180 3.07 3.78 18.00  0  0    3    3
## Cadillac Fleetwood 10.4   8 472.0 205 2.93 5.25 17.98  0  0    3    4
```

```
mtcars[, 2] # extracting second column.
```

```
##  [1] 6 6 4 6 8 6 8 4 4 6 6 8 8 8 8 8 8 4 4 4 4 8 8 8 8 4 4 4 8 6 8 4
```

```
mtcars[10:15,1:4] #observatons 10 to 15 with columns 1 to 4 entries only
```

```
##                      mpg cyl  disp  hp
## Merc 280            19.2   6 167.6 123
## Merc 280C           17.8   6 167.6 123
## Merc 450SE          16.4   8 275.8 180
## Merc 450SL          17.3   8 275.8 180
## Merc 450SLC         15.2   8 275.8 180
## Cadillac Fleetwood 10.4   8 472.0 205
```

This is all good but, we our tables don't look good. We can make this look little better by using `knitr::kable()`.

Kable

```
knitr::kable(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

Note that kable only accepts data in a data frame or matrix format. You can make few tweaks to your tables in a kable. Use `format` parameter to set your format to either `latex, pipe, html, simple` or `rst`. Use `digits` to round off your numerical values to the desired number of decimals. Use `row.names` and `col.names` to manage row names and/or column names of your tables. Run `?knitr::kable` in R junk to learn more about kable tables.

```
jupitor_moons = c("Metis", "Adrastea", "Amalthea", "Theba", "Io", "Europa")
moon_diameter = c(43, 16.4, 167, 98.6, 3643.2, 3121.6)
moon_mass = c(3.6, 0.2, 208, 43, 8931900, 480000)

#combining into data frame
jupiter = data.frame(moon_diameter, moon_mass, row.names = jupitor_moons)

#using kable to display data.frame
knitr::kable(jupiter, row.names = TRUE,
             col.names = c("Moon Diameter (Km)", "Moon mass (e+16 Kg)"), digits = 1,
             caption = "First Six jupiter moons")
```

Table 2: First Six jupiter moons

	Moon Diameter (Km)	Moon mass (e+16 Kg)
Metis	43.0	3.6
Adrastea	16.4	0.2
Amalthea	167.0	208.0
Theba	98.6	43.0
Io	3643.2	8931900.0
Europa	3121.6	480000.0

	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

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21.0	6	160	110	3.9	2.6	16.5	0	1	4	4
Mazda RX4 Wag	21.0	6	160	110	3.9	2.9	17.0	0	1	4	4
Datsun 710	22.8	4	108	93	3.9	2.3	18.6	1	1	4	1
Hornet 4 Drive	21.4	6	258	110	3.1	3.2	19.4	1	0	3	1
Hornet Sportabout	18.7	8	360	175	3.1	3.4	17.0	0	0	3	2
Valiant	18.1	6	225	105	2.8	3.5	20.2	1	0	3	1

Kable Extra

We can also add vertical lines to a kable table. We can use `kableExtra` package to achieve this.

```
library(knitr)
library(kableExtra)
library(dplyr)
```

To use pipes and to make our work easier, we are going to use `dplyr` package.

```
mthead = head(mtcars)
mthead%>%
  kbl()%>%
   kable_styling()
```

Aligning the column contents. you can use a vector, or a string to align each column.

Column border We can add column borders to a specific column(s). To do this, we use `column_spec()` as shown in the following R chunk, The first parameter is the columns we want to have borders, in this case columns 2 to 11. Just make sure you include the end border.

```
mthead %>%
   kbl(align = "lcrlcrlcrlc", digits = 1) %>% # aligning the column in content.
   column_spec(2:12, border_left = T, border_right = T) %>% # adding vertical lines
   kable_styling(full_width = F)
```

Font size Changing the font size.

```
mthead %>%
   kbl() %>%
   kable_styling(font_size = 9)
```

Color changing the color of a column. We are going to change the background, and font color of column 1.

```
mthead %>%
   kbl() %>%
   column_spec(2, color = "red", background = "blue") %>%
   kable_styling()
```

we can change the font type, size,color and background color as well.

	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

	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

```
mthead %>%
   kbl() %>%
   row_spec(1:3, color = "green", background = "blue") %>%
   kable_styling()
```

combining everything More mutation of colors and details. We are changing the colors of `disp` column. We are also adding `tooltip` to display which kind of car you are looking it at. Just hover over the values, and you will see.

```
mthead %>%
   mutate(
      disp = cell_spec(disp, color = spec_color(disp, option = "C", alpha = 1, begin = 0, end = 0.8), #
                       tooltip = paste0(row.names(.)))
      ) %>%
   mutate_if(is.numeric, function(x){
    cell_spec(x, color = spec_color(x), background = spec_color(x, option = "B", alpha = 0.5, begin = 0
   kable(escape = F, align = "c") %>%
   kable_styling(full_width = F)
```

In the `mutate_if()`, we are changing the color and background color of every cell. excepts for the cells in `disp` column, which we format before the mutate. The background color is not that useful here. We can therefore, remove it. We can also add a hover over gray box.

```
mthead %>%
   mutate(
      disp = cell_spec(disp, color = spec_color(disp, option = "C", alpha = 1, begin = 0, end = 0.8), #
                       tooltip = paste0(row.names(.)))
      ) %>%
   mutate_if(is.numeric, function(x){
```

	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

mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
21	6	160	110	3.9	2.62	16.46	0	1	4	4
21	6	160	110	3.9	2.875	17.02	0	1	4	4
22.8	4	108	93	3.85	2.32	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	3.44	17.02	0	0	3	2
18.1	6	225	105	2.76	3.46	20.22	1	0	3	1

mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
21	6	160	110	3.9	2.62	16.46	0	1	4	4
21	6	160	110	3.9	2.875	17.02	0	1	4	4
22.8	4	108	93	3.85	2.32	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	3.44	17.02	0	0	3	2
18.1	6	225	105	2.76	3.46	20.22	1	0	3	1

```
    cell_spec(x, color = spec_color(x), bold = T)}) %>%
  kable(escape = F, align = "c") %>%
  kable_styling(full_width = F, "hover")
```

We can add a divider value color to a specific columns. Let's make 18 the cut off value for `qsec` column.

```
mthead %>%
  mutate(
    qsec = ifelse(qsec > 18,
                  cell_spec(qsec, color = "blue", bold = T),
                  cell_spec(qsec, color = "green"))
    ) %>%
  kable(escape = F, align = "c") %>%
  kable_styling(full_width = F)
```

We can see values greater than 18 are light blue in color and values less than 18 are green in color.

Themes

1. `kable_styling()`. The default theme when used HTML table is twitter bootstrap on this table theme. This is what we have used for the previous tables.
2. `kable_classic()`.

```
mthead %>%
  kbl() %>%
  kable_classic()
```

3. `kable_classic_2()`.

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

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
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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

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
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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


```
mthead %>%
   kbl() %>%
   kable_classic_2(full_width = F)
```

4. `kable_material()`.

```
mthead %>%
   kbl() %>%
   kable_material()
```

5. `kable_paper()`.

```
mthead %>%
   kbl %>%
   kable_paper()
```

6. 'kable_minimal()'

```
mthead %>%
   kbl() %>%
   kable_minimal()
```

Please take a look at the `kableExtra` webpage to see other themes.

	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
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Valiant	18.1	6	225	105	2.76	3.460	20.22	1	0	3	1

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
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	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
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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