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Using the Waffle Package: Another Way to Graphically Display Data

1. Introduction

A. Purpose

The purpose of this post is to educate all proficient or learning R developers on how to use Waffle which is square (waffle) pie charts in R. The waffle graphs are essentially the regular pie chart but in cube form.

B. Motivation

My personal motivation on choosing Waffle in particular is that it gives a different perspective on the typical graphs we haved used so far like the scatter plots, bar graphs, and box and whisker plots. Unlike regular pie charts, the waffle charts are easy to accurately compare since with pie charts the partitioning of the different variables is harder to distinguish while the square charts of a waffle chart can be easily computed. Waffle charts can be created through multiple programs like Tableau, jQuery, R and Excel. Find the pros and cons for the waffle chart here

C. Background

In this posting the main package we will be using is 'waffle' the elaborated PDF documentation of the package and its information is here

The package was last updated in January 7th 2017 and is maintained by Bob Rudis. One important thing to know about the waffle feature is that you need to convert everything into percentiles.
For consise and more in depth explaination on the different functions of the waffle package and how to utilize them, I found this article extremely enlightening.

2. Examples

Initial installation of the package steps:

You'll need ggplot2 so install it if you haven't already, then install waffle:

```
#if you haven't already install ggplot2
install.packages("ggplot2")

#install extrafont so you can use icons
install.packages("extrafont")

#then install waffle
install.packages("waffle")

#install color brewer so we have diff color sets
install.packages("RColorBrewer")
```

```
#load both packages into the console
# some of the packages may or may not be used
library(ggplot2)
library(waffle)
library(extrafont)
```

```
## Registering fonts with R
```

```
library(RColorBrewer)
```

Now let's create the first waffle graphic. Steps on how to do this was pulled from this post.

1. First step is importing the different font. font_import() will ask if you want to import fonts in the console type in "y" and press enter. Importing the fonts may take couple minutes as there is a ton of fonts that are being imported!

```
#importing the fonts
font_import()

# check that Fonts are imported
fonts()

# this should be fine for Mac OSX
loadfonts()

# use this if things look odd in RStudio under Windows
loadfonts(device = "win")
```

Before we make a waffle function we first need to understand how to use waffle. The waffle function has multiple **arguments** which were all pulled from Rdocumentaion page.

- parts: named vector of values to use for the chars

- rows: number of rows of blocks
- keep: keep factor levels (i.e. for consistent legends across waffle plots)
- xlab: text for below the chart. Highly suggested this be used to give the "1 sq == xyz" relationship if it's not obvious
- title: chart title
- colors: exactly the number of colors as values in parts. If omitted, Color Brewer "Set2" colors are used.
- size: width of the separator between blocks (defaults to 2)
- flip: flips x & y axes
- reverse: reverses the order of the data
- equal: by default, waffle uses coord_equal; this can cause layout problems, so you can use this to disable it if you are using ggsave or knitr to control output sizes (or manually resizing the chart)
- pad: how many blocks to right-pad the grid with
- use_glyph: use specified FontAwesome glyph
- glyph_size: size of the FontAwesome font
- legend_pos: position of legend

```
# getting the basic waffle chart
waffle(c(30, 30, 35, 10), rows = 5,
       title = "The basic waffle chart")
```
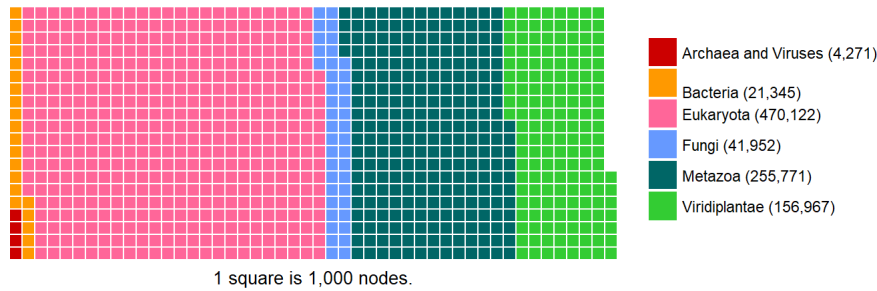
The basic waffle chart

Now let's make a waffle chart based off of a data set. This data set and examples is pulled from this post.

```
# data set from NCBI Taxonomy database
tax_count <- c(`Archaea and Viruses (4,271)`= 4271, `
Bacteria (21,345)`= 21345,
`Eukaryota (470,122)`= 470122,
`Fungi (41,952)`= 41952, `Metazoa (255,771)`= 255771,
 `Viridiplantae (156,967)`= 156967)
```

You can chose the colors for the waffle charts 3 ways. There is the initial default colors, then your can specify the colors via the color number/code, or you can type in the name of the color. Use this color cheatsheet to help decide on the different colors. The code snippet below is one using the color code. Since the color name is a string make sure that it is put within " " no matter if it is a number or name.
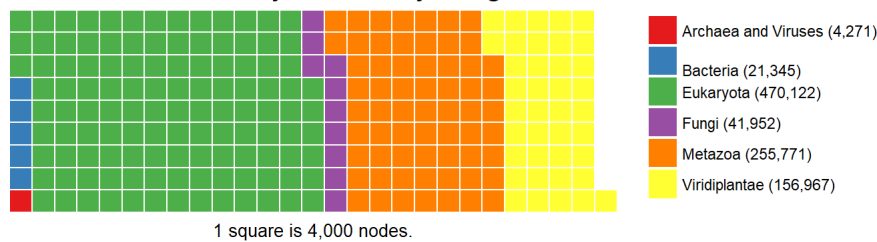
```
# now making the data into waffle format
waffle(tax_count/1000, rows=20, size=0.5,
       colors=c("#cc0000", "#ff9900", "#ff6699", "#6699ff", "#006666", "#33cc33"),
       title="All NCBI Taxonomy Nodes by Kingdom",
       xlab="1 square is 1,000 nodes.")
```

All NCBI Taxonomy Nodes by Kingdom

Archaea and Viruses (4,271)
Bacteria (21,345)
Eukaryota (470,122)
Fungi (41,952)
Metazoa (255,771)
Viridiplantae (156,967)

1 square is 1,000 nodes.

```
# you can also compress the waffle
waffle(tax_count/4000, rows=9, size=0.5,
       colors=brewer.pal(6,"Set1"), title="All NCBI Taxonomy Nodes by Kingdom",
       xlab="1 square is 4,000 nodes.")
```

All NCBI Taxonomy Nodes by Kingdom

Archaea and Viruses (4,271)
Bacteria (21,345)
Eukaryota (470,122)
Fungi (41,952)
Metazoa (255,771)
Viridiplantae (156,967)

1 square is 4,000 nodes.

Comparing this waffle charts to pie charts. This is just a visual so you can see the different between the two charts, and to learn how to make a pie chart (if you haven't already learned)! For more information check out this R-manual about pie charts
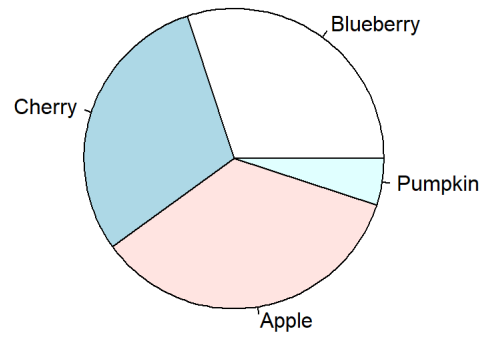
```
require(grDevices)

#the ratios for each variable
pie.sales <- c(0.3, 0.3, 0.35, 0.05)

#labels for each variable above
names(pie.sales) <- c("Blueberry", "Cherry",
    "Apple", "Pumpkin")

#regular pie graph with default colours
pie(pie.sales, main= "Basic Pie Graph of Pies")
```
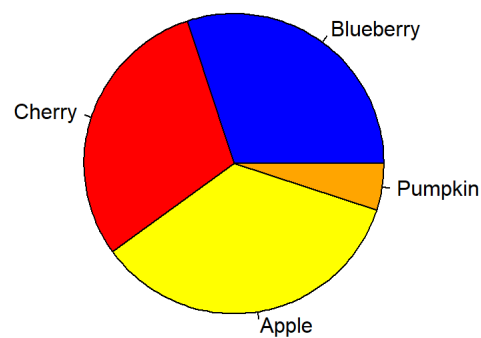
Basic Pie Graph of Pies

Blueberry
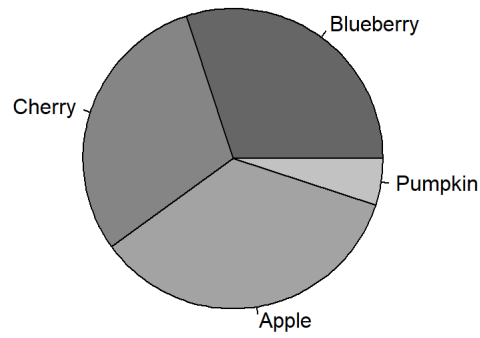
Cherry

Pumpkin

Apple

```
#regular pie graph with assigned colors
pie(pie.sales, col = c("blue", "red", "yellow", "orange")
    , main= "Basic Pie Graph of Pies")
```

Basic Pie Graph of Pies

Blueberry

Cherry

Pumpkin

Apple

```
#pie graph with a gray scale
pie(pie.sales, col = gray(seq(0.4, 1.0, length = 6))
    , main= "Basic Pie Graph of Pies")
```
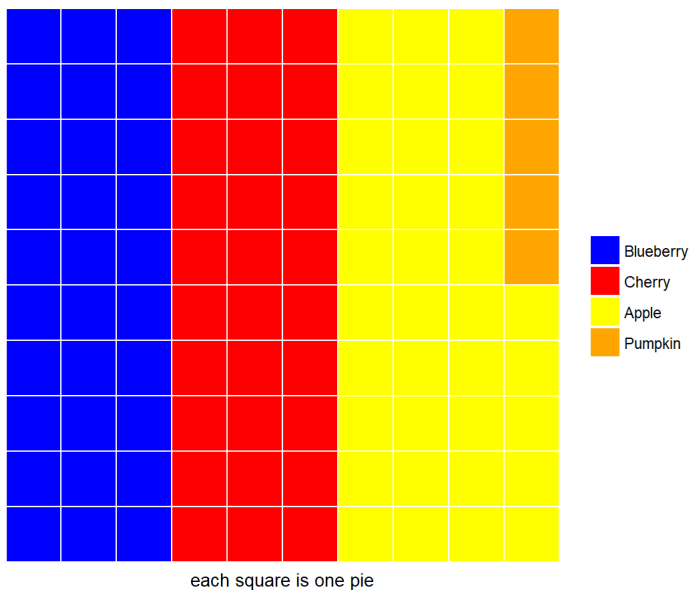
Basic Pie Graph of Pies

Here is a waffle representation of the Basic Pie Graph of pies.

```
pies <- c("Blueberry" = 30, "Cherry" = 30,
    "Apple" = 35, "Pumpkin" = 5)
waffle(pies, row = 10, size = 0.5,
        title = "Basic Waffle Graph of pies",
        xlab= "each square is one pie",
        colors= c("blue", "red", "yellow", "orange"))
```

Basic Waffle Graph of pies

each square is one pie

One last main function in the "waffle" package is the *iron()* function. This function basically stitches together multiple waffle plots. Find more examples on how to use *iron()* from this [RDocumentation] Post(https://www.rdocumentation.org/packages/waffle/versions/0.7.0).

```
skill <- c(`Novice`=100, `Pro`=10)

A <- waffle(skill, rows=7, size=1,
            colors=c("red", "blue"),
    title="R Skills of Stat133 Students (Sept 2017)",
            xlab="1 square = 1 Students")

skill <-  c(`Novice`=50, `Pro`=60)

B <- waffle(skill, rows=7, size=1,
            colors=c("red", "blue"),
      title="R Skills of Stat133 Students (Oct 2017)",
            xlab="1 square = 1 Students")

skill <-  c(`Novice`=10, `Pro`=100)

C <- waffle(skill, rows=7, size=1,
            colors=c("red", "blue"),
      title="R Skills of Stat133 Students (Nov 2017)",
            xlab="1 square = 1 Students")

iron(A, B, C)
```
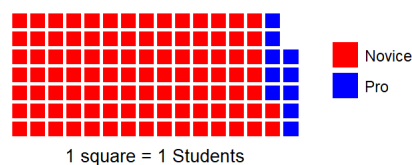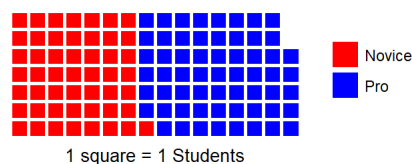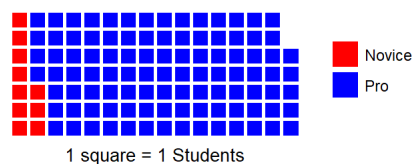

R Skills of Stat133 Students (Sept 2017)

■ Novice
■ Pro

1 square = 1 Students

R Skills of Stat133 Students (Oct 2017)

■ Novice
■ Pro

1 square = 1 Students

R Skills of Stat133 Students (Nov 2017)

■ Novice
■ Pro

1 square = 1 Students

3. Discussion

Overall using the waffle charts to graphically display data is useful when you want to show the different quantities of a certain data set looking at the large picture. Moreover within this post we learned how to not only to create the basic waffle chart but one with different colors, different sizes other than squares and different fonts.

4. Conclusion

Although there is many ways to represent data, the waffle charts, in my opinion, are underrepresented even though they are quite powerful. True, the waffle package that I demonstrated on how to use is not the only package that can produce waffle charts, but it is the current best and most versatile package as of now. The takeaway message from this post is that you can now be able create square (waffle) charts in different colors, sizes, and combined together. Moreover, this post also brushes up on how to make pie charts. This post also differentiates the waffle and pie chart where the waffle easier to count and get solid numbers on while pie graphs are hard to determine the exact numbers based on looking at just the graph.

5.References

- http://www.tableaulearners.com/2017/waffle-chart-tableau/
- http://harrycaufield.net/severalog/2016/7/29/8jt1lrt7hd2vqh4heu7mcuqrdcg0od
- https://cran.r-project.org/web/packages/waffle/waffle.pdf
- https://www.r-bloggers.com/infographic-style-charts-using-the-r-waffle-package/
- https://www.rdocumentation.org/packages/waffle/versions/0.7.0/topics/waffle
- https://github.com/hrbrmstr/waffle
- https://stat.ethz.ch/R-manual/R-devel/library/graphics/html/pie.html
- https://www.rdocumentation.org/packages/waffle/versions/0.7.0
- https://www.r-bloggers.com/making-waffle-charts-in-r-with-the-new-waffle-package/
- https://www.nceas.ucsb.edu/~frazier/RSpatialGuides/colorPaletteCheatsheet.pdf