R Workshop week 2: making graphs part 1

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Setup

```
library(tidyverse)   # tidyverse is a combo of packages including ggplot2
library(car)

head(Soils) # our example dataset

##   Group Contour Depth Gp Block   pH     N Dens   P    Ca   Mg    K   Na Conduc
## 1     1     Top  0-10 T0     1 5.40 0.188 0.92 215 16.35 7.65 0.72 1.14   1.09
## 2     1     Top  0-10 T0     2 5.65 0.165 1.04 208 12.25 5.15 0.71 0.94   1.35
## 3     1     Top  0-10 T0     3 5.14 0.260 0.95 300 13.02 5.68 0.68 0.60   1.41
## 4     1     Top  0-10 T0     4 5.14 0.169 1.10 248 11.92 7.88 1.09 1.01   1.64
## 5     2     Top 10-30 T1     1 5.14 0.164 1.12 174 14.17 8.12 0.70 2.17   1.85
## 6     2     Top 10-30 T1     2 5.10 0.094 1.22 129  8.55 6.92 0.81 2.67   3.18
```

ggplot syntax

The simplest scatterplot

ggplot code syntax:

`ggplot(data = , aes(x = , y =))+

geom_point()`

In the first line of code specify the dataset

Then, in aes() known as the aesthetic, include x and y columns in dataset to plot (just the name, $ is not needed).

Additional arguments can be added to the aesthetic if you want to R to use a column to automatically add colors (with `col =`) or shapes (`pch =`).

Add + to add a layer to the graph.

The only required layer is to define what type of graph to make. In this case `geom_point()` makes a scatterplot (But note this code will only run when both x and y variables provided contain continuous (i.e. numerical) data.

```
scatterplot <- ggplot(Soils, aes(x = N, y = pH))+
  geom_point()

scatterplot
```

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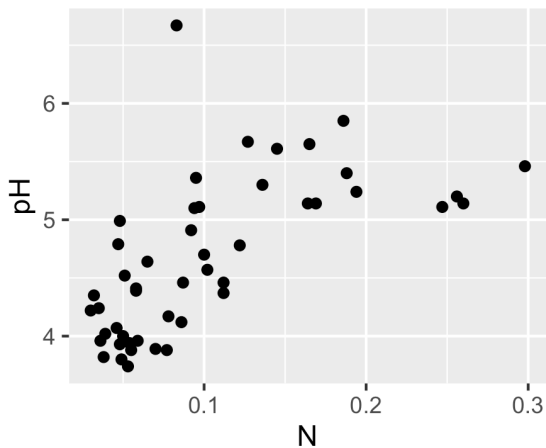
For the 2 graphs below see the comment on the right side of each line of code to distinguish what each ggplot function does

```
boxplot <-
  ggplot(Soils, aes(x = Depth, y = N, col = Depth))+
  geom_boxplot()+                        # specify graph is a boxplot
  theme_classic()+                       # clean, modern plot theme (not gray back
ground now)
  ylab("N (%)")+                         # change y axis title/label
  labs(col = "Soil Depth (cm)")+         # renames legend title
  theme(axis.ticks.x = element_blank(),  # removes x axis tick marks
        axis.text.x = element_blank(),   # removes x axis text labels
        axis.title = element_blank())    # removes x axis title


boxplot
```
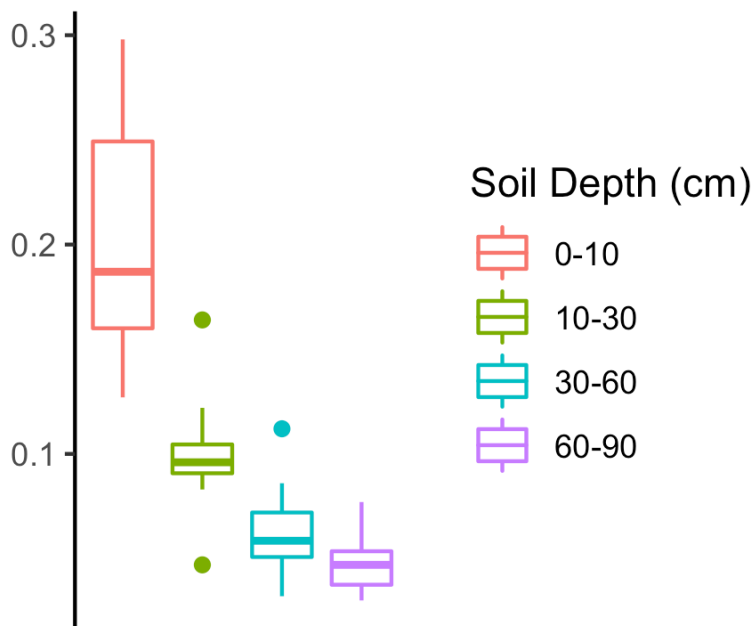


```
boxplot_no_legend <-
    ggplot(Soils, aes(x = Depth, y = N, fill= Depth))+ # changed to fill color
  geom_boxplot()+
  theme_classic()+
  ylab("N (%)")+
  xlab("Depth (cm)") +                      # added x axis title
  theme(axis.text.x = element_text(angle=45, # changed x axis text angle
                            vjust=1,   # text position adjustment
                            hjust=1),  # text position adjustment
        legend.position = "none")           # removed legend
```

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```
boxplot_no_legend
```
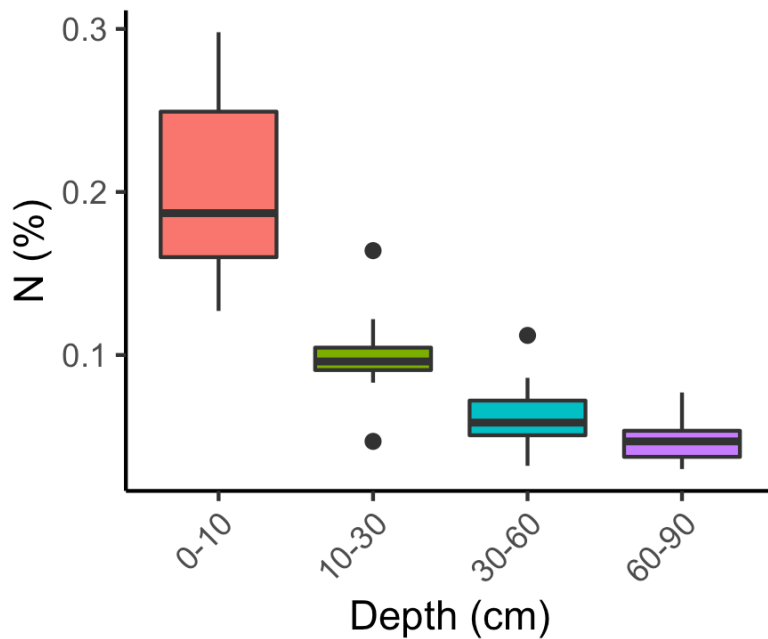

Here are some user-friendly resources for customizing ggplot graphs:

Topic	Link
customize labels	https://www.datanovia.com/en/blog/ggplot-axis-ticks-set-and-rotate-text-labels/
ggplot functions cheat sheet	https://www.maths.usyd.edu.au/u/UG/SM/STAT3022/r/current/Misc/data-visualization-2.1.pdf
Intro to ggplot, ch 6	https://bookdown.org/ybrandvain/Applied-Biostats/viz1.html

Also, remember that the quickest way to access resources is to pull up documneation in R Studio in the help table or by running a line of code with `?function`. This works for arguments/functiontions used with the `ggplot()` function.

For example, running the line of code `?pch` is the easiest way to look up what shapes you can use for points in a scatterplot.

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Multi-panel figures

Option 1 ⬤ EASIEST

Use the patchwork package

Here is a good resource for learning all the arrangement options:
https://gotellilab.github.io/GotelliLabMeetingHacks/NickGotelli/ggplotPatchwork.html

```r
#install.packages("patchwork")
library(patchwork)

# Making 1 more graph to use to show how to change a satellite plot to a bar graph

bargraph <- ggplot(Soils, aes(x = Depth, y = pH, fill = Depth))+  # note changed col to fill
  geom_bar(stat = "identity") +        # changed geom_point to geom_bar
  theme_classic()+
  ylab("pH")+
  xlab("depth (cm)") +
  theme(legend.position = "none")
```
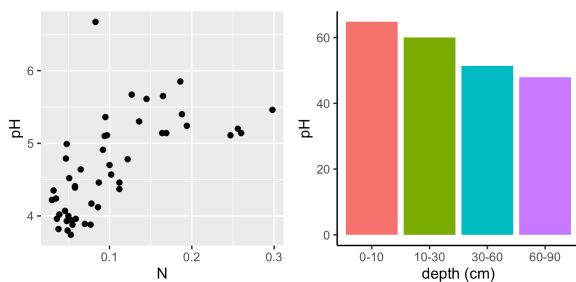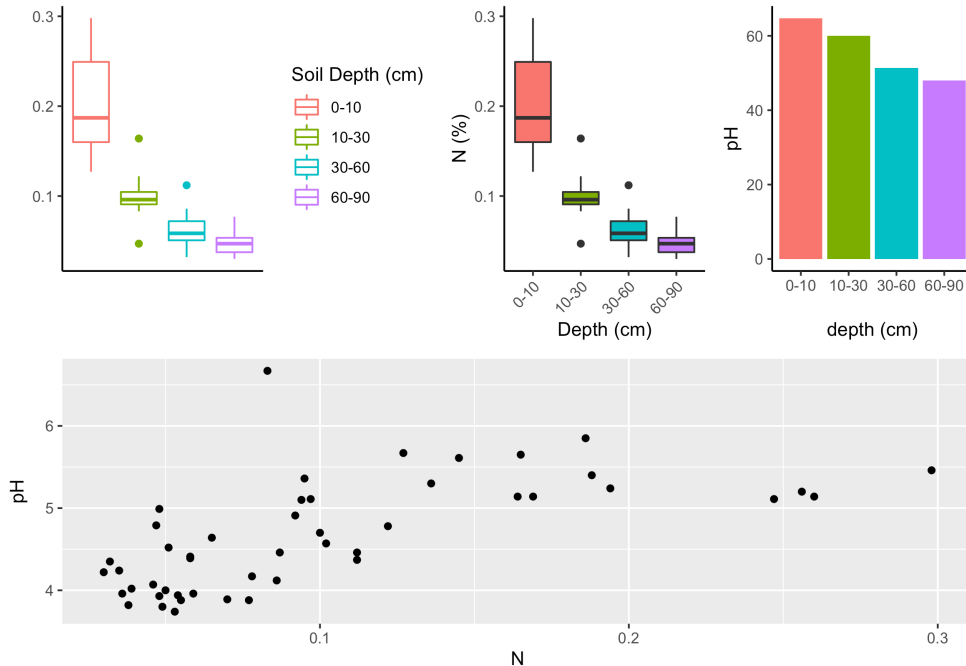
Place to plots together horizontally

#```{r fig.width = 5, fig.height = 3}

```r
scatterplot + bargraph
```


Place 3 plots in a special arrangement

```r
(boxplot | boxplot_no_legend | bargraph)/scatterplot
```

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Option 2 INTERMEDIATE

Faceting

Faceting allows you to divide up a plot into multiple panels in order to look at subsets of data in different panels. Note: you'll need your data in a long format so you can refer to a single column that contains factors that will R will use to parse the data into different groups (e.g. Soils$Depth).

Add a layer (line of code) to your graph with the function facet_wrap() or use facet_grid() if you want to specify how many panels vertically & horizontally.

Note: the column you use to separate data into different panels needs to mode factor (aka categories)

```r
ggplot(Soils, aes(x = Depth , y = pH, fill = Block))+
  geom_boxplot()+
  facet_wrap(. ~ Depth, scales = "free")+
  theme_classic()+
  ggtitle("Multi-panel figure with each depth increment as a separate panel")
```

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Multi-panel figure with each depth increment as a separate panel
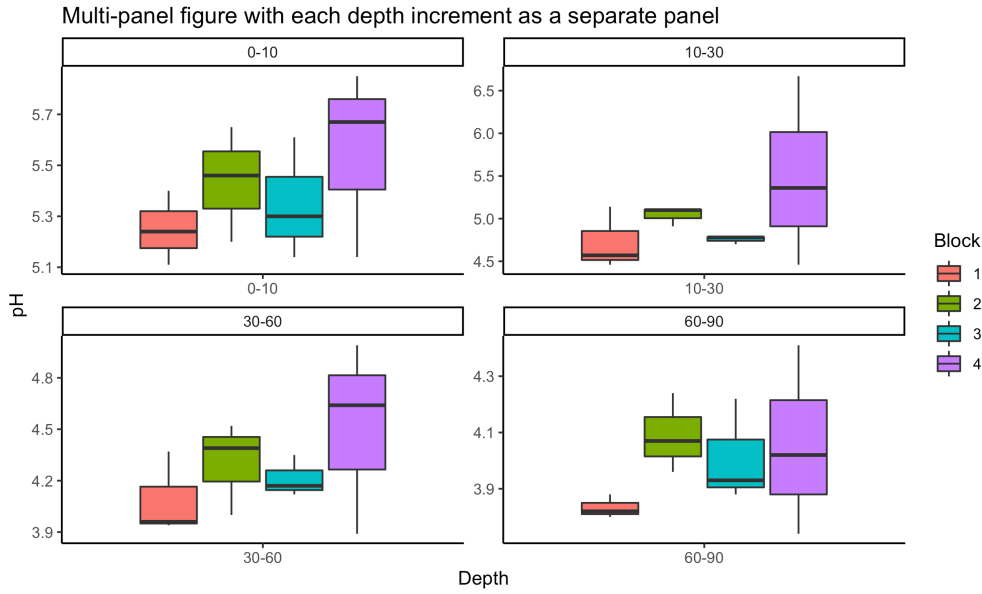
Faceting to make a planel for data that corresponds to every Block & Depth

```
ggplot(Soils, aes(x = N , y = pH, col = Depth))+
  geom_point()+                          #changed to a scatterplot
  facet_wrap(Block ~ Depth, scales = "free")+
  theme_bw()+                            # changed the theme
  ggtitle("Similar graph as above: \n Changed to points, changed theme, and added a
group to facet")
```

Similar graph as above:
Changed to points, changed theme, and added a group to facet
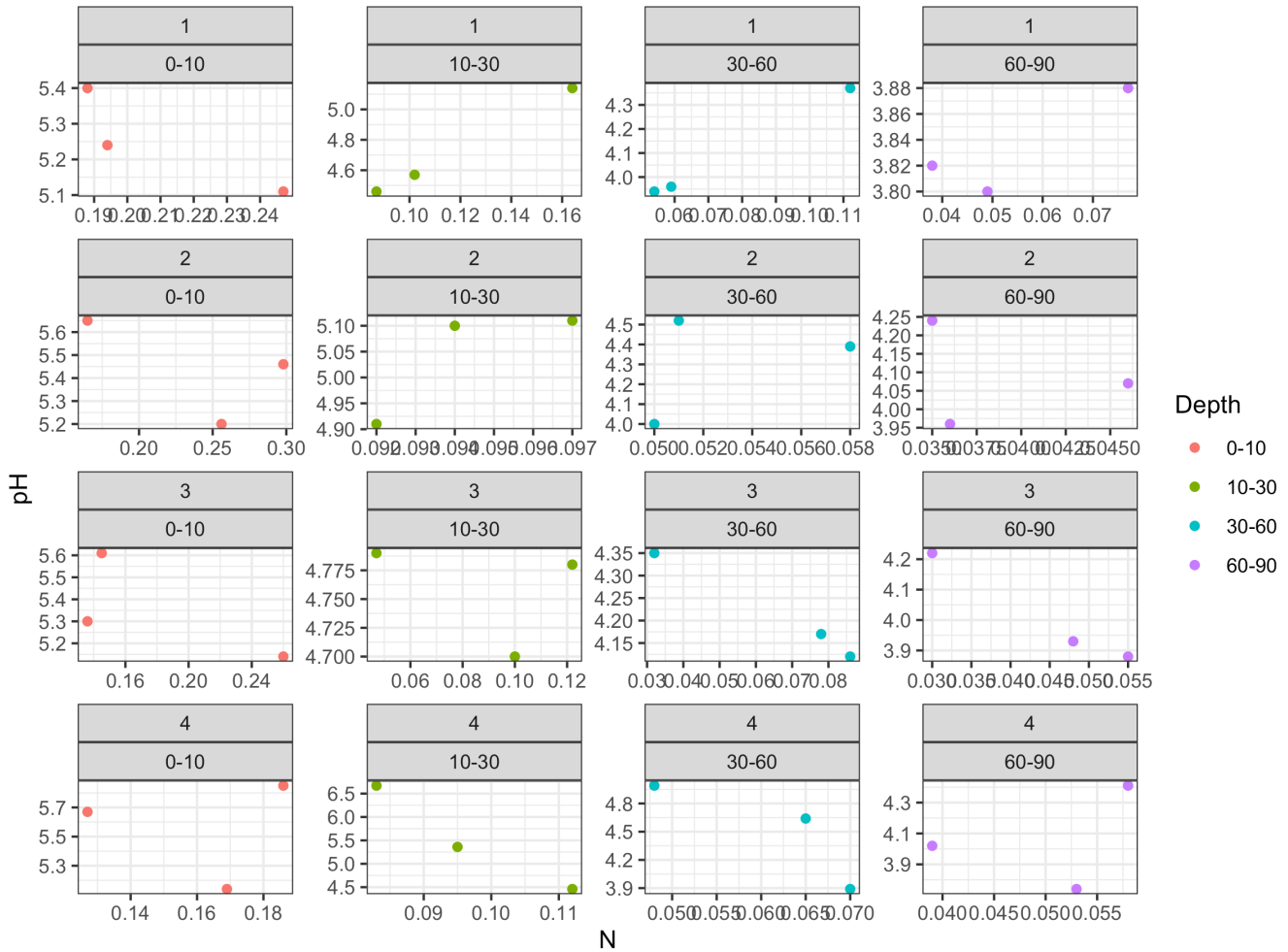
Other R packages that contain functions for arranging panels together include:

- gridExtra::grid.arrange   *#note syntax used here is package name::function*

- ggpubr::ggarrange

- cowplot::plot_grid

See *R Workshop week 3: making graphs part 2* for addition common plotting functions and info on color palette