

Day 4

Basics of Rmarkdown and data visualization with ggplot2

Content

- Basics of Rmarkdown
 - Main elements
 - unhrdown
 - Recap of data cleaning from Day 3
 - Knit file into different outputs
- ggplot2
 - Main elements
 - unhrthemes

Image of Vinicius presenting Rmarkdown and ggplot2 in 2 hours



Rmarkdown

Rmarkdown
TEXT. CODE. OUTPUT.
(GET IT TOGETHER, PEOPLE.)



Illustration by Allison Horst

Exploratory versus explanatory analysis

- Exploratory: understand the data, represent complexities, analytical, expert user group
- Explanatory: wider audiences, understandable visual data / editorial decisions

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What is Rmarkdown?

- Rmarkdown is based on Markdown.

What is ~~R~~markdown Markdown?

- Markdown is a system for writing simple, readable text that is easily converted to HTML.
- Make the syntax of the raw (pre-HTML) document as readable possible.

```
<body>
  <section>
    <h1>Rock Climbing Packing List</h1>
    <ul>
      <li>Climbing Shoes</li>
      <li>Harness</li>
      <li>Backpack</li>
      <li>Rope</li>
      <li>Belay</li>
    </ul>
  </section>
</body>
```

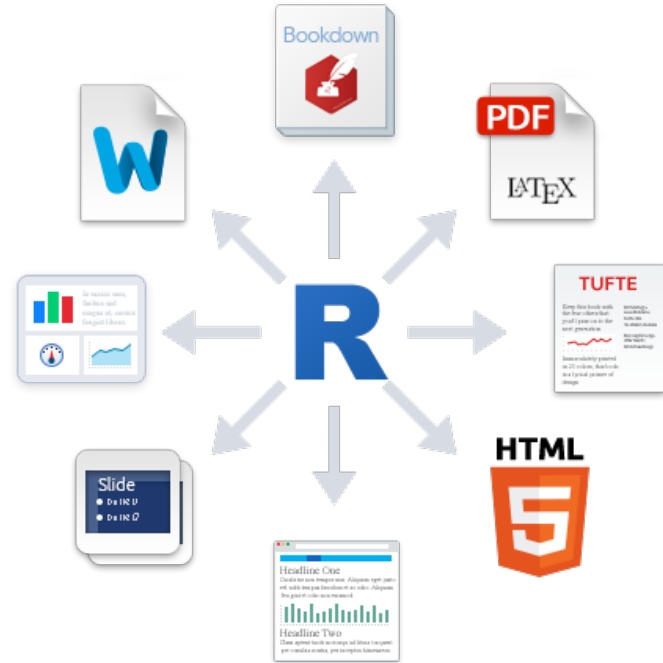


```
# Rock Climbing Packing List

* Climbing Shoes
* Harness
* Backpack
* Rope
* Belay
```

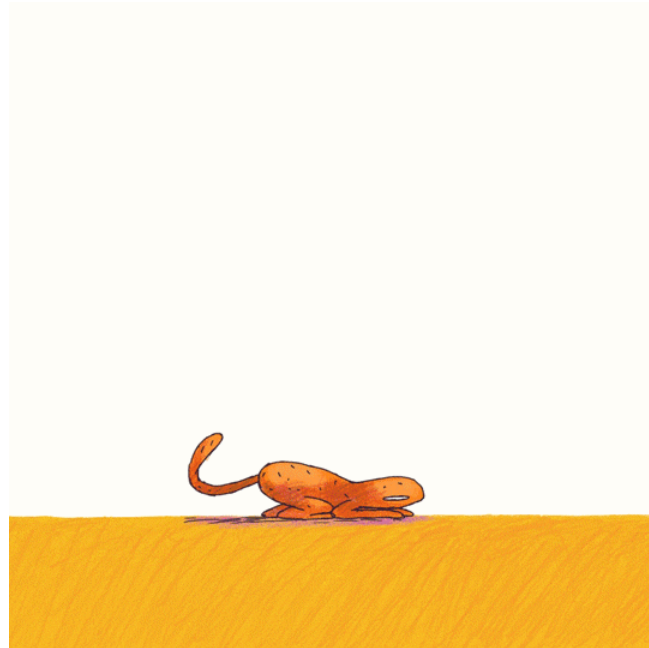

What is Rmarkdown?

- Markdown syntax to create dynamic documents, presentations and reports in Rstudio
- Renders many different types of files



Why Rmarkdown?

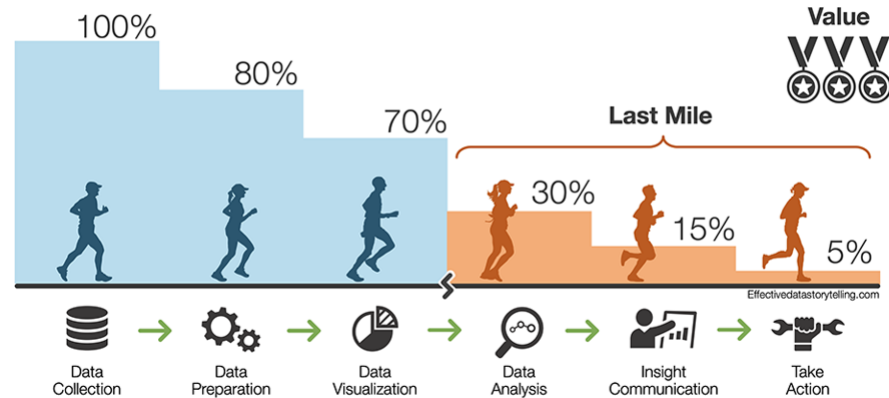
- Dynamic documents
 - Filters
 - Outputs



Why Rmarkdown?

- Reproducibility

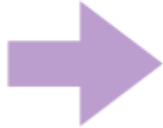
Data Analytics Marathon



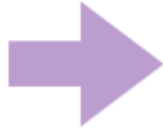
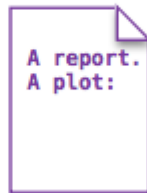
Simple workflow

- Open
- Write
- Embed
- Render

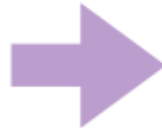
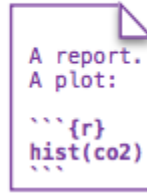
i. Open - Open a file that uses the .Rmd extension.



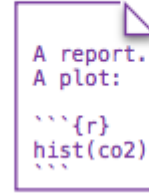
ii. Write - Write content with the easy to use R Markdown syntax



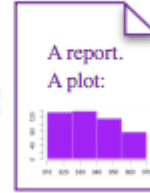
iii. Embed - Embed R code that creates output to include in the report



iv. Render - Replace R code with its output and transform the report into a slideshow, pdf, html or ms Word file.



=



=



Required packages

```
library("rmarkdown")
```

```
library("knitr")
```

```
library("ggplot2")
```

unhcrverse: unhcrdown

Set of templates following UNHCR Brand recommendations.

<https://github.com/vidonne/unhcrdown>

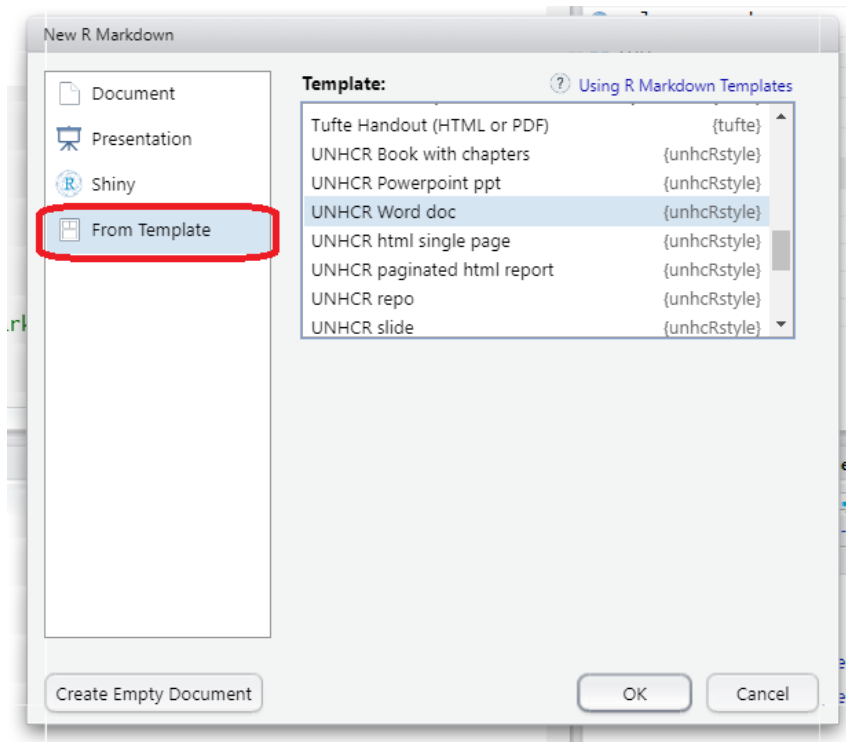
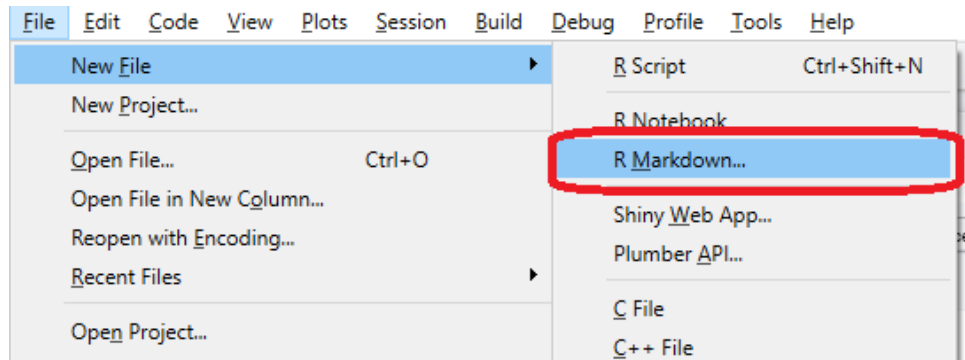
```
install.packages("remotes")
```

```
library(remotes)
```

```
remotes::install_github("vidonne/unhcrdown")
```



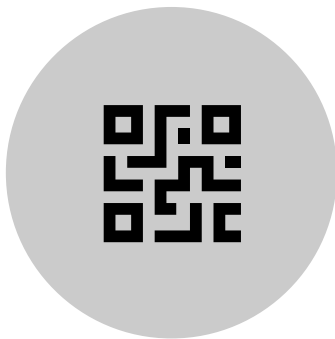
Using unhcardown



How to read an Rmarkdown file?



METADATA



CODE



TEXT

Metadata

- YAML
 - Yet Another Markup Language >> YAML Ain't Markup Language
 - Syntax for hierarchical data structures that is commonly used for configuration files
 - Requires specific formatting to render (e.g. colons after fields, avoid adding extra spaces etc.)
 - Identifies backticks or lists information as strings

```
---  
title: "UNHCR Branded Rmarkdown"  
author: First Last Name  
date: "15 December, 2021"  
output: unhcrdown::paged_report  
---
```

Metadata: Date

- Backstick r
- Specific formats

```
---  
author: "Pan-Africa DIMA Units"  
date: "`r format(Sys.Date(), '%d %B %Y')`"  
output:  
  unhrdown::docx_simple  
---
```

Code	Meaning	Code	Meaning
%a	Abbreviated weekday	%A	Full weekday
%b	Abbreviated month	%B	Full month
%c	Locale-specific date and time	%d	Decimal date
%H	Decimal hours (24 hour)	%l	Decimal hours (12 hour)
%j	Decimal day of the year	%m	Decimal month
%M	Decimal minute	%p	Locale-specific AM/PM
%S	Decimal second	%U	Decimal week of the year (starting on Sunday)
%w	Decimal Weekday (0=Sunday)	%W	Decimal week of the year (starting on Monday)
%x	Locale-specific Date	%X	Locale-specific Time
%y	2-digit year	%Y	4-digit year
%z	Offset from GMT	%Z	Time zone (character)

Text: Markdown basics

Plain text

End a line with two spaces
to start a new paragraph.

italics and **bold**

``verbatim code``

sub/superscript²~2~

~~strikethrough~~

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End a line with two spaces
to start a new paragraph.

italics and **bold**

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sub/superscript²~2~

~~strikethrough~~

Header1

Header 2

Header 3

Header 4

Header1 {#anchor}

Header 2 {#css_id}

Header 3 {.css_class}

Header 4

Header 5

Header 6

<<http://www.rstudio.com>>

[link] (www.rstudio.com)

Jump to [Header 1](#anchor)

image:

![Caption] (smallorb.png)

* unordered list

+ sub-item 1

+ sub-item 2

- sub-sub-item 1

* item 2

Continued (indent 4 spaces)

1. ordered list

2. item 2

i) sub-item 1

A. sub-sub-item 1

<http://www.rstudio.com>

link

Jump to Header 1

image:



Caption

• unordered list

◦ sub-item 1

◦ sub-item 2

▪ sub-sub-item 1

• item 2

Continued (indent 4 spaces)

1. ordered list

2. item 2

i. sub-item 1

A. sub-sub-item 1

1. A list whose numbering



UNHCR
The UN Refugee Agency

Codes

Inline codes

- In the written part of the document
- Great to automate update

Methodology

This report analyzes data on UNHCR's population of concern in the year **`**r asr_year**`**.

Code chunks

- Lines of code to render plots, tables, calculate summary statistics, load packages etc.

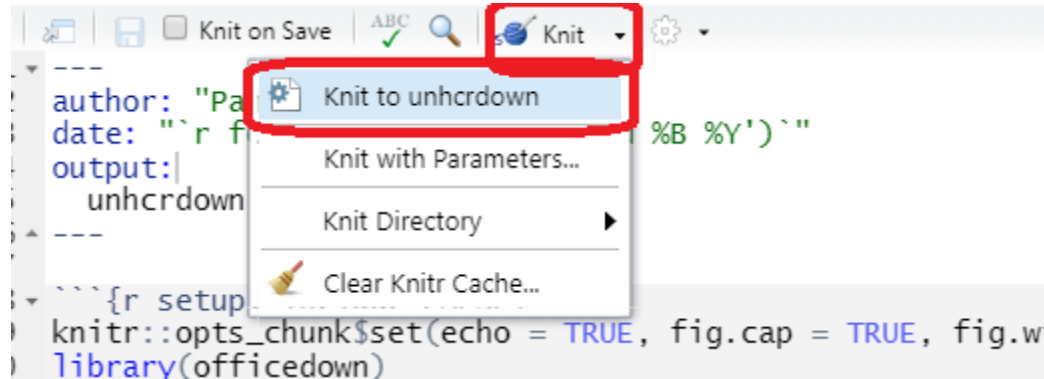
```
```{r, echo=FALSE, message=FALSE, warning=FALSE, results = 'hide'}  
library(ggplot2)
library(unhcrthemes)
library(scales)

column_graph <- ggplot(asr_top5, aes(asylum_name, total_sum)) +
 geom_col(fill = unhcr_pal(n = 1, "pal_blue"))

column_graph
```

# Knit

- “Knit” button (Ctrl+Shift+K): render report in chosen output



# Demo

## Objectives

- Identification of main elements in the Rmarkdown file
- Knit
- Explain data manipulation in first code chunk
- Filter by year = 2019 + identify inline codes

# Ahmadou's cheat sheet



## dp\_lyr essentials

Main dp\_lyr verbs you will learn in this training:

- `filter()`: keep rows that satisfy your conditions
- `select()`: keep or exclude some columns
- `rename()`: rename columns
- `mutate()`: add a new column
- `summarize()`: get summary statistics
- `group_by()`: data manipulation operations by group

# Good practices in Rmarkdown

- Data manipulation



# Quiz

# Data visualization in R (ggplot2)



Illustration by Allison Horst

*Statistics and Computing*

Leland Wilkinson

# The Grammar of Graphics

Second Edition

## ggplot2: grammar of graphics

The quick brown fox jumps over the lazy dog.

Article   Adjective   Adjective   Noun   Verb   Preposition

- Graphics = distinct layers of grammatical elements.
- Meaningful plots through aesthetic mappings.

# Basic syntac

- Data
- Mapping (aesthetics)
- Geometric representation (geom)



Geometries  
Aesthetics  
Data



```
ggplot(data, aes(x, y)) + geom_*()
```

# Intermediary syntax

- Statistics
- Facet
- Coordinates
- Labels
- Theme

```
ggplot (data = <DATA>) +
 <GEOM_FUNCTION> (mapping = aes(<MAPPINGS>),
 stat = <STAT>, position = <POSITION>) +
 <COORDINATE_FUNCTION> +
 <FACET_FUNCTION> +
 <SCALE_FUNCTION> +
 <THEME_FUNCTION>
```

required

Not required, sensible defaults supplied

Data

*{variables of interest}*

Aesthetics

*x-axis  
y-axis*

*colour  
fill*

*size  
labels*

*alpha  
shape*

*line width  
line type*

Geometries

*point*

*line*

*histogram*

*bar*

*boxplot*

Themes

*non-data ink*

Statistics

*binning*

*smoothing*

*descriptive*

*inferential*

Coordinates

*cartesian*

*fixed*

*polar*

*limits*

Facets

*columns*

*rows*

# Demo

## Objectives

- Show base graphics
- Basic syntax
- Analysis of changes in graphs
- Return to Rmarkdown to interpret the column chart

# Quiz

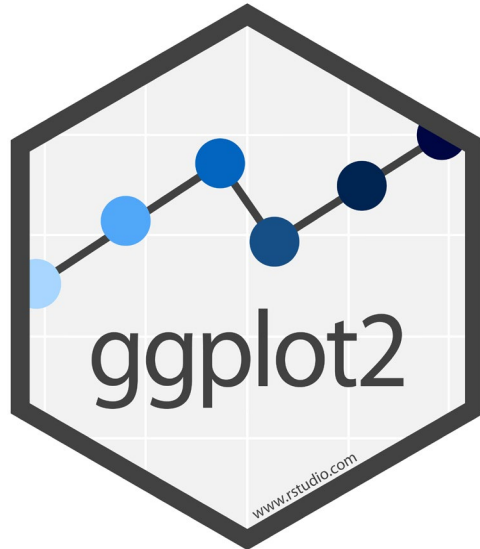


BASE



Components:





# ggplot2 resources

- ggplot2 package:  
<https://ggplot2.tidyverse.org/>
- ggplot2 cheat sheet
- ggplot2 extensions:  
<https://exts.ggplot2.tidyverse.org/>
- Basics of ggplot2
- UNHCRverse: [unhcrthemes](#)

## Data visualization with ggplot2 : : CHEAT SHEET



### Basics

ggplot2 is based on the **grammar of graphics**, the idea that you can build every graph from the same components: a **data set**, a **coordinate system**, and **geoms**—visual marks that represent data points.



To display values, map variables in the data to visual properties of the geom (**aesthetics**) like **size**, **color**, and **x** and **y** locations.



Complete the template below to build a graph.

```
ggplot(data = <DATA>) +
 <GEOM_FUNCTION> mapping = aes(<MAPPINGS>) +
 stat = <STAT> position = <POSITION> +
 <COORDINATE_FUNCTION> +
 <SCALE_FUNCTION> +
 <THEME_FUNCTION>
```

ggplot(data = mpg, aes(x = cyl, y = hwy)) Begins a plot that you finish by adding layers. Add one geom function per layer.

last\_plot() Returns the last plot.

ggsave("plot.png", width = 5, height = 5) Saves last plot as 5 x 5 file named "plot.png" in working directory. Matches file type to file extension.

### Aes

Common aesthetic values.

color and fill - string: "red", "violetred3"

linetype - integer or string: 0 = "blank", 1 = "solid", 2 = "dashed", 3 = "dotted", 4 = "dotteddash", 5 = "longdash", 6 = "twodash"

linewidth - string: "round", "butt", or "square"

linjoin - string: "round", "mitre", or "bevel"

size - integer (line width in mm)

shape - integer/shape name or a single character ("x")

### Geoms

Use a geom function to represent data points, use the geom's aesthetic properties to represent variables.

**GRAPHICAL PRIMITIVES**  
a = ggplot(economics, aes(date, unemploy))  
b = ggplot(mpg, aes(x = long, y = lat))

a = geom\_blank() and a = expand\_limits()  
b = geom\_curve(aes(yend = lat + 1, xend = long + 1, curvature = 1), x = end, y = end, alpha, angle, color, curvature, linetype, size)

a = geom\_path(linend = "butt", linjoin = "round", linetype = 3)  
b = geom\_point(aes(alpha = 50))  
c = geom\_polygon(aes(long = long, ymin = lat, ymax = long + 1, ymax = lat + 1), xmax, xmin, ymax, ymin, alpha, color, fill, linetype, size)

a = geom\_rect(aes(xmin = long, ymin = lat, xmax = long + 1, ymax = lat + 1), xmax, xmin, ymax, ymin, alpha, color, fill, linetype, size)

a = geom\_ribbon(aes(ymin = unemploy - 900, ymax = unemploy + 900), x, ymax, ymin, alpha, color, fill, group, linetype, size)

**LINE SEGMENTS**  
common aesthetics: x, y, alpha, color, linetype, size

b = geom\_abline(intercept = 0, slope = 1)  
c = geom\_hline(aes(yintercept = lat))  
d = geom\_vline(aes(xintercept = long))

b = geom\_segment(aes(yend = lat + 1, xend = long + 1))  
c = geom\_spoke(aes(angle = 1:155, radius = 1))

**ONE VARIABLE continuous**  
c = ggplot(mpg, aes(hwy))  
c2 = ggplot(mpg)

c = geom\_area(aes(x = "bin"))  
c = geom\_bar(aes(x = fill, y = count))  
c = geom\_density(aes(x = "gaussian"))  
c = geom\_dotplot()

c = geom\_histogram(bins = 5)  
c = geom\_jitter(alpha = 0.5, height = 0.2)  
c = geom\_line(aes(x = hwy, y = count))  
c = geom\_point(aes(x = hwy, y = count))  
c = geom\_raster(aes(x = hwy, y = count))  
c = geom\_smooth(method = "lm")  
c = geom\_text(aes(x = hwy, y = count))  
c = geom\_violin(aes(x = hwy, y = count))

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c = geom\_dotplot()

### TWO VARIABLES both continuous

a = ggplot(mpg, aes(cty, hwy))

a = geom\_bin2d(bins = c(10, 25, 50))  
b = geom\_density\_2d()

a = geom\_point()  
b = geom\_hex()

a = geom\_quantile()  
b = geom\_rug(sides = "bt")

a = geom\_smooth(method = "lm")  
b = geom\_area()

a = geom\_text(aes(x = hwy, y = count))  
b = geom\_violin(aes(x = hwy, y = count))

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f = geom\_smooth(method = "lm")  
g = geom\_text(aes(x = hwy, y = count))  
h = geom\_violin(aes(x = hwy, y = count))

### continuous bivariate distribution

h = ggplot(diamonds, aes(carat, price))

h = geom\_bin2d(bins = c(10, 25, 50))  
b = geom\_density\_2d()

h = geom\_point()  
b = geom\_hex()

h = geom\_quantile()  
b = geom\_rug(sides = "bt")

h = geom\_smooth(method = "lm")  
b = geom\_area()

h = geom\_text(aes(x = hwy, y = count))  
b = geom\_violin(aes(x = hwy, y = count))

h = geom\_area(aes(x = hwy, y = count))  
b = geom\_bar(aes(x = hwy, y = count))  
c = geom\_density(aes(x = hwy, y = count))  
d = geom\_dotplot()

h = geom\_histogram(bins = 5)  
b = geom\_jitter(alpha = 0.5, height = 0.2)  
c = geom\_line(aes(x = hwy, y = count))  
d = geom\_point(aes(x = hwy, y = count))  
e = geom\_raster(aes(x = hwy, y = count))  
f = geom\_smooth(method = "lm")  
g = geom\_text(aes(x = hwy, y = count))  
h = geom\_violin(aes(x = hwy, y = count))

h = geom\_area(aes(x = hwy, y = count))  
b = geom\_bar(aes(x = hwy, y = count))  
c = geom\_density(aes(x = hwy, y = count))  
d = geom\_dotplot()

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b = geom\_jitter(alpha = 0.5, height = 0.2)  
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d = geom\_point(aes(x = hwy, y = count))  
e = geom\_raster(aes(x = hwy, y = count))  
f = geom\_smooth(method = "lm")  
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h = geom\_violin(aes(x = hwy, y = count))

h = geom\_area(aes(x = hwy, y = count))  
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# Rmarkdown resources

- [Rmarkdown website](#) by Rstudio
- [Rmarkdown Cheat Sheet](#)
- [Knitr in a Knutshell](#)
- ++ Learn & Connect Trainings

# Tomorrow

- Recap + questions
- Extra!
  - Naming conventions
  - ASR and country names
  - Secret participant
- Structuring an R community in Pan-Africa





# THANK YOU