

Oxford RUG 2023-02-23

Interactive data visualisation in R Shiny with {htmlwidgets}

Charlotte Joey Hadley
 @charliejhadley



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Interactive Data Network

idn.it.ox.ac.uk

VISIBLE DATA

visibledata.co.uk

Rin 3 Moths





UNIVERSITY OF
OXFORD

Interactive Data Network

idn.it.ox.ac.uk

- Promote reproducible research workflows and good research data management
- Support researchers in using interactive dataviz to promote Open Data
- Host interactive dataviz built by researchers at Oxford (currently using shinyapps.io)

Invisible data is not Open Data

“Data available in the supplementary materials” - all too often an empty promise



@charliejhadley

Research data is too often born and buried in a[n Excel] table

“Most scientific data is created in a form and organization that facilitates its generation rather than focusing on its eventual use.”

“[... data management] has mostly focused on the efficiency of query-based retrieval of the collected data, rather than on data exploration”

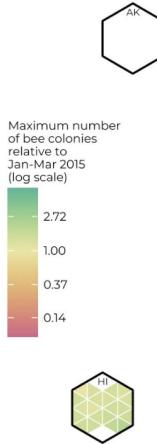
Table 2. Successes and failures for articles with non-zero metric scores, aggregated by journal, and only including journals for which there is at least one success or failure.

Metric+	Mostly success	Mostly failure	Z	Equal	Journals
Tweets**	1097 (58%)	646 (34%)	10.8	148 (8%)	1891
**	1032 (59%)	586 (33%)	11.1	139 (8%)	1757
FbWalls**	414 (53%)	282 (36%)	5.0	86 (11%)	782
**	308 (55%)	188 (34%)	5.4	62 (11%)	558
RH	276 (51%)	221 (41%)	2.5	47 (9%)	544
	193 (51%)	157 (41%)	1.9	30 (8%)	380
Blogs**	190 (58%)	104 (32%)	5.0	32 (10%)	326
**	129 (57%)	70 (31%)	4.2	26 (12%)	225
Google+	61 (50%)	53 (44%)	0.7	7 (6%)	121
	25 (48%)	24 (46%)	0.1	3 (6%)	52
MSM	29 (56%)	17 (33%)	1.8	6 (12%)	52
	13 (52%)	9 (36%)	0.9	3 (12%)	25
Reddits	22 (51%)	17 (40%)	0.8	4 (9%)	43
	9 (47%)	7 (37%)	0.5	3 (16%)	19
Forums	5 (83%)	1 (17%)	1.6	0 (0%)	6
	3 (100%)	0 (0%)	1.7	0 (0%)	3
Q&A	4 (67%)	1 (17%)	1.3	1 (17%)	6
	2 (67%)	0 (0%)	1.4	1 (33%)	3
Pinterest	2 (67%)	1 (33%)	0.6	0 (0%)	3
	0 (- %)	0 (- %)	-	0 (- %)	0
LinkedIn	0 (- %)	0 (- %)	-	0 (- %)	0
	0 (- %)	0 (- %)	-	0 (- %)	0

+ In each cell the upper figure is for all journals and the lower figure is for journals with at least 10 articles tested. * Ratio of successes to failures significantly different from 0.5 at $p=0.05$, ** Significant at $p=0.01$; both Bonferroni corrected for $n=11$.
doi:10.1371/journal.pone.0064841.t002

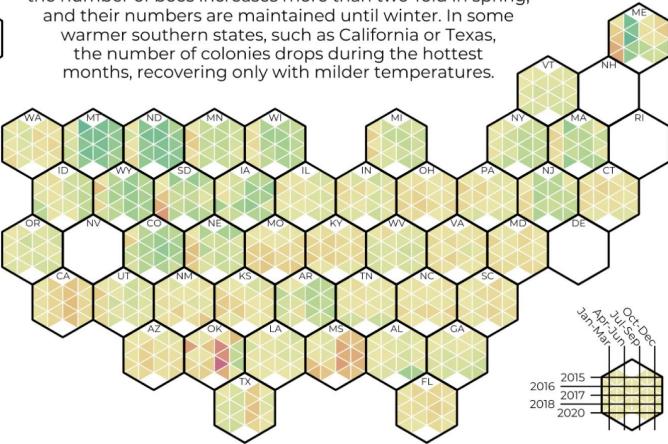
Data visualisation is awesome

Data from USDA
Graph by @irg_bio



Seasonality in the number of bee colonies

The number of bee colonies in the US changes with the seasons depending on the state. In some northern states, the number of bees increases more than two-fold in spring and their numbers are maintained until winter. In some warmer southern states, such as California or Texas, the number of colonies drops during the hottest months, recovering only with milder temperatures.



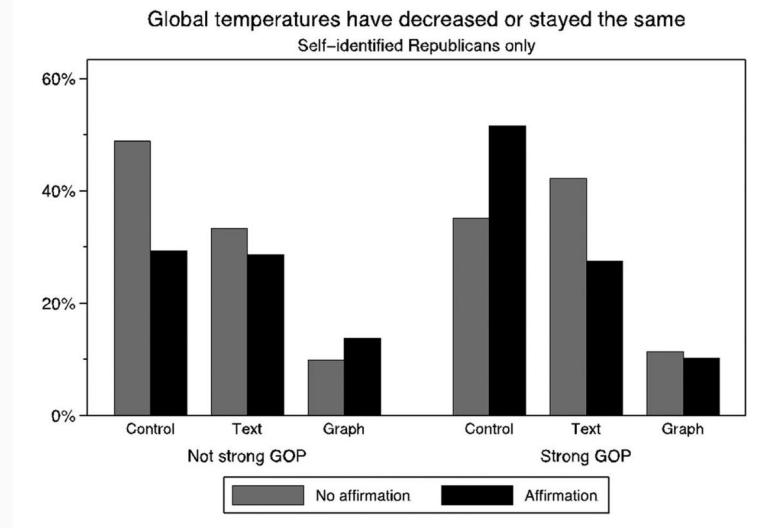
@charliejhadley

~~A picture is worth a thousand words~~

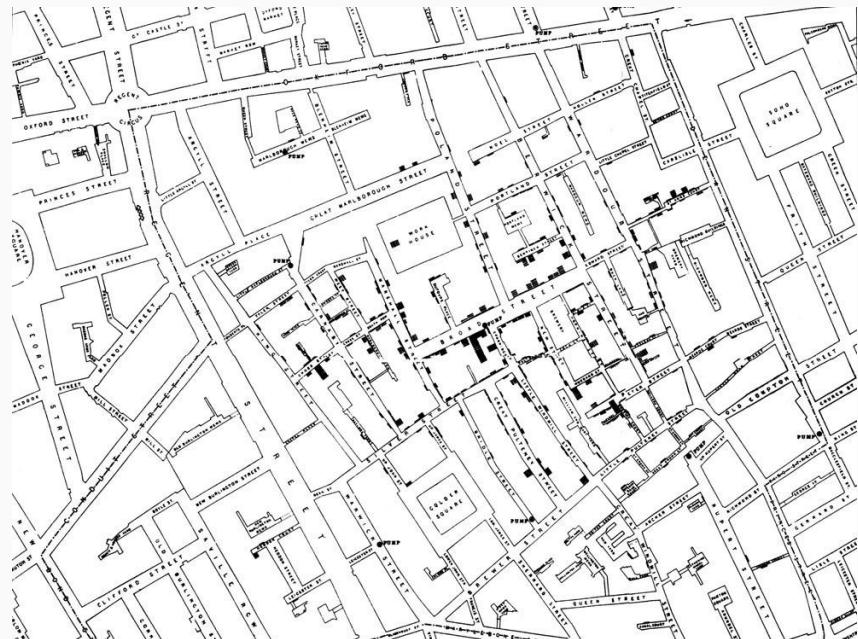
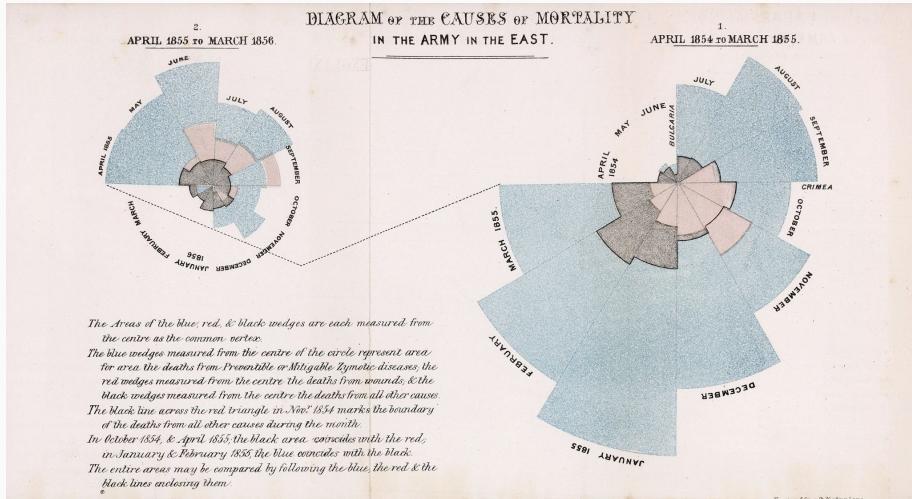
Charts are more accurately read

There is considerable evidence that charts

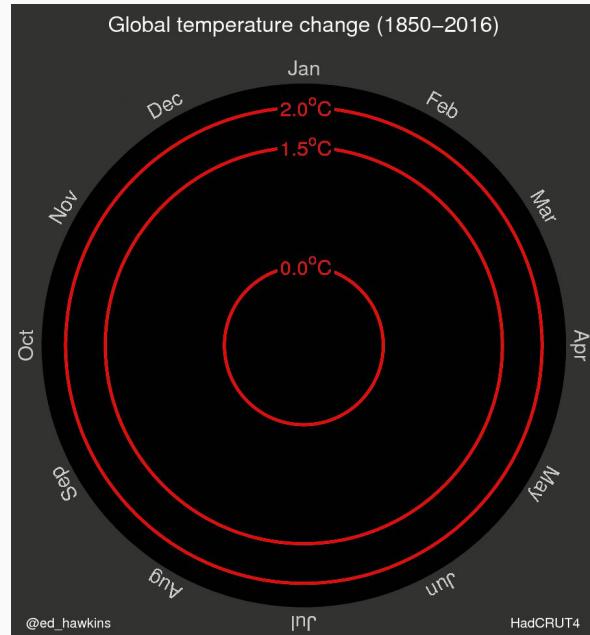
- Improve comprehension of information
- Improve accuracy of reader measurements
- Improve confidence in understanding and decision making



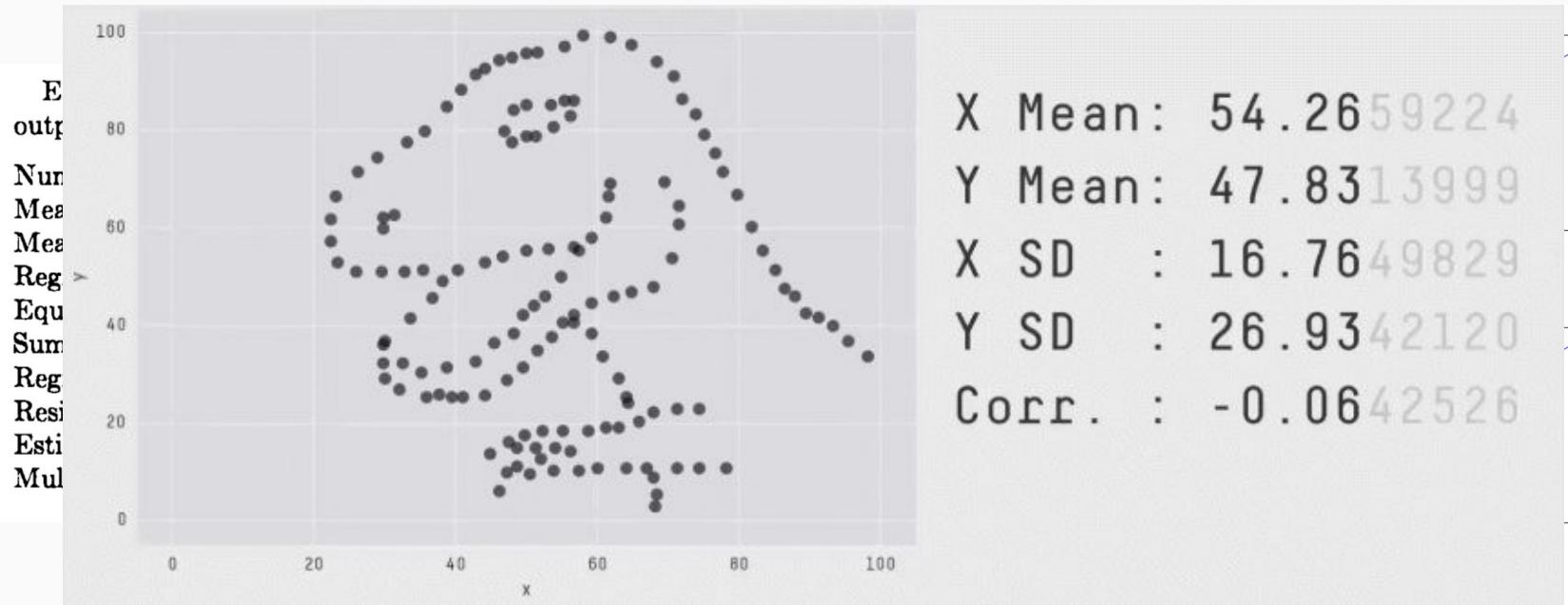
Charts have a history of impact



Charts tell impactful stories



Charts are necessary to understand data



Anscombe, F. J. Graphs in Statistical Analysis. *The American Statistician* 27, 17–21 (1973).

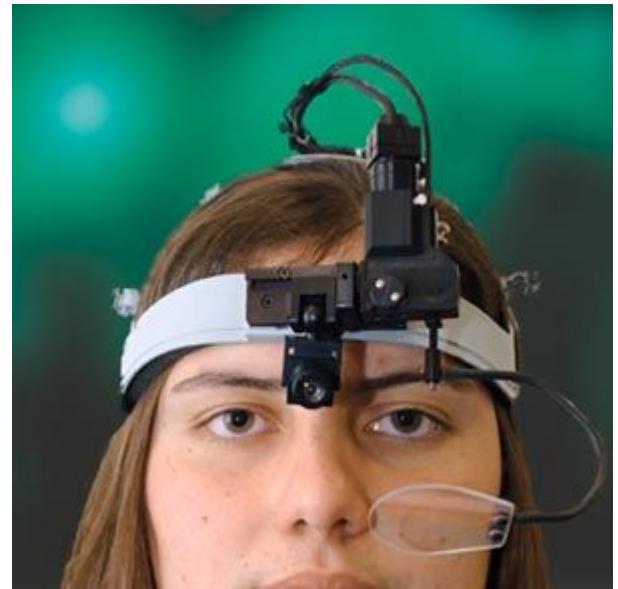
Cairo, A. Download the Datasaurus: Never trust summary statistics alone; always visualize your data.

<http://www.thefunctionalart.com/2016/08/download-datasaurus-never-trust-summary.html> (2016).

Interactive data visualisation in R Shiny
with {htmlwidgets}

Evidence-based visual perception theory

[ENG7218 lecture slides](#)



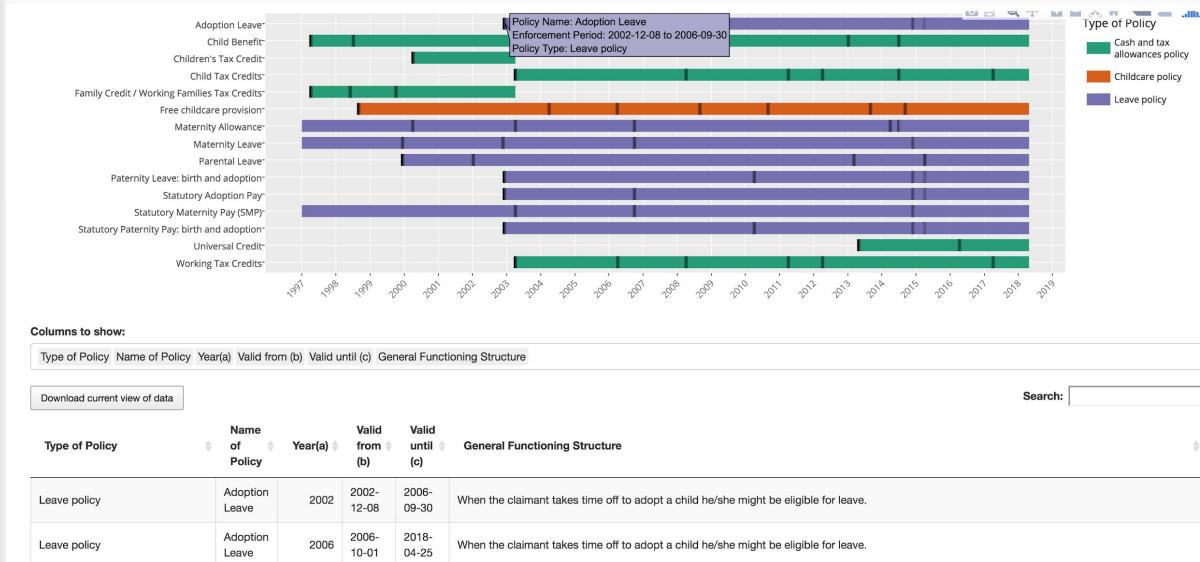
Moving beyond dead trees

“... interactivity is the new colour chart...”



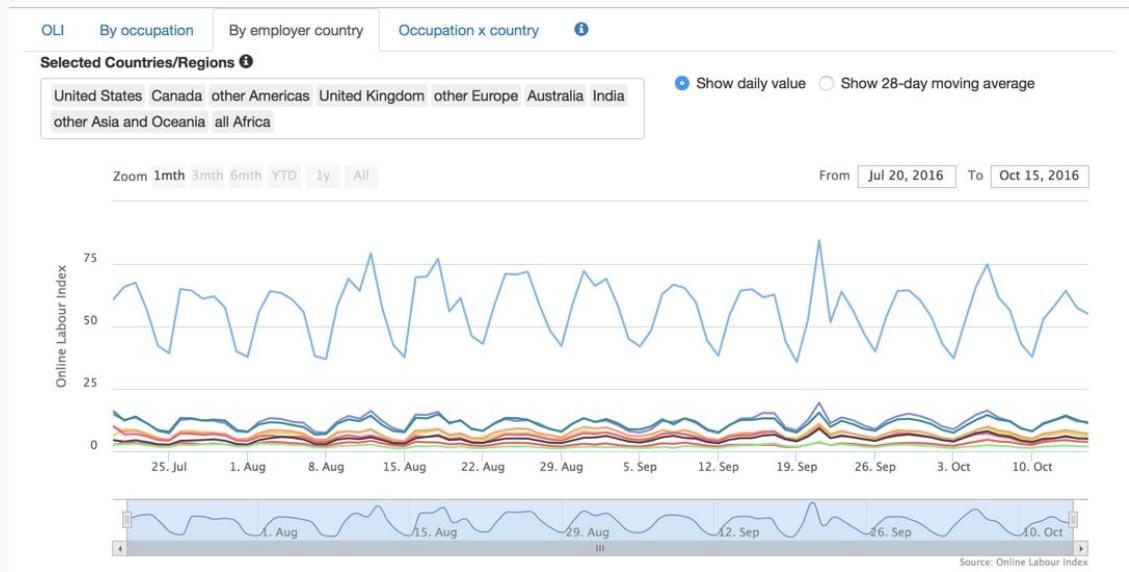
What does interactivity provide?

- Provide alternative methods to access data



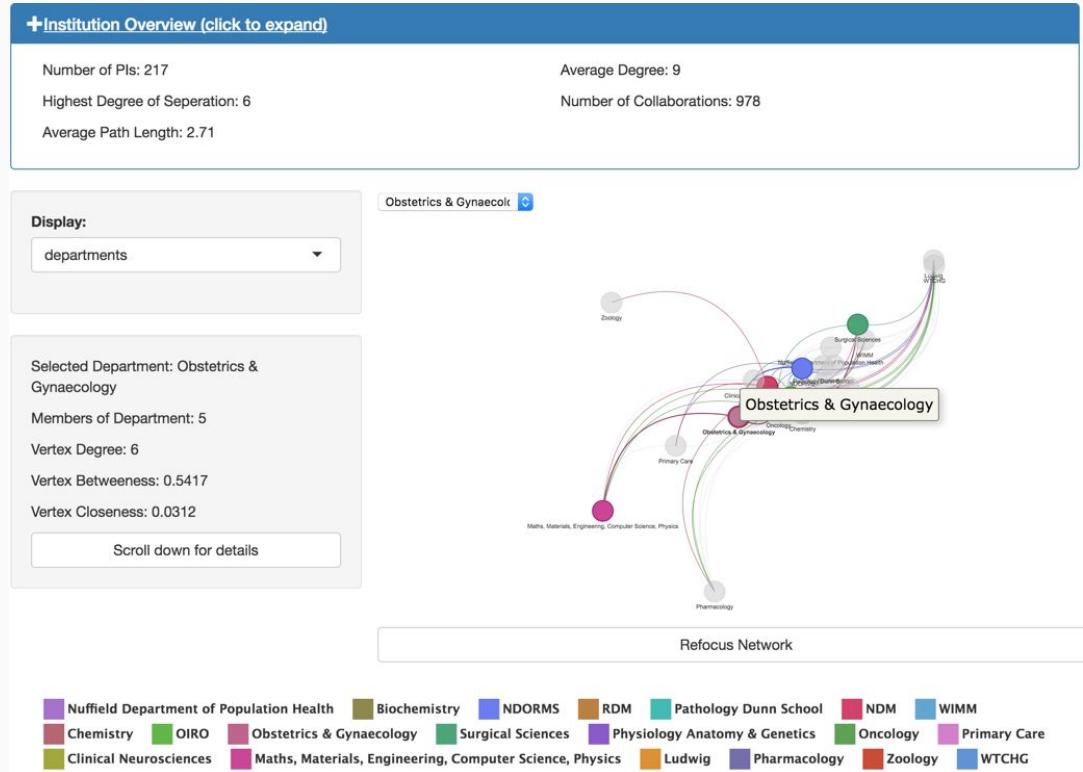
What does interactivity provide?

- Provide alternative methods to access data
- Allow users to slice through datasets



What does interactivity provide?

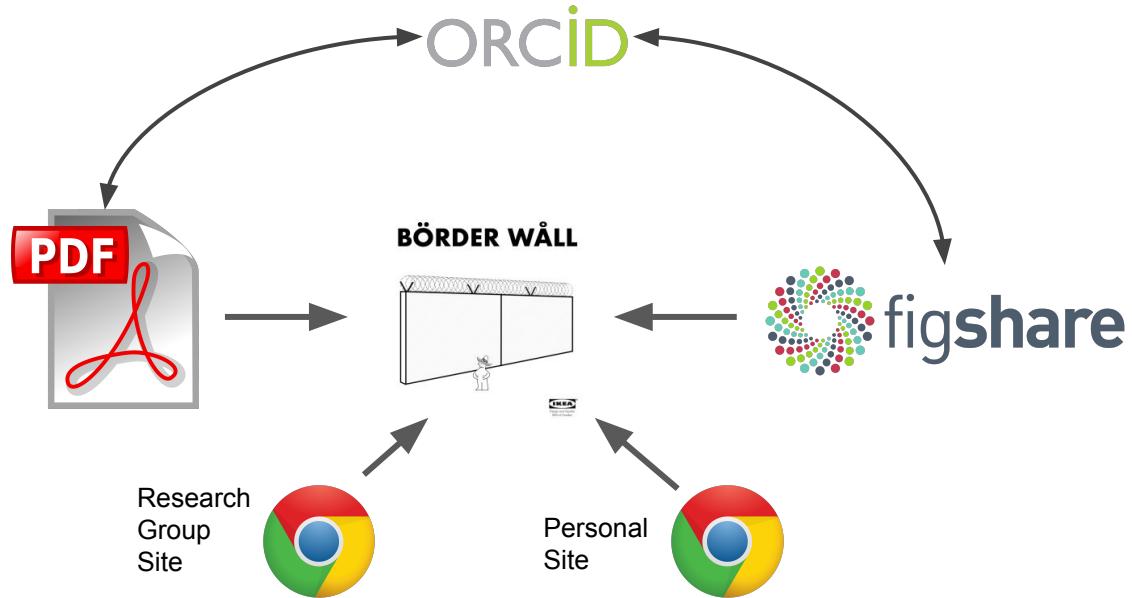
- Provide alternative methods to access data
- Allow users to slice through datasets
- Combine summary and detailed information



The Data Gap

Datasets should be obvious when approaching research from any of the directions:

- Academic publisher's website
- Research group site
- Personal site



Don't silo data with dataviz services

Duplicating data on a visualisation services adds **more data gaps**

- Datasets easily become out of sync
- Dataviz services typically have pervasive licenses for your data
- There's no audit trail



Don't silo data with dataviz services

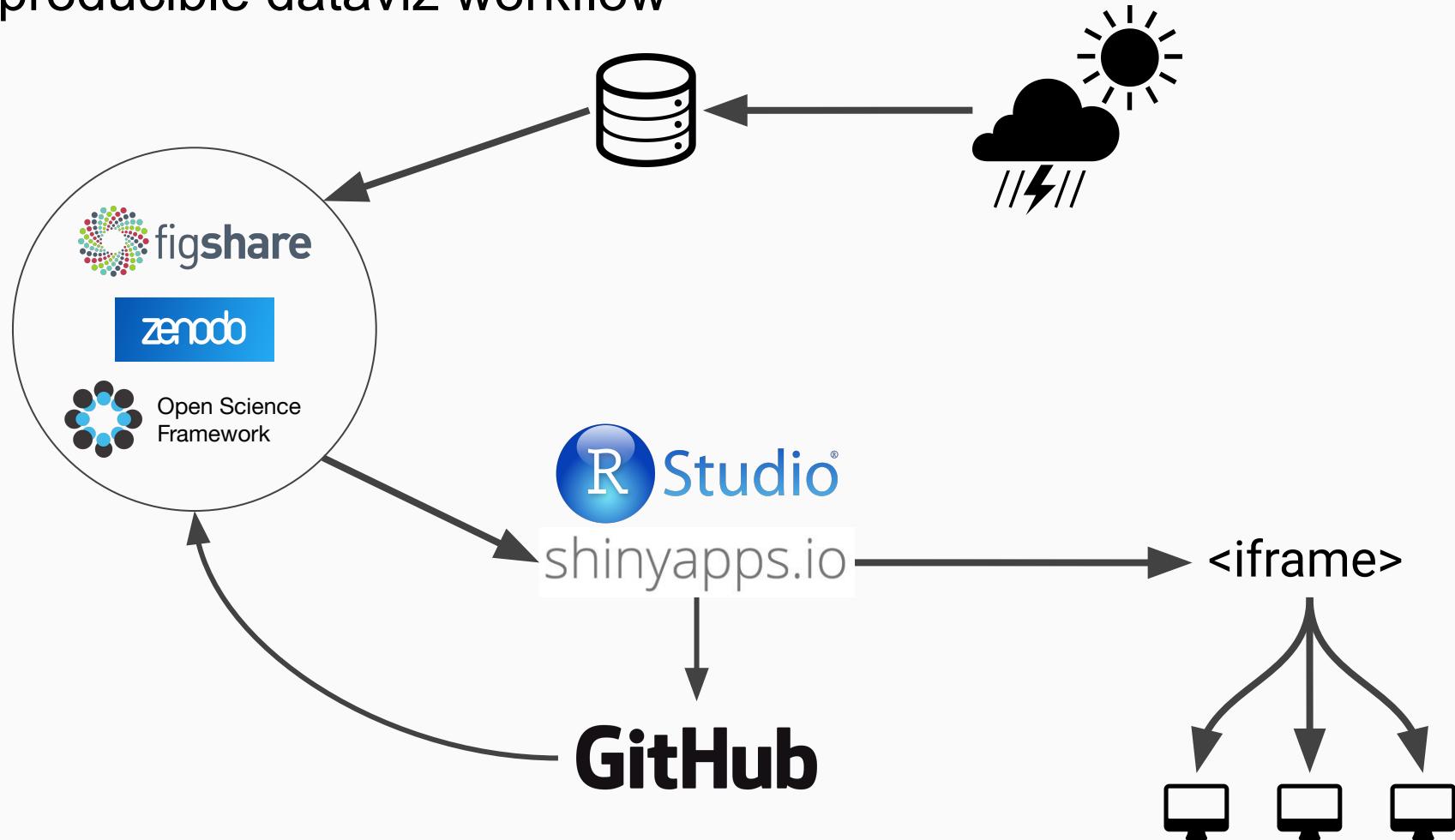
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Only **ONE** cloud service provided
this at a reasonable cost... Shiny



Reproducible dataviz workflow

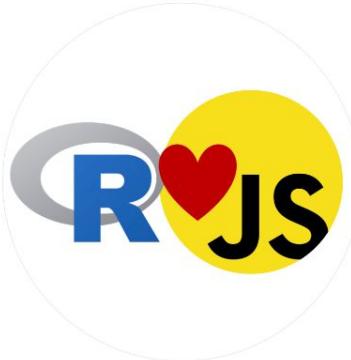


Interactive data visualisations with R

Quarto



{htmlwidgets}



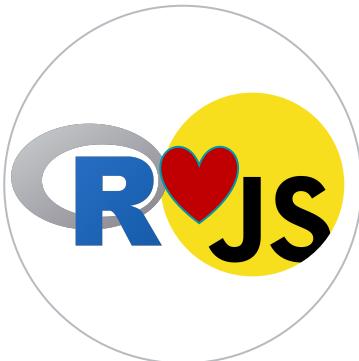
{shiny}





Quarto

{htmlwidgets}



{shiny}





Quarto

Quarto allows us to build:

- Interactive reports and slides
- Static reports and slides (PDF, MS Word and PowerPoint)
- Entire websites

Quarto allows us to build using either of these languages:

- R
- Python
- Julia



Quarto

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- Interactive reports and slides
- Static reports and slides (PDF, MS Word and PowerPoint)
- Entire websites

**Quarto is the next evolution
of RMarkdown**

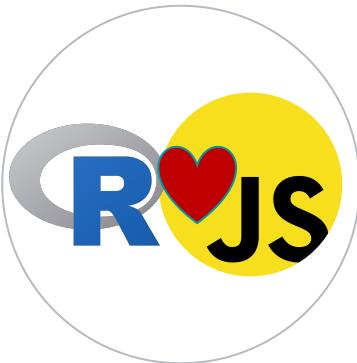
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- R
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Quarto

{htmlwidgets}



{shiny}

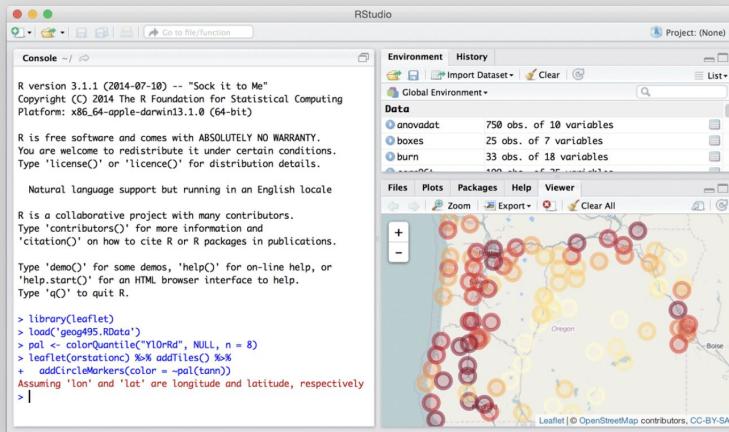


Bring the best of JavaScript data visualization to R

Use JavaScript visualization libraries at the R console, just like plots

Embed widgets in R Markdown documents and Shiny web applications

Develop new widgets using a framework that seamlessly bridges R and JavaScript



```
R version 3.1.1 (2014-07-10) -- "Sock it to Me"
Copyright (C) 2014 The R Foundation for Statistical Computing
Platform: x86_64-apple-darwin13.1.0 (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

Natural language support but running in an English locale

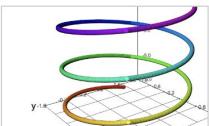
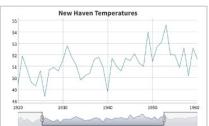
R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

> library(leaflet)
> load('geog495.RData')
> pal <- colorQuantile("YlOrRd", NULL, n = 8)
> leaflet(crs(raster)) %>% addTiles() %>%
+   addCircleMarkers(color = -pal(tann))
Assuming 'lon' and 'lat' are longitude and latitude, respectively
> |
```

At the R console In R Markdown docs In Shiny apps

Widgets in action



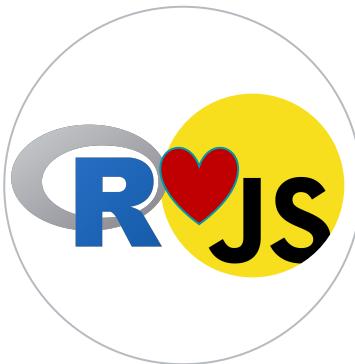
Just a line or two of R code can be used to create interactive visualizations. See the featured widgets in the [showcase](#) and browse over 50 available widgets in the [gallery](#).

[See the showcase »](#)

Quarto



{htmlwidgets}



{shiny}

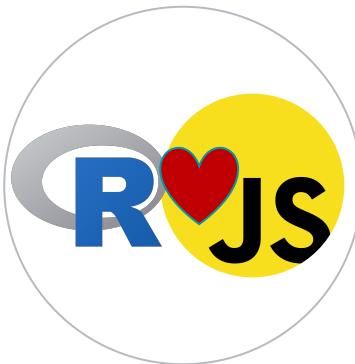


Doesn't require a server – everything
happens in the browser



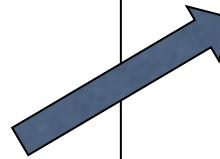
Quarto

{htmlwidgets}



Needs a server

{shiny}



{shiny} for R

{shiny} is a **fully self-contained** framework for building ~~web-apps~~ dashboards with R.



We write the UX with R code.

We write the server side of the code with R.

A beta tool for building {shiny} GUI

shinyuieditor 0.1.0

Quick Start Live Demo Articles Reference Changelog

Tour App | ← →

Shiny UI Editor

Elements

- Tab Panel
- Tabset Panel
- Action Button
- Numeric Input
- Slider Input
- Text Input
- Checkbox Input
- Checkbox Group
- Select Input
- Radio Buttons
- Plot Output
- Text Output
- Dynamic UI Output
- Grid Card
- Grid Text Card
- Grid Plot Card

My Navbar Page Settings Plot 1 Plot 2 +

Empty tabset. Drag elements or Tab Panel on to add content

Properties

Page Title: My Navbar Page

The screenshot shows the shinyuieditor application interface. At the top, there's a navigation bar with links for Quick Start, Live Demo, Articles, Reference, Changelog, and a Tour App. Below the title 'shinyuieditor 0.1.0' is a sidebar titled 'Elements' containing icons for various Shiny UI components: Tab Panel, Tabset Panel, Action Button, Numeric Input, Slider Input, Text Input, Checkbox Input, Checkbox Group, Select Input, Radio Buttons, Plot Output, Text Output, Dynamic UI Output, Grid Card, Grid Text Card, and Grid Plot Card. To the right of the sidebar is a workspace titled 'My Navbar Page' which includes tabs for Settings, Plot 1, Plot 2, and a plus sign. A message in the workspace says 'Empty tabset. Drag elements or Tab Panel on to add content'. On the far right is a 'Properties' panel with a section for 'Page Title' containing the value 'My Navbar Page'. At the bottom of the workspace is a large blue rectangular area.

Hosted for you

shinyapps.io

Self-hosted



Commercially licensed
CMS for Shiny apps



shinyapps.io by RStudio

FREE

\$ 0 /month

New to Shiny? Deploy your applications for FREE.

5 Applications

25 Active Hours

Community Support

RStudio Branding

STARTER

\$ 9 /month
(or \$100/year)

More applications. More active hours!

25 Applications

100 Active Hours

Premium Email Support

BASIC

\$ 39 /month
(or \$440/year)

Take your users to the next level!

Unlimited Applications

500 Active Hours

Performance Boost

Premium Email Support

STANDARD

\$ 99 /month
(or \$1,100/year)

Password protection? Authenticate your users!

Unlimited Applications

2,000 Active Hours

Authentication

Performance Boost

Premium Email Support

PROFESSIONAL

\$ 299 /month
(or \$3,300/year)

Professional has it all! Personalize your domains.

Unlimited Applications

10,000 Active Hours

Authentication

Account Sharing

Performance Boost

Custom Domains

Premium Email Support

{shiny} in production

California COVID Assessment Tool [Introduction](#) [Nowcasts](#) [Forecasts](#) [Scenarios](#) [Downloads](#) [Technical Notes](#) [About CalCAT](#)

Long term Scenarios

Long-term forecasts predicated on various specific assumptions

Please select Geography: Select a Model Output:

California Hospital Admits Include Actuals

Note: Detailed model scenario descriptions can be found below the graph or on the Technical Notes tab.

Scenario Hub (Round 15)

Ensemble early boosting, no variant, Er

Scenario Hub (Round 14)

Ensemble broad boosting, no variant, E

LEMMa

Nothing selected

IHME

IHME reference, IHME best masks

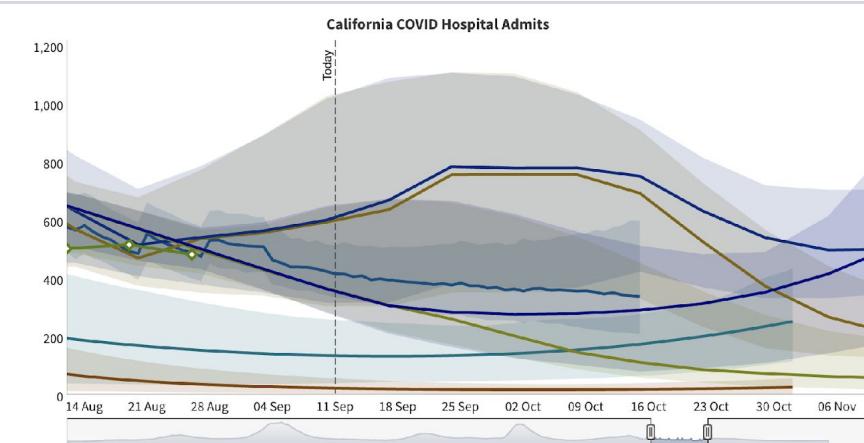
Shaman Group (Columbia University)

Columbia 1x increased transmission

Plot Options:

Show 50% Uncertainty Interval

[Download Scenarios in Graph](#)



Legend

- IHME reference
- IHME best masks
- Columbia 1x increased transmission
- Ensemble broad boosting, no variant
- Ensemble restricted boosting, new variant
- Ensemble early boosting, no variant
- Ensemble late boosting, new variant
- New Admits for COVID-19

Use slice below graph to adjust date range.



Features for shiny apps

- Manage user access to shiny apps
- Manage admin rights to shiny apps
- Manage server resources



Features for shiny apps

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For RMarkdown & Quarto aps

- Manage access to shiny apps
- Programmatically run reports by schedule or a trigger



Features for shiny apps

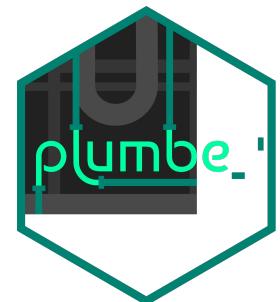
- Manage user access to shiny apps
- Manage admin rights to shiny apps
- Manage server resources

For RMarkdown & Quarto aps

- Manage access to shiny apps
- Programmatically run reports by schedule or a trigger

For hosting R API

- Create from R code using {plumber}





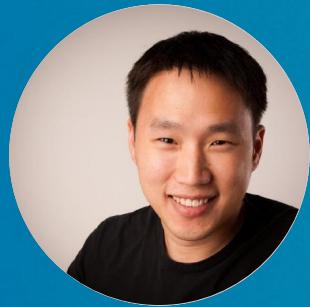
shiny for Python!

Shiny makes it easy to build interactive web applications with the power of Python's data and scientific stack.

- **Approachable:** Write your application in Python; no web development skills required.
- **Flexible:** Built from the ground up to support custom layouts, styles, and the modularity required for full-fledged applications, all from Python.
- **Performant:** Uses reactivity to efficiently handle data processing and minimize expensive re-computations.

Note! Shiny for Python is currently in Alpha. It may be unstable, and the API may change. We're excited to hear your feedback, but please don't use it for production applications just yet!

shiny.rstudio.com/py



Joe Cheng

The Past and Future of Shiny

rstudio::conf(2022)

Are R users ready to write web apps?

- R users are **not afraid to learn**: stats, viz, coding, git, grammar of graphics. They will sit through tutorials, read reference docs
- R users are **incredibly motivated** by what Shiny offers them
 - A force multiplier for their existing skills in R, by broadening their audience
 - Produces “mic drop” moments

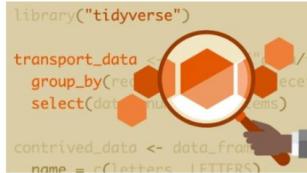
rstudio.com/conference/2022/keynotes/past-future-shiny

Thanks for listening

LinkedIn Learning



Go from zero to well designed shiny apps in 2h50m with a thorough, easy to follow explanation of reactivity.



A thorough introduction to tidyverse concepts and how to use them to solve common data wrangling tasks.



Learn how to make interactive charts, tables, maps and more in this dedicated 5h30min course.



Learn to use RMarkdown to build reports and slide decks in both PDF and interactive HTML.



Learn how to combine {shiny} and RMarkdown together to create slide decks with interactive elements.



Need to make maps but don't know any GIS? After this course you can make static and interactive maps!

R in 3 Months

R for the Rest of Us

