Making data interactive: our experiences

Stephen Rhead & Karen Melrose
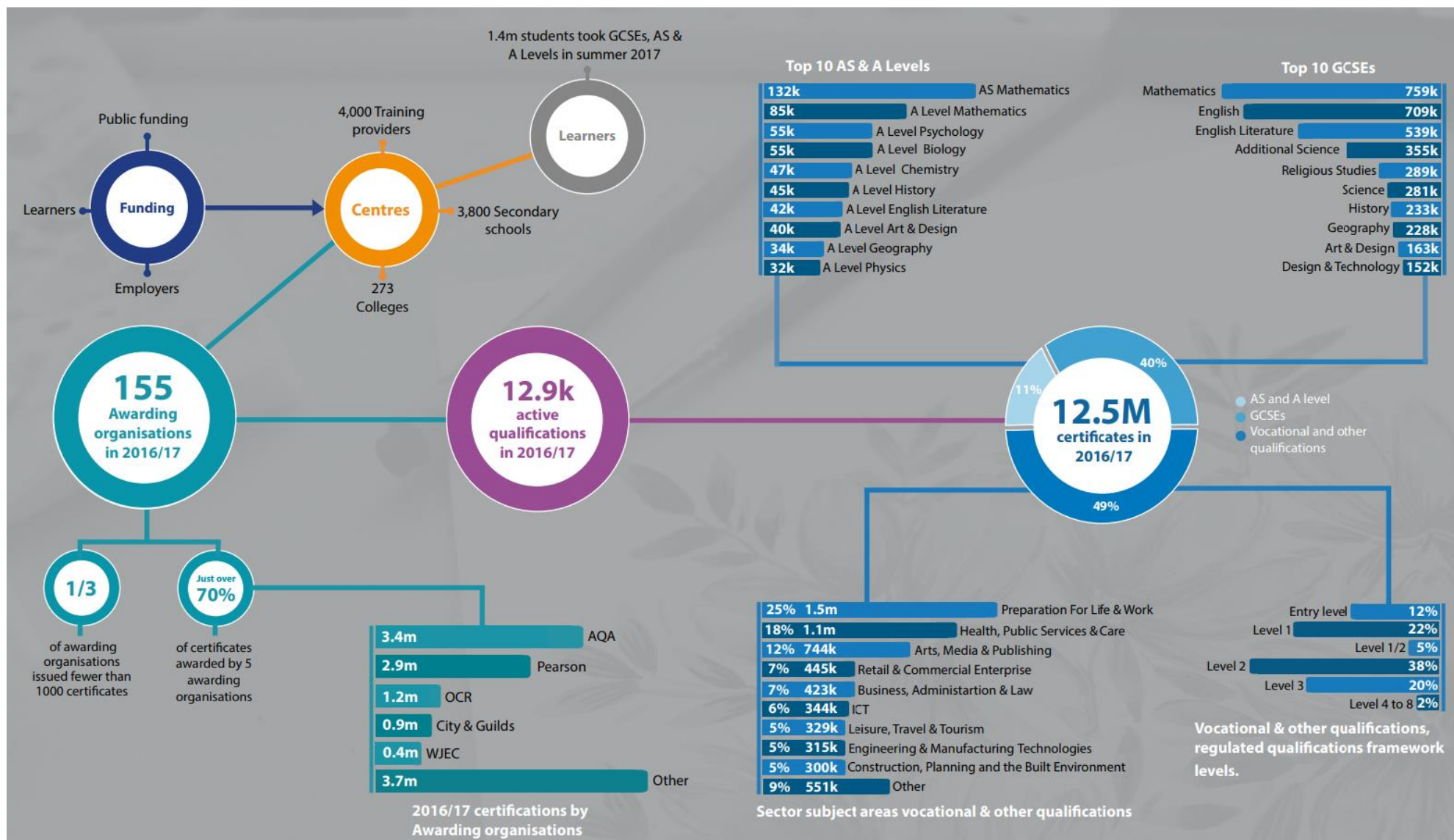
3rd October 2018

Overview

- Introduction to Ofqual and Ofqual Analytics

- Demonstration of our interactive apps

- Overview of R Shiny

- Challenges

- Measuring usage using Google Analytics

- Recognition and feedback

Ofqual

- The Office of Qualifications and Examinations Regulation (Ofqual) regulates qualifications, examinations and assessments in England

- We are responsible for making sure that:
  - regulated qualifications reliably indicate the knowledge, skills and understanding students have demonstrated
  - assessments and exams show what a student has achieved
  - people have confidence in the qualifications that we regulate
  - students and teachers have information on the full range of qualifications that we regulate

The regulated qualifications market

1.4m students took GCSEs, AS & A Levels in summer 2017

Public funding

Learners

Employers

Funding

Centres

Learners

4,000 Training providers

3,800 Secondary schools

273 Colleges

155 Awarding organisations in 2016/17

12.9k active qualifications in 2016/17

12.5M certificates in 2016/17
- 40%
- 11%
- 49%
  - AS and A level
  - GCSEs
  - Vocational and other qualifications

1/3 of awarding organisations issued fewer than 1000 certificates

Just over 70% of certificates awarded by 5 awarding organisations

Top 10 AS & A Levels
132k	AS Mathematics
85k	A Level Mathematics
55k	A Level Psychology
55k	A Level Biology
47k	A Level Chemistry
45k	A Level History
42k	A Level English Literature
40k	A Level Art & Design
34k	A Level Geography
32k	A Level Physics

Top 10 GCSEs
Mathematics	759k
English	709k
English Literature	539k
Additional Science	355k
Religious Studies	289k
Science	281k
History	233k
Geography	228k
Art & Design	163k
Design & Technology	152k

2016/17 certifications by Awarding organisations
3.4m	AQA
2.9m	Pearson
1.2m	OCR
0.9m	City & Guilds
0.4m	WJEC
3.7m	Other

Sector subject areas vocational & other qualifications
25%	1.5m	Preparation For Life & Work
18%	1.1m	Health, Public Services & Care
12%	744k	Arts, Media & Publishing
7%	445k	Retail & Commercial Enterprise
7%	423k	Business, Administartion & Law
6%	344k	ICT
5%	329k	Leisure, Travel & Tourism
5%	315k	Engineering & Manufacturing Technologies
5%	300k	Construction, Planning and the Built Environment
9%	551k	Other

Vocational & other qualifications, regulated qualifications framework levels.
Entry level	12%
Level 1	22%
Level 1/2	5%
Level 2	38%
Level 3	20%
Level 4 to 8	2%

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Data @ Ofqual

We collect:

- Awarding organisation information
- Qualification information
- Certification data

GCSE/A level data:

- Candidate level data
- Malpractice
- Reviews of marking and appeals
- Special consideration
- Access arrangements

Official Statistics @ Ofqual

https://www.gov.uk/government/organisations/ofqual/about/statistics

Transformation programme – out with the old

Statistical Release

Malpractice for GCSE and A level:

Summer 2016 exam series

Contents

Published:
13 December 2016

Vikas Dhawan
Head of Profession

statistics@ofqual.gov.uk

Key points

This release provides information on reported malpractice for GCSE and A level, in England, Wales and Northern Ireland, other UK regions and overseas, during the summer 2016 exam series.

The key findings for this release are as follows:

- This year's results are similar to previous years. There were 2,430 penalties issued by exam boards to candidates in the summer 2016 exam series, broadly the same as 2015 (2,460 penalties).

- Penalties for candidate malpractice remained extremely rare across all five exam boards and represent 0.011% of the total number of unit entries, the same proportion as last year (entries decreased year-on-year).

- The most common type of candidate malpractice was possessing a mobile phone or other electronic device in an exam. The number of penalties issued to candidates for this increased by 15% compared to last year, from 790 to 900.

- There were 388 penalties issued to school and college staff in 2016, up 48% on last year when there were 262.

- In contrast, there were 41% fewer penalties issued to schools and college, falling from 288 to 169. The highest percentage of penalties issued to schools and colleges this year were written warnings (79%), continuing the trend of the past four years.

Ofqual/16/6132

Malpractice for GCSE and A level: summer 2016 exam series

Types of penalties issued to candidates

The penalties for candidate malpractice vary depending on the type of offence. They include warnings, loss of marks and disqualification from units, components or qualifications. For example, candidates who bring a mobile phone into an exam room but do not have their phone at their desk might receive a warning, whereas candidates found using a mobile phone during an exam might be disqualified from the unit or the qualification in that exam series. An individual candidate can be penalised more than once and by more than one exam board if they commit malpractice offences when sitting more than one assessment.

Penalties issued in summer 2016 comprised 1,300 loss of marks (53% of penalties), 690 warnings (28% of penalties), and 450 disqualifications (18 per cent of penalties; see table 2 and figure 2).

The number of penalties that resulted in a loss of marks increased by 18% compared to last summer (from 1,100 to 1,300). The number of warnings decreased by 18% (from 840 to 690) and the number of disqualifications decreased by 14% (from 520 to 450).

Figure 2: Number of penalties issued to candidates for malpractice for the summer exam series, 2012 to 2016
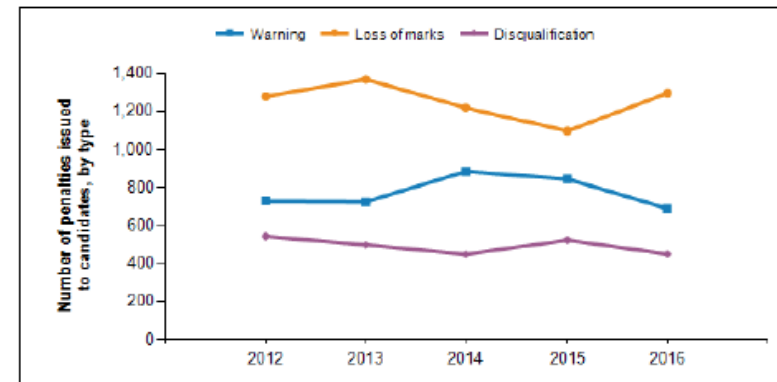
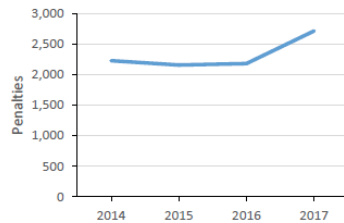# Transformation programme – in with the new

Malpractice for GCSE, AS and A level — Summer 2017 exam series (Ofqual). Published: 5 January 2018. Coverage: England. Official Statistics.
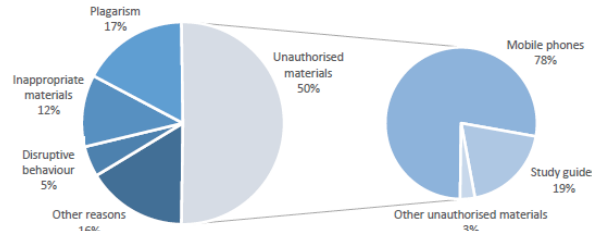
This release presents figures on penalties issued by exam boards for student, school or college staff, and school or college, malpractice for GCSE, AS and A level examinations for the 2017 summer exam series in England.

Number of penalties issued to students increases — 2,715 penalties were issued to students in 2017, up from 2,180 compared to 2016 and representing 0.015% of entries (compared to 0.011% in 2016).

**Access to a mobile phone: main reason for student penalties** — Plagiarism 17%, Unauthorised materials 50%, Inappropriate materials 12%, Disruptive behaviour 5%, Other reasons 16%. Unauthorised materials breakdown: Mobile phones 78%, Study guides 19%, Other unauthorised materials 3%.

Number of penalities issued to school or college staff increases — 895 penalties were issued to staff, up from 360 in 2016. Exam boards are more likely to issue formal written warnings for similar offences rather than informal advisory notes this year. This still involves a very small proportion of the total number of staff in England (350K).
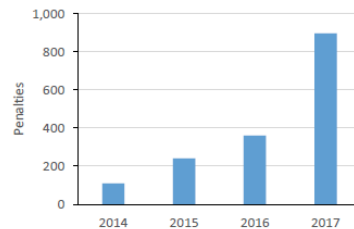
Number of penalties issued to schools or colleges decreases — 120 penalties were issued to schools/colleges, down from 155 in 2016. The actual number of penalties is small given the overall number of centres (over 5,000).
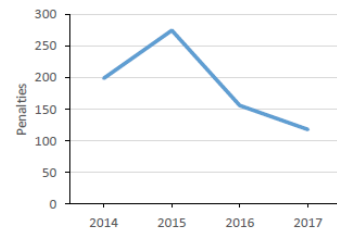
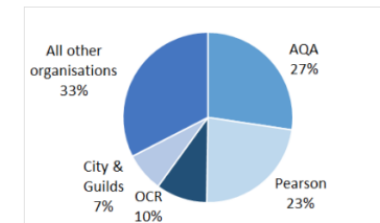## Statistics transformation programme – making data show its story

By Gareth Pryce
27 March 2018

We launched a transformation programme in early 2017 to refresh our statistical releases. The objectives were to make our statistics more engaging, informative and targeted to different types of users.

Ofqual is the regulator of qualifications, examinations and assessments in England. Our statistical releases give a picture of the education landscape in the country. Our users range from the Parliament to public and includes government departments such as the Department for Education and Ofsted, awarding organisations, research bodies, schools and colleges, teachers, parents, learners and media.

Due to reforms in GCSEs and A levels, the content of a number of our publications needed updating. Our transformation programme therefore focused on refreshing both the design and content of the publications.

We studied the statistical releases of a few other departments who had implemented similar initiatives and are thankful to the DWP for providing advice and resources for our transformation programme. Smaller departments such as Ofqual can benefit from the larger departments in more ways than one.
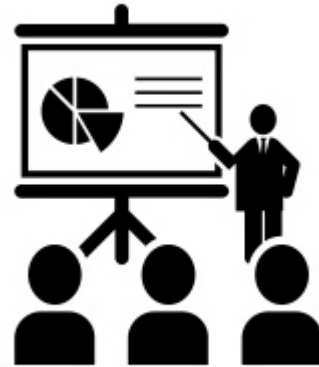
Pie chart: All other organisations 33%, AQA 27%, Pearson 23%, OCR 10%, City & Guilds 7%.

https://gss.civilservice.gov.uk/blog/statistics-transformation-programme-making-data-show-its-story/

Stakeholders

Ofqual Analytics

https://analytics.ofqual.gov.uk/

Analytics

Ofqual analytics presents a selection of data in an engaging and accessible way by using interactive visualisations. We hope this innovative approach to presenting data will make it easier to understand and explore the data we produce.

You can access the full range of our statistical reports and research reports on our main website.

If you have any comments on the design, usability or content of these interactive analytics, please contact us at analytics@ofqual.gov.uk.

Interactive visualisations

August 2018

- Variability in GCSE results for centres (schools and colleges) - 2017 to 2018
- Map of GCSE grade outcomes by county in England - 2017 and 2018
- Distribution of GCSE 9 to 1 grades - 2018
- Variability in A level results for centres (schools and colleges) - 2017 to 2018
- Map of A level grade outcomes by county in England - 2017 and 2018

November 2017
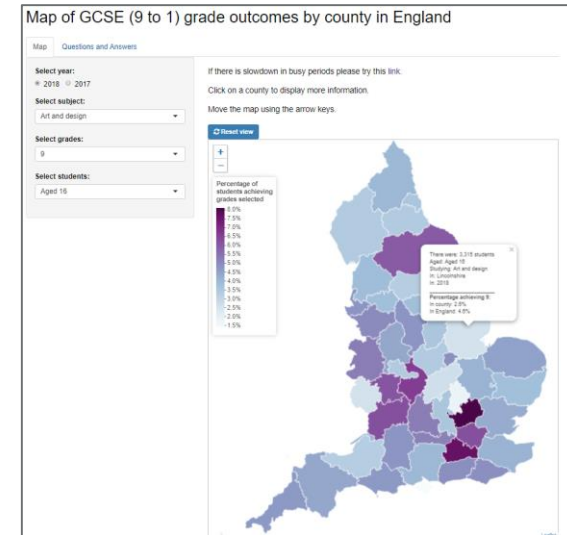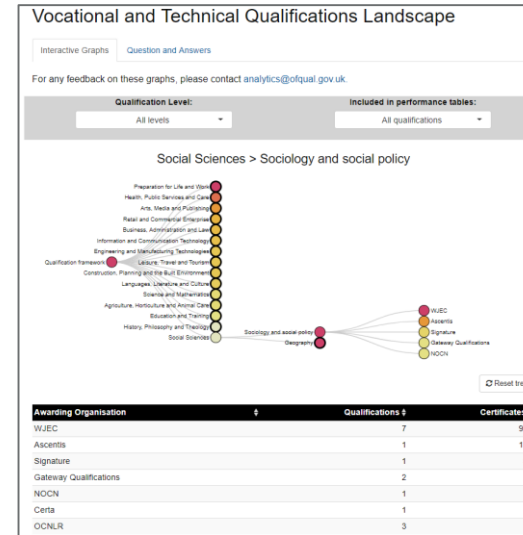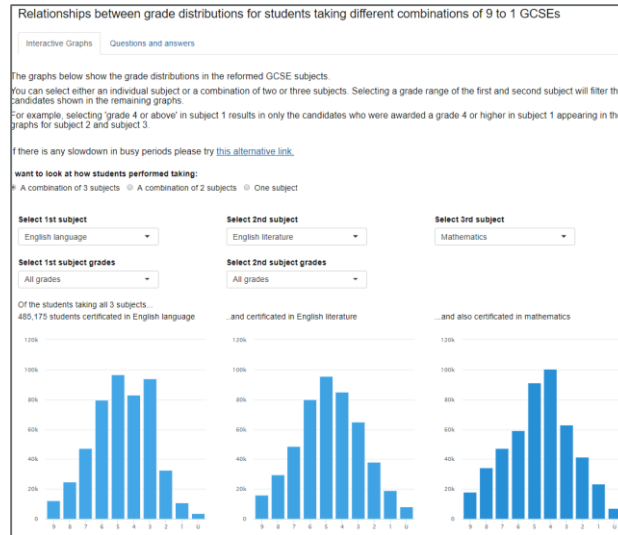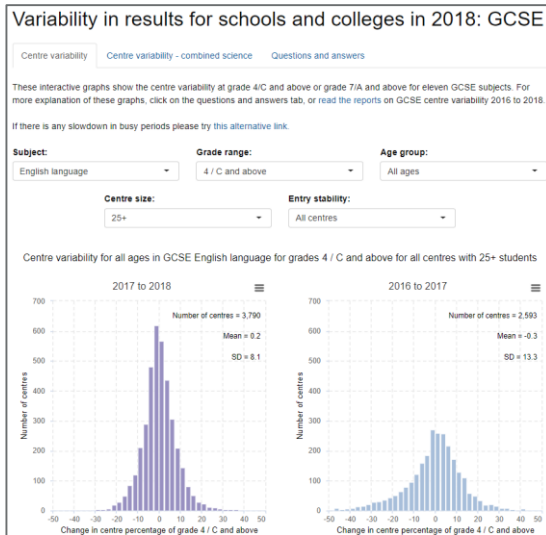
- Vocational and technical qualifications landscape

August 2017

- Variability in GCSE results for individual centres (schools and colleges) - 2016 to 2017
- Distribution of GCSE 9 to 1 grades - 2017
- Variability in AS and A level results for individual centres (schools and colleges) - 2016 to 2017

Our Apps

Shiny

- Open source R package from RStudio

- Web application framework for R

- Shiny turns R code into interactive web applications ("Shiny apps")

- No HTML, JavaScript or CSS knowledge is required

- Can be hosted online and shared with the world
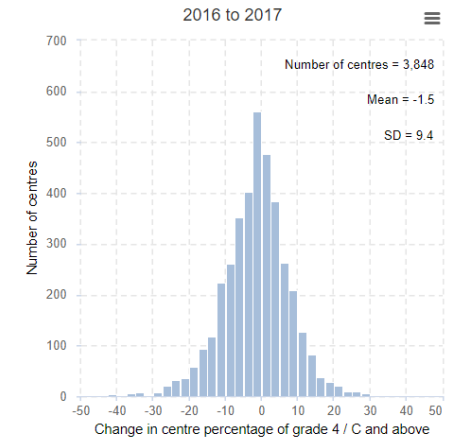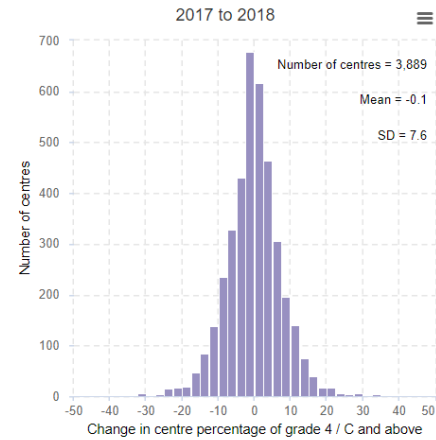
Shiny Applications

Computer running R
(Server.R)

Web Page
(UI.R)

Why did we use Shiny?

- Analysts needed to develop interactive visualisations themselves

- Limited timescales
  - < 3 months (proposed in May 2017 and launched in mid-August 2017)
  - Little time to learn HTML, JavaScript or CSS

- Strong knowledge of R
  - Little upskilling required

- Plenty of JavaScript visualisation libraries available for R (incl. Plotly and Highcharts)[1]

- Can customise appearance using CSS

- It's free!*

[1]https://www.htmlwidgets.org/

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Be Agile!

Sharing Shiny apps (1) – Deploy to the cloud

- Shinyapps.io

- RStudio's hosting service

- Advantages
  - Easy to use – do not need to own server
  - SSL encryption
  - Scalable

- Disadvantages
  - Only published/open data can be used

Sharing Shiny apps (2) – Deploy on premises

- Deploy Shiny apps on premises with either Shiny Server (open source) or Shiny Server Pro (commercial)

- Shiny server builds a web sever specifically to host Shiny apps

- Advantages
  - Shiny app and data never leaves your control
  - SSL encryption (commercial)
  - Scalable (commercial)

- Disadvantages
  - Pro is costly (~$10k/year for 20 users) – need to factor in procurement!
  - SSL encryption and scalability not available in open source server
  - Linux based
  - Need a very patient, willing and friendly IT team!

The server

- Decided to use open source shiny server

- Largest and most time consuming hurdle

- Very fortunate that our IT team was fully on board

- In a space of three months our IT team:
  - Built and configured a shiny server on a virtual machine (VM)
  - Become familiar with Linux OS
  - Added SSL certification to the server
  - Dealt patiently and swiftly with our changing requirements

SSL encryption

- http – **H**yper**t**ext **T**ransfer **P**rotocol
- Used for transferring data from a web server to a browser to view web pages
- Data is not encrypted
- https – secure http
- Involves use of SSL (**S**ecure **S**ockets **L**ayer) certificate
- Secure encrypted connection
- Benefits of https
  - Demonstrates to visitors you're serious about security and protecting information
  - Some organisations / browsers block websites without valid SSL certificate

http://

https://

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SSL encryption

- https included as standard for Shinyapps.io and commercial shiny server

- Not included for open source server

- Workaround needed

- IT team used a Nginx reverse proxy to add SSL certification to the shiny server.
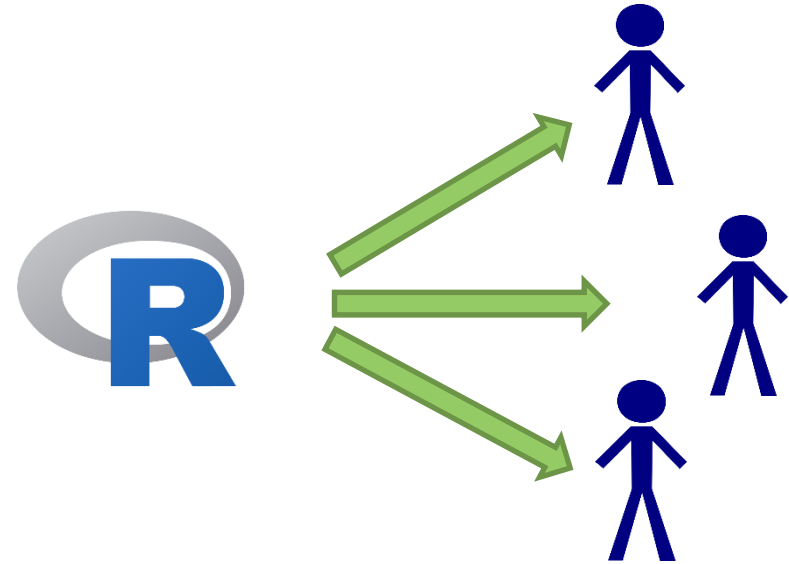
http://

**https://**

Scaling

- R is a single threaded application

Scaling

- R is a single threaded application

- It cannot serve multiple users at *precisely* the same time

- Computations stack

Scaling

- R is a single threaded application

- It cannot serve multiple users at *precisely* the same time

- Computations stack

- Possible to configure multiple R processes per app on Shinyapps.io or commercial server

- Cannot do this on open source server
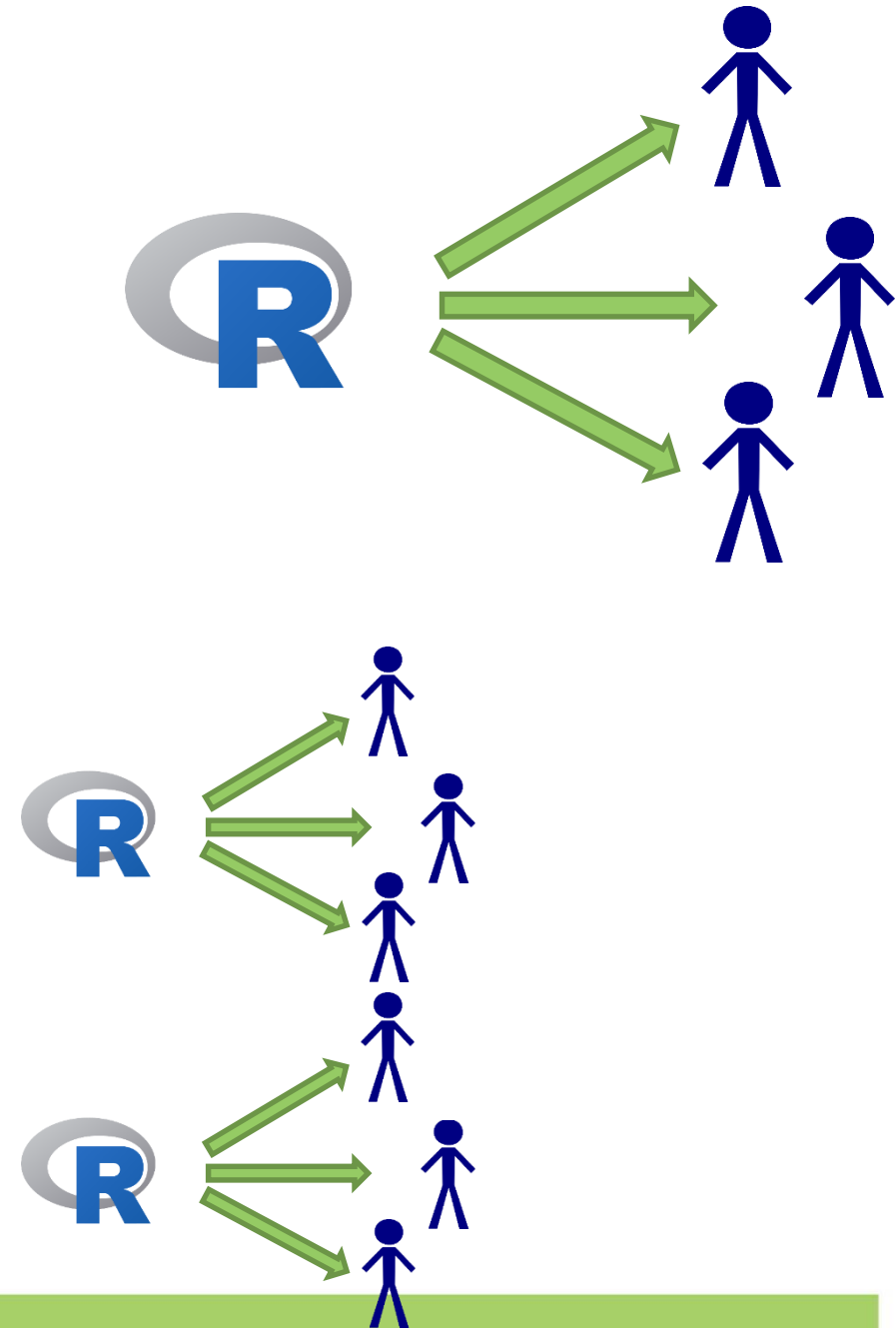
Scaling solutions

- Ensure there are as many cores on VM as apps

Scaling solutions

- Ensure there are as many cores on VM as apps

- If many reactive elements consider adding a go button

Click to update:

Go!

Scaling solutions

- Ensure there are as many cores on VM as apps

- If many reactive elements consider adding a go button

- Add mirror links

Scaling solutions

- Ensure there are as many cores on VM as apps

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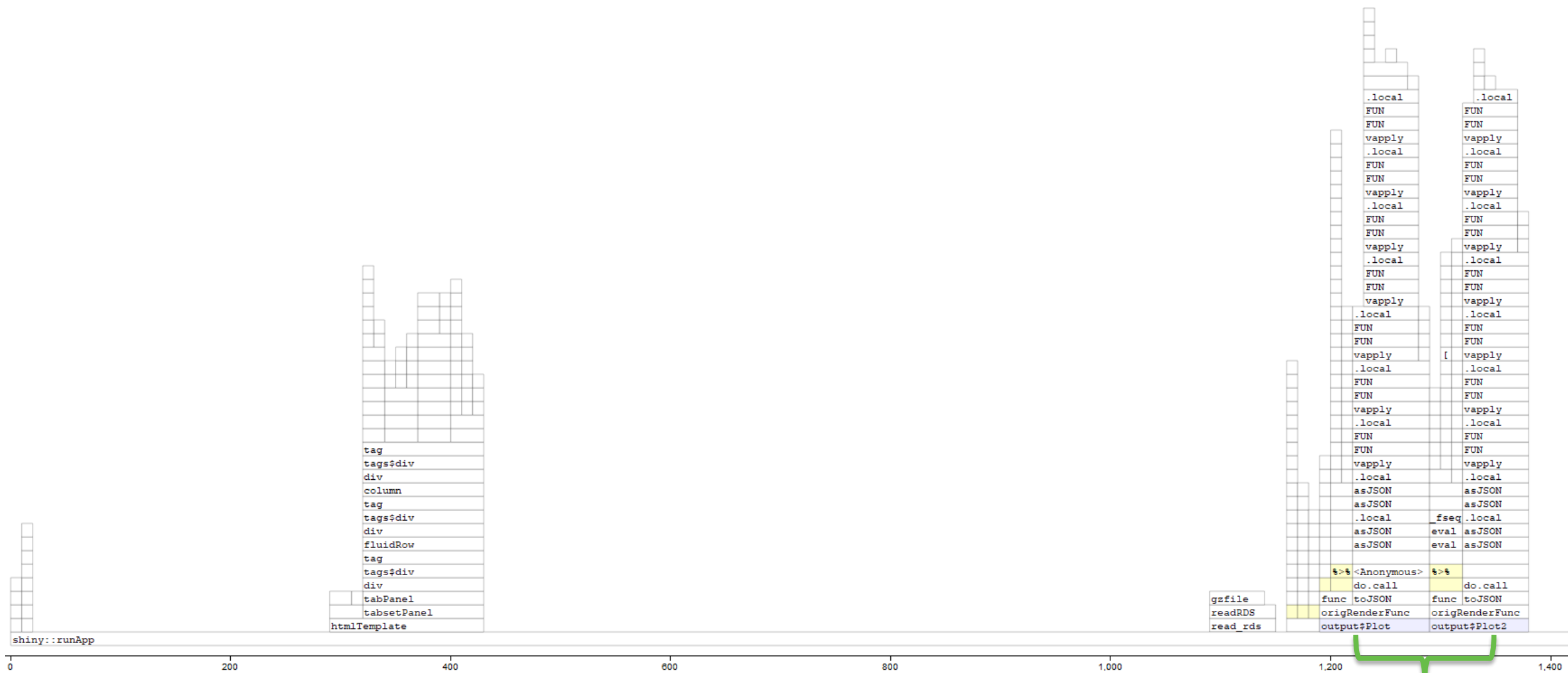
- Keep it simple
  - Data
  - Code
  - Analysis

Scaling solutions

- Ensure there are as many cores on VM as apps

- If many reactive elements consider adding a go button

- Add mirror links

- Keep it simple
  - Data
  - Code
  - Analysis

- Optimise code
  - Profvis, microbenchmark etc.

Optimising code

~150 ms

User development

- User development very important!

- Invited majority of organisation to test apps simultaneously

- Collective brainpower noticed things we did not
  - Product visibly refined after testing

- Allowed us to test scaling as load testing tools do not work for Shiny[1]
  - Shiny stores state inside of a websocket connection
  - Mechanisms of shiny cause problems for tools
  - Packages are being developed (shinyloadtest)

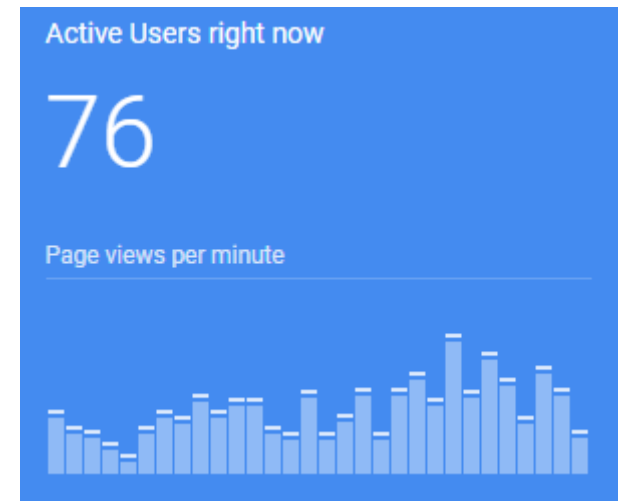[1]https://www.rstudio.com/resources/videos/scaling-shiny/

Google Analytics

- Google analytics is a free service offered by Google

- Collects information about who visits your website and what they do whilst they are there

- Very easy to setup – just need to know a little JavaScript

What we used Google Analytics for

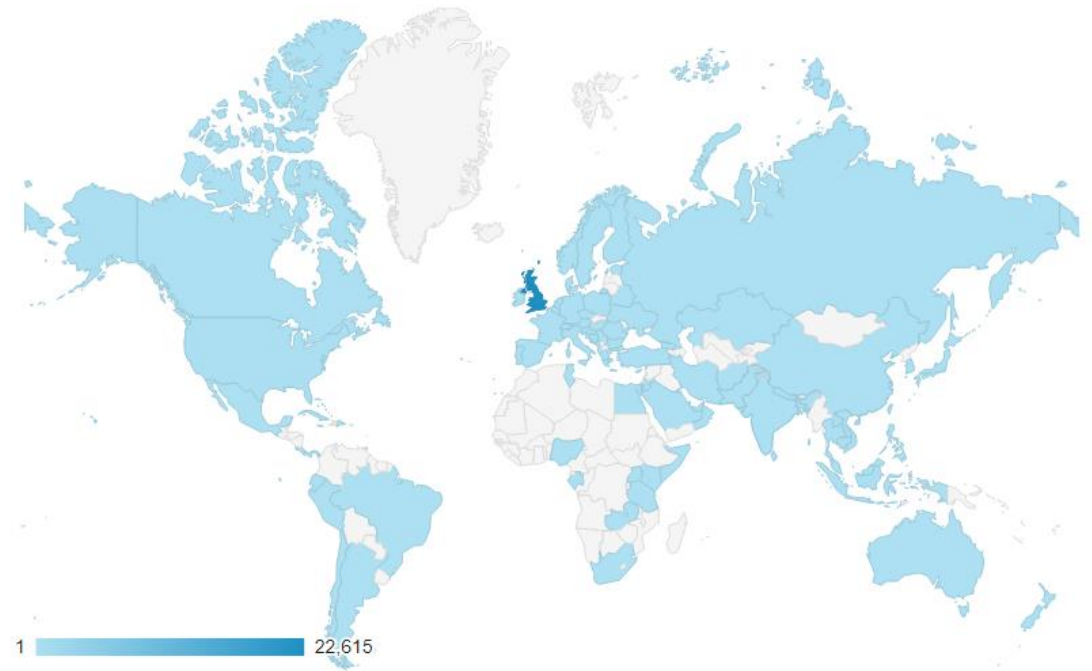- Track number of users and page views

What we used Google Analytics for

- Track number of users and page views

- See where users where coming from

What we used Google Analytics for

- Track number of users and page views

- See where users where coming from

- Track how people were getting to our apps

Top Channels
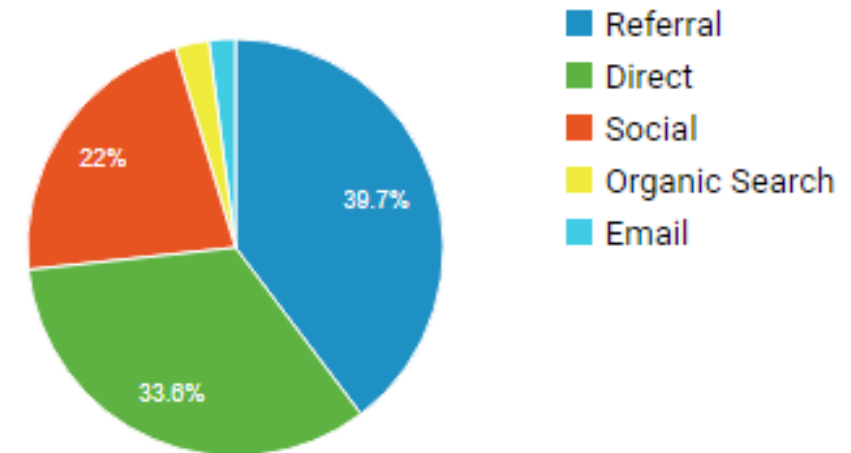
- Referral — 39.7%
- Direct — 33.8%
- Social — 22%
- Organic Search
- Email

What we used Google Analytics for

- Track number of users and page views

- See where users where coming from

- Track how people were getting to our apps

- What devices people were using

Desktop	Mobile	Tablet
44.3%	42.9%	12.8%
↑6.9%	↓8%	↑1.1%

Recognition and Feedback

- Since launch Ofqual Analytics has been accessed 100,000 times

- Increase in traffic of 266% in month after A-level results day in 2018 compared to month after A-level results day in 2017

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Recognition and Feedback

- Since launch Ofqual Analytics has been accessed 100,000 times

- Feedback has been very positive

"..it's great to see such openness and support in helping schools understand how their results fit into the bigger picture. I've spent a decent chunk of today playing/exploring the data sets – fascinating."

Recognition and Feedback

- Since launch Ofqual Analytics has been accessed 100,000 times

- Feedback has been very positive

"*These tools are very interesting and really useful in providing important <u>national context</u> when schools are analysing their own results. It's great that the data is <u>available so quickly</u> as well because normally it takes months for anything at a national scale to be published. Thank you very much for providing this facility and well done! <u>It's brilliant.</u>*"
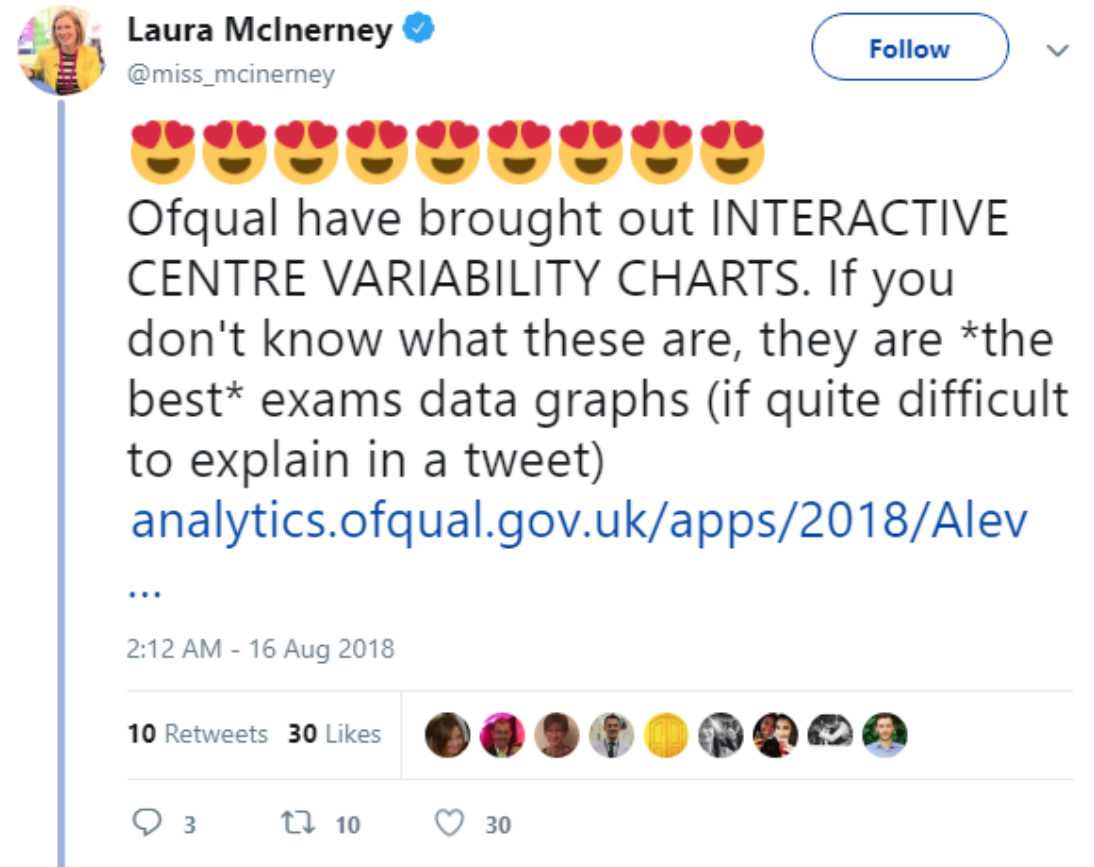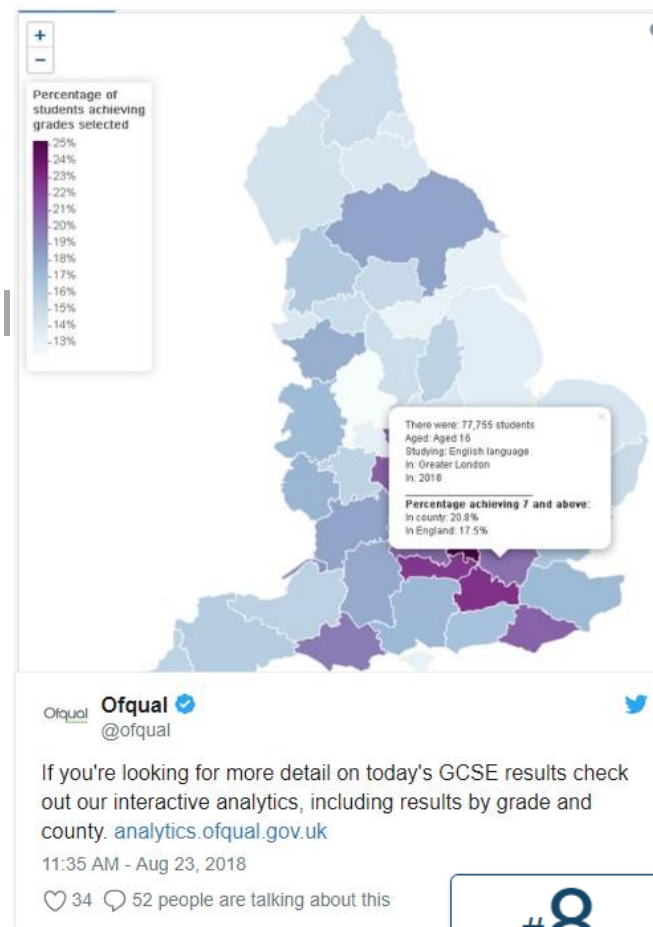
Recognition and Feedback

- Since launch Ofqual Analytics has been accessed 100,000 times

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Recognition and Feedback

- Since launch in August 2017 Ofqual analytics has been accessed over 100,000 times

- Feedback has been very positive

- Ranked highly amongst the UK government tweets on results day

Percentage of students achieving grades selected
- 25%
- 24%
- 23%
- 22%
- 21%
- 20%
- 19%
- 18%
- 17%
- 16%
- 15%
- 14%
- 13%

There were: 77,755 students
Aged: Aged 16
Studying: English language
In: Greater London
In: 2018

Percentage achieving 7 and above:
In county: 20.8%
In England: 17.5%

Ofqual ✓
@ofqual

If you're looking for more detail on today's GCSE results check out our interactive analytics, including results by grade and county. analytics.ofqual.gov.uk

11:35 AM - Aug 23, 2018

♡ 34   💬 52 people are talking about this

#8 This was the 8th most engaging Tweet from UK Government accounts on August 23, 2018.

Within its first day, this tweet received

🔁 41 retweets

⭐ 26 favorites

and reached a potential

📢 84,175 people

Other top Tweets from UK Government accounts on August 23, 2018:

Recognition and Feedback

- Since launch in August 2017 Ofqual analytics has been accessed over 100,000 times

- Feedback has been very positive

- Ranked highly amongst the UK government tweets on results day

- Shortlisted for the Campion award for excellence in official statistics

- Highlighted by the Office for Statistics Regulation in their innovation review

Resources

- Datacamp (https://www.datacamp.com/) – videos, tutorials and exercises
- O'Reilly Media
- Stack Overflow (https://stackoverflow.com/)
- R bloggers (https://www.r-bloggers.com/)
- Shiny galleries and articles (https://shiny.rstudio.com/)

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