AphA

Association of Professional Healthcare Analysts

In Pursuit of Excellence

Chart with **Purpose**

Simon Wellesley-Miller

Senior Analytical Manager NHS England
SW Insights and Intelligence Team
Deputy Director of Regions APHA
Fellow of the NHS –R Community
Chair of NHS England Open Source Steering Group
Making Data Count champion
MSc Healthcare Data Science
Winner of Norton Fitzwarren Disco Dance Off 1989

What this workshop is **not**

A workshop telling you not to do 3d pie charts, zero your x axis, what chart to use when, what colours to use, what level of interactivity, don't use legends, accessibility, what fonts to use etc etc

All that stuff is totally available elsewhere

https://github.com/nhsengland/data-viz-community-of-practice

Text and **Fonts** matter

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Interactive workshop

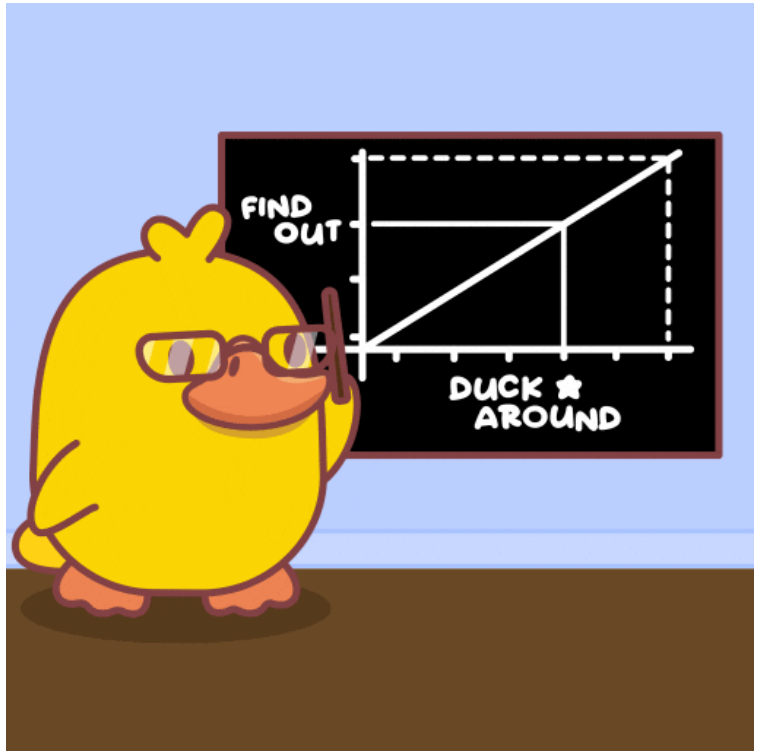
- This is a workshop you can **win**!

- There will be a **prize** for the best analytical mind here today

- Will have to **self score** on a trust basis

- **Speed** is a consideration

- **One** point for a correct answer – a **bonus** point if you answer within 5 seconds



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What is **purpose**?

Here is the result of my analysis...

12

DATA

SORTED

ARRANGED

PRESENTED VISUALLY

EXPLAINED WITH A STORY

ACTIONABLE (USEFUL)

Less impact

Analytics

More impact

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What it is...

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A visualisation is any kind of graphical representation to enable **discovery, exploration, analysis** and **communication.**

What is it for...

- **Exploring** Data
- **Simplifying** Complex Data
- Identifying **Trends** and **Patterns**
- Communicating **Insights**
- Enabling Faster **Decision-Making**

What is it for...

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A visualisation is an argument, not an image, and its purpose is **insight**, not illustration.

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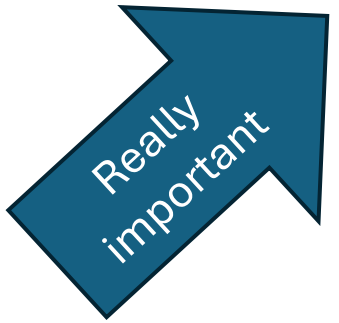
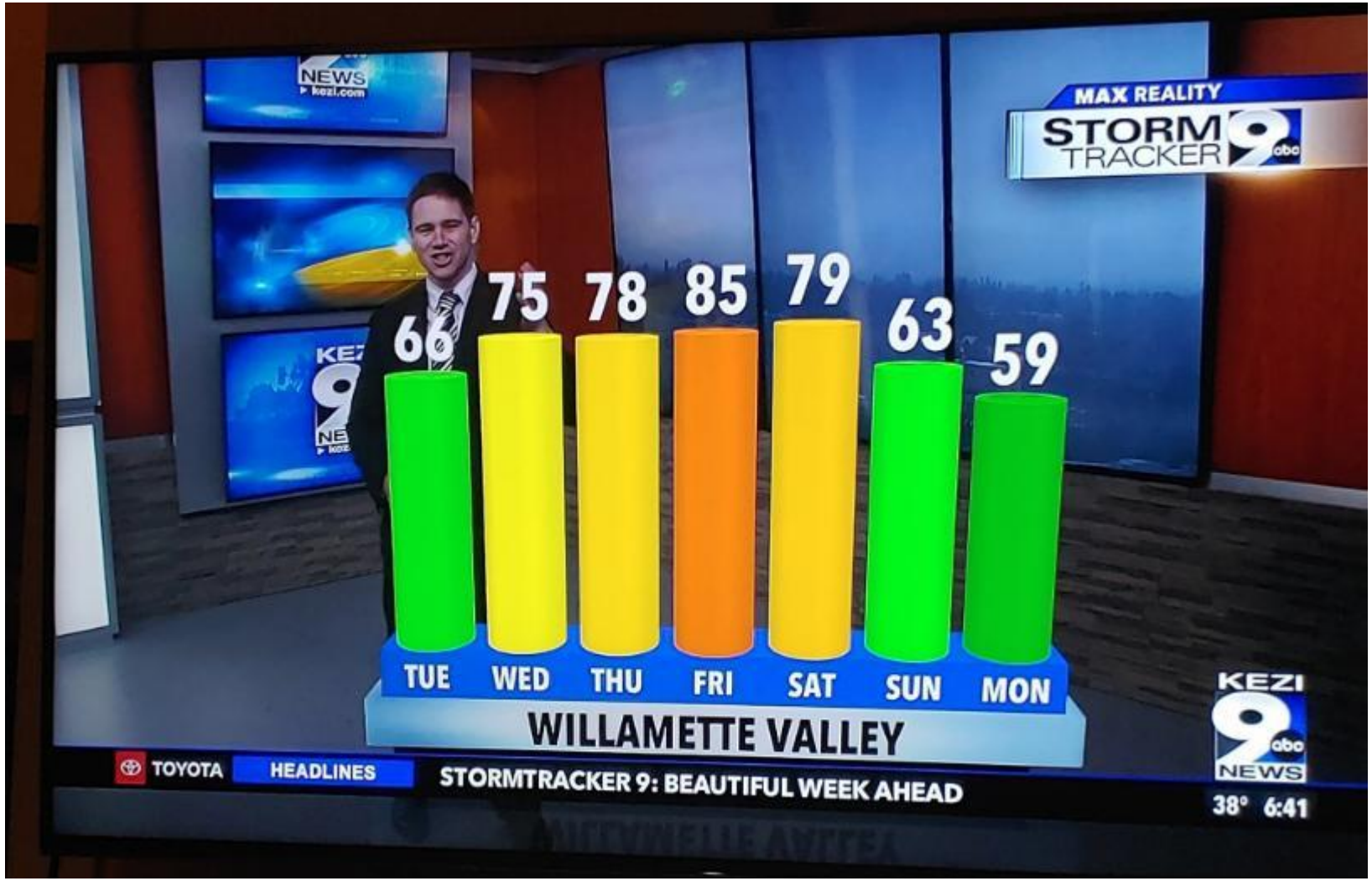
A visualisation is an argument, not an image, and its purpose is **insight**, not illustration.

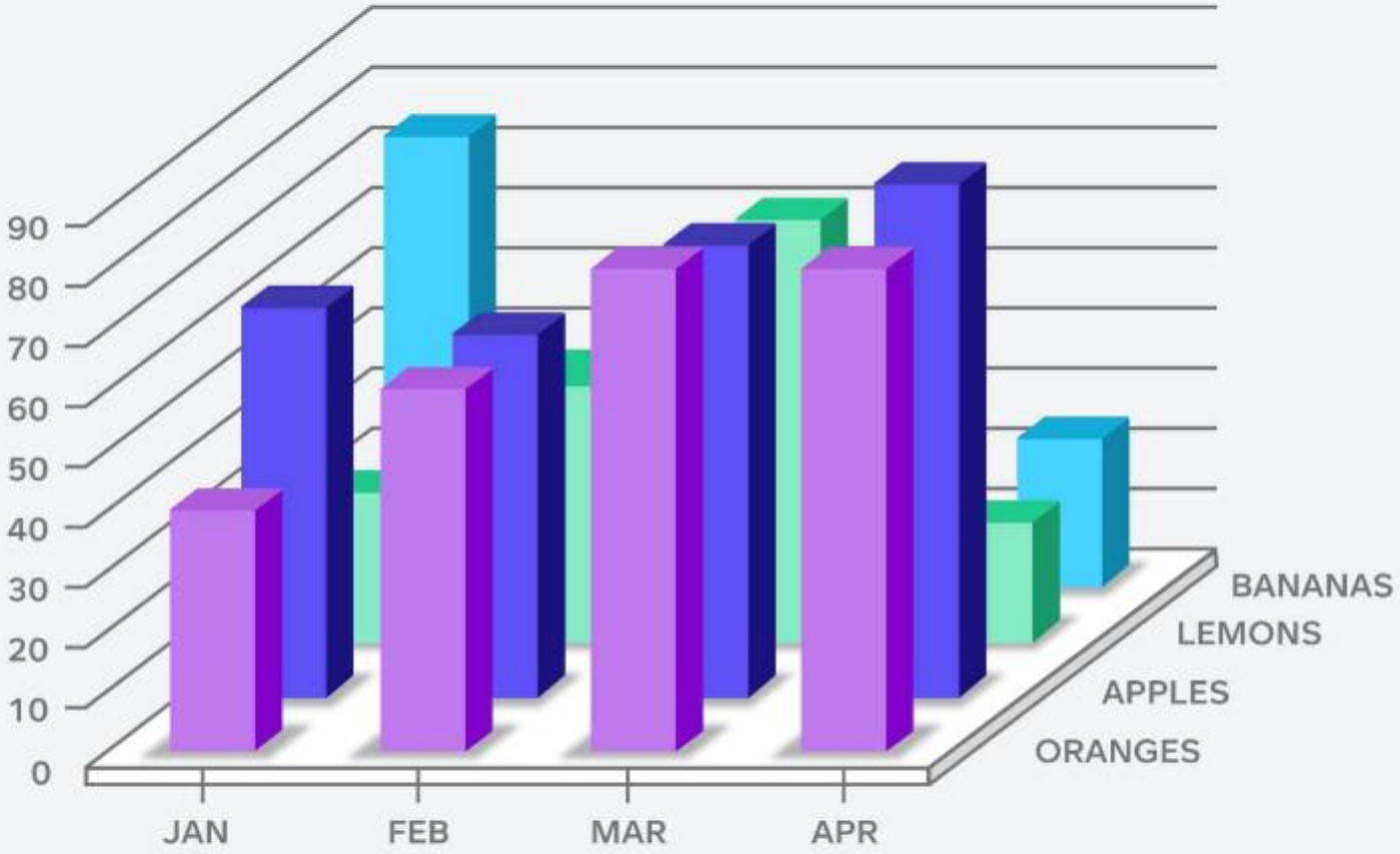


Let's look at how **not** to do it...

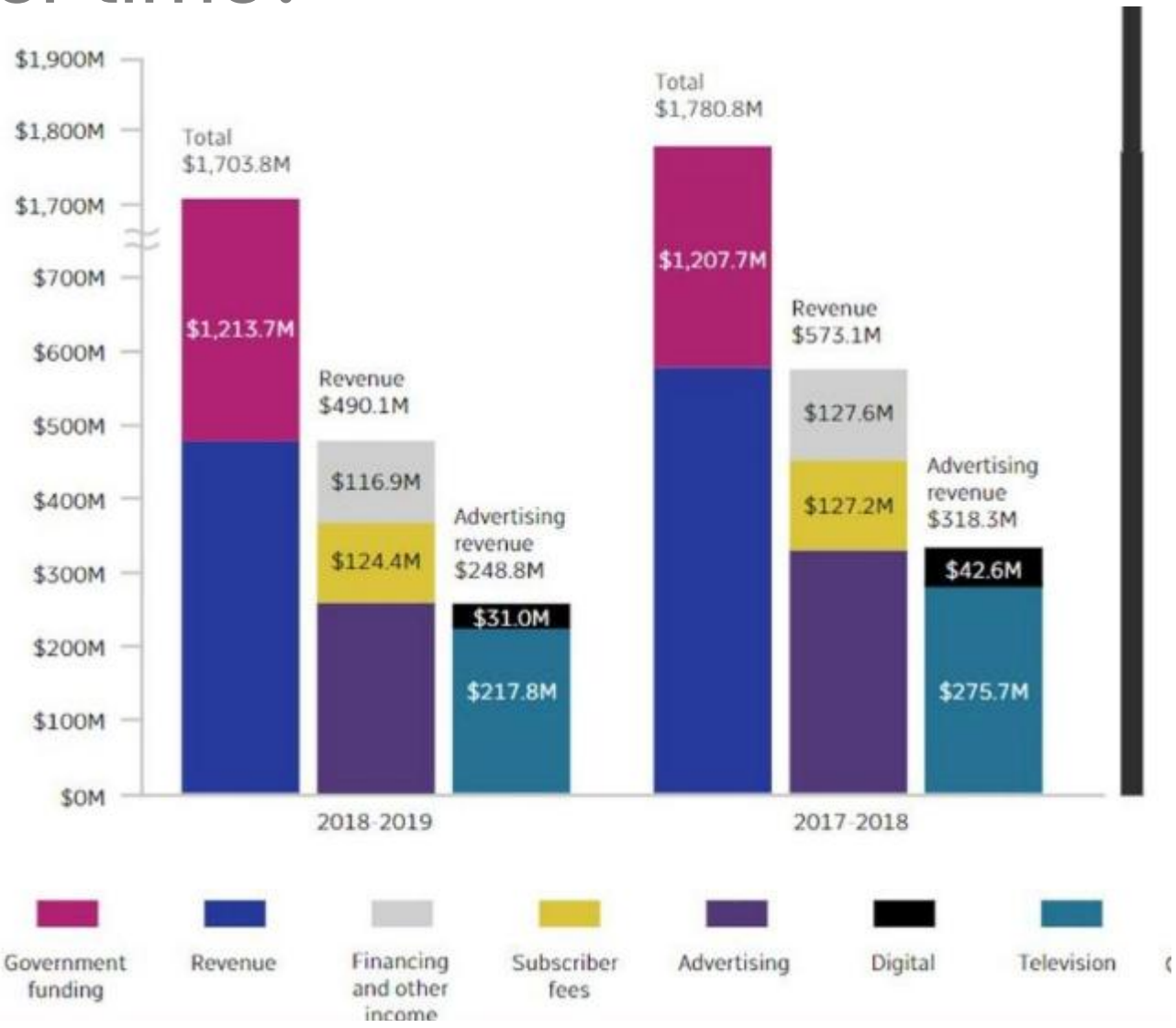
When was the **coldest** day?



What is the **February** position for **Lemons**?



Has ‘Financing and other income’ increased over time?



Which area do we need to take **action**?

Performance

		Oct 19	Nov 19	Dec 19	Jan 20	Feb 20	Mar 20	Apr 20	May 20	Jun 20	Jul 20	Aug 20	Sep 20	Oct 20	Month Target	F-YTD Actual	Rolling 12mth	Trend
CQC level of inquiry: Responsive																		
Access Management - RTT, CWT and Diagnostics																		
364	RTT Incomplete Performance	78.87%	79.49%	78.88%	79.51%	80.44%	76.79%	68.50%	58.70%	46.66%	39.28%	48.20%	57.16%	64.82%	92.00%	54.92%	65.90%	
632	Patients waiting over 52 weeks (RTT)	184	175	188	160	143	196	483	1017	1784	2495	2802	3250	3568	0	15399	16261	
412	Cancer 2 weeks wait GP referral	94.18%	93.74%	90.43%	87.42%	92.00%	93.05%	87.39%	87.77%	83.15%	85.99%	79.03%	84.86%	90.28%	93.00%	85.35%	87.22%	
413	Cancer 2 weeks wait referral - Breast	96.43%	97.22%	97.83%	98.86%	95.40%	95.70%	95.45%	97.50%	96.49%	96.39%	94.34%	91.26%	91.26%	93.00%	93.97%	94.88%	
419	Cancer 62 day referral to treatment - GP	72.87%	74.14%	73.13%	64.63%	68.56%	66.83%	52.10%	64.39%	58.70%	60.00%	70.81%	74.29%	76.84%	85.00%	66.43%	66.59%	
536	Diagnostic Waiting Times Performance > 6 Wks	5.89%	7.53%	9.88%	11.51%	6.66%	19.03%	59.35%	60.25%	51.56%	41.59%	34.71%	26.81%	21.73%	1.00%	41.06%	28.01%	
Access Management - Emergency Flow																		
459	A&E 4 hour performance (monthly SITREP)	72.23%	69.30%	67.69%	69.02%	71.42%	73.99%	82.82%	91.11%	90.72%	93.63%	88.91%	85.26%	81.51%	95.00%	87.79%	82.02%	
Patient Flow																		
399	Weekend Discharges	18.2%	22.9%	21.2%	18.5%	22.6%	19.8%	19.6%	25.5%	20.1%	18.5%	25.6%	18.0%	21.3%	20.7%	21.1%	21.1%	
404	Discharges before 1pm	17.9%	18.2%	18.3%	18.7%	18.9%	16.1%	18.7%	18.1%	17.9%	16.8%	16.9%	16.2%	16.9%	18.4%	17.3%	17.6%	
747	Bed Occupancy	93.1%	94.1%	92.3%	94.7%	93.9%	81.5%	61.8%	63.6%	70.7%	77.9%	80.8%	83.7%	83.4%	91.6%	74.6%	81.6%	
1357	Number of Stranded Patients (LOS 7+ Days)	577	575	659	596	599	389	342	394	860	447	532	484	513		3572	6390	
1358	Number of Super Stranded Patients (LOS 21+ Days)	243	242	267	259	273	177	120	137	335	164	200	184	184		1324	2542	
800	Delayed Transfer of Care Days (per calendar day)	15.7	18.3	18.3	21.3										0.0		19.3	
762	Ambulance Delays > 30 Minutes	470	924	1282	452	1488	1248	822	516						0	1338	6732	
772	12 Hour DTAs	42	28	65	166	76	43	13	12	28	37	45	34	53	0	222	507	

Which speciality is showing a significant deteriorating trend in performance?

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Specialty RTT Performance

Specialty Performance	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Trend	Trend
Cardiology	94.7%	92.0%	92.3%	92.3%	93.0%	92.7%	94.3%	93.7%	94.4%	↑	0.7%
Dermatology	98.4%	98.1%	98.2%	95.8%	89.3%	85.7%	90.3%	90.8%	92.1%	↑	1.3%
Ear, Nose & Throat	92.0%	92.9%	92.3%	91.8%	90.0%	89.1%	88.4%	88.4%	87.0%	↓	-1.4%
Gastroenterology	86.5%	87.7%	86.3%	87.7%	87.7%	86.7%	85.8%	85.5%	86.1%	↑	0.6%
General Medicine	100.0%	100.0%	100.0%	100.0%	100.0%	92.3%	100.0%	100.0%	100.0%		0.0%
General Surgery	75.5%	78.5%	82.4%	87.5%	89.0%	87.1%	90.4%	88.8%	87.9%	↓	-0.9%
Geriatric Medicine	98.9%	98.9%	98.0%	96.3%	94.4%	96.9%	98.0%	99.1%	98.6%	↓	-0.5%
Gynaecology	87.0%	87.8%	89.3%	89.3%	88.9%	87.9%	87.9%	87.1%	85.3%	↓	-1.8%
Neurology	92.1%	92.1%	92.8%	89.2%	83.2%	84.7%	86.3%	87.6%	86.7%	↓	-0.9%
Ophthalmology	81.2%	84.5%	84.9%	86.3%	89.2%	89.3%	90.4%	90.0%	87.6%	↓	-2.4%
Oral Surgery	78.8%	81.8%	83.6%	82.6%	81.8%	83.9%	84.6%	85.7%	83.5%	↓	-2.2%
Orthopaedics	88.6%	92.0%	91.4%	89.3%	87.4%	87.1%	85.5%	83.6%	83.2%	↓	-0.4%
Other	87.9%	88.4%	90.0%	89.7%	89.8%	89.6%	91.0%	91.5%	90.4%	↓	-1.1%
Plastic Surgery	82.2%	84.7%	87.6%	89.2%	88.7%	88.2%	88.6%	87.9%	84.7%	↓	-3.2%
Respiratory Medicine	79.3%	83.4%	87.5%	89.8%	92.2%	93.2%	92.6%	92.2%	86.1%	↓	-6.1%
Rheumatology	79.4%	81.5%	79.9%	76.0%	74.1%	71.5%	74.9%	75.7%	75.6%	↓	-0.1%
Urology	85.4%	87.5%	88.7%	89.9%	91.5%	91.4%	92.0%	92.2%	90.6%	↓	-1.6%
TRUST	86.1%	87.7%	88.7%	88.7%	88.3%	87.9%	88.7%	88.7%	87.4%	↓	-1.3%

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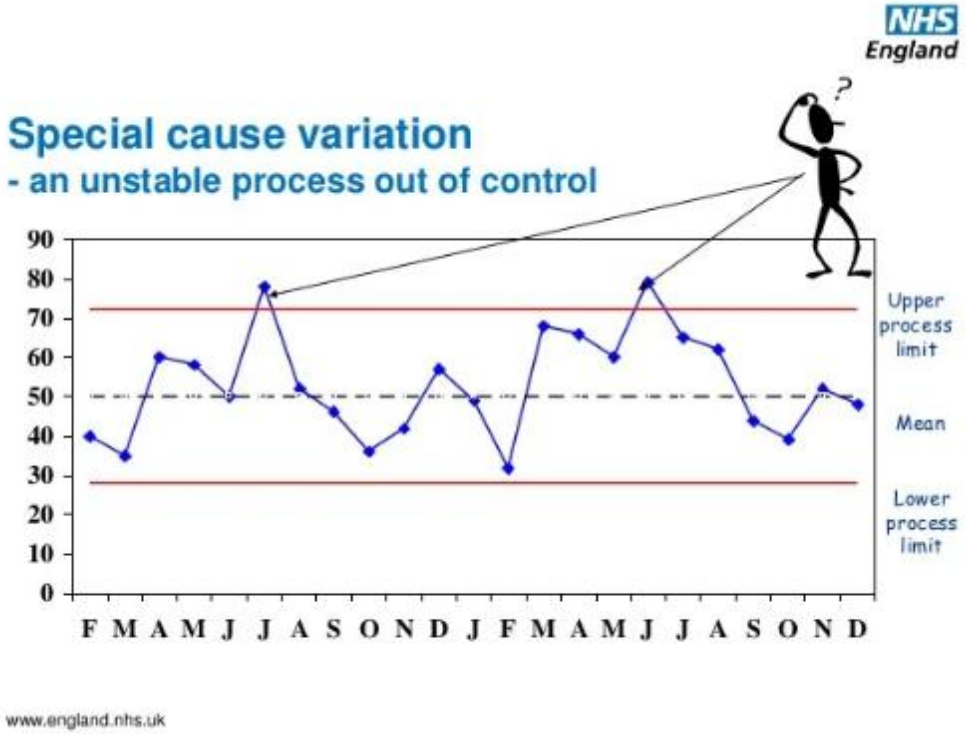
Check the scores

Use of SPC

Shout out to **Statistical Process Control Charts**

Multiple types of SPC

Find out more from the awesome **Making Data Count** team



Not about just merely presenting data, we as analysts should be **persuading** and **influencing** our stakeholders to **action**.

We should be looking at the data and telling them what it **informs** us and then pull a visualisation that supports our claims.

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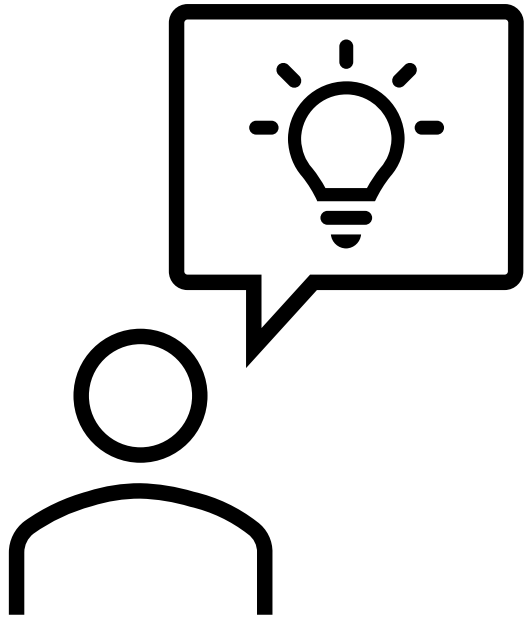
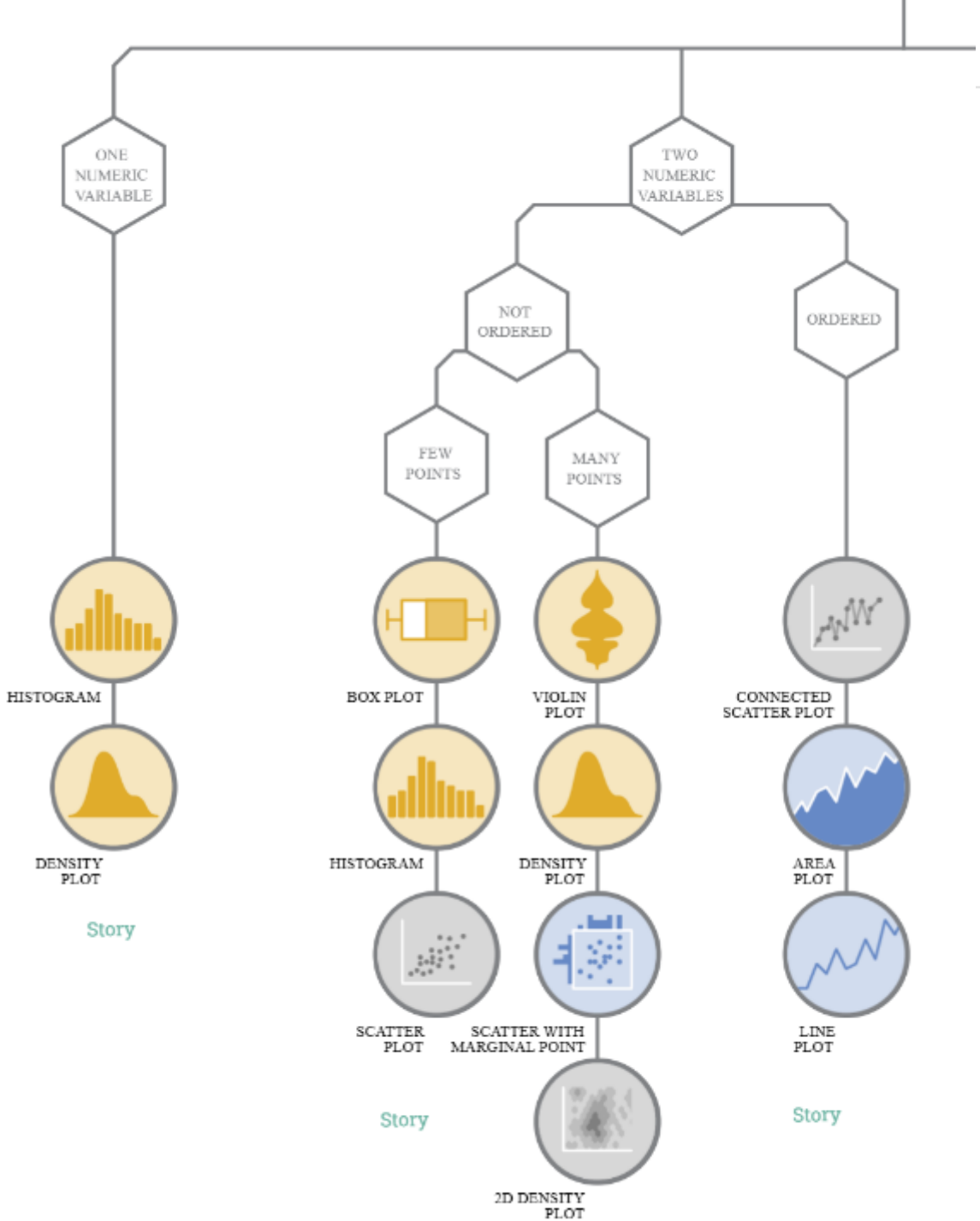
Think about what it is you want to **convey**

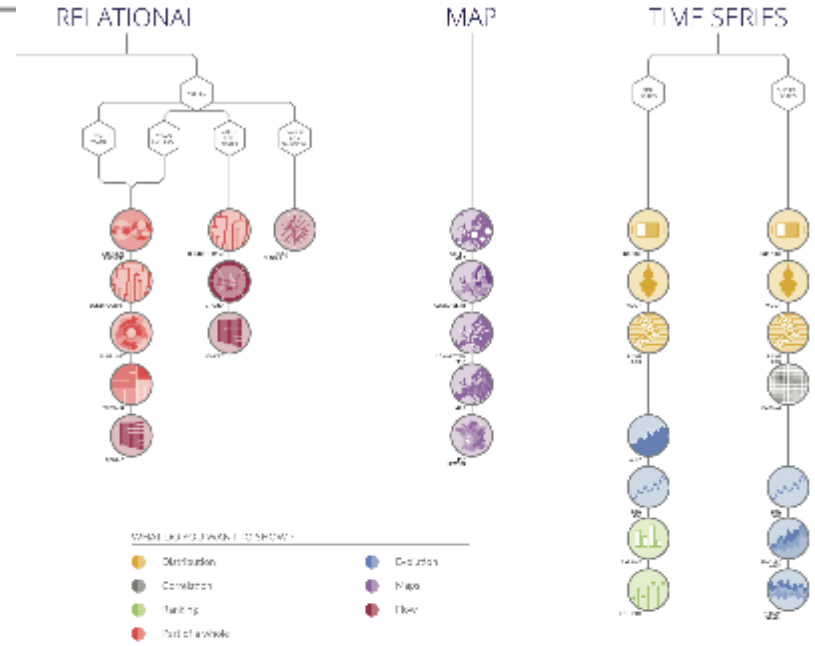


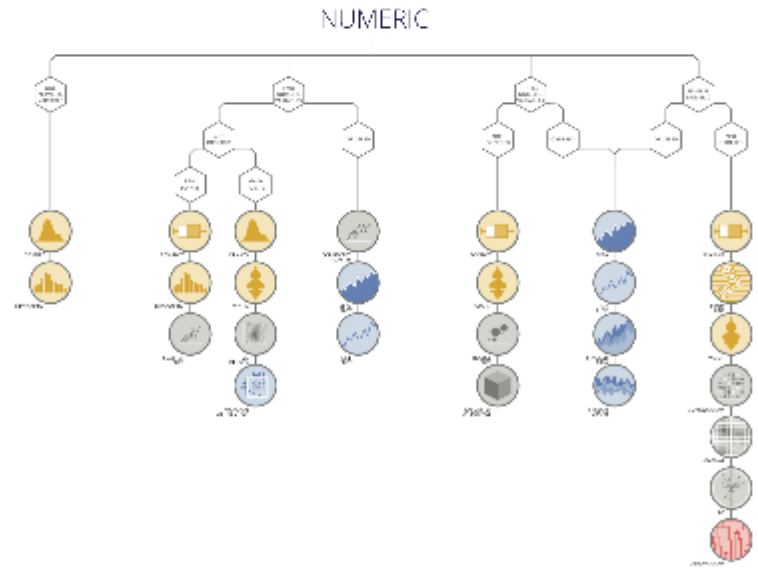
Some basic design principles

- **Data-Ink Ratio**: Maximize the proportion of ink that represents data.
- **Minimize Non-Data Ink**: Reduce elements that do not convey data.
- **Graphical Integrity**: Ensure visual representations are truthful and clear.
- **Architectural Excellence**: Strive for high-quality design in visualisations.

[a] Edward R. Tufte. *Beautiful Evidence*. Graphics Press, LLC, first edition, May 2006. ISBN 0-9613921-7-7



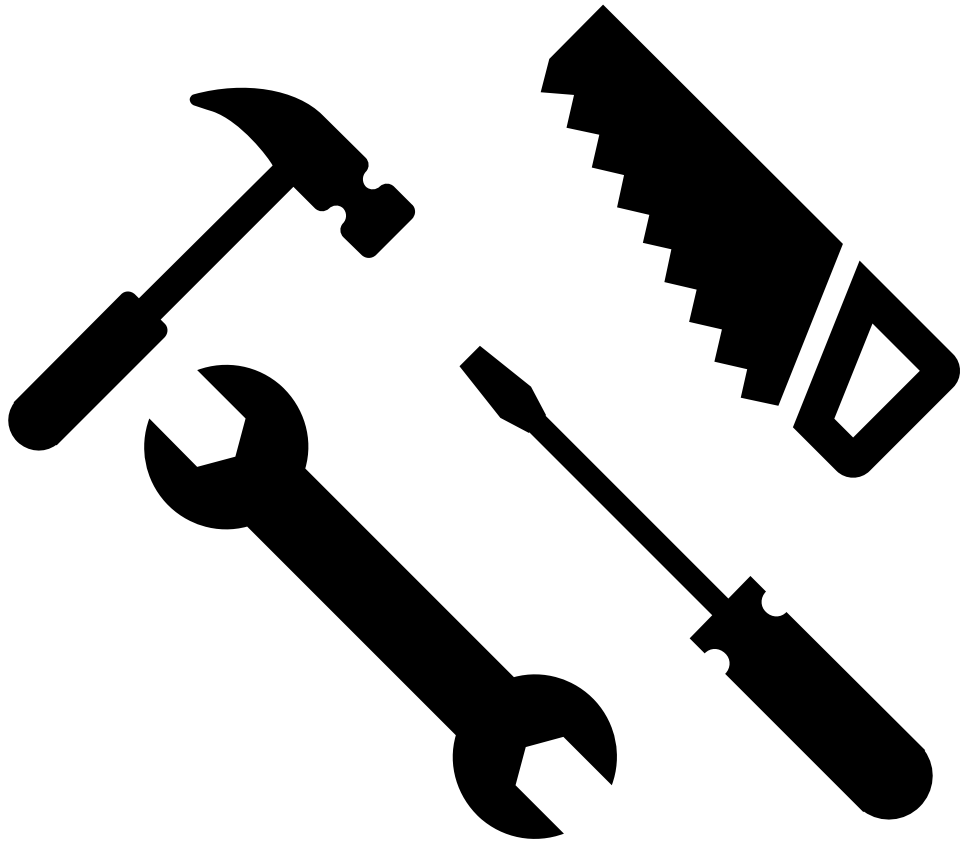




https://www.data-to-viz.com/

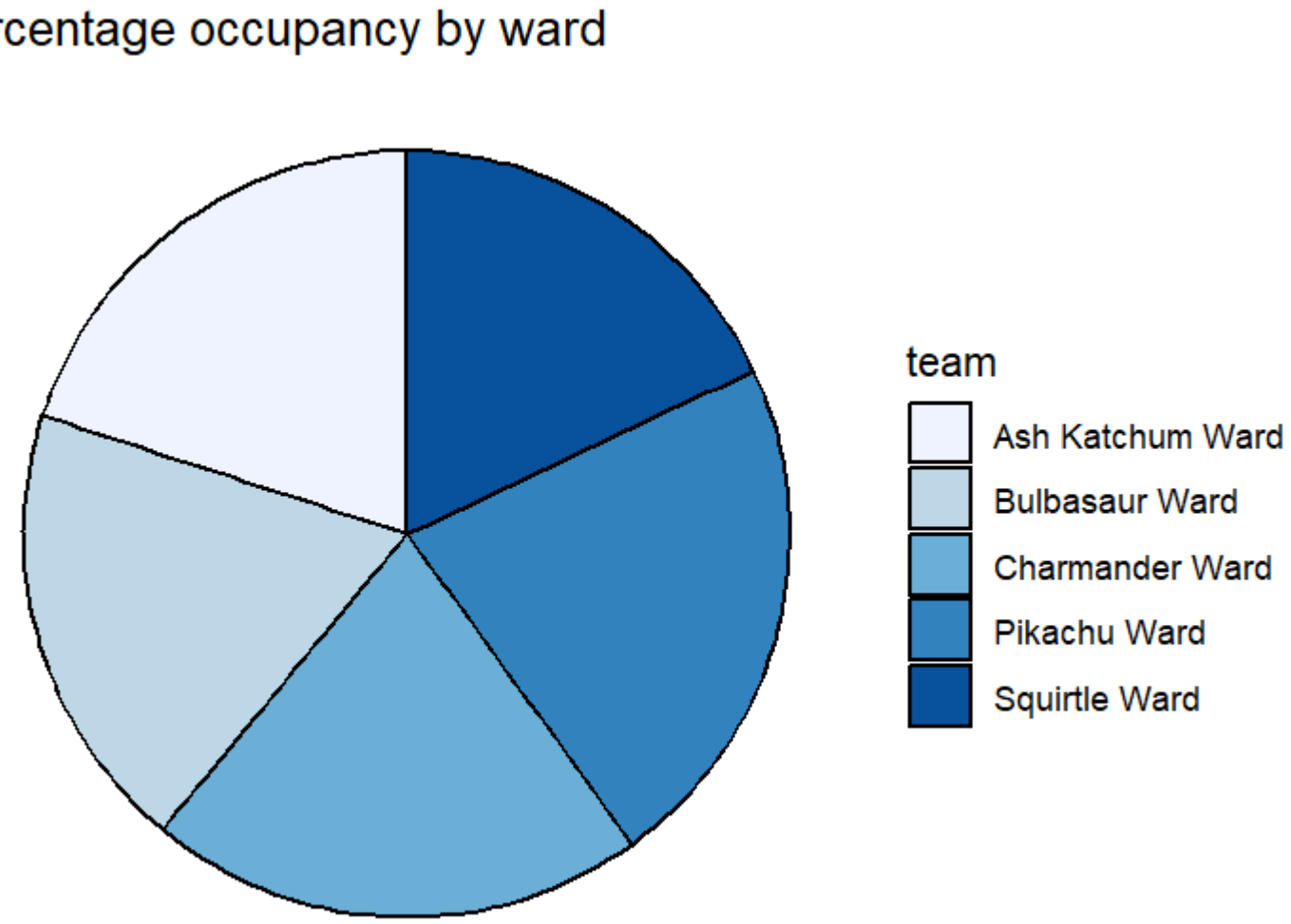
Start with the insight

- Not which BI tool
- Not what type of graph
- Not what visual
- What **message**



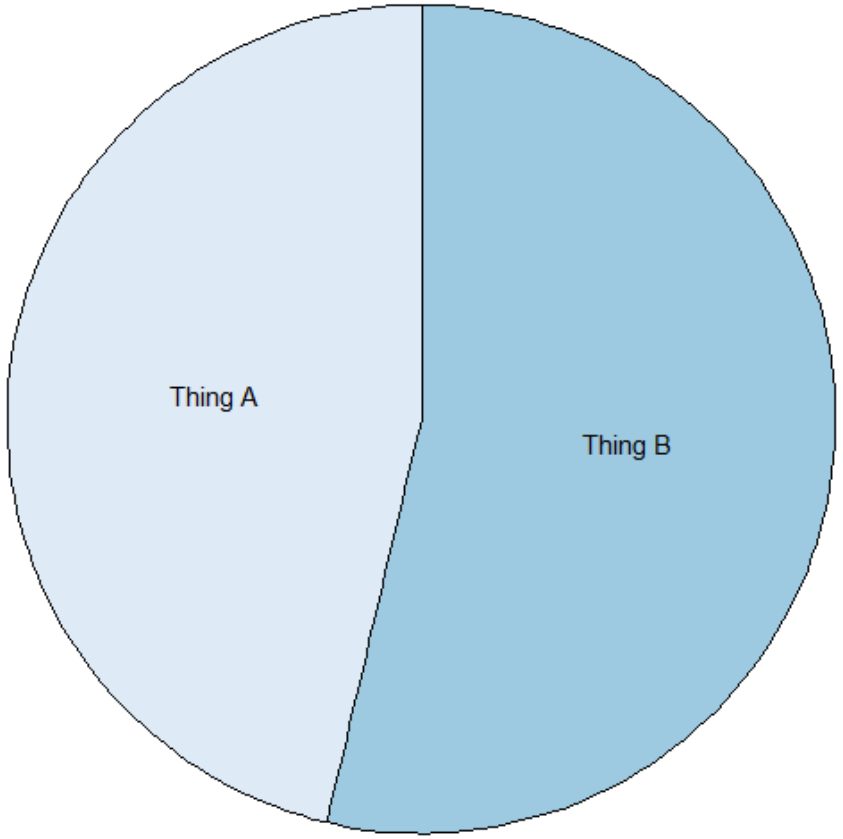
Let's look at how **not** to do it...

Which ward has the **highest** occupancy?

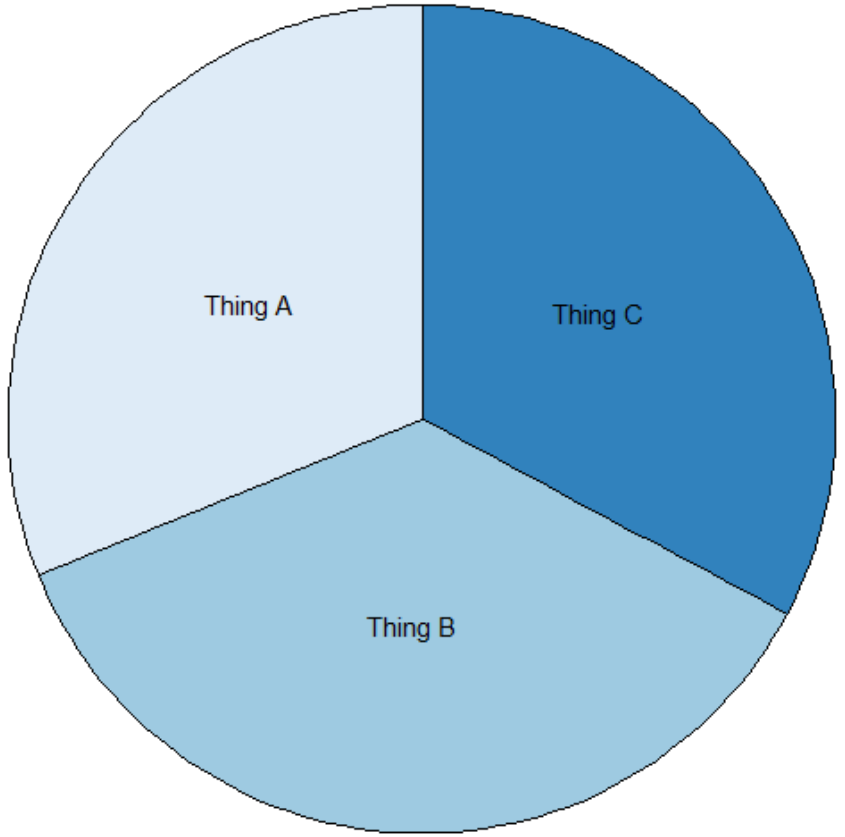


Poor old pie charts

Thing A vs Thing B



Thing A vs Thing B vs Thing C



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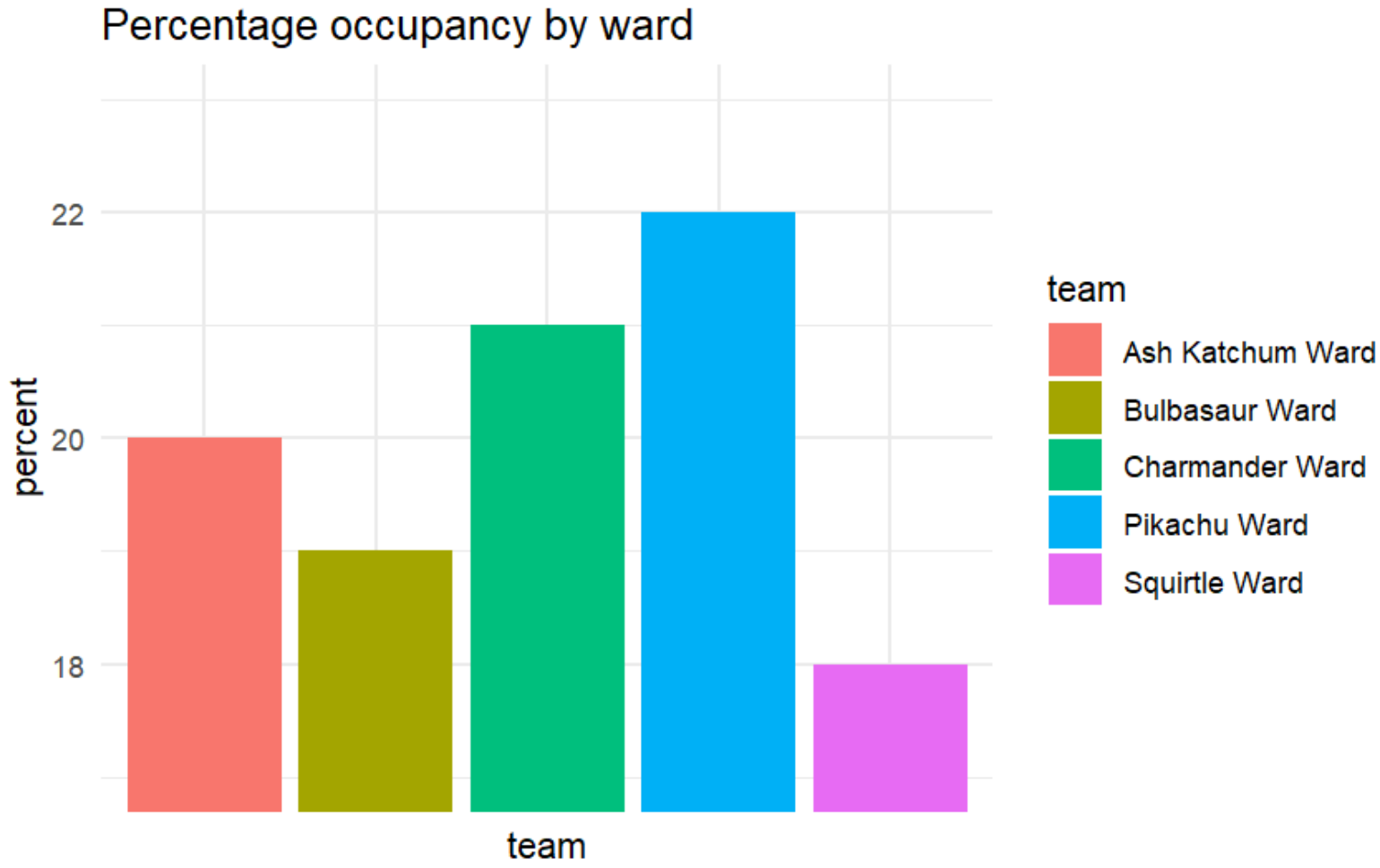

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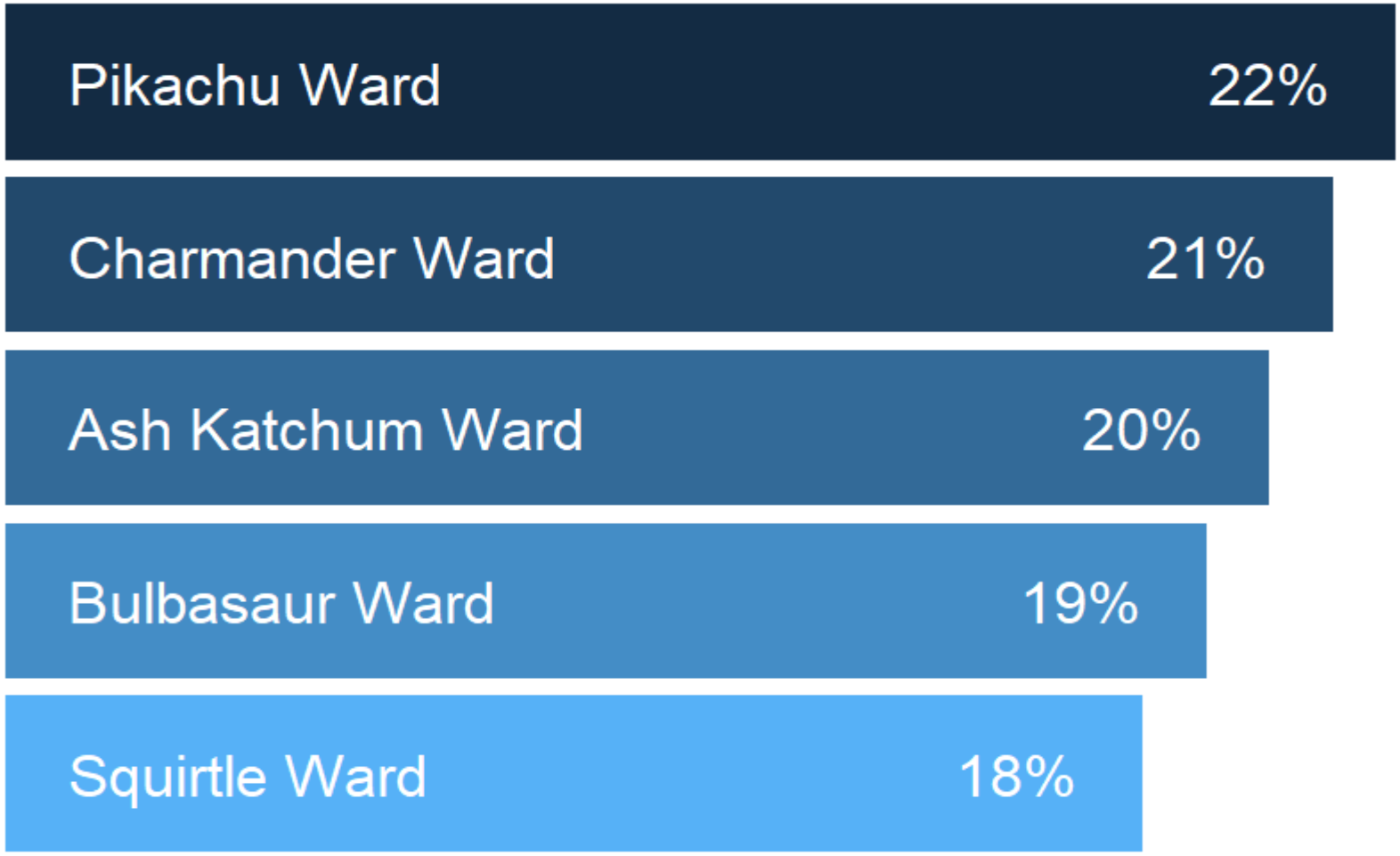
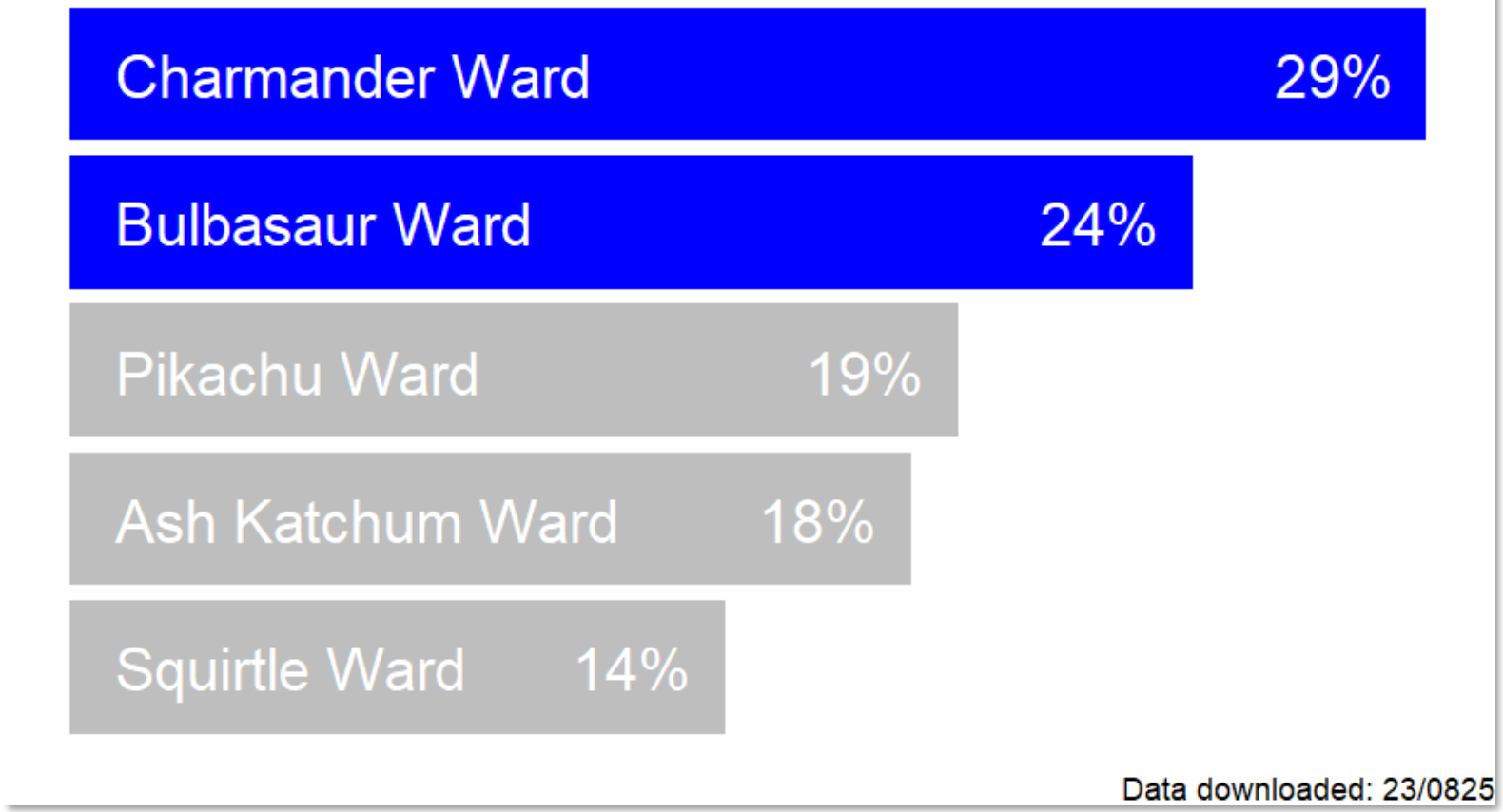


Let’s look at how to do it…

Q Which **ward(s)** have an **occupancy over 20%?**

Bulbasaur Ward and Charmander Ward are showing over 20% occupancy

Chart showing bed occupancy percentage as at 23 Aug 25



Data downloaded: 23/0825

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Check the scores

Design principles

Clarity

Don’t use the title just to describe the thing

Use it to put forward your point

These can be created dynamically to provide appropriate insight right from the start

Simplicity

Reduce that junk

Do you need a legend, or can you directly label

How many data points do you need

What scale do you need?

Purposeful

What is the point of the chart?

What message is it you are trying to convey?

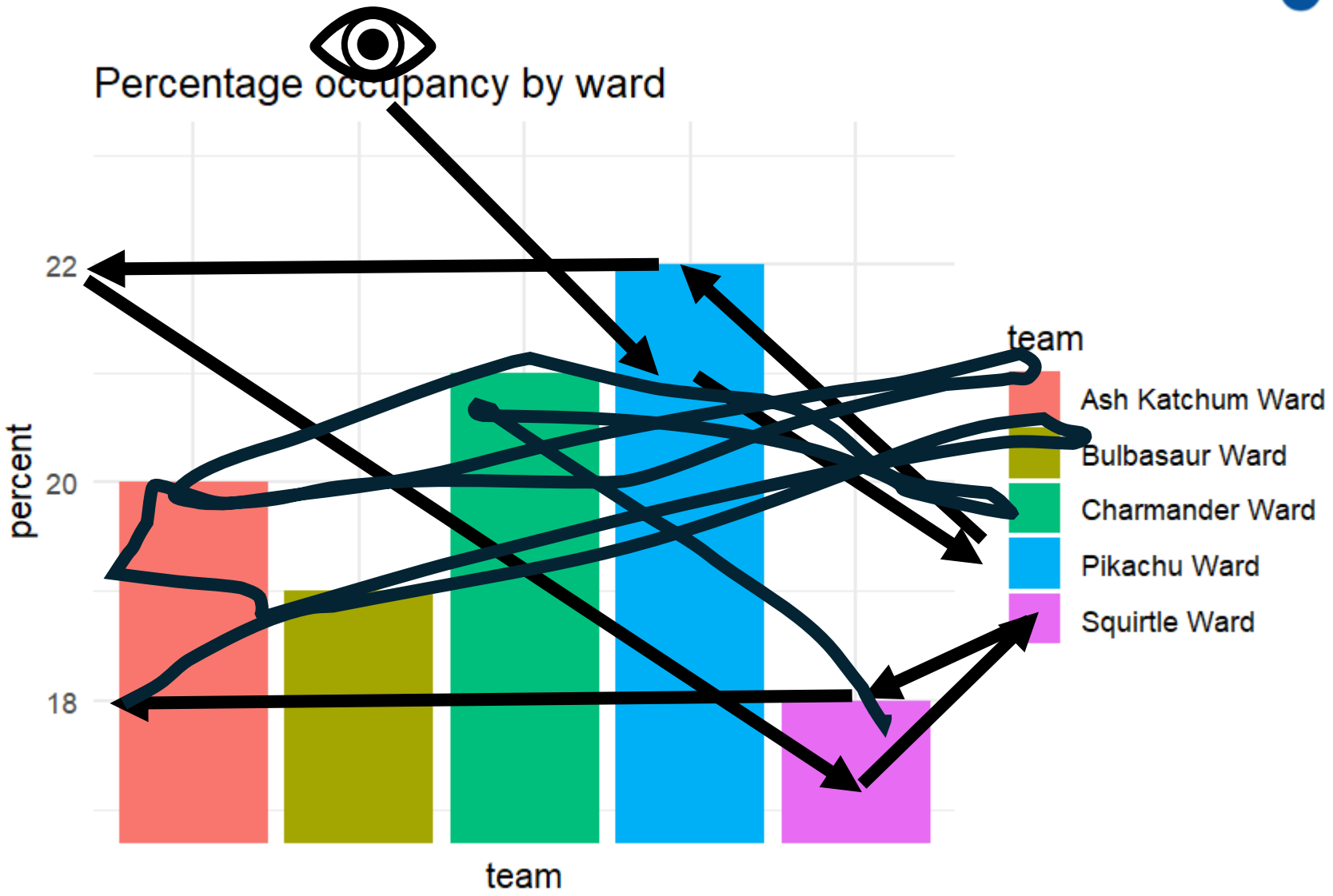
Cognitive load

Think about eye movement

Don’t make your user tilt their head

Don’t make them work for the answer

Cognitive Load - Think about eye movement



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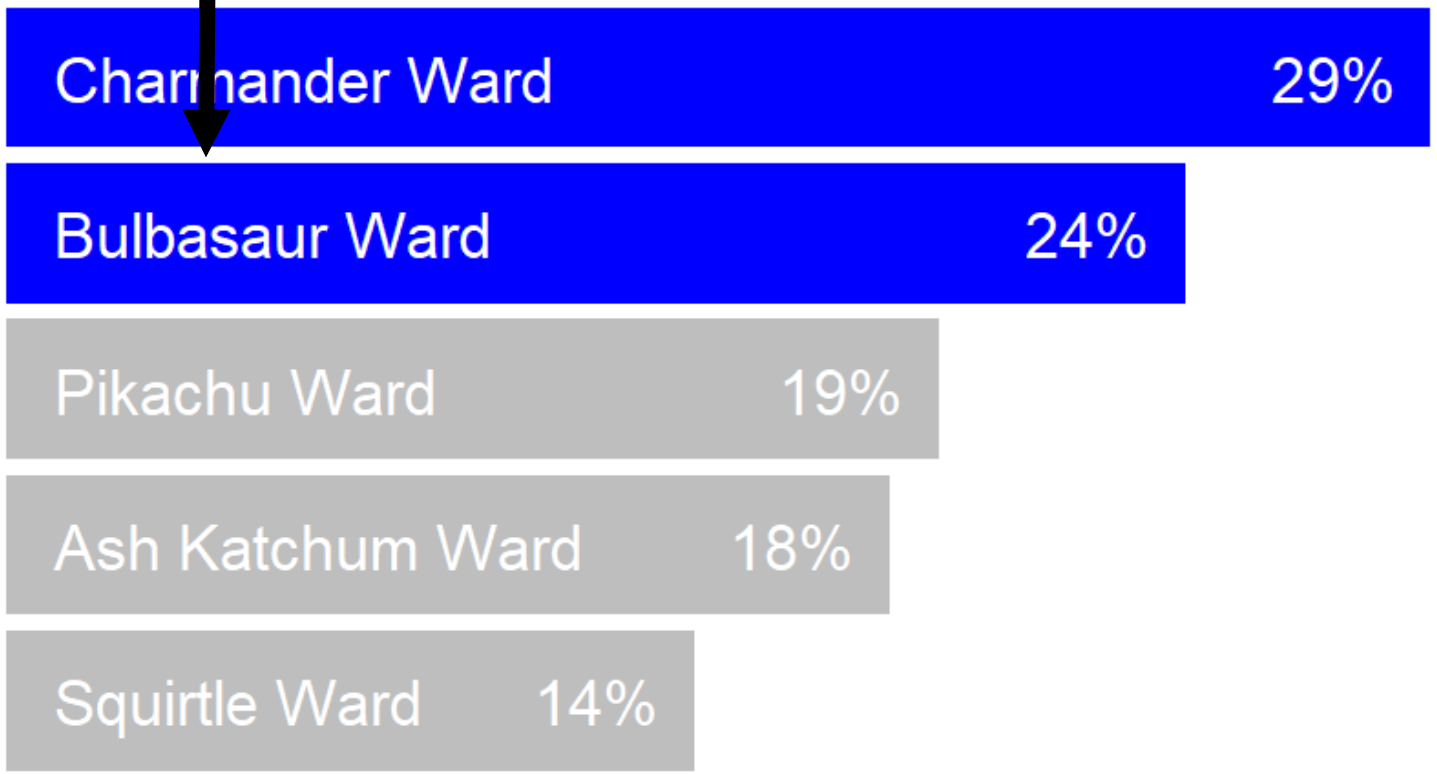

Data downloaded: 23/0825

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"The goal is to turn data into **information**, and information into **insight**"

Carly Fiorini

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“Chart with **purpose**”

Simon Wellesley-Miller

Let's look at how **not** to do it...

Which ward **decreased** most over time?

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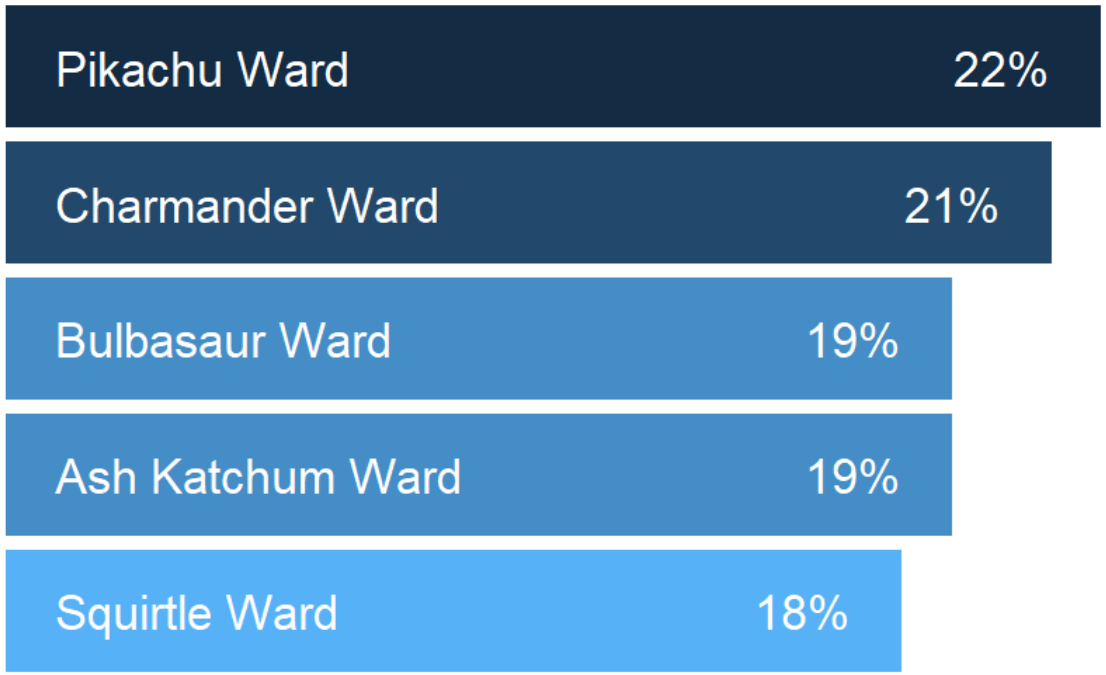
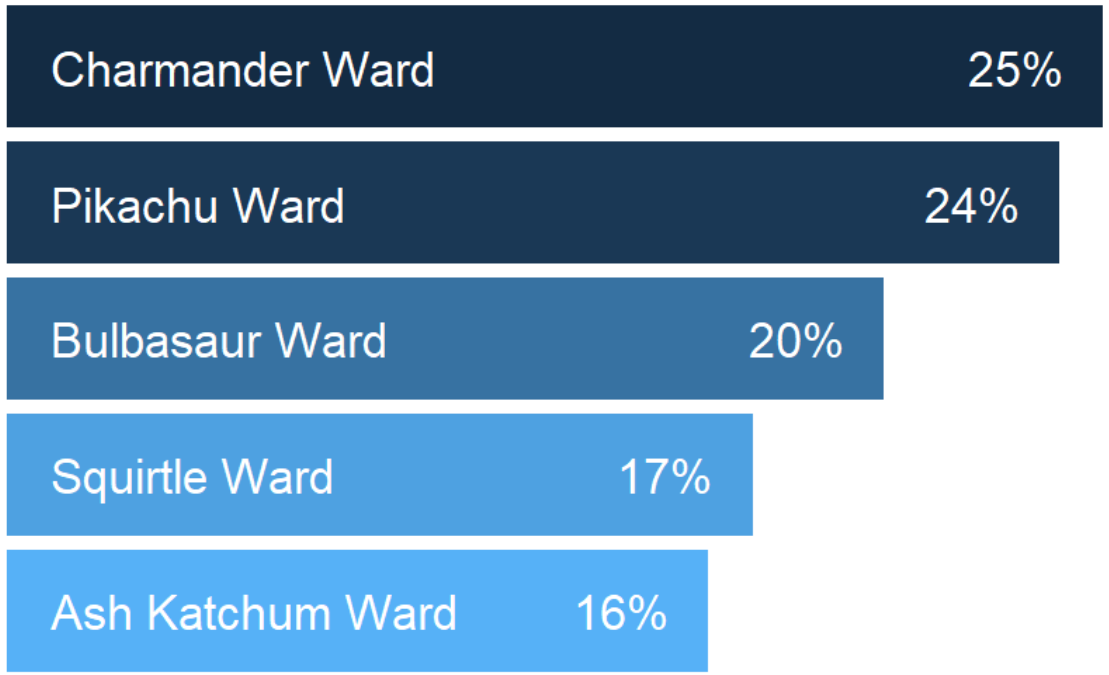
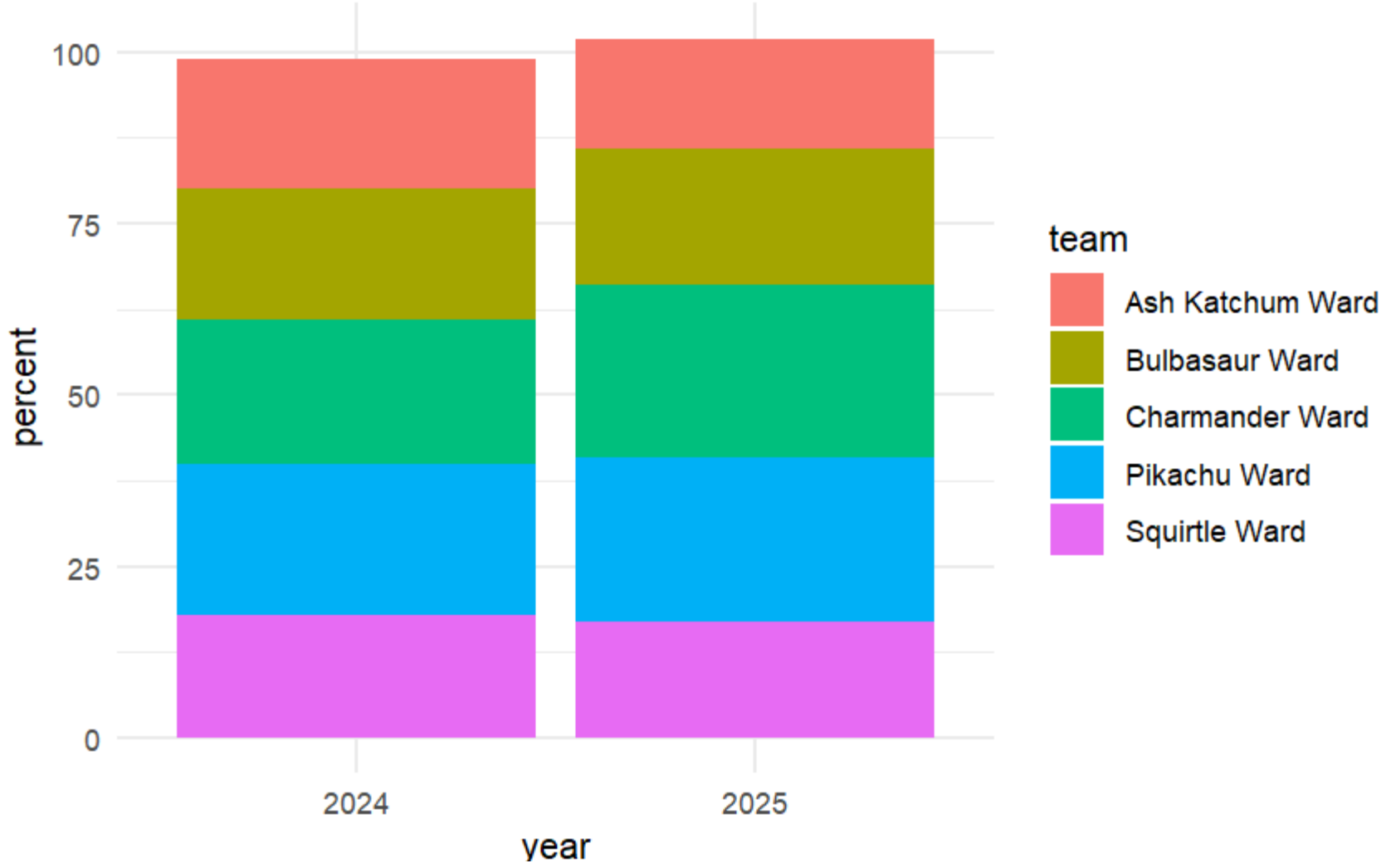
KPI position as at 2024



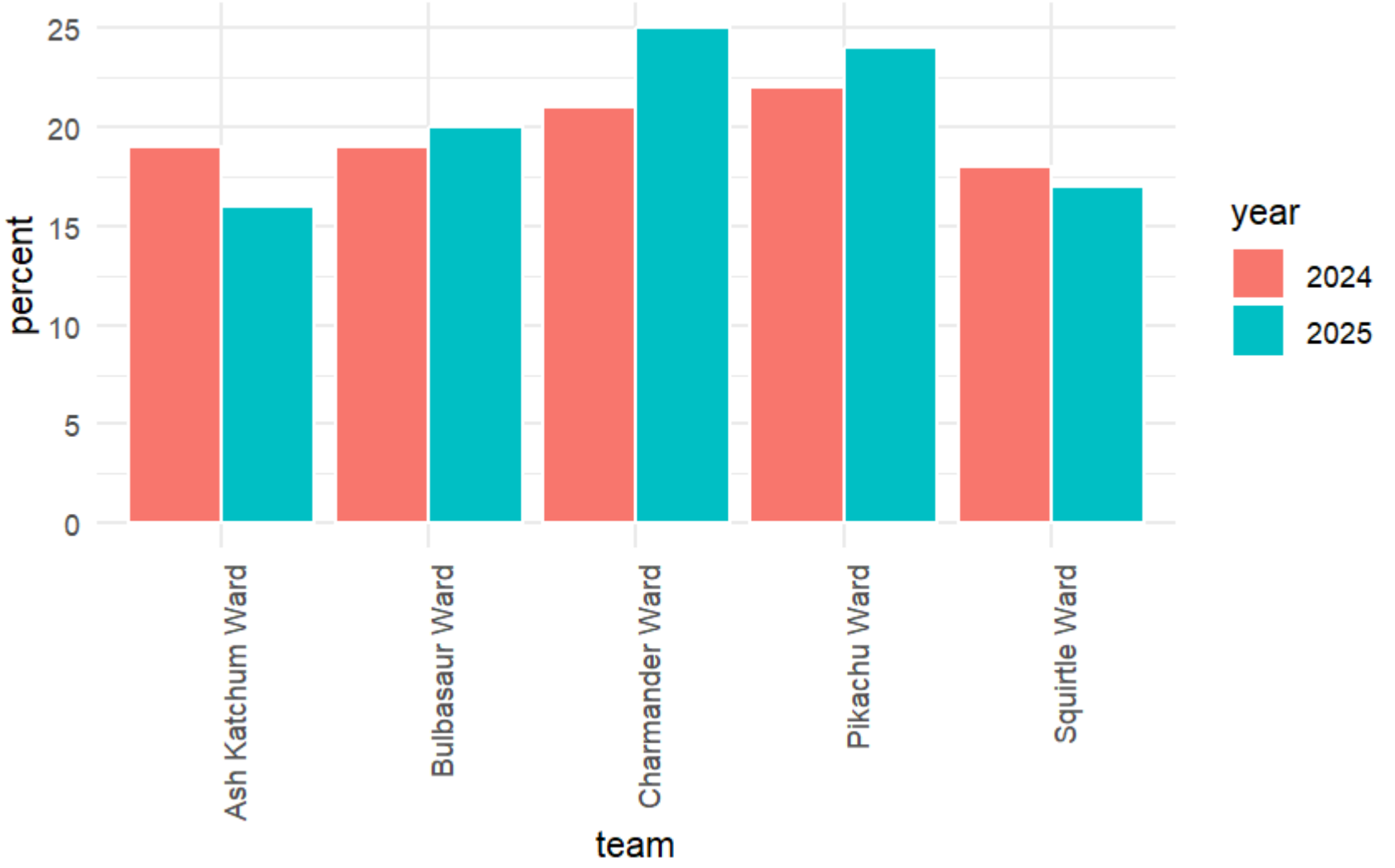
KPI position as at 2025



Let's look another way...



Try again?


25
20
15
10
5
0
percent
Ash Katchum Ward
Bulbasaur Ward
Charmander Ward
Pikachu Ward
Squirtle Ward
team
year
2024
2025

Let's look at **how to do it**...

Which ward saw the **largest** increase?

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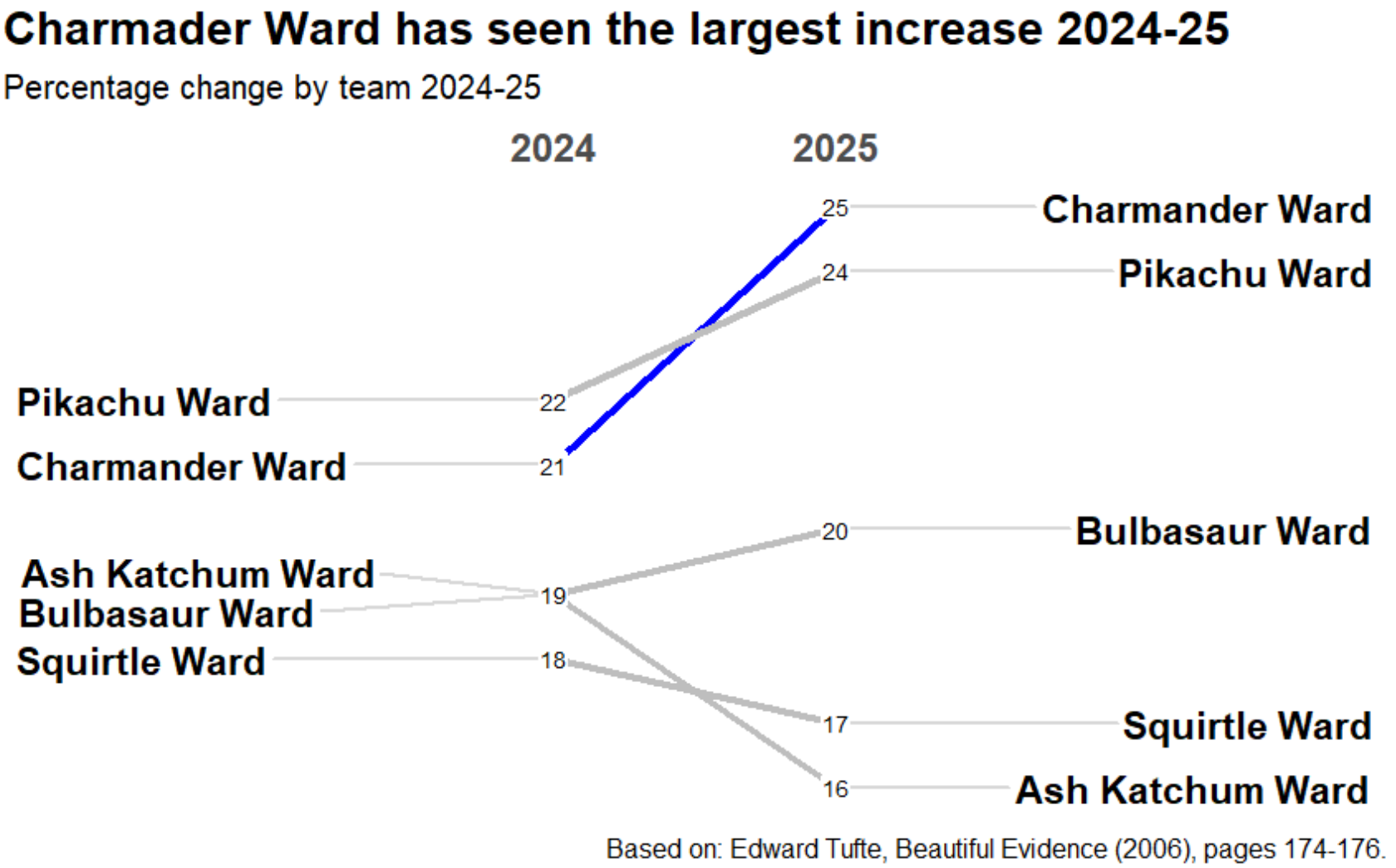
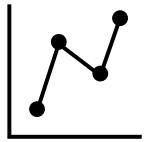


Based on: Edward Tufte, Beautiful Evidence (2006), pages 174-176.

Think about what the **message** is

- What type of chart **focuses** on that?
- How can I **deliver the message** with the least amount of ink / most amount of data?
- How can I deliver the message with the least amount of **cognitive load** (eye movement + maths) on the user?
- Can I **spell out my message** and back it up with data?



Tufte Principles

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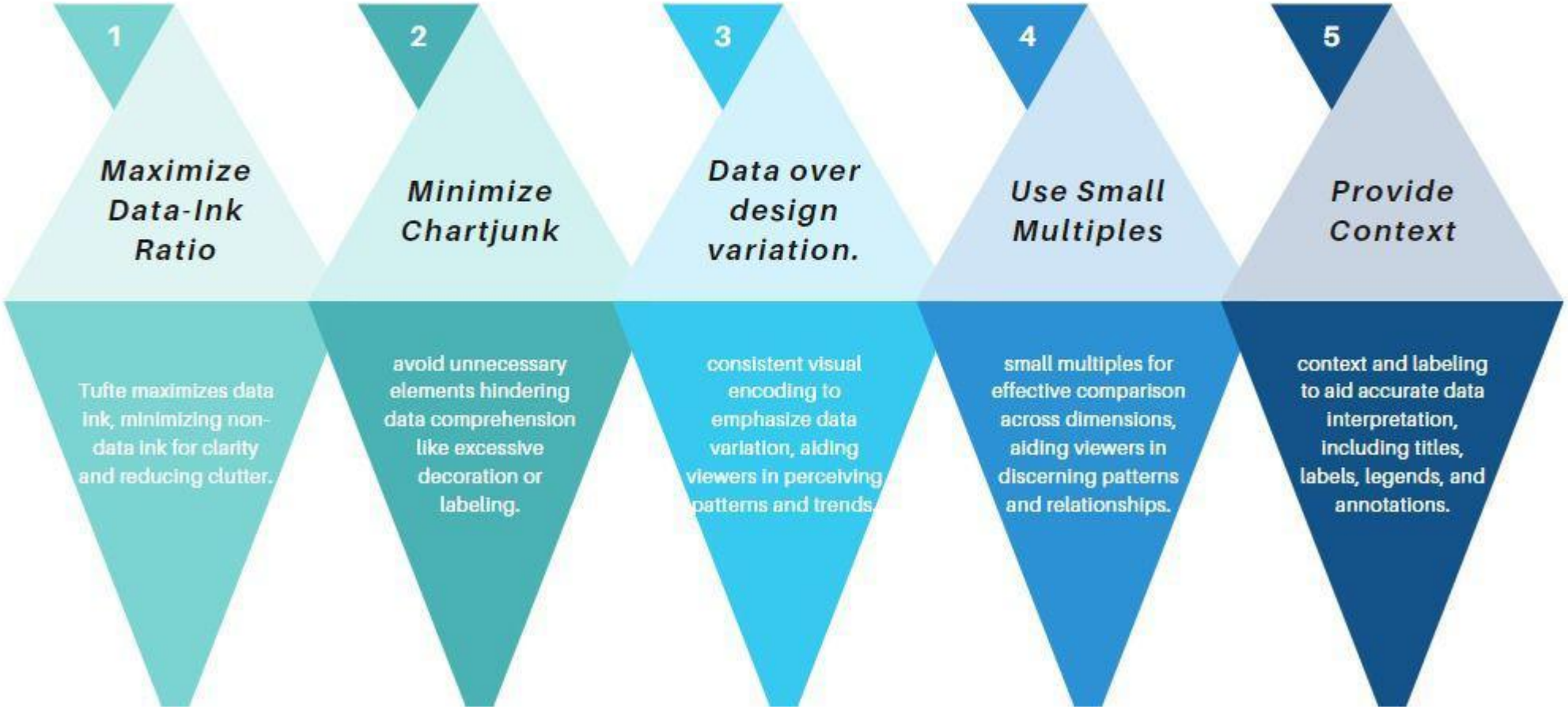

The other Tufty who also had some important messages (More around Road Safety)

Tufte Principles

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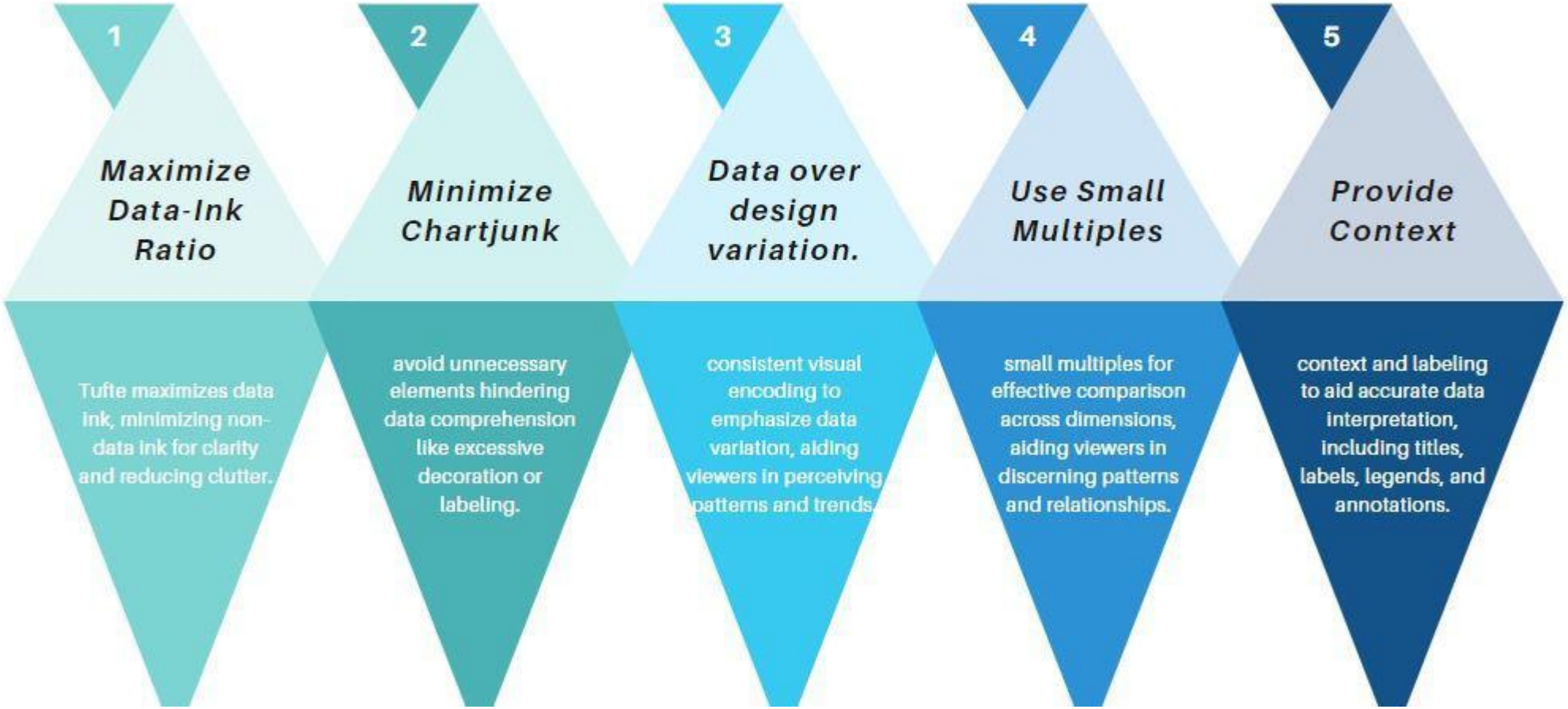


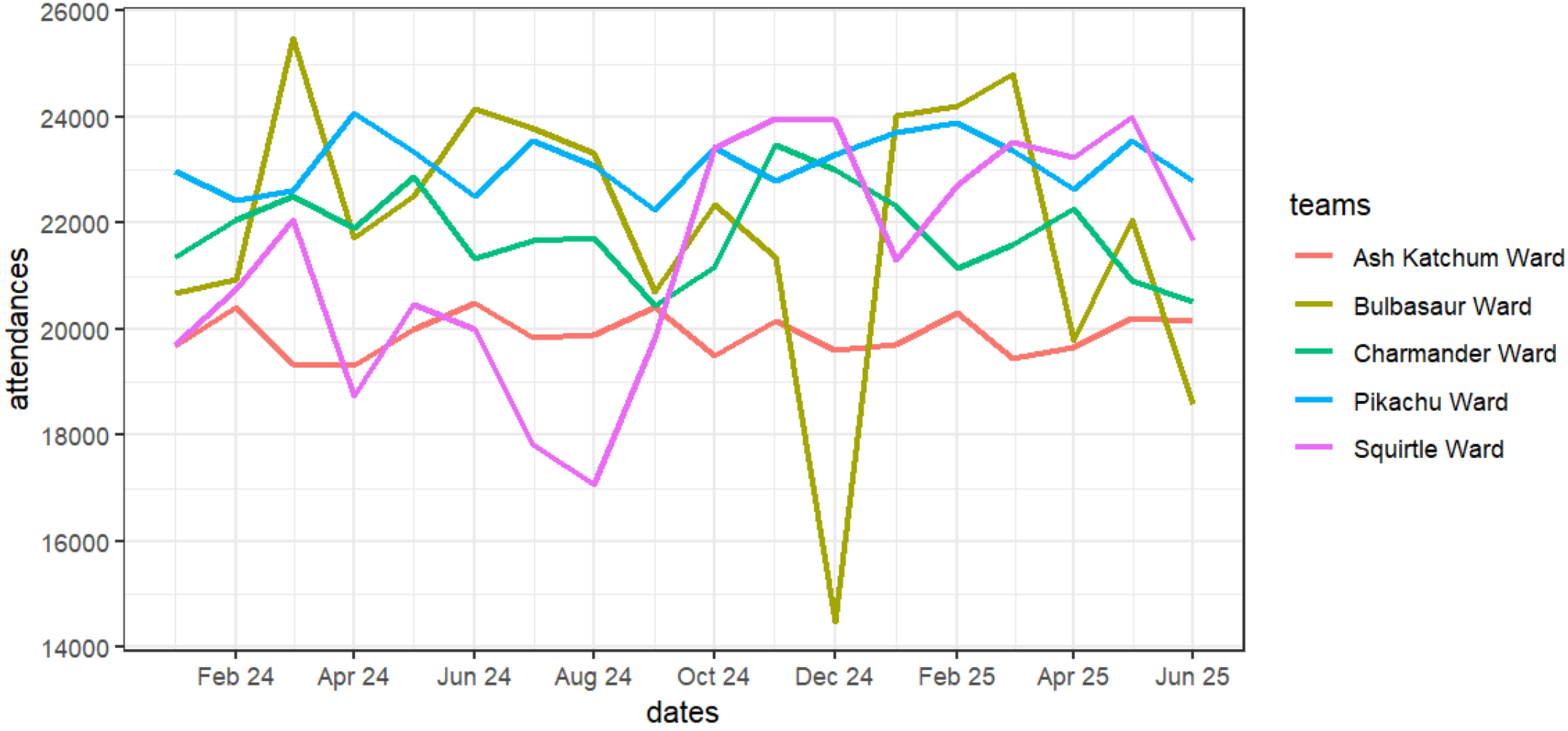
Let's look at the concept of **small multiples**

- Rather than a two point change, lets look at multiple changes over time.

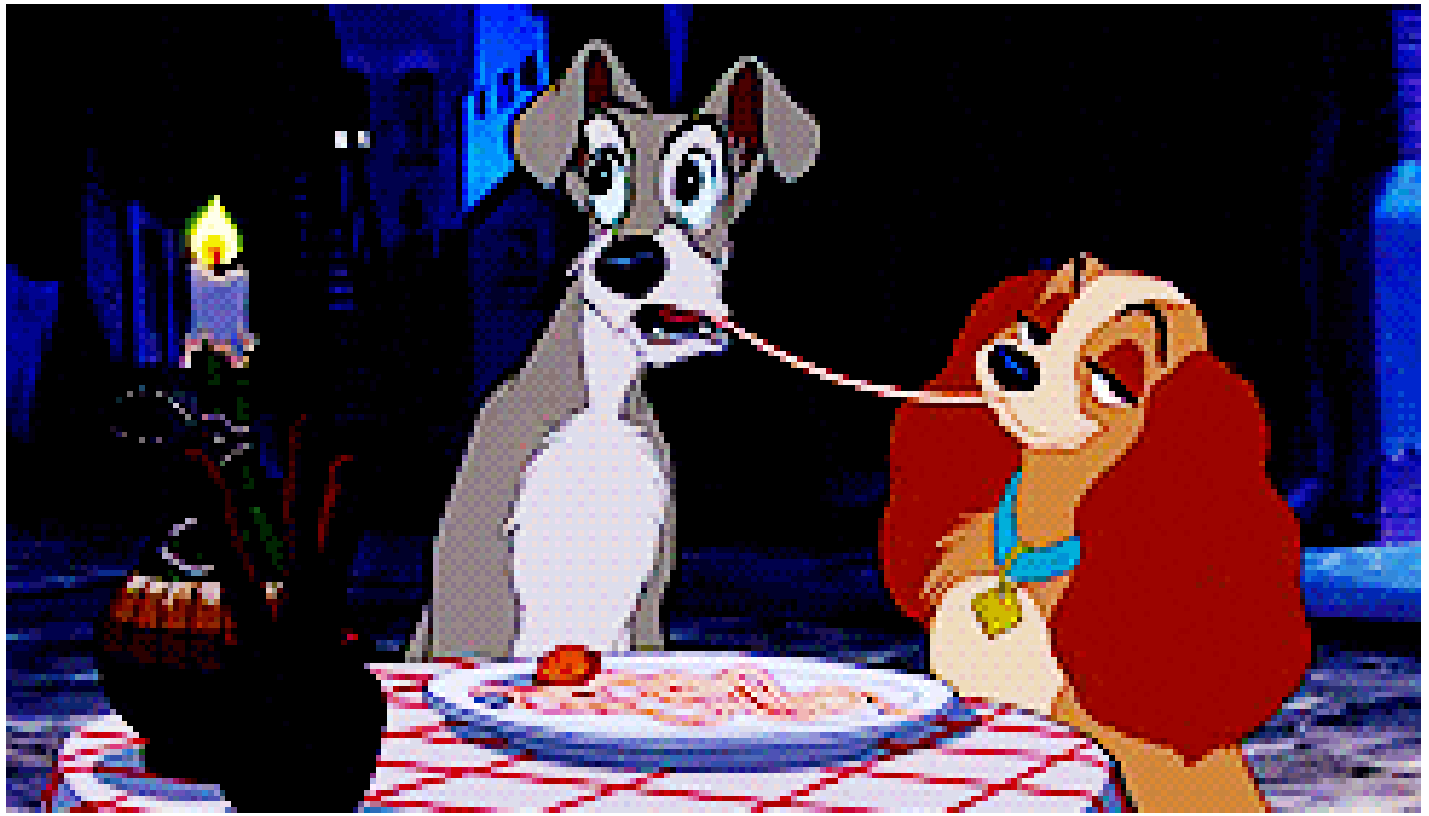
- Helpfully illustrated by a thing called a line chart

Let's look at how **not** to do it...

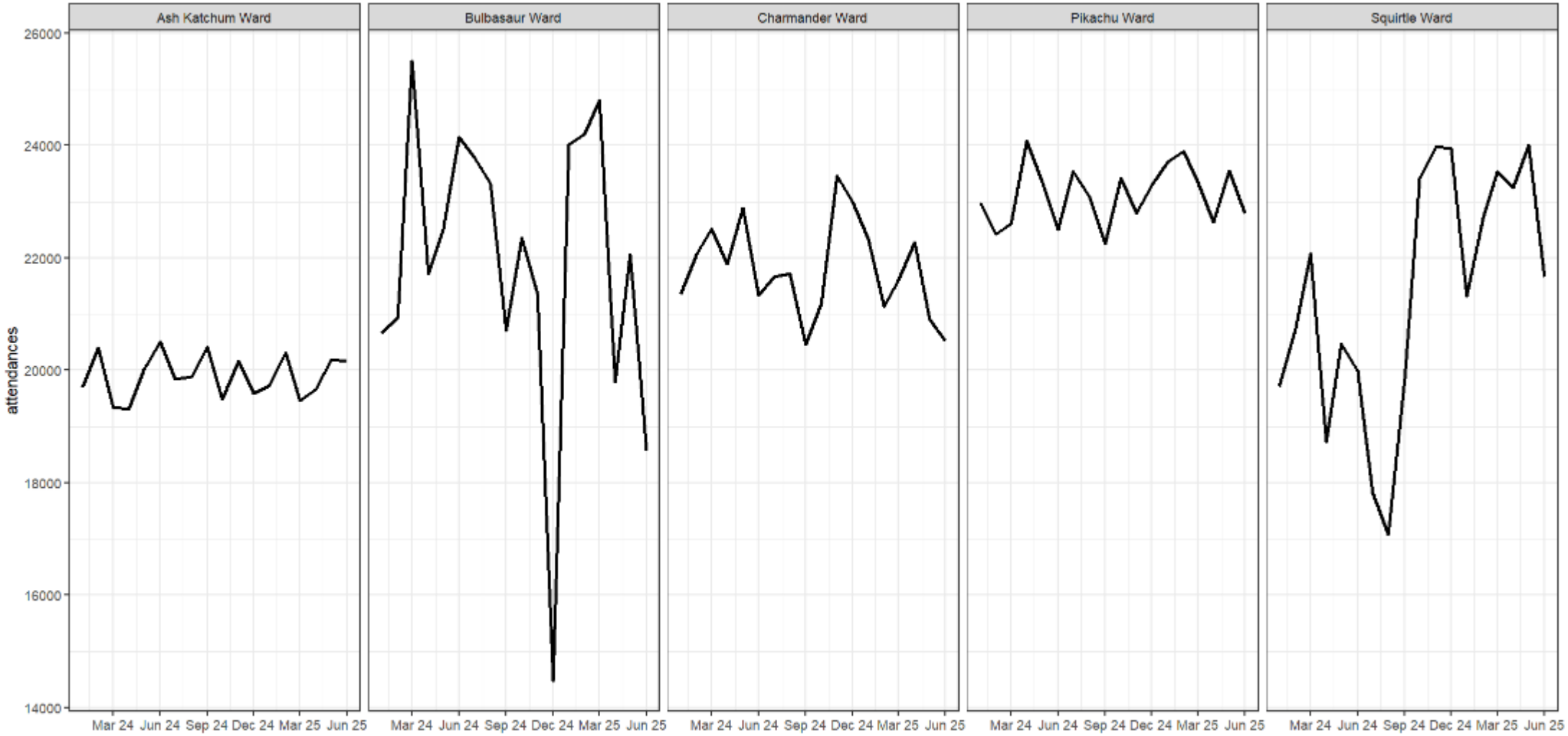
Which ward has been **consistently performing the best**?



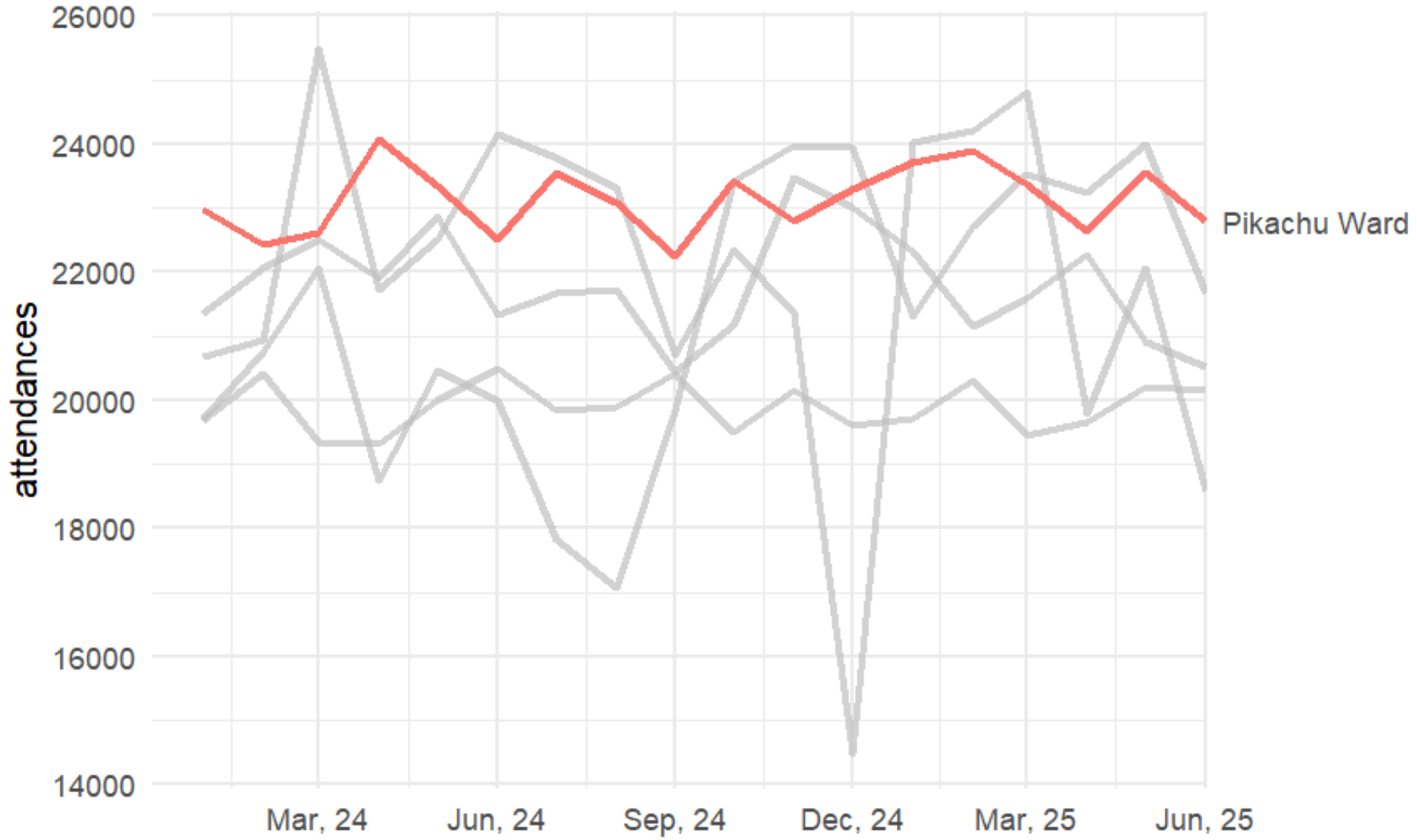
Spaghetti – and that's with only 5 traces and they are quite big on the screen



Concept of **small multiples**

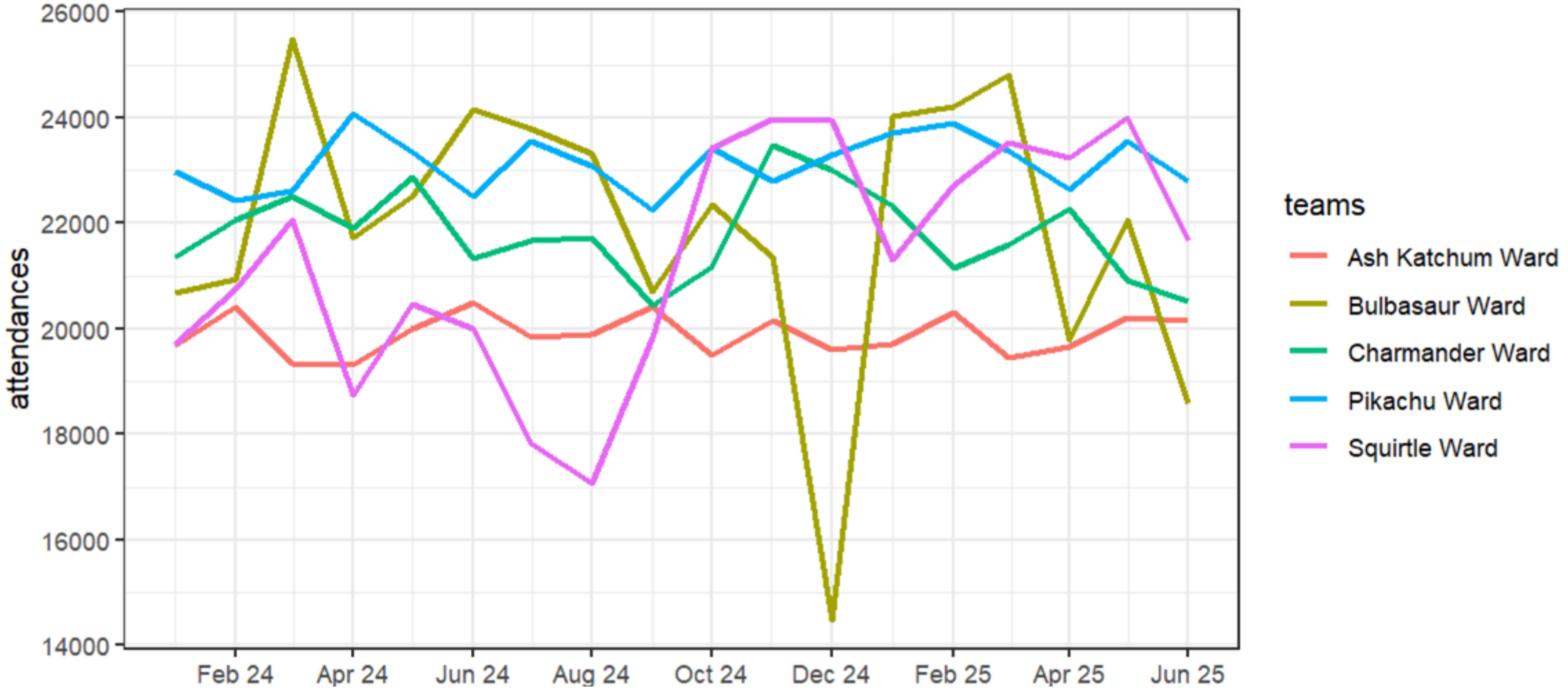


Or plot it all but **draw focus**

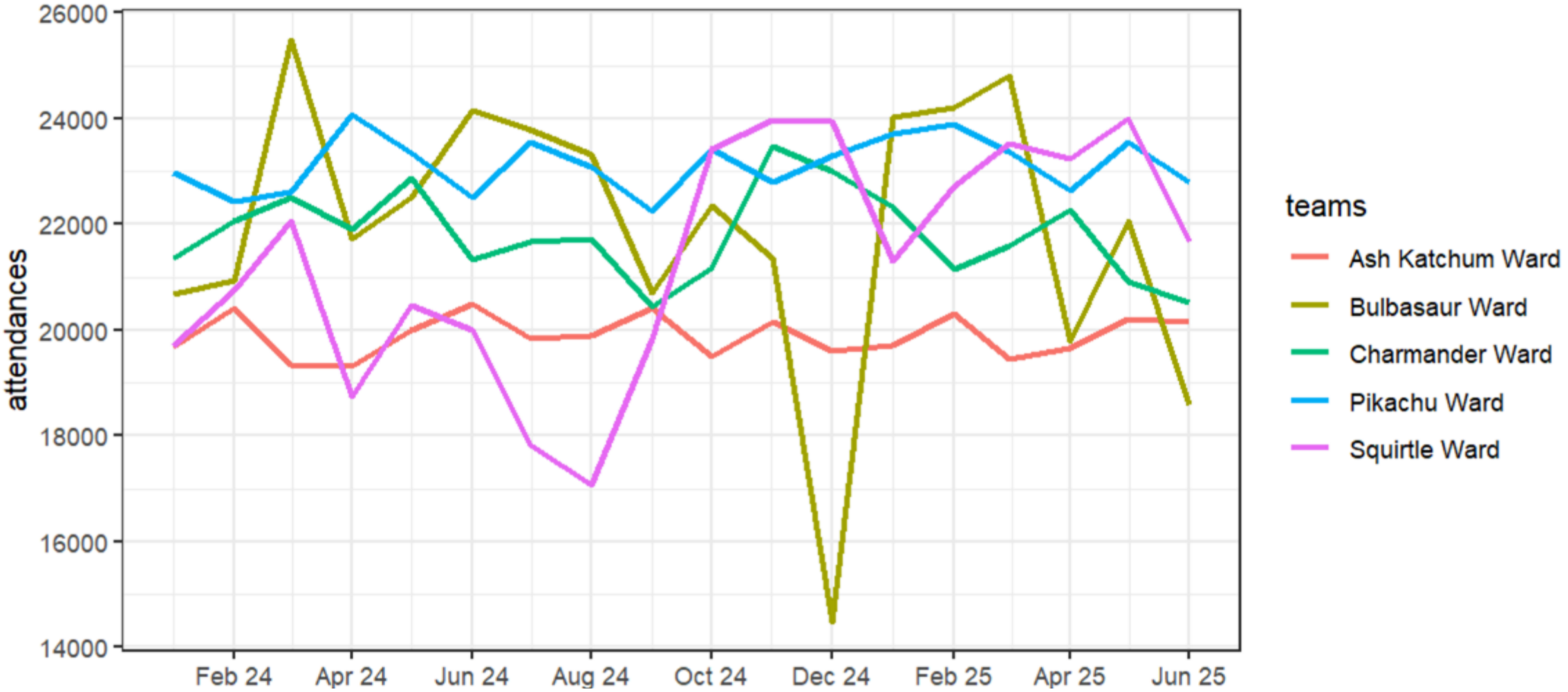


Let's look at how **not** to do it...

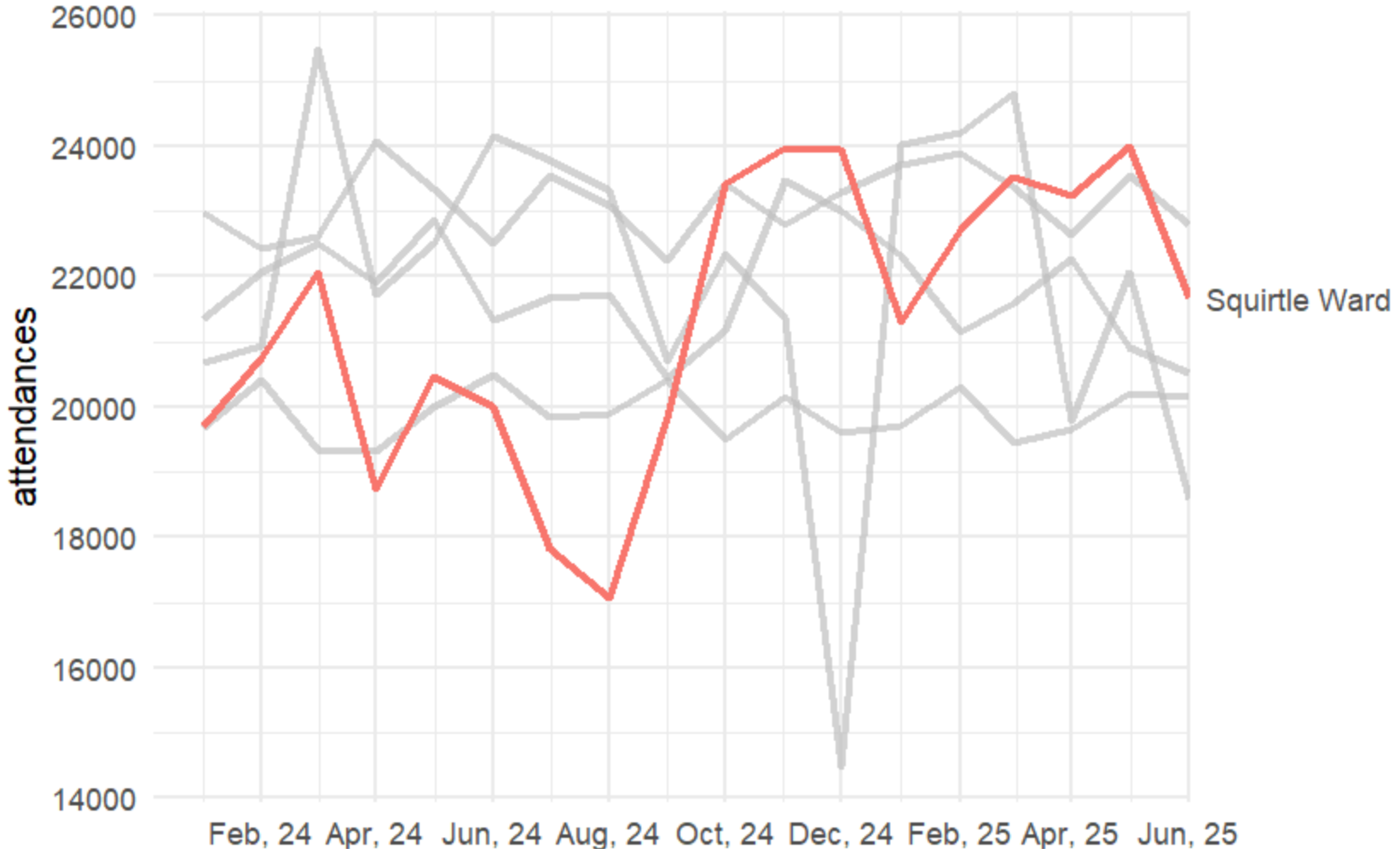
Which ward **changed it process** in October 2024?



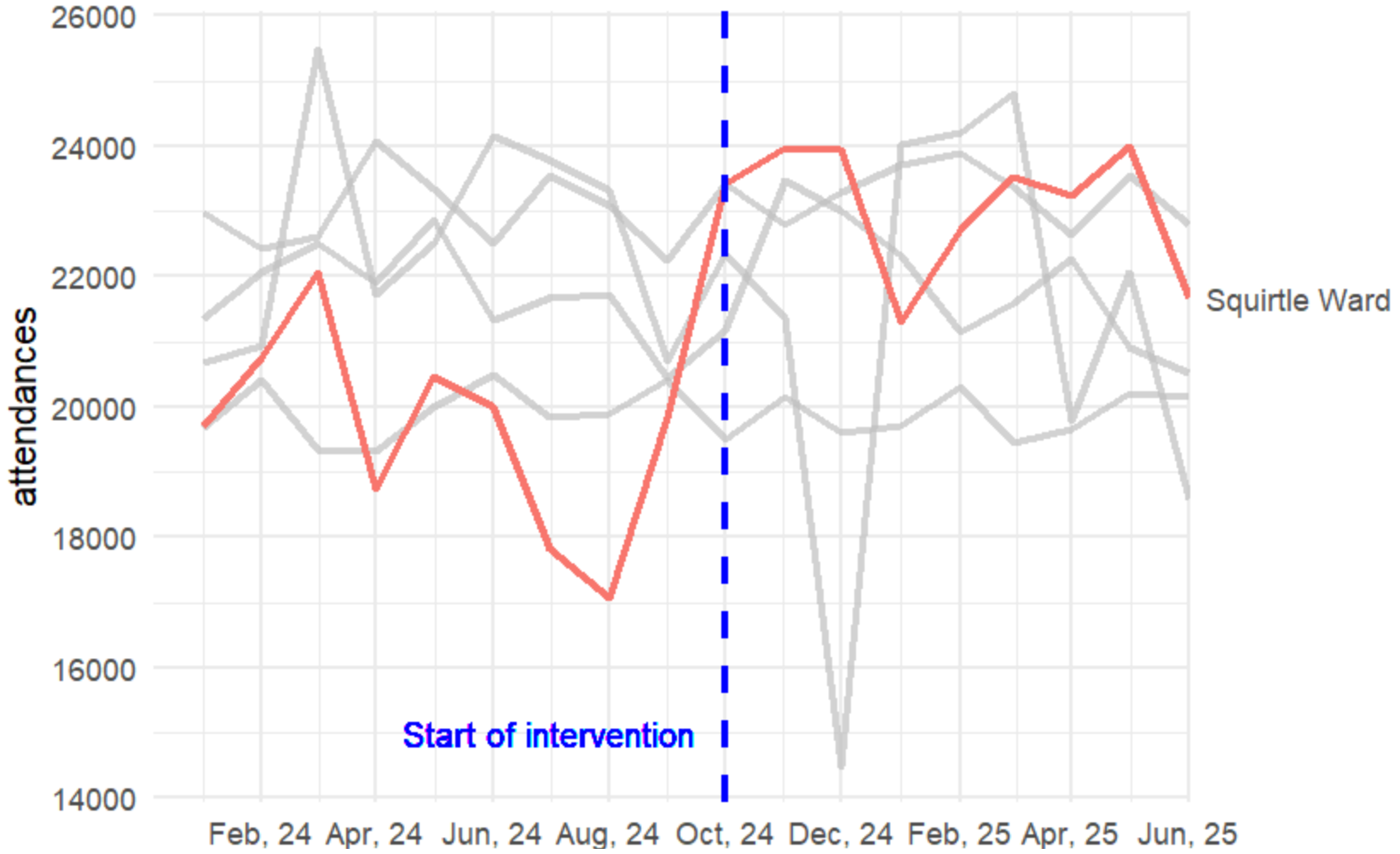
Let's add **context** and **annotations**



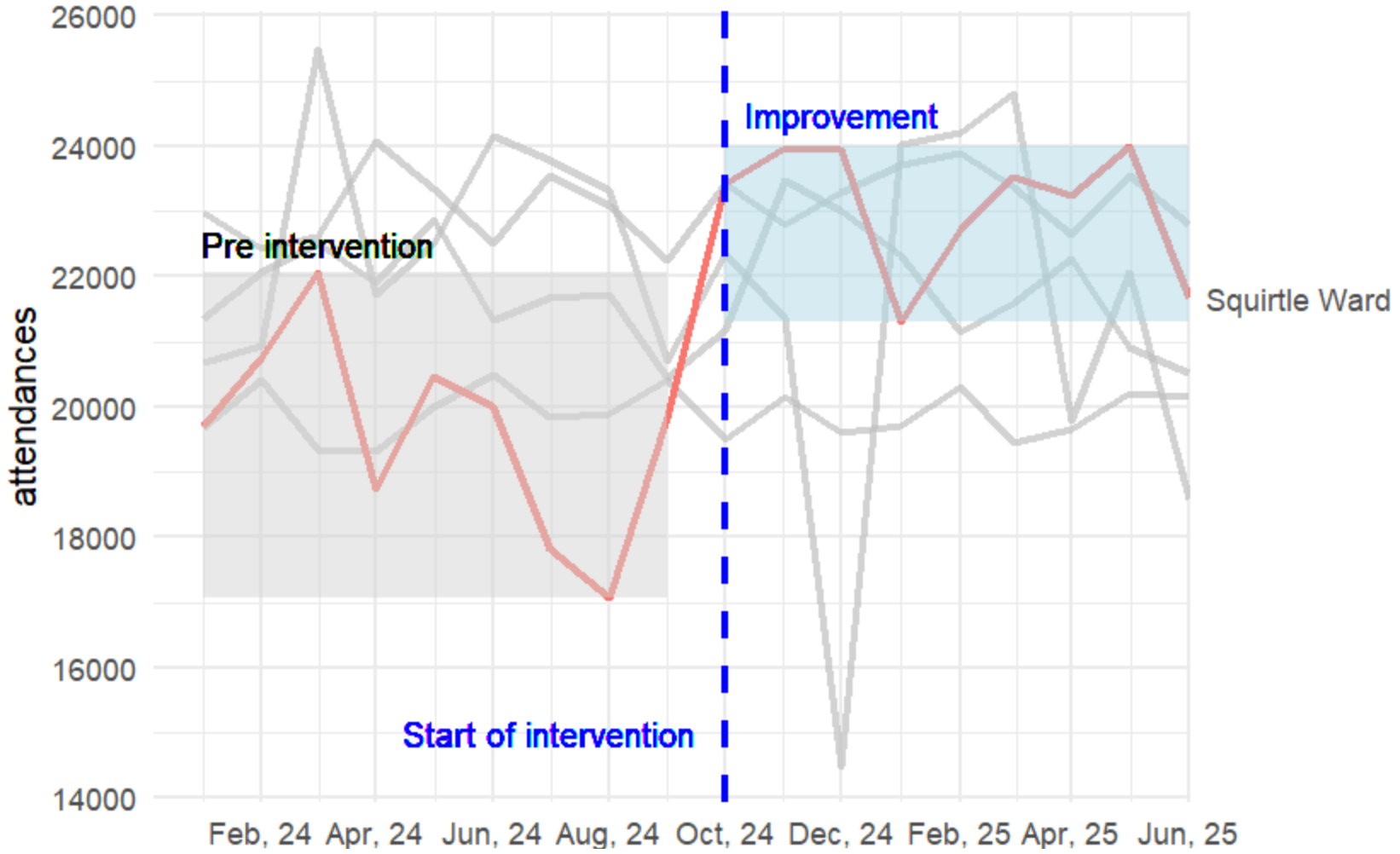
Squirtle Ward changed it process in October 2024 – draw focus



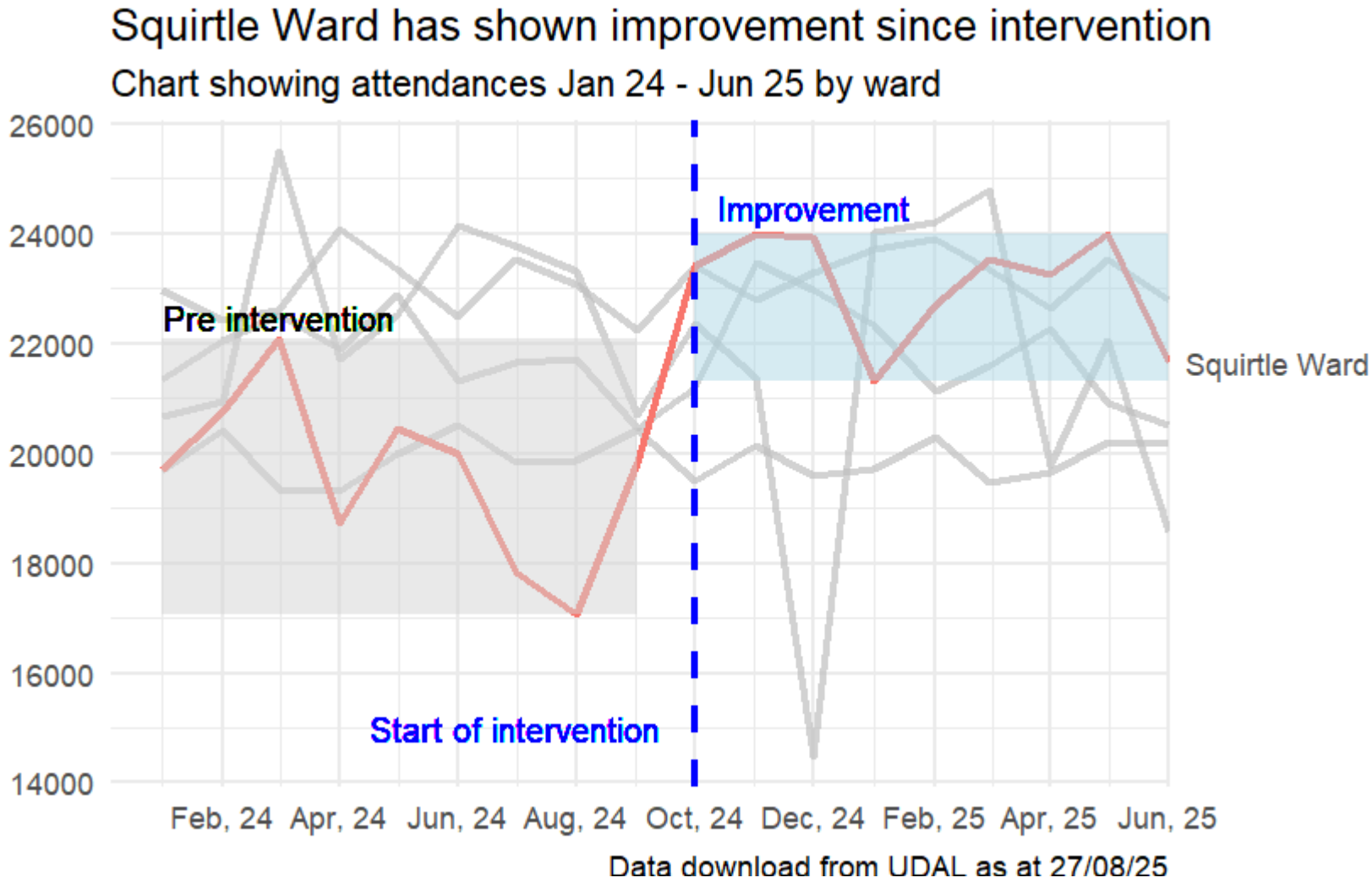
Let's be clear about when the intervention happened



Be super clear about the pre and post performance



Let's add a title that spells out our analysis



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Check the scores

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SIMPLICITY

VERSUS

CLARITY

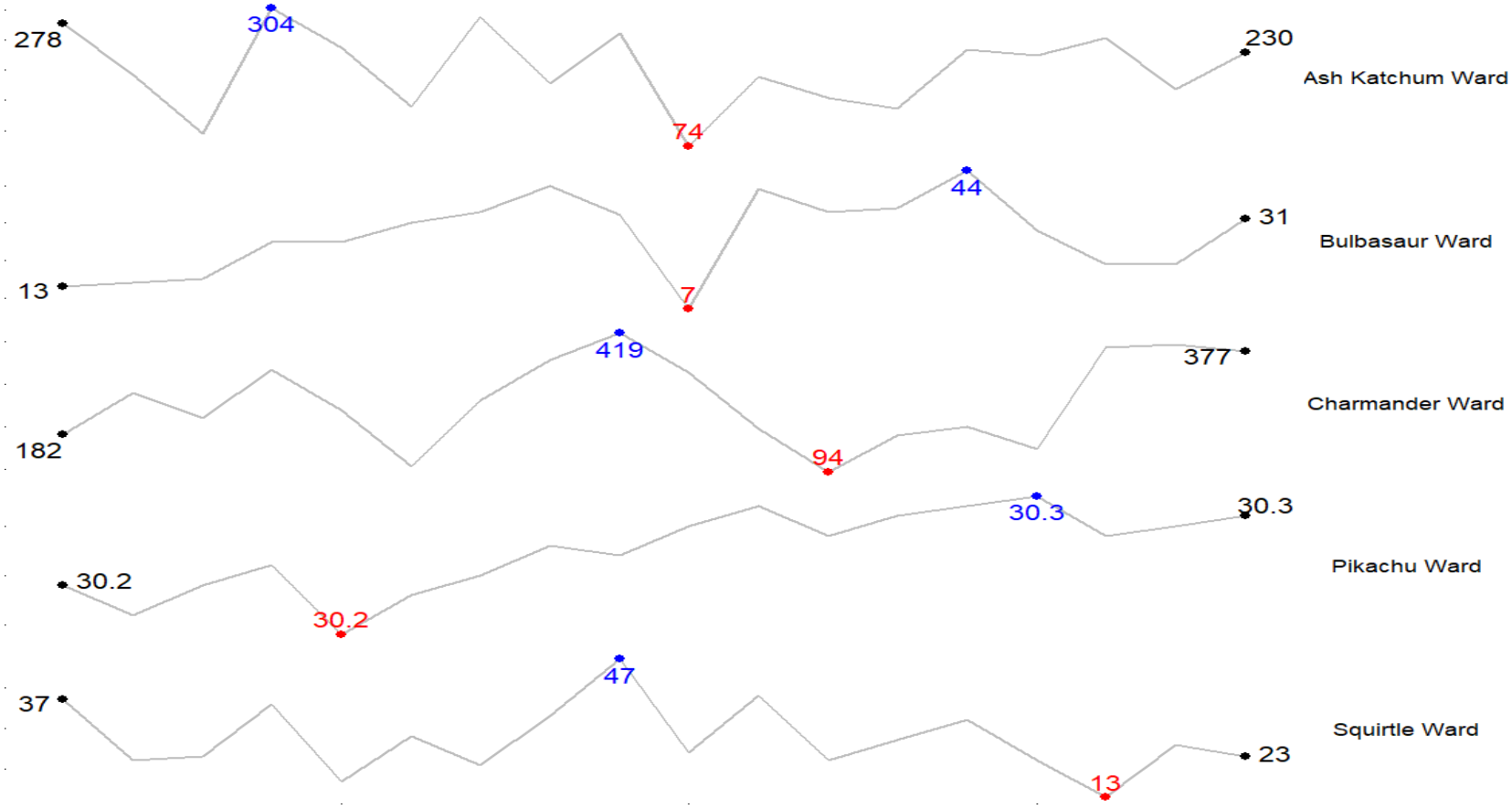
NOPE, THEY'RE NOT THE SAME THING.

Let's look at how **not** to do it...

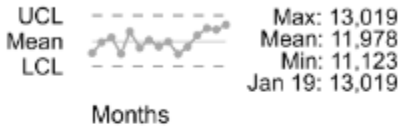
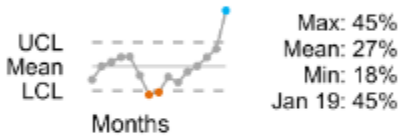
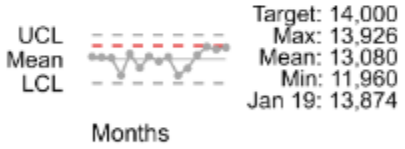
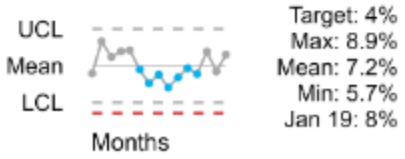
Which ward has seen the **most improvement** in its kpi?

teams	kpi_val	spark
Ash Katchum Ward	230	
Bulbasaur Ward	31	
Charmander Ward	377	
Pikachu Ward	30	
Squirtle Ward	23	

Using **Tufte** rules for sparklines



Using **Tufte** rules for sparklines

Period	Metric Name	Value	Sparky mc line!!!!	Assurance	Variation	Commentary
Jan 2019	R1K	13,019				This process has no target The measure is within common cause variation, with no significant change.
Jan 2019	RF4	44.8%				This process has no target There is evidence of special cause variation of a improving nature.
Jan 2019	RJ2	13,874				This process will not consistently achieve or fail the target. The measure is within common cause variation, with no significant change.
Jan 2019	RQM	8%				This process is not capable, it will consistently fail without a redesign or change. The measure is within common cause variation, with no significant change.

https://github.com/Simon-W-M/SPC_summary_table

Let's think about **insight** from your visualisation

- You may have a great visual but is it still possible to **misinterpret** it
- Is your data telling us what we think it is telling us – do you really **understand** your data?
- Here is a very famous example

World War 2 bombers

In 1942 bombers were being **shot down** on bombing sorties.

Bombers had to carry a lot of **fuel** and **crew** and **bombs**.

There is a limited weight **trade off** between all of these variables.

They also didn't want to be shot down and so had **armour**.

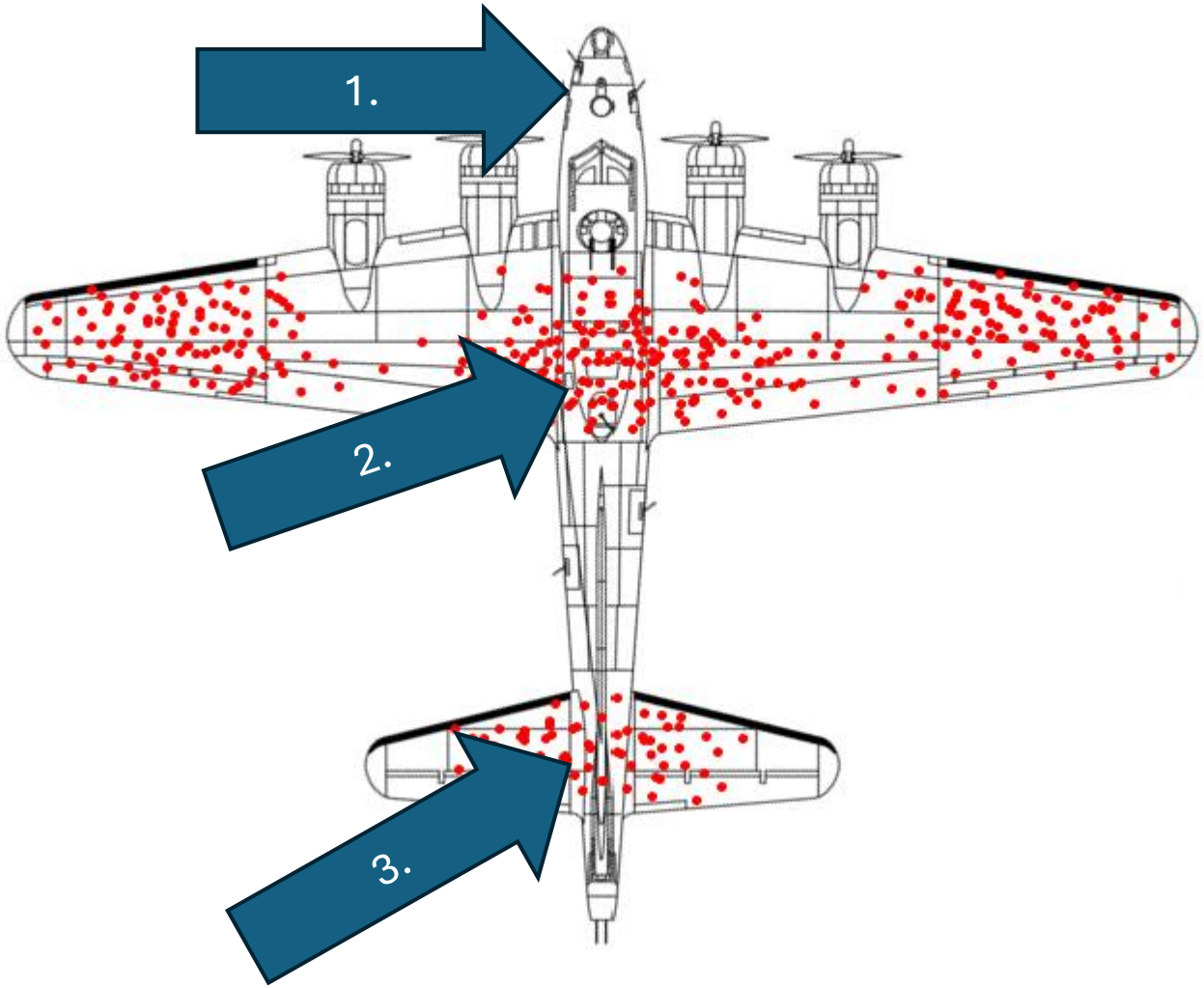
Armor is **heavy** and **limits** amount of bombs and slows plane down making it an easier target

So they really want to put it in the **appropriate** places.

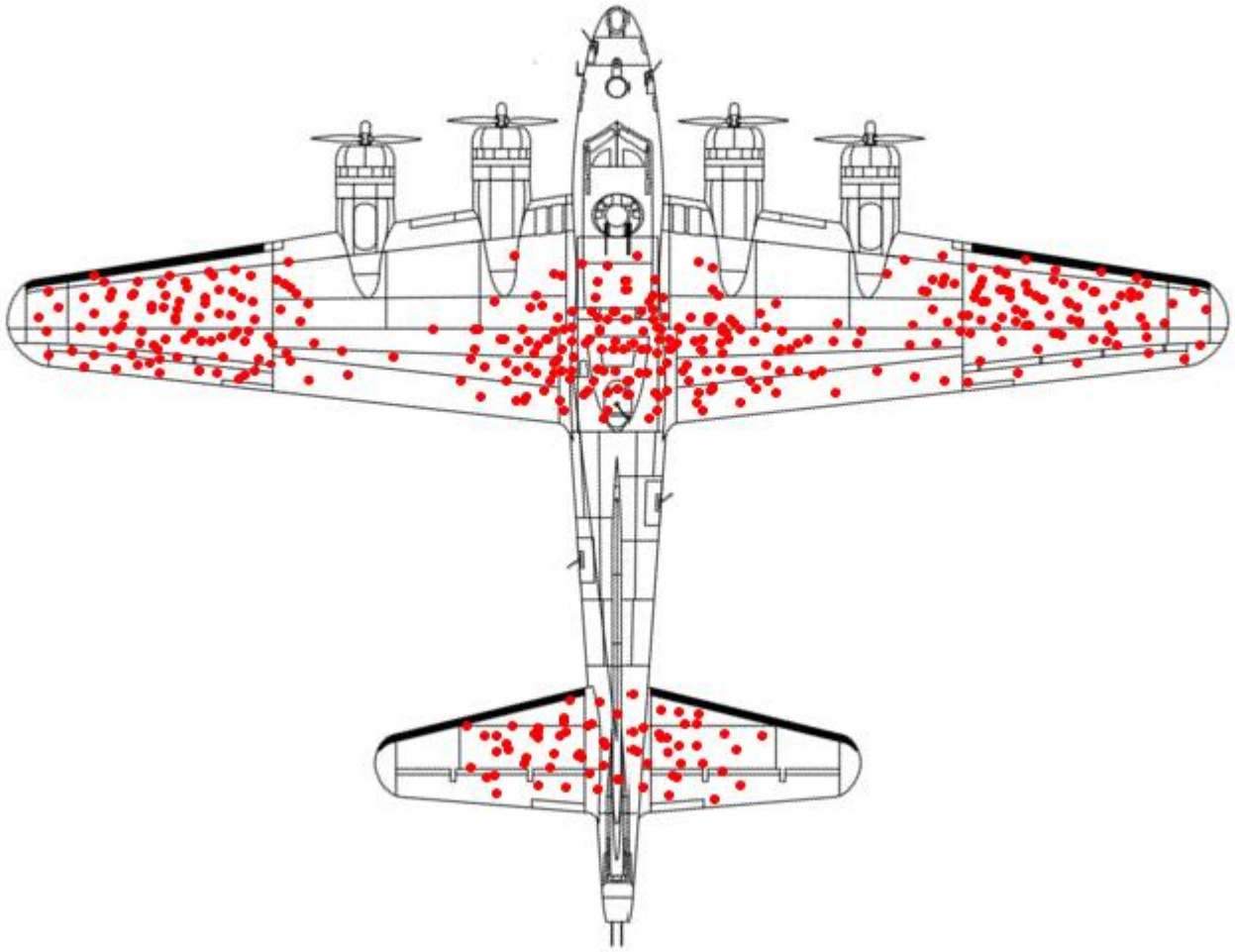
A study was carried out **mapping** where planes were being shot.

Let’s have a look…

Where do we put the **armour**?



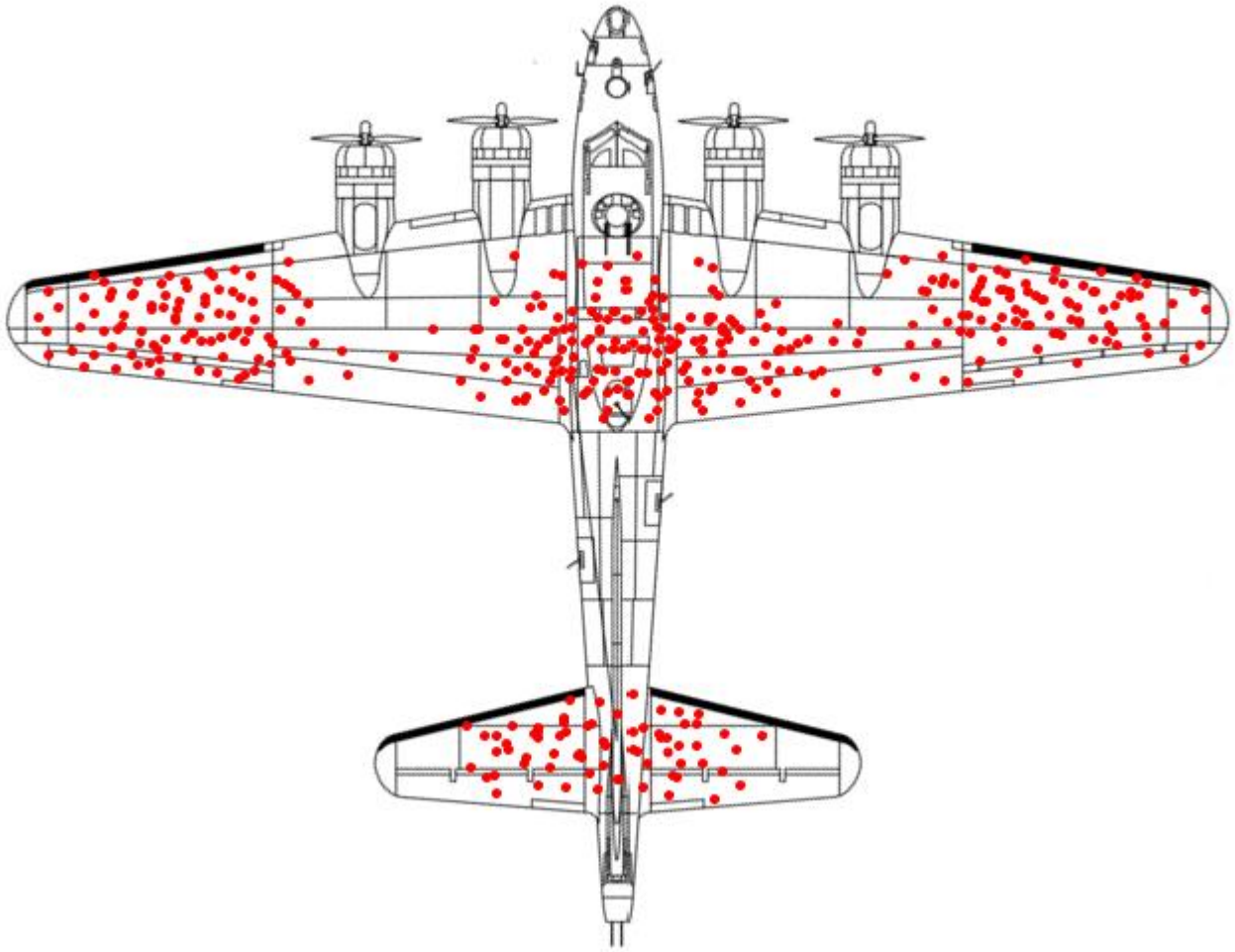
Where do we put the **armour**?



What planes do we have data for?

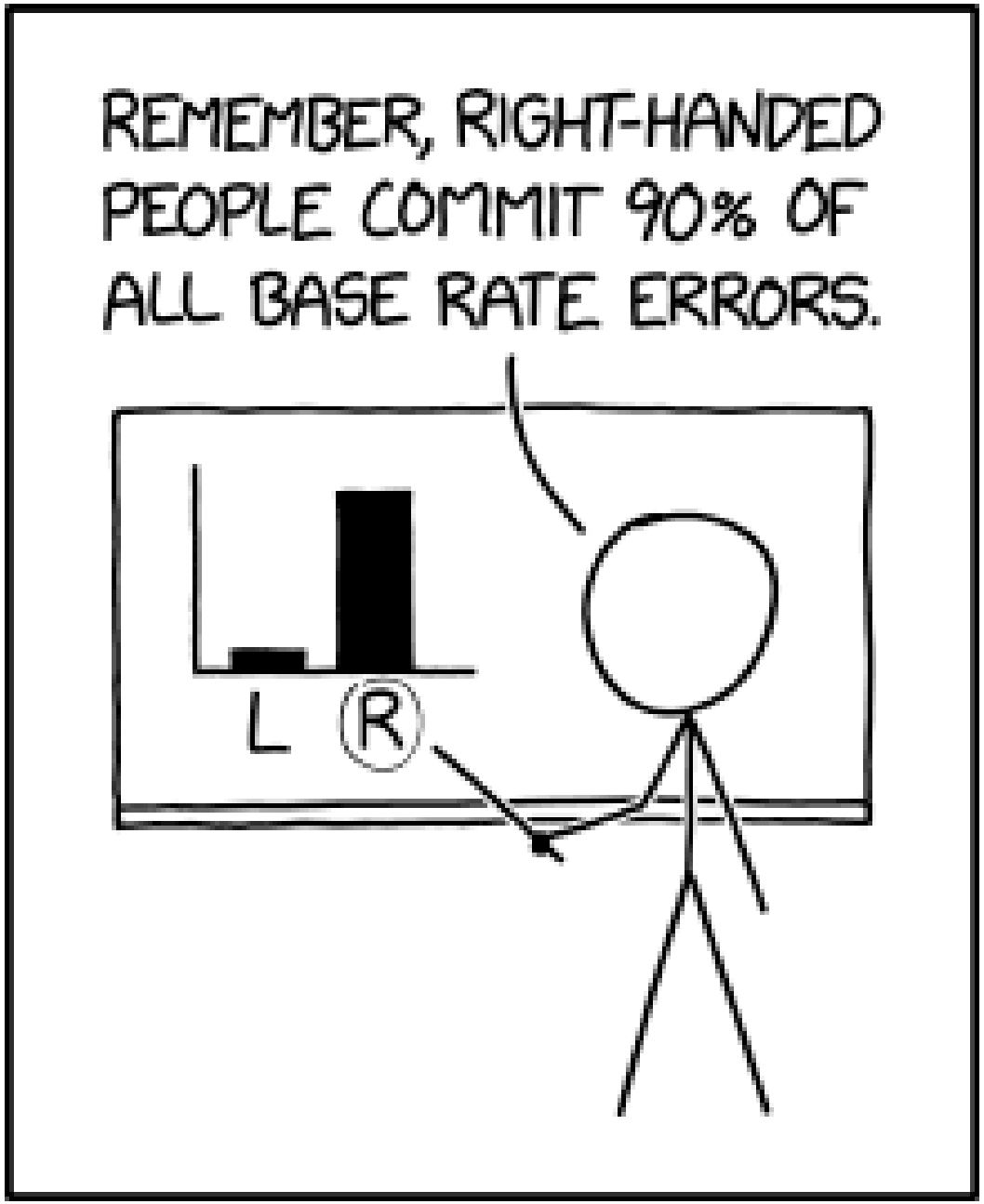
The ones that made it home.

Where do we put the armour?



Based on work of
Abraham Wald
1902-1950

Considered to be one of the fathers of operational research



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Let's look at how **not** to do it...

Is February the **least** accident-prone month of the year?

Month	AE_Attendances
Jan 2025	2,218,130
Feb 2025	2,088,071
Mar 2025	2,389,064

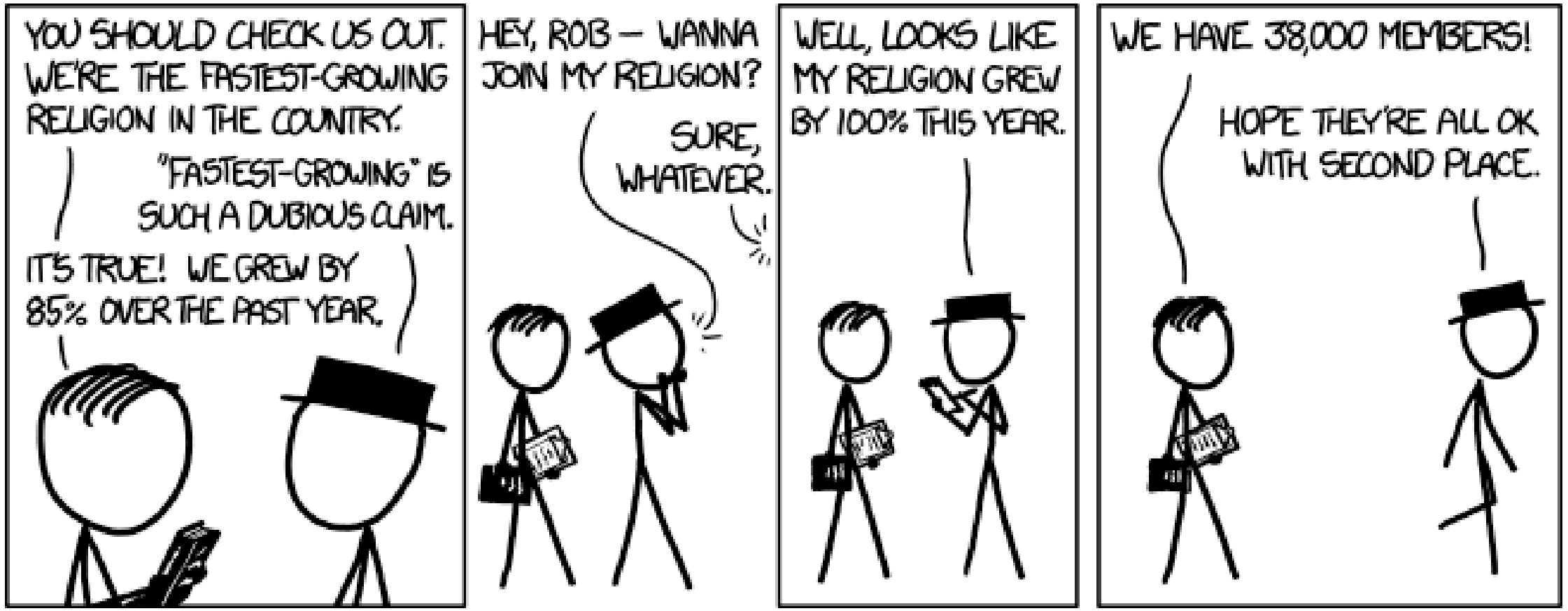
Every February for the last 10 years we have seen a reduction of around 5-7% of AE attendances compared to the surrounding months of January and March

Statistics » A&E Attendances and Emergency Admissions 2024-25

A simple **standardisation** changes the narrative completely.

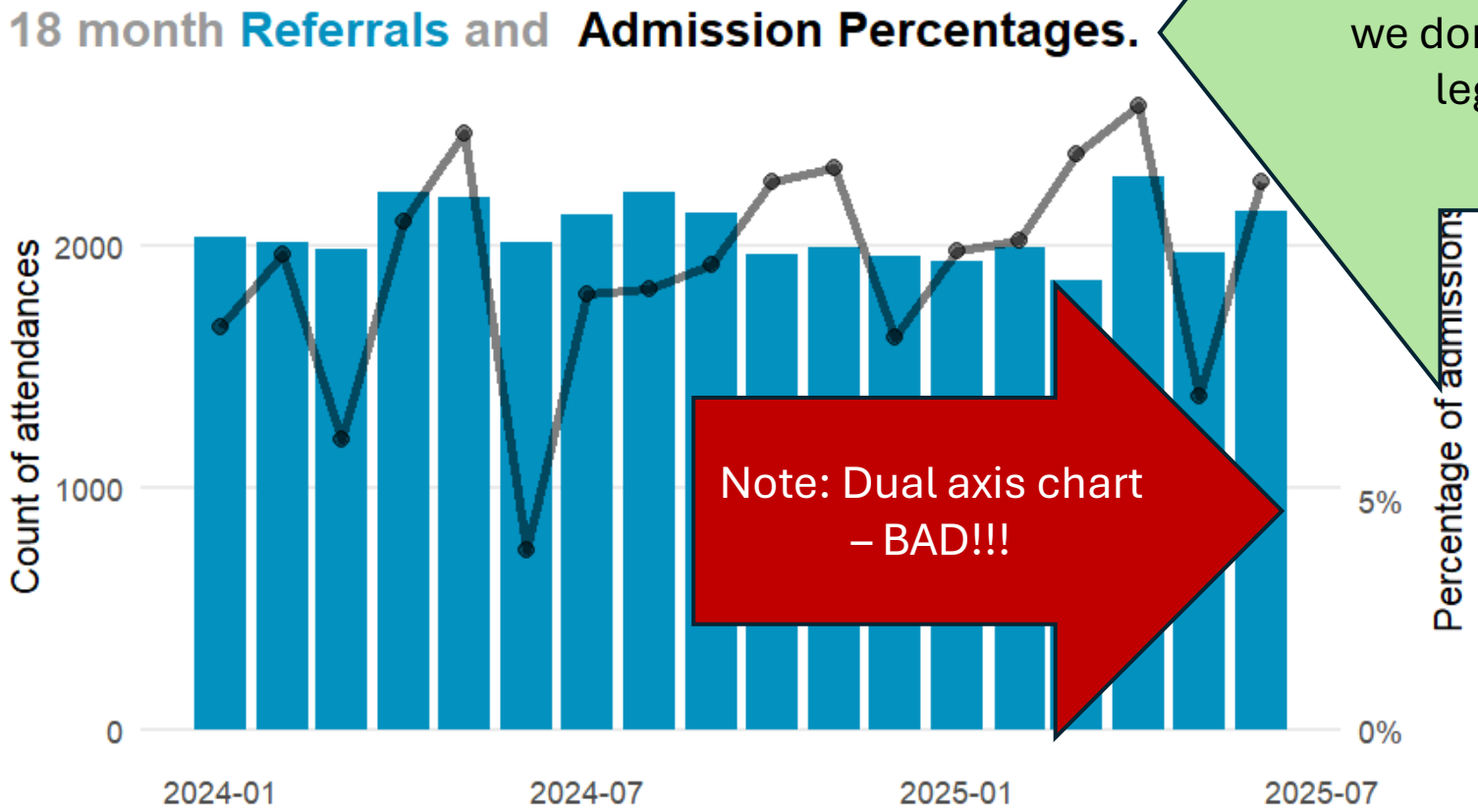
Month	AE_Attendances	Days_in_month	Rate_attendances (Attendances / Days in Month)
Jan 2025	2,218,130	31	71,552.6
Feb 2025	2,088,071	28	74,574.0
Mar 2025	2,389,064	31	77,066.6

Be careful of comparing big things to small things – especially when using percentages



Let's look at how **not** to do it...

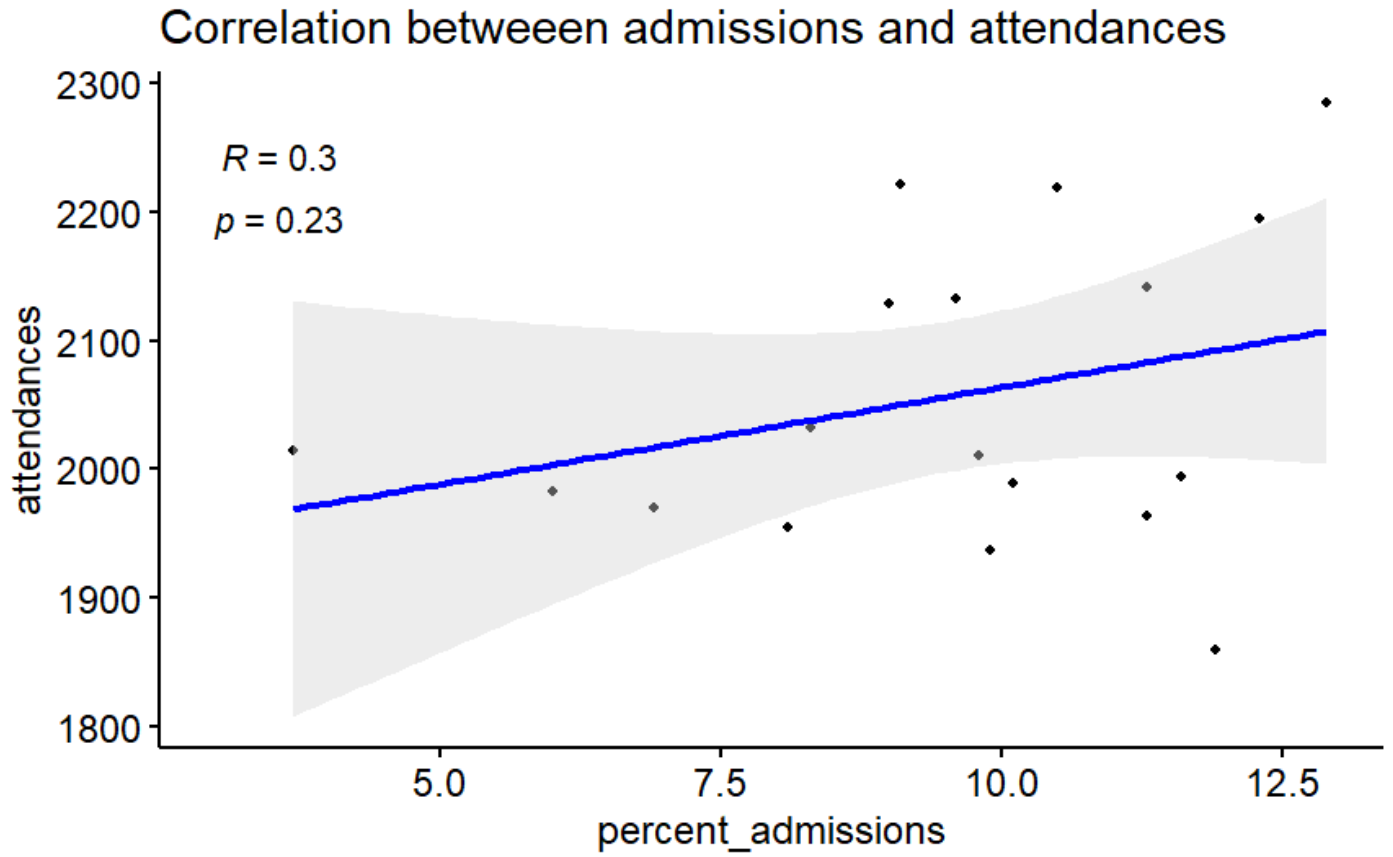
Is there a **correlation** between **referrals** and **admissions**?



Data downloaded from UDAL 28-08-25

Note: good use of colour in title so we don't need a legend.

Nope – numbers are completely random

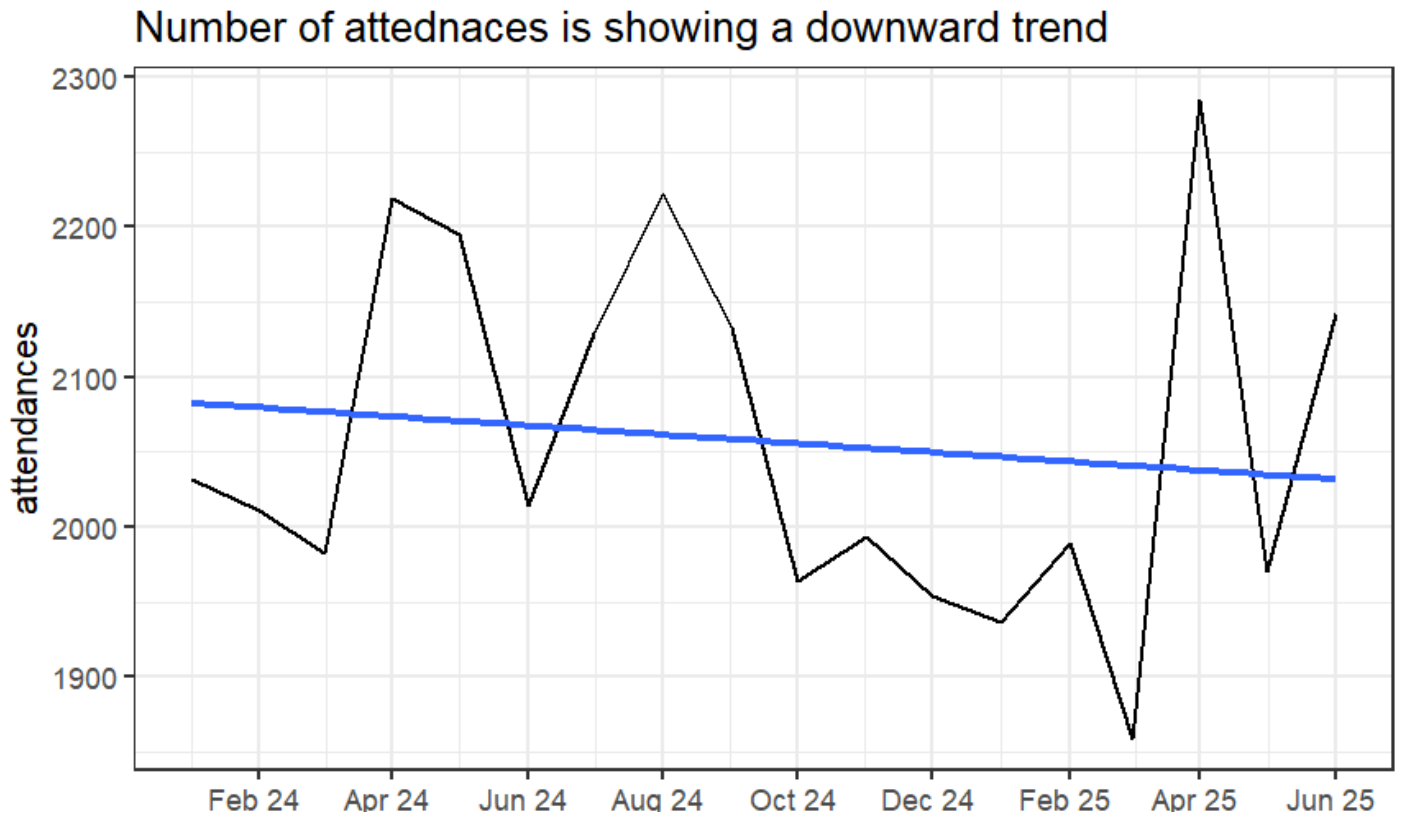


Characteristic	Beta	95% CI	p-value
(Intercept)	1,913	1,660, 2,166	<0.001
percent_admissions	15	-11, 41	0.2

Abbreviation: CI = Confidence Interval

‘Trendlines’

Characteristic	Beta	95% CI	p-value
(Intercept)	4,024	-3,682, 11,729	0.3
dates	-0.10	-0.48, 0.29	0.6
Abbreviation: CI = Confidence Interval			

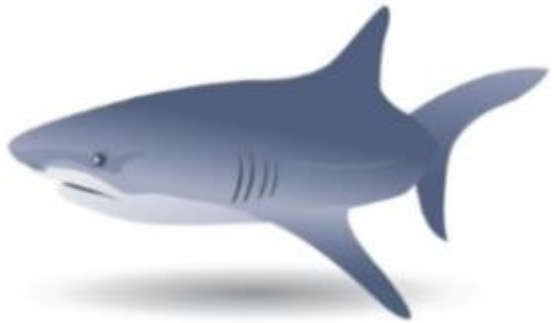


FALSE!

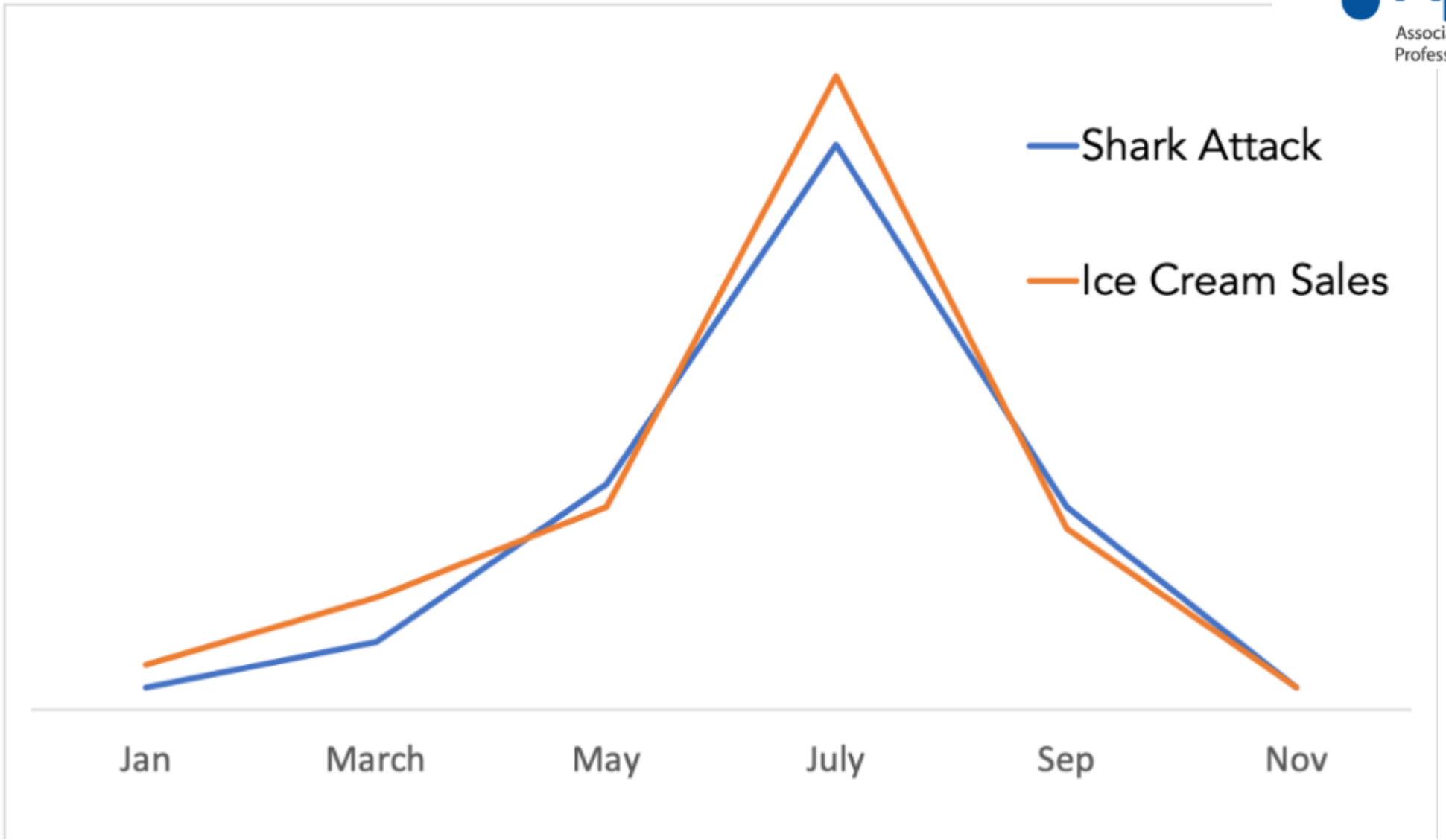
Let’s look at another example…

A quick tangent on correlation and causation

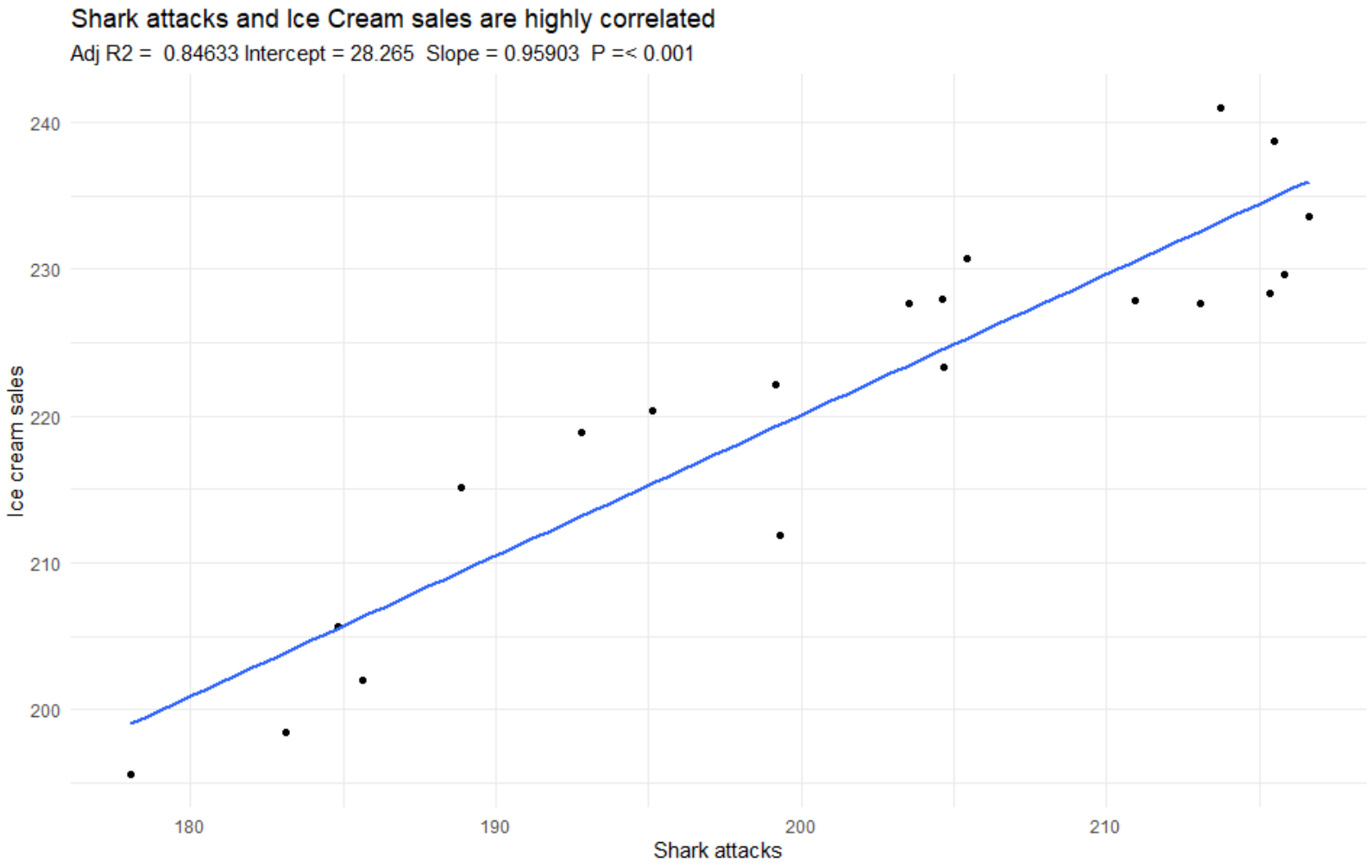
If you eat **ice cream** are you more likely to be attacked by a **shark**?



A quick tangent on correlation and causation



A quick tangent on correlation and causation



A quick tangent on correlation and causation

If you eat ice cream are you more likely to be attacked by a shark?

A quick tangent on correlation and causation

If you eat ice cream are you more likely to be attacked by a shark?

Yes!

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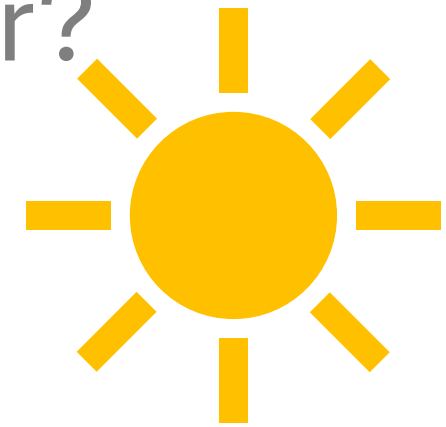
If you eat ice cream are you more likely to be attacked by a shark?

Yes, but are there another **covariant variables** we have not accounted for?



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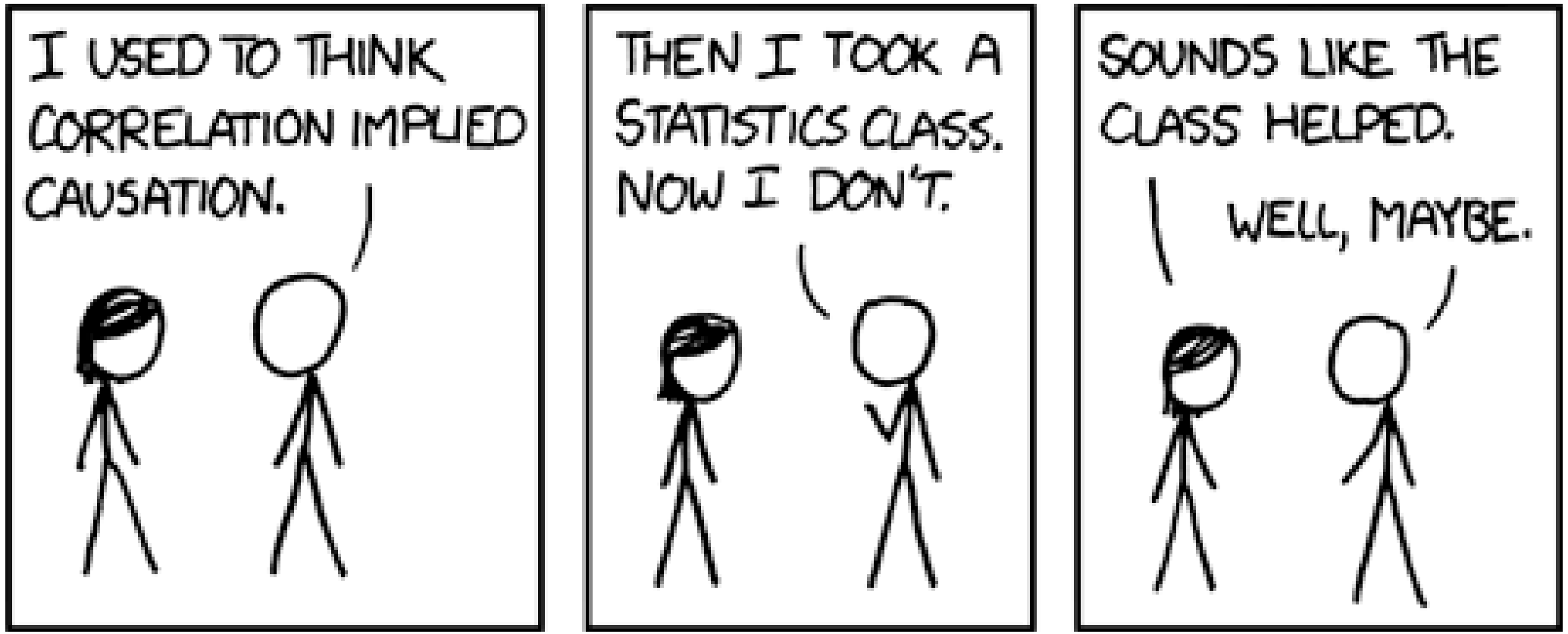

Some principles

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- Build **narratives** and test your visualisations

- Start with a sentence of what your **story** is, then break that up into parts to tell the story with charts and visualisations to **evidence** the story

- If your chart isn't telling a story or providing **insight** – ask yourself **why not**?

What kind of **story** are you trying to tell?

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What is the trend?

Is this a seasonal thing?

Can we forecast what is going to happen?

Which patient groups are failing?

What are the size of the numbers under the percentages?

What are the impacts on patients?

What would happen if we did x?

How does this benchmark to other places?

What are the financial implications?

Was doing X effective?

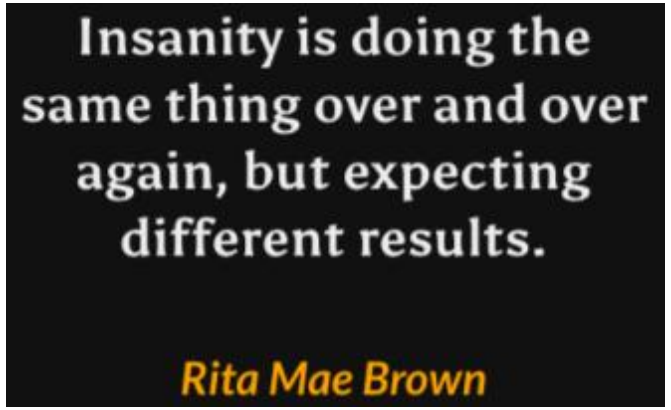
What are staffing implications?

Do we have assurance we can consistently meet target?

Where are the biggest pressures?

Fundamentals

- What is your visualisation – if it is just one chart in a pack of 50 similar charts – **what's it for**?
- I know we all have lovely performance packs, but what level of analysis are we bringing with those, are we just presenting numbers or are we using our data to **promote positive change**?
- Identifying **trends** and **benchmarking** should be the minimum.
- How do you pull **outliers**?
- How can you bring further **insight** to those metrics?



Fundamentals

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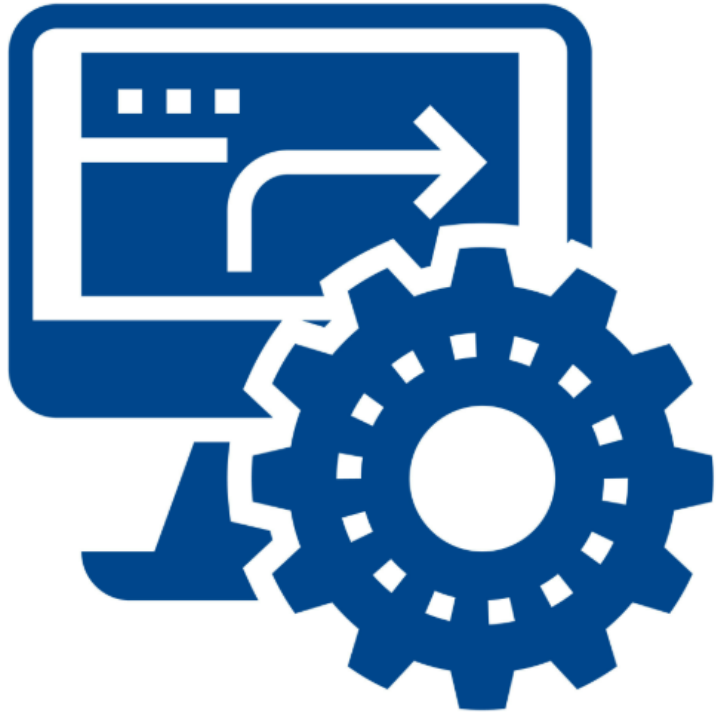
- As analysts we should be **driving action**, getting the best for our patients
- Reporting performance is not going anywhere, but we need to do it in a way where it can have **impact**
- Our role should be to **influence and support** our decision makers in making robust decisions to support patient care
- We should **challenge** anyone who just wants a dashboard, or just wants the numbers
- We should **upskill** ourselves to provide data **insights**
- Provide **narrative** and **expert advice** based on data
- Think about how your **insight** could provide an opportunity for an **intervention**

Putting this stuff into action

- Seems like lot of work
- Start simple – get **cleverer**
- Much of this stuff can be **automated**
- You can run **statistics** over your metrics and identify which ones are outliers and need further investigation
- Automate **narrative** and **context** to graphs



I wanna dashboard!!!

Think about the **purpose** and who is going to use it.

Is it an **exploration** tool of everything or is it there to provide **insight**?

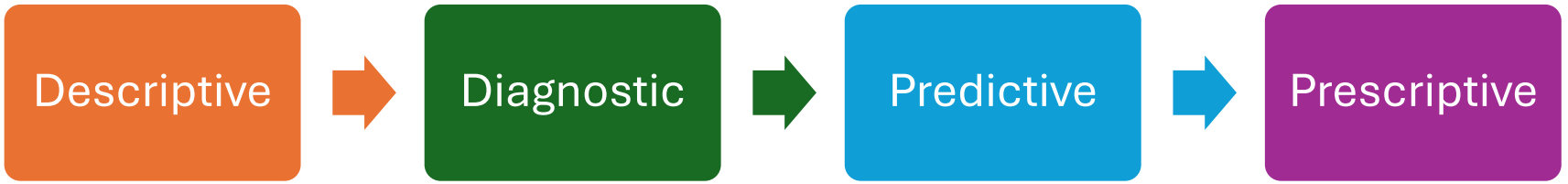
How many **clicks** are you expecting your users to make to get to something **meaningful**?

Ask yourself

- What is the **goal** of this analysis?
- Who will use this **insight**?
- What **data sources** are available?
- How **reliable / clean / complete** is the data?
- What **trends**, **patterns**, **anomalies** can we detect?
- What **decisions** can we **influence**?
- What **assumptions** are we making? Are they **valid**?
- Can the analysis **recommend** a course of action?
- Can we measure the **impact** of our analysis?
- When shall we **review** the analysis?

Finishing up

- Stakeholders **don’t** just want the numbers / data
- They want analysis that **recommends a course of action**
- They **may not** tell you this out loud or even know that is what they want
- Look at how you can give **overview summaries** of the big stuff
- Then use that to **drill** into the detail stuff



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A visualisation is an argument, not an image, and its purpose is **insight**, not illustration.

Final question before prize giving…

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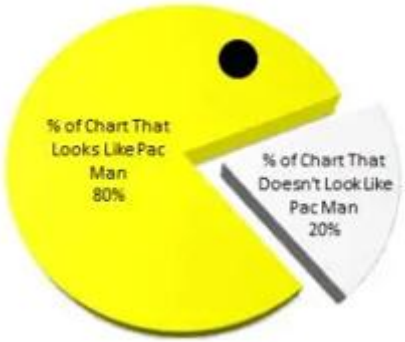
Are you going to try to adopt some of this stuff?



Prize time!

Credits and further info

- These slides and the R code that built most of the charts can be found here: https://github.com/Simon-W-M/chart_with_purpose_workshop

- SPC Summary table can be found here: https://github.com/Simon-W-M/SPC_summary_table

- Great chart types and explanations: https://www.data-to-viz.com/

- NHS Data Visualisations – Community of Practice https://github.com/nhsengland/data-viz-community-of-practice

Finally, what have we learned?

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- Add **context** to your charts
- **Analysis** first, charts to support your analysis
- Bring **insight**, not numbers
- Work with your **stakeholders** and find out what they want, what they really really want
- Chart with **purpose**!
- Be careful of **sharks** when eating ice cream

“Chart with purpose”

Simon Wellesley-Miller

Paws for discussion

Cute kitten gif

Thank You

www.linkedin.com/in/simon-wellesley-milleriller-017630196/

simon.wellesley-miller@nhs.net