

Statistical Traps: How not to Fall in them

24. Correlation doesn't sell newspapers

Mastering Data Visualization: Theory & Foundations

STATISTICAL TRAPS

Correlation doesn't sell newspapers



Correlation is **not causation**

Concepts > Association

Concepts > Association

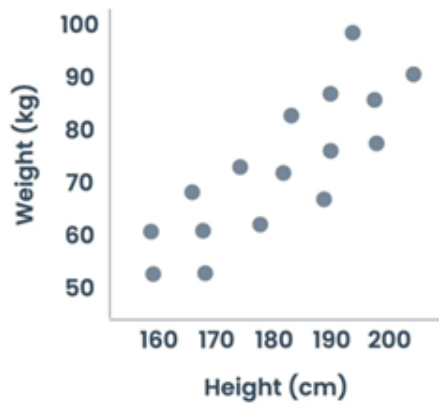


Concepts > Association



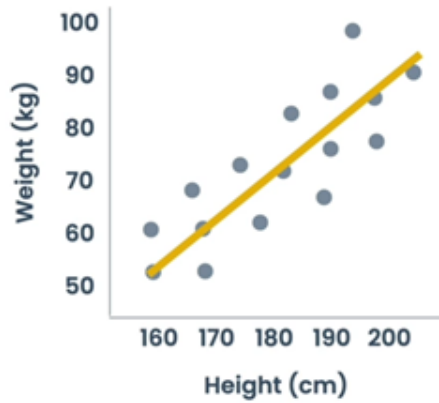
Two measurements are associated when knowing something about the state of one tells you something about the state of the other.

Concepts > Correlations



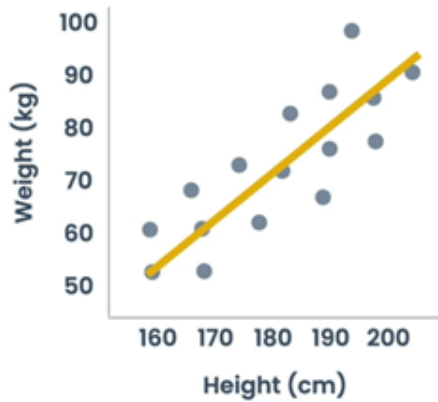
Concepts > Correlations

LINEAR CORRELATION

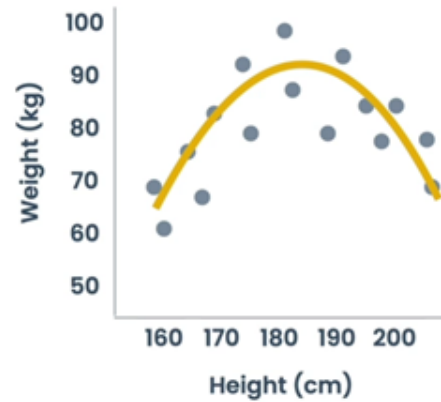


Concepts > Correlations

LINEAR CORRELATION



NON-LINEAR CORRELATION



CORRELATION COEFFICIENT

between -1 and 1.

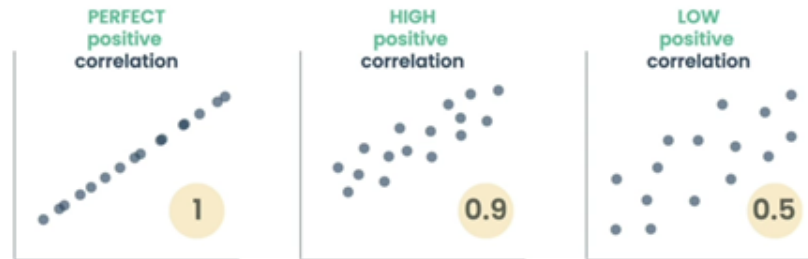
Concepts > Correlations

CORRELATION COEFFICIENT

between -1 and 1.

+: positive correlation

WHEN ONE INCREASES, THE OTHER DOES TOO



Concepts > Correlations

CORRELATION COEFFICIENT

between -1 and 1.

+: positive correlation

WHEN ONE INCREASES, THE OTHER DOES TOO

0: no correlation = no information

ONE VARIABLE GIVES NO INFORMATION ON THE OTHER



Concepts > Correlations

CORRELATION COEFFICIENT

between -1 and 1.

+: positive correlation

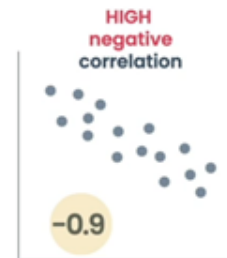
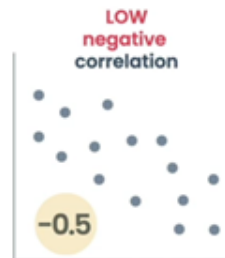
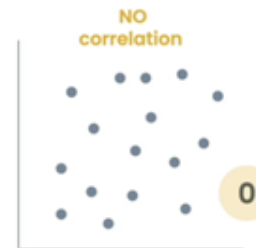
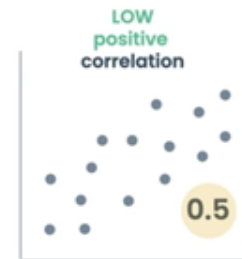
WHEN ONE INCREASES, THE OTHER DOES TOO

0: no correlation = no information

ONE VARIABLE GIVES NO INFORMATION ON THE OTHER

-: negative correlation

WHEN ONE INCREASES, THE OTHER DECREASES



Concepts > Causation

Concepts > Causation

CAUSE AND EFFECT

CORRELATION DOESN'T IMPLY CAUSALITY

CORRELATION  CAUSALITY

Concepts > Causation

CAUSE AND EFFECT

CORRELATION DOESN'T IMPLY CAUSALITY

CORRELATION  **CAUSALITY**

CAUSALITY DOES IMPLY CORRELATION

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***CORRELATION IS A NECESSARY CONDITION FOR CAUSALITY,
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Concepts > Causation

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Concepts > Causation

JAMA Internal Medicine | Original Investigation

Association of Exposure to Artificial Light at Night While Sleeping With Risk of Obesity in Women

Yong Moon Park, MD, PhD, Alexander J. White, PhD, Chandni Jackson, PhD, MS, Corina K. Wehling, PhD, Dale P. Sardis, PhD

Supplement

IMPORTANCE Short sleep has been associated with obesity, but to date the association between exposure to **artificial light at night (ALAN)** while sleeping and obesity is unknown.

OBJECTIVE To determine whether ALAN exposure while sleeping is associated with the prevalence and risk of obesity.

DESIGN, SETTING, AND PARTICIPANTS This baseline and prospective analysis included women aged 35 to 74 years enrolled in the Sister Study in all 50 US states and Puerto Rico from July 2003 through March 2009. Follow-up was completed on August 14, 2015. A total of 43 732 women with no history of cancer or cardiovascular disease who were not shift-workers, daytime sleepers, or pregnant at baseline were included in the analysis. Data were analyzed from September 1, 2011, through December 31, 2018.

EXPOSURES Artificial light at night while sleeping reported at enrollment, categorized as no light, small nightlight in the room, light outside the room, and light or television in the room.

MAIN RESULTS AND CONCLUSIONS Prevalent obesity at baseline was based on measured general obesity (body mass index [BMI] ≥ 30.0) and central obesity (waist circumference [WC] ≥ 88 cm, waist-to-hip ratio [WHR] ≥ 0.85 , or waist-to-height ratio [WHtR] ≥ 0.5). To evaluate incident overweight and obesity, self-reported BMI at enrollment was compared with self-reported BMI at follow-up (mean [SD] follow-up, 5.7 [1.0] years). Generalized log-linear models with robust error variances were used to estimate multiplicative adjusted prevalence ratios (PRs) and relative risks (RRs) with 95% CIs for prevalent and incident obesity.

SOURCE: ASSOCIATION OF EXPOSURE TO ARTIFICIAL LIGHT AT NIGHT WHILE SLEEPING WITH RISK OF OBESITY IN WOMEN. JAMA INTERN MED; DOI: 10.1001/JAMAINTERNMED.2019.0571

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Body
Mass
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Concepts > Causation

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40K



Body
Mass
Index

Percentage of women with BMI ≥ 30



Concepts > Causation

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Yong-Moon Park, MD, PhD, Alexander J. White, PhD, Chandra L. Jackson, PhD, MS, David S. Hwang, PhD, Dan P. Larkin, PhD

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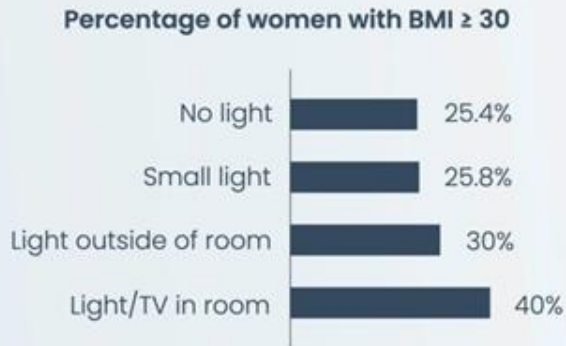
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NEWS RELEASES

Monday, June 10, 2019

Sleeping with artificial light at night associated with weight gain in women

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Concepts > Causation

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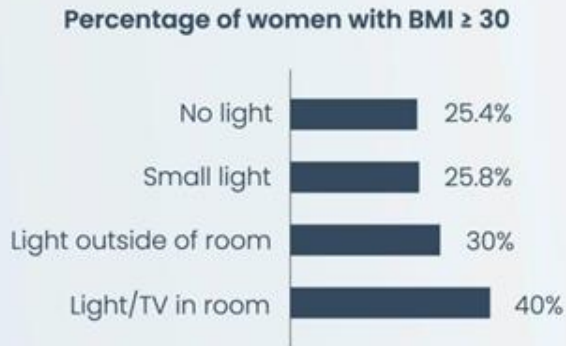
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TV LIGHT WHILE SLEEPING CAUSES OBESITY

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Concepts > Causation

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Yong-Moon Park, MD, PhD, Alexander J. White, PhD, Chandra Jackson, PhD, MS, Clara S. Weiberg, PhD, Dan P. Lander, PhD

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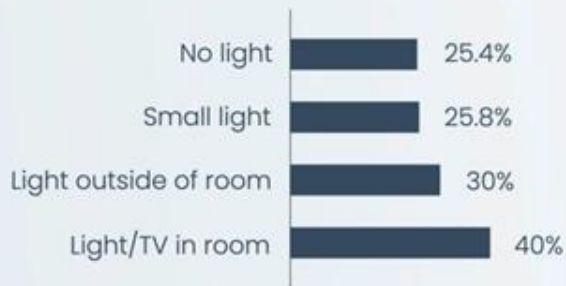


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Body
Mass
Index

Percentage of women with BMI ≥ 30



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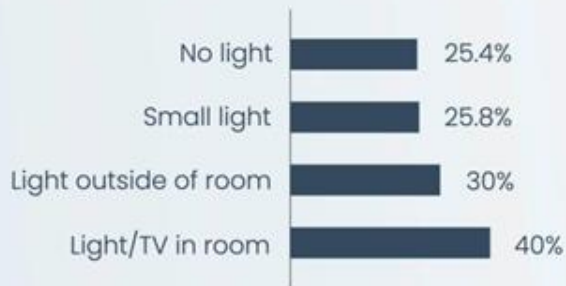


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TV LIGHT CAUSES BAD SLEEP CAUSES OBESITY

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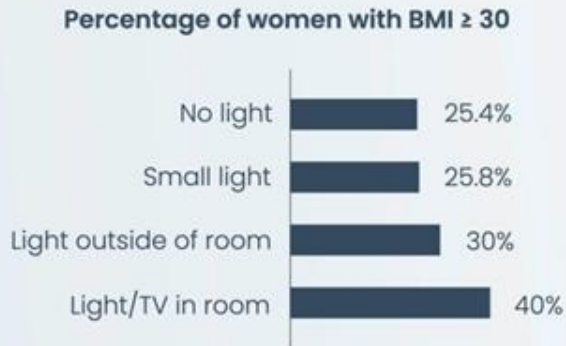
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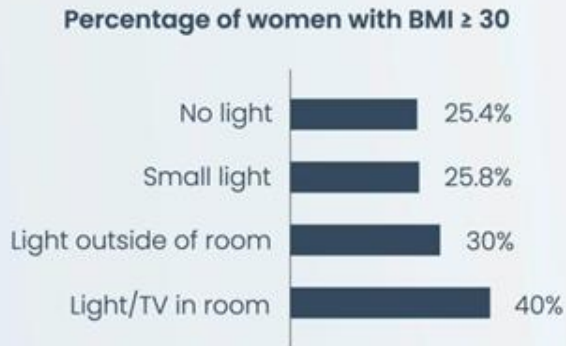
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40K
Body Mass Index



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TV LIGHT WHILE SLEEPING CAUSES OBESITY

TV LIGHT CAUSES BAD SLEEP CAUSES OBESITY



BAD HABITS CAUSE OBESITY
LEAVING TV ON WHILE SLEEPING

1/28/2025 7:04:56 PM

Concepts > Causation

JAMA Internal Medicine | Original Investigation Association of Exposure to Artificial Light at Night While Sleeping With Risk of Obesity in Women

Yong-Moon Park, MD, PhD, Alexander J. White, PhD, Chandra L. Jackson, PhD, MS, Clara K. Henning, PhD, Dale P. Lander, PhD

IMPORTANCE Short sleep has been associated with obesity, but to date the association between exposure to artificial light at night (ALAN) while sleeping and obesity is unknown.

OBJECTIVE To determine whether ALAN exposure while sleeping is associated with the prevalence and risk of obesity.

DESIGN, SETTING, AND PARTICIPANTS This baseline and prospective analysis included women aged 30 to 74 years enrolled in the Sister Study in all 50 US states and Puerto Rico from July 2003 through March 2009. Follow-up was completed on August 14, 2015. A total of 43 732 women with no history of cancer or cardiovascular disease who were not postmenopausal, daytime sleepers, or pregnant at baseline were included in the analysis. Data were analyzed from September 1, 2010, through December 31, 2016.

EXPOSURES Artificial light at night while sleeping reported at enrollment, categorized as no light, small nightlight in the room, light outside the room, and light or television in the room.

MEASUREMENTS AND MAIN RESULTS Prevalent obesity at baseline was based on measured general obesity (body mass index [BMI] ≥ 30.0) and central obesity (waist circumference [WC] ≥ 88 cm, waist-to-hip ratio [WHR] ≥ 0.85 , or waist-to-height ratio [WHtR] ≥ 0.5). To evaluate incident overweight and obesity, self-reported BMI at enrollment was compared with self-reported BMI at follow-up (mean [SD] follow-up, 5.7 [3.2] years). Generalized log-linear models with robust error variance were used to estimate multiplicative adjusted prevalence ratios (PRs) and relative risks (RRs) with 95% CIs for prevalent and incident obesity.

SOURCE: ASSOCIATION OF EXPOSURE TO ARTIFICIAL LIGHT AT NIGHT WHILE SLEEPING WITH RISK OF OBESITY IN WOMEN. JAMA INTERN MED; DOI: 10.1001/JAMAINTERNMED.2019.0571

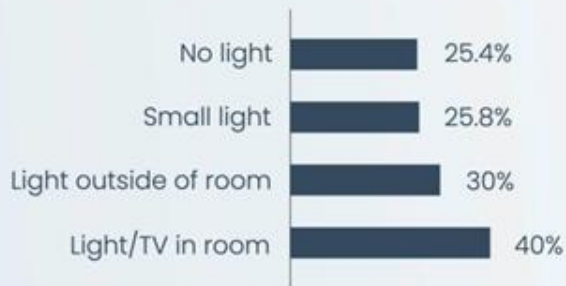


40K



Body Mass Index

Percentage of women with BMI ≥ 30



NEWS RELEASES

Monday, June 10, 2019

Sleeping with artificial light at night associated with weight gain in women

Eliminating light while sleeping could reduce obesity.

SOURCE: [HTTPS://WWW.NIH.GOV/NEWS-EVENTS/NEWS-RELEASES/SLEEPING-ARTIFICIAL-LIGHT-NIGHT-ASSOCIATED-WEIGHT-GAIN-WOMEN](https://www.nih.gov/news-events/news-releases/sleeping-artificial-light-night-associated-weight-gain-women)

TV LIGHT WHILE SLEEPING CAUSES OBESITY

TV LIGHT CAUSES BAD SLEEP CAUSES OBESITY



BAD HABITS CAUSE OBESITY
LEAVING TV ON WHILE SLEEPING



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Concepts > Causation



ASSOCIATION BETWEEN A AND B

COULD HAPPEN BECAUSE...

Concepts > Causation



ASSOCIATION BETWEEN A AND B

COULD HAPPEN BECAUSE...

A CAUSES B

Concepts > Causation



ASSOCIATION BETWEEN A AND B

COULD HAPPEN BECAUSE...

A CAUSES B RAIN CAUSES UMBRELLA SALES

Concepts > Causation



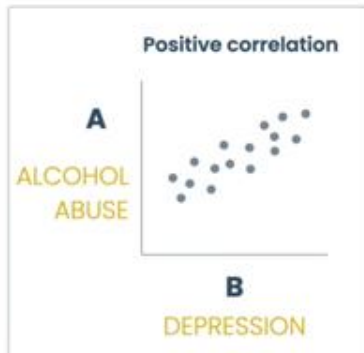
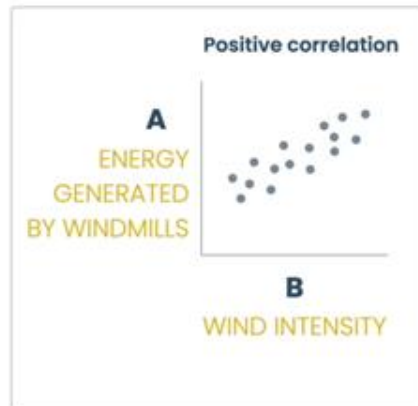
ASSOCIATION BETWEEN A AND B

COULD HAPPEN BECAUSE...

A CAUSES B RAIN CAUSES UMBRELLA SALES

B CAUSES A WIND INTENSITY CAUSES WINDMILL-GENERATED ENERGY

Concepts > Causation



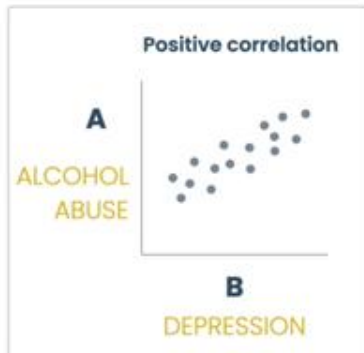
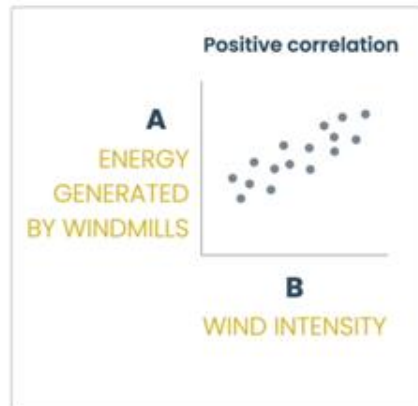
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Concepts > Causation



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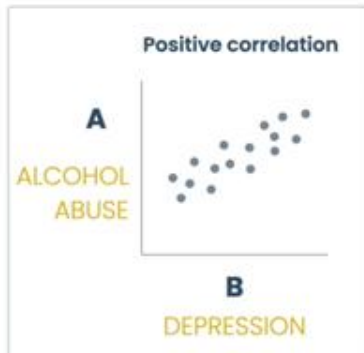
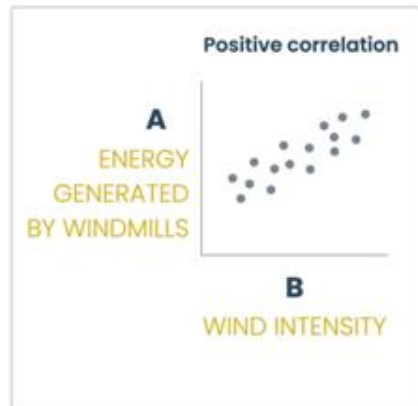
A CAUSES B RAIN CAUSES UMBRELLA SALES

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CYCLIC CAUSATION

DEPRESSION CAUSES ALCOHOL ABUSE
& ALCOHOL ABUSE CAUSES DEPRESSION

Concepts > Causation



ASSOCIATION BETWEEN A AND B

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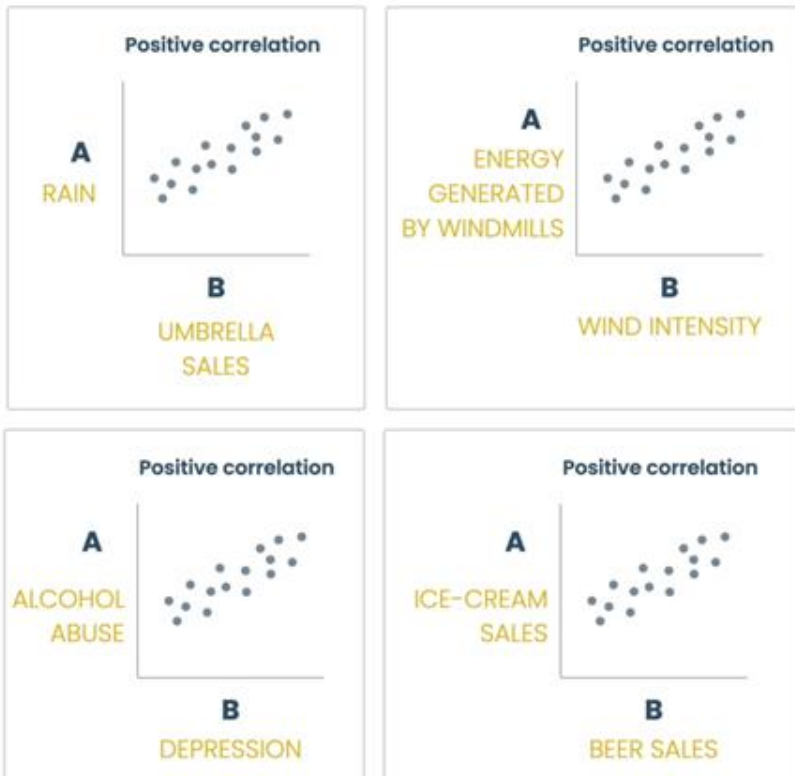
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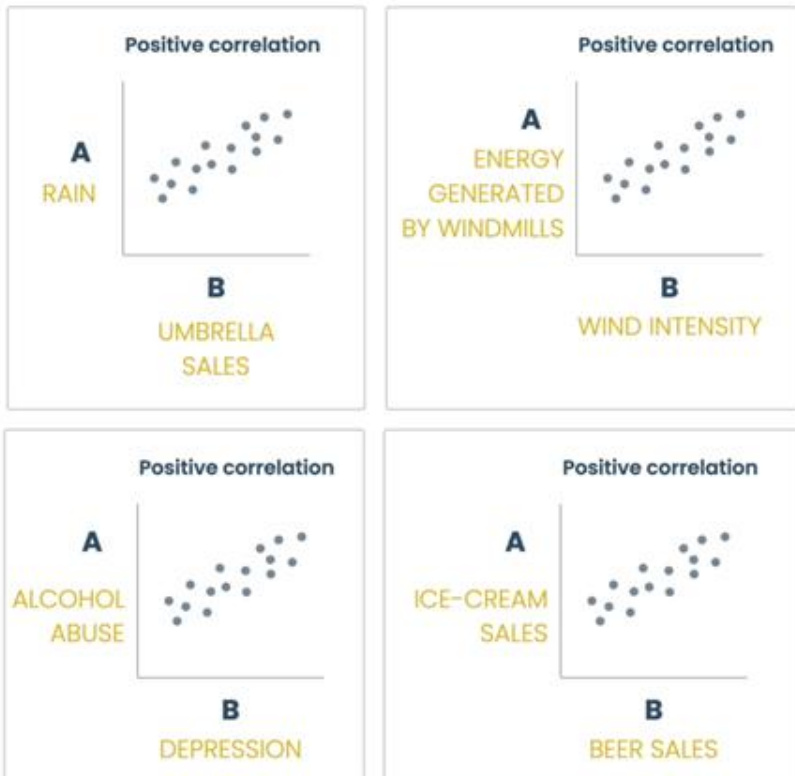
CYCLIC CAUSATION

DEPRESSION CAUSES ALCOHOL ABUSE & ALCOHOL ABUSE CAUSES DEPRESSION

HIDDEN FACTOR C CAUSES A AND B



Concepts > Causation



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Concepts > Causation



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HIDDEN FACTOR C CAUSES A AND B

HOT WEATHER → ICE-CREAM SALES
HOT WEATHER → BEER SALES

SPECIAL OFFER → ICE-CREAM SALES
SPECIAL OFFER → BEER SALES

ASSOCIATION BETWEEN A AND B

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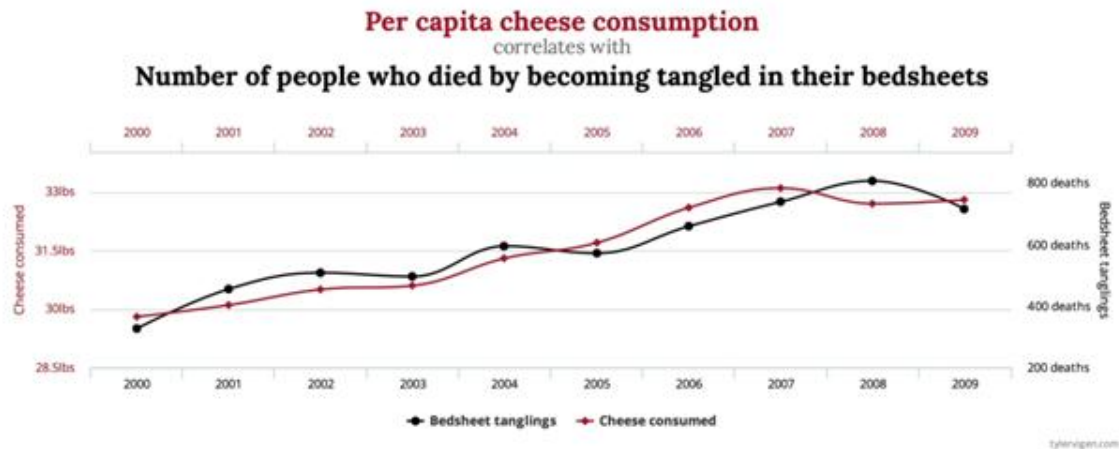
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HIDDEN FACTOR C CAUSES A AND B

HOT WEATHER  ICE-CREAM SALES
BEER SALES

SPECIAL OFFER  ICE-CREAM SALES
BEER SALES

COINCIDENCE



SOURCE: [HTTPS://WWW.TYLERVIGEN.COM/SPURIOUS-CORRELATIONS](https://www.tylervigen.com/spurious-correlations)

ASSOCIATION BETWEEN A AND B

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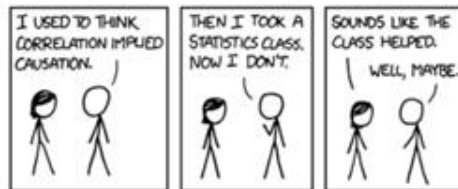
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COINCIDENCE

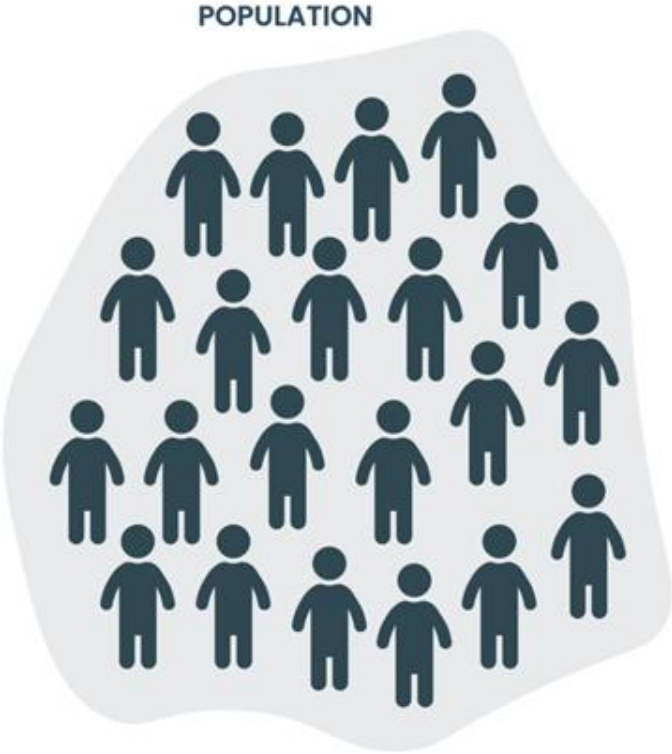


SOURCE: XKCD COMICS

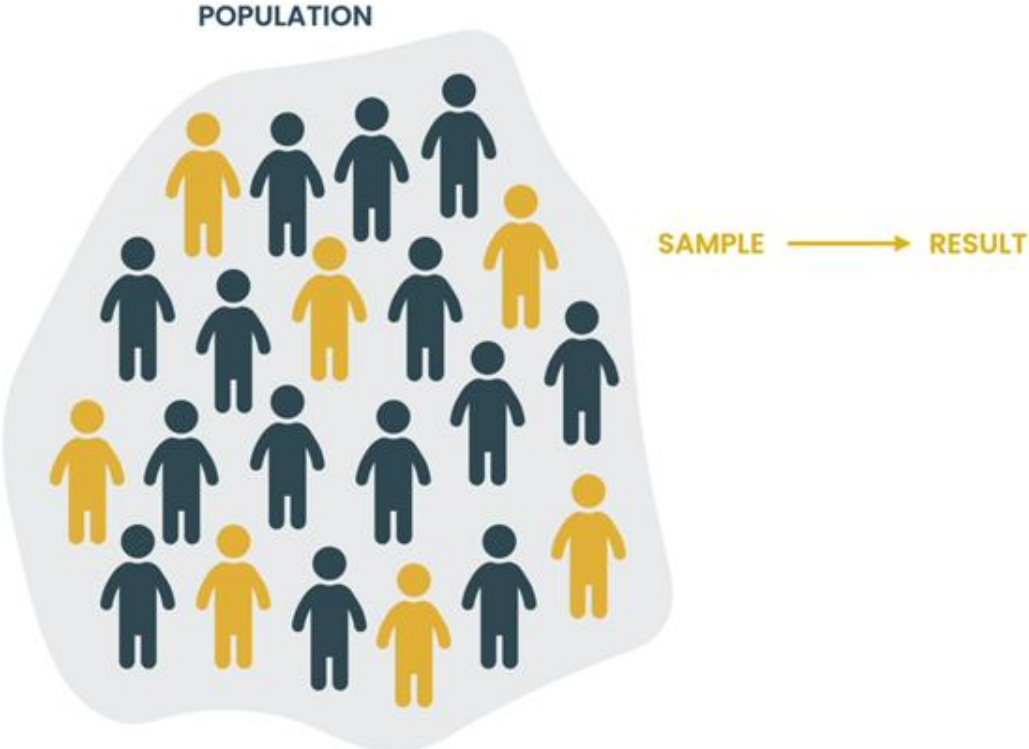
25- Selection Bias and Data Attrition

What you **see** depends on
where you **look**

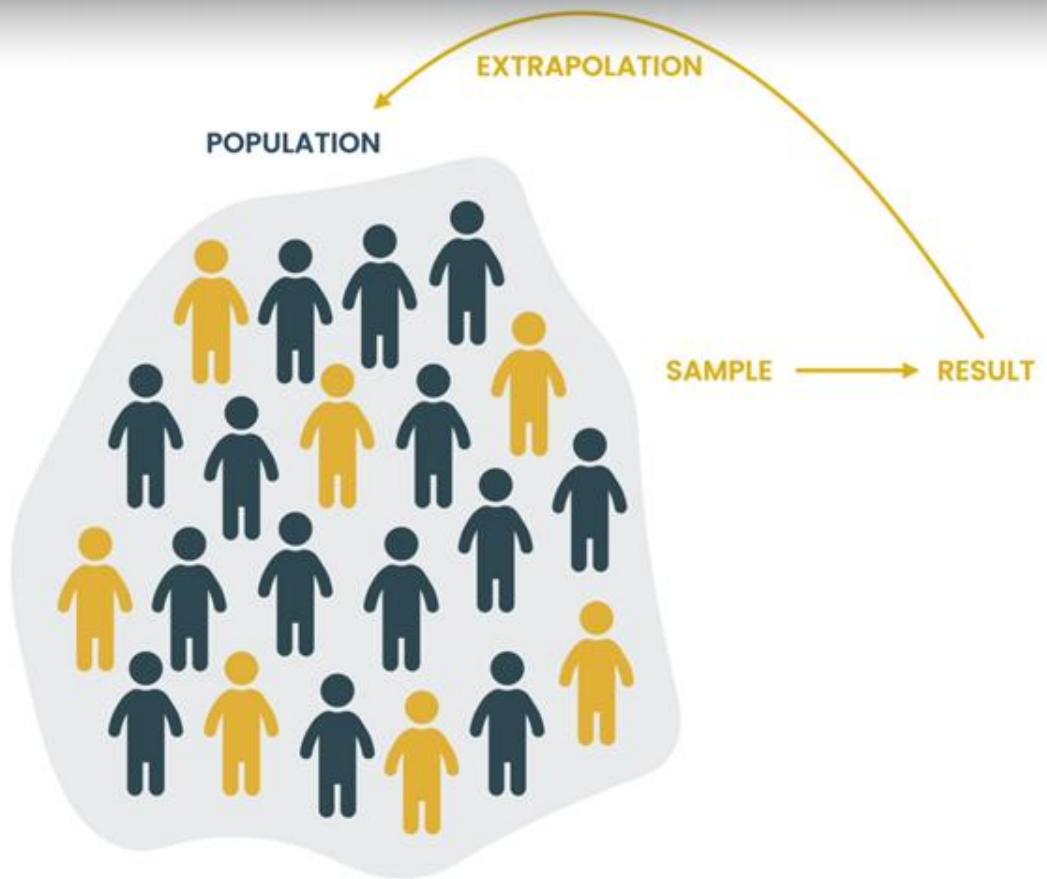
25. Selection Bias and Data Attrition
Sampling



Sampling



25. Selection Bias and Data Attrition
Sampling



25. Selection Bias and Data Attrition
Sampling



25. Selection Bias and Data Attrition

Sampling

1.95
m

SAMPLE



POPULATION

1.70
m

25. Selection Bias and Data Attrition

Sampling



Selection bias

THE INDIVIDUALS YOU SAMPLE FOR YOUR STUDY DIFFER SYSTEMATICALLY FROM THE POPULATION

25. Selection Bias and Data Attrition

Selection bias

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THE INDIVIDUALS YOU SAMPLE FOR YOUR STUDY DIFFER SYSTEMATICALLY FROM THE POPULATION

RANDOM SAMPLE OF THE POPULATION



25. Selection Bias and Data Attrition

Selection bias

THE INDIVIDUALS YOU SAMPLE FOR YOUR STUDY DIFFER SYSTEMATICALLY FROM THE POPULATION

RANDOM SAMPLE OF THE POPULATION



THE SAMPLE SHOULD BE RANDOM *WITH RESPECT TO THE QUESTION WE ARE ASKING*



A → Z

Selection bias



25. Selection Bias and Data Attrition
Selection bias

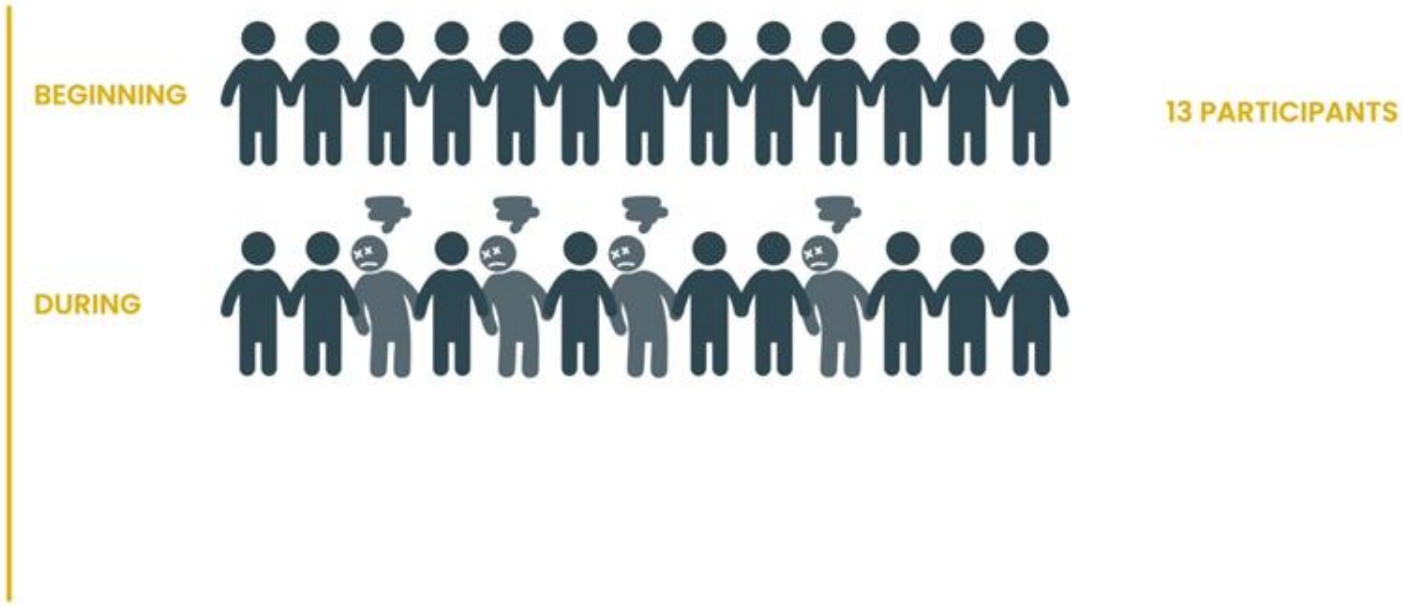


BEGINNING

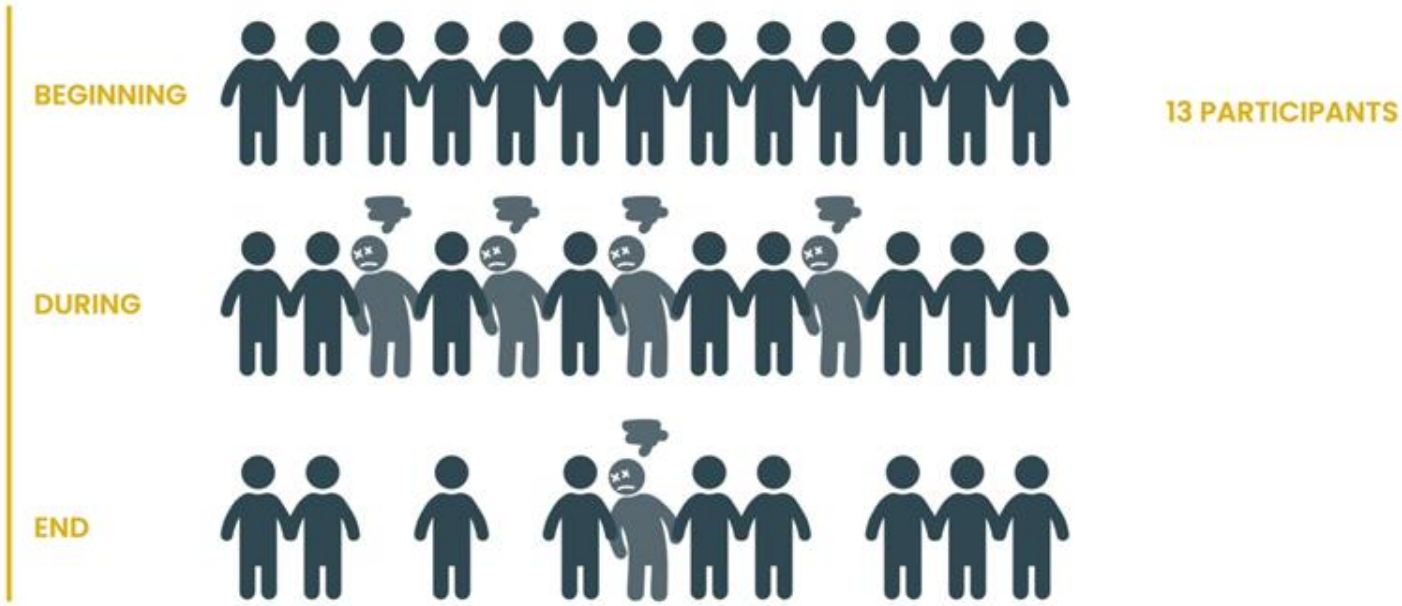


13 PARTICIPANTS

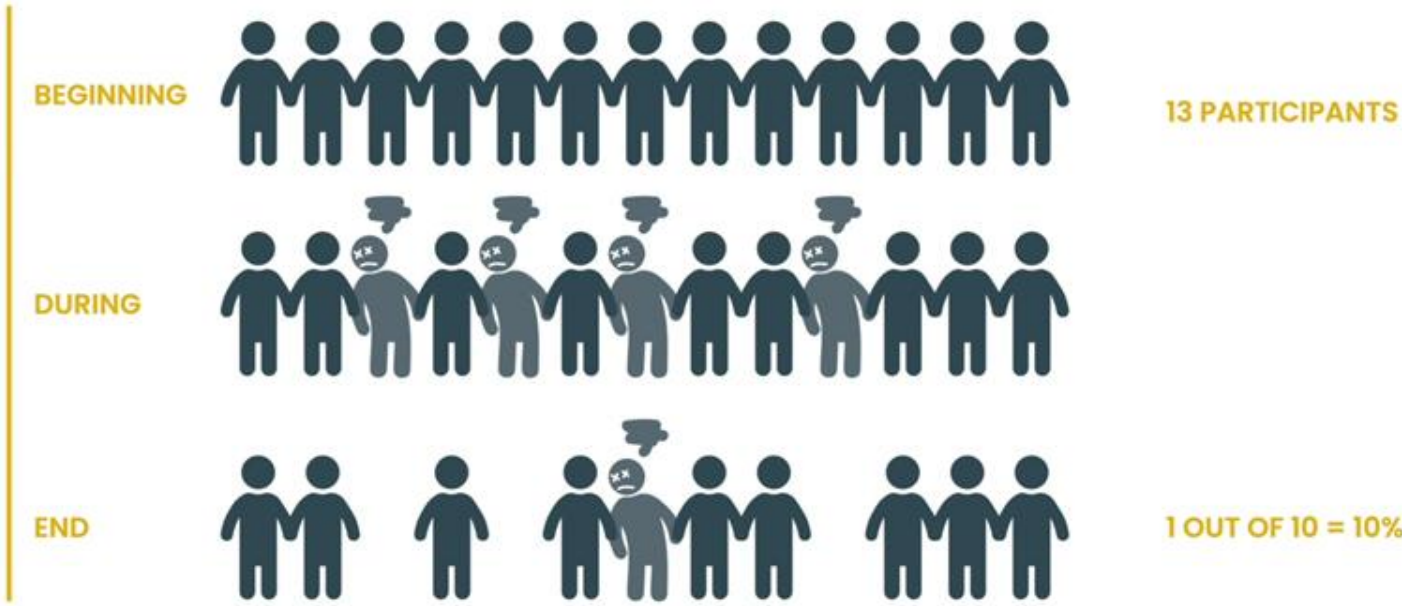
25. Selection Bias and Data Attrition
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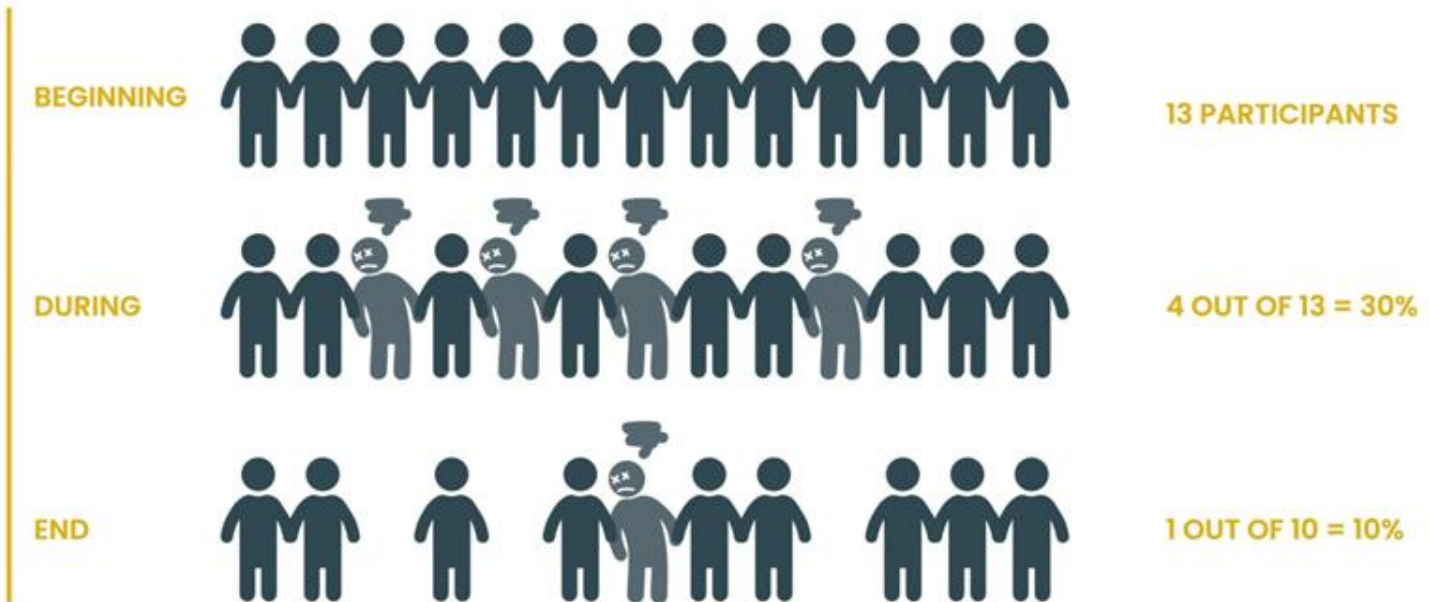
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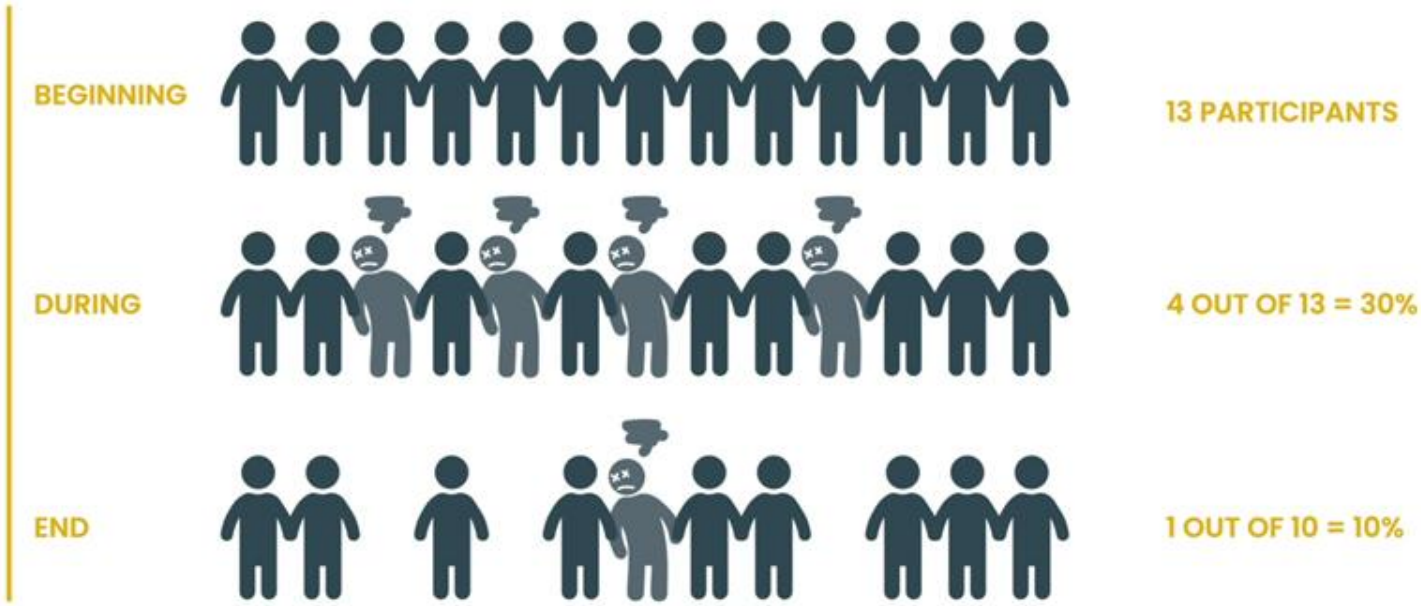
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Selection bias



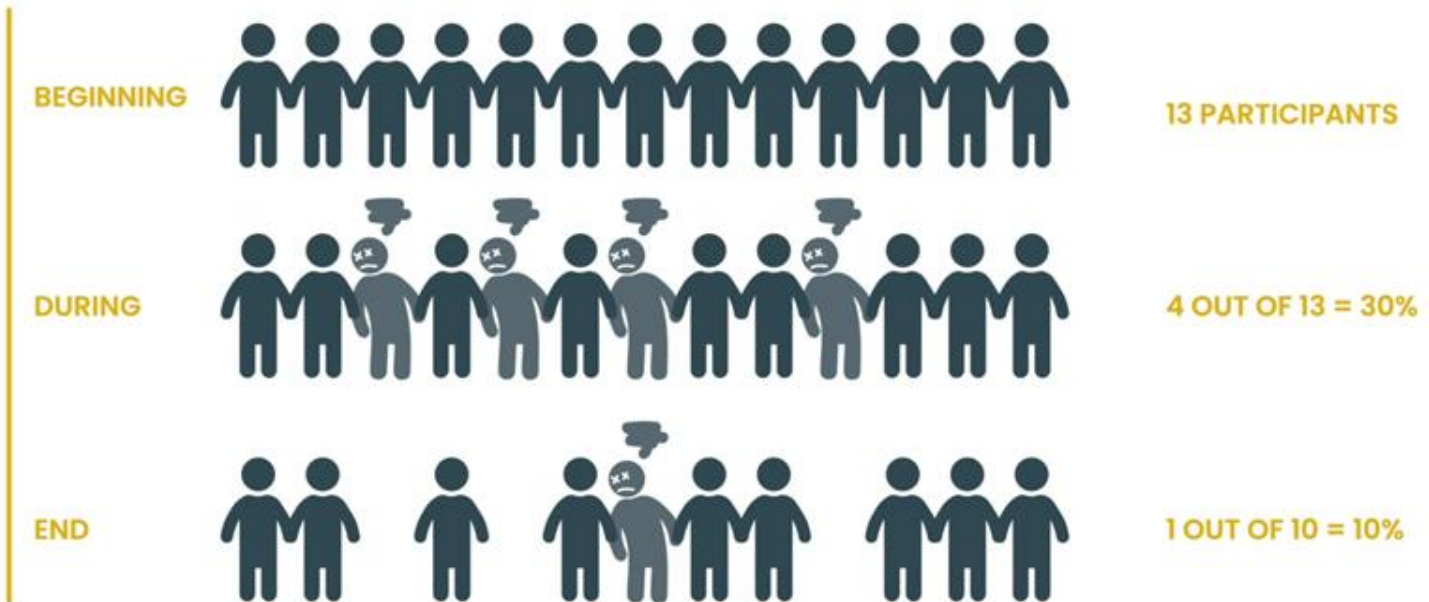
Selection bias > Attrition bias



25. Selection Bias and Data Attrition

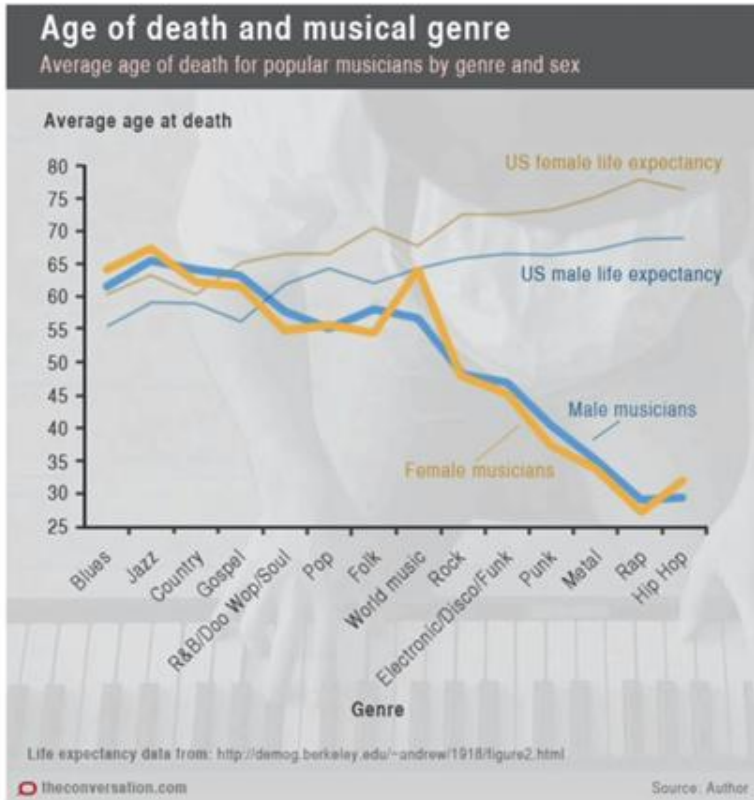
Selection bias > Attrition bias

INITIALLY RANDOM SAMPLE >> NON-RANDOM SUBSET OF THE SAMPLE IS NOT TAKEN INTO ACCOUNT



25. Selection Bias and Data Attrition

Music to die for

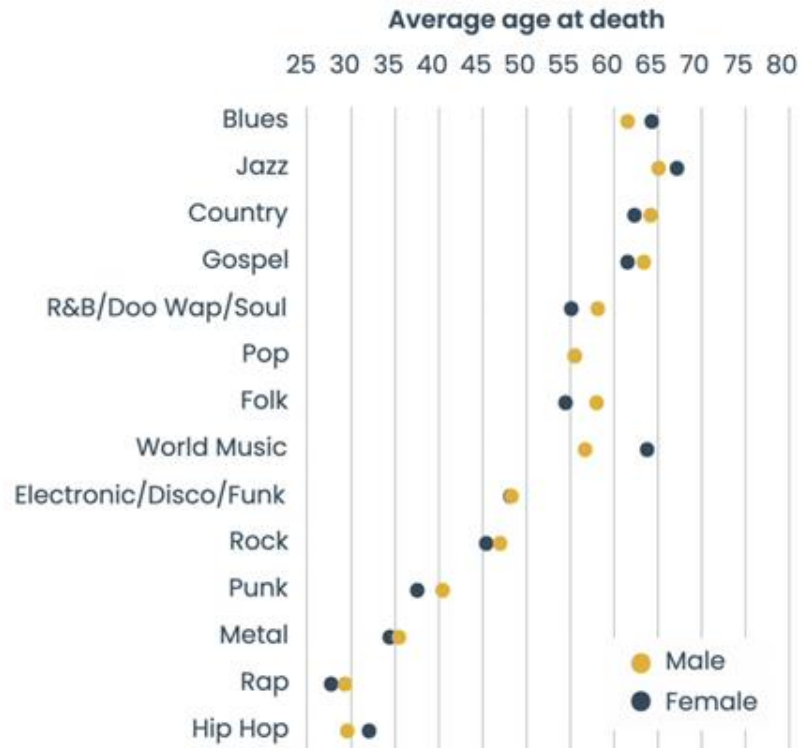
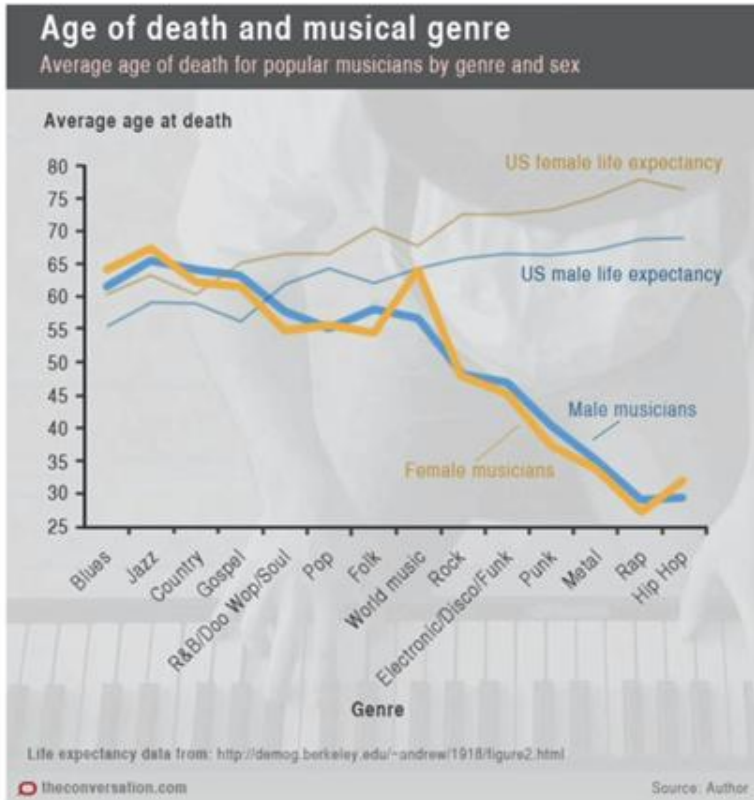


SOURCE: [HTTPS://THECONVERSATION.COM/MUSIC-TO-DIE-FOR-HOW](https://theconversation.com/music-to-die-for-how)

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25. Selection Bias and Data Attrition

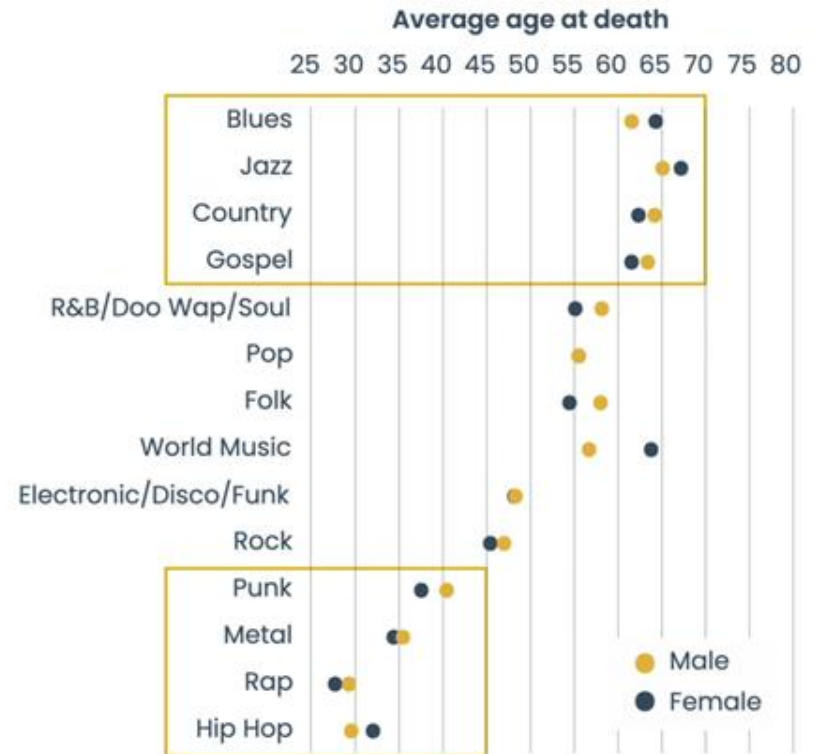
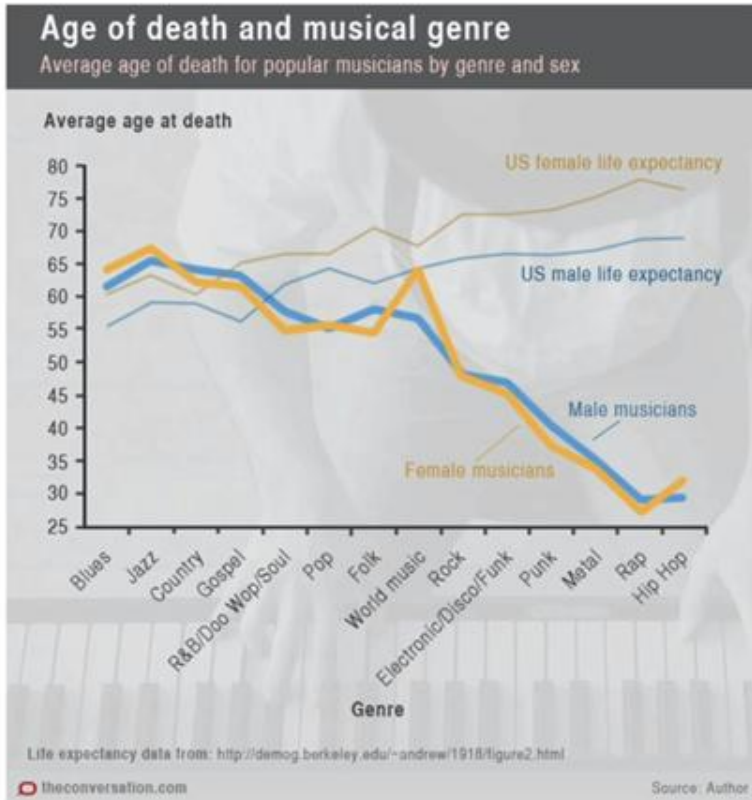
Music to die for



SOURCE: [HTTPS://THECONVERSATION.COM/MUSIC-TO-DIE-FOR-HOW](https://theconversation.com/music-to-die-for-how)

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Music to die for



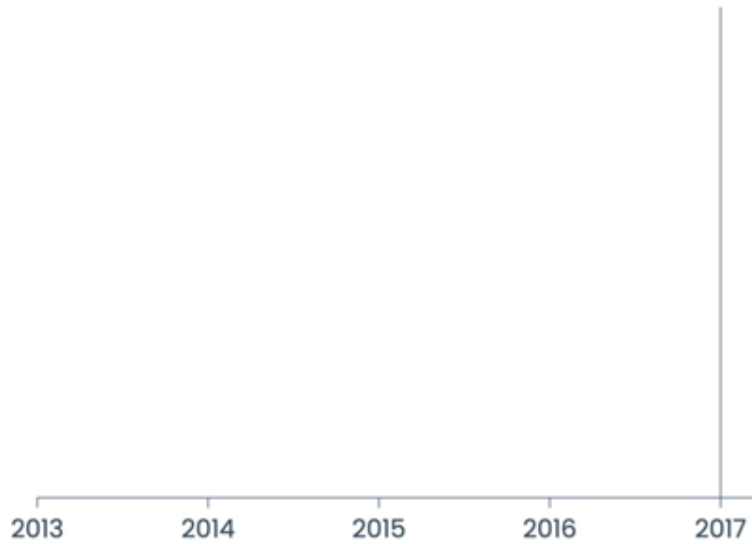
SOURCE: [HTTPS://THECONVERSATION.COM/MUSIC-TO-DIE-FOR-HOW-](https://theconversation.com/music-to-die-for-how-)

Attrition bias and chameleons

SOURCE: REDRAWN. ORIGINAL: CALLING BULLSHIT, C.T. BERGSTROM & J.D. WEST

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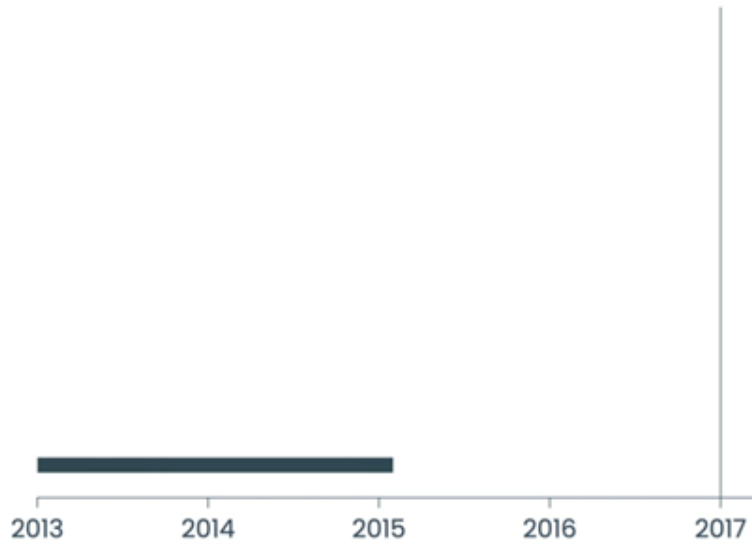
Attrition bias and chameleons



SOURCE: REDRAWN. ORIGINAL: CALLING BULLSHIT, C.T. BERGSTROM & J.D. WEST

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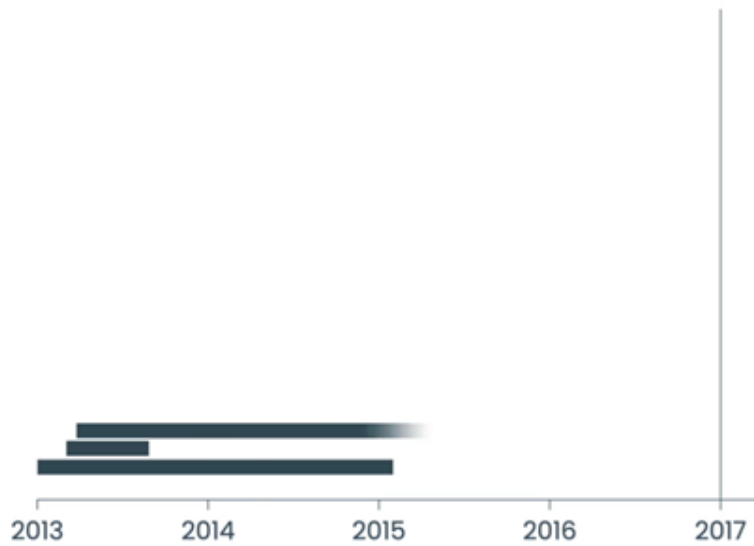
Attrition bias and chameleons



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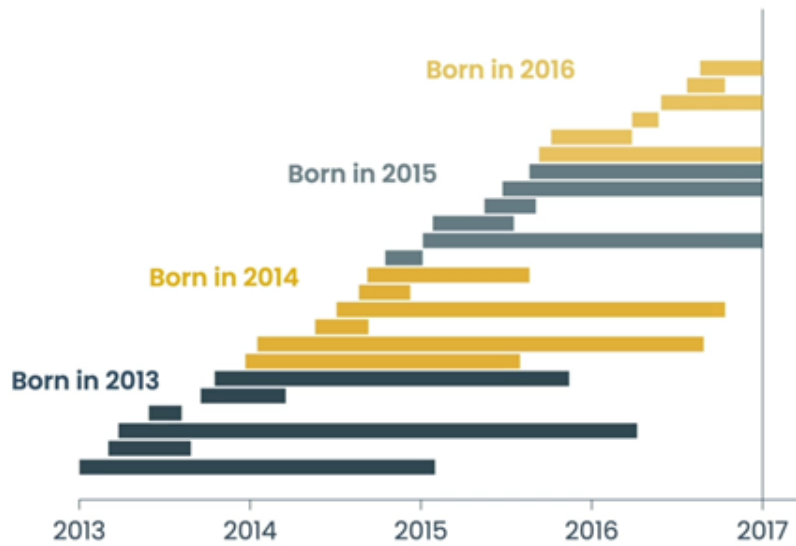
Attrition bias and chameleons



SOURCE: REDRAWN. ORIGINAL: CALLING BULLSHIT, C.T. BERGSTROM & J.D. WEST

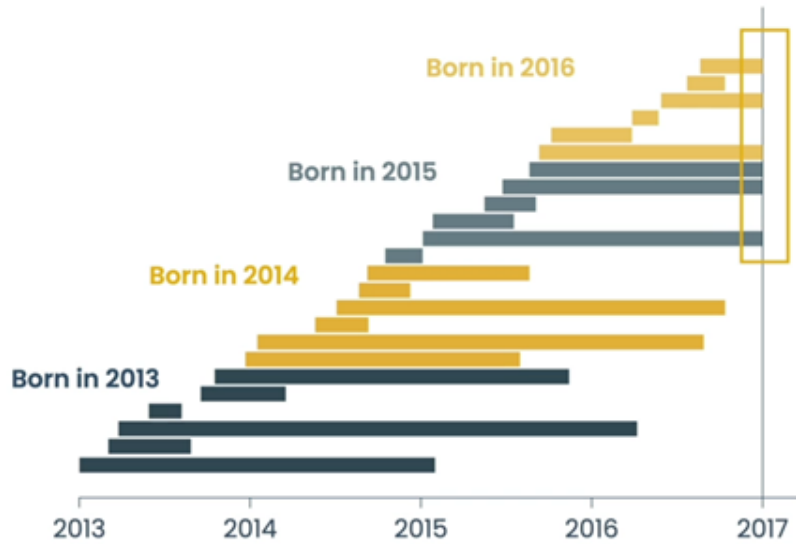
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Attrition bias and chameleons



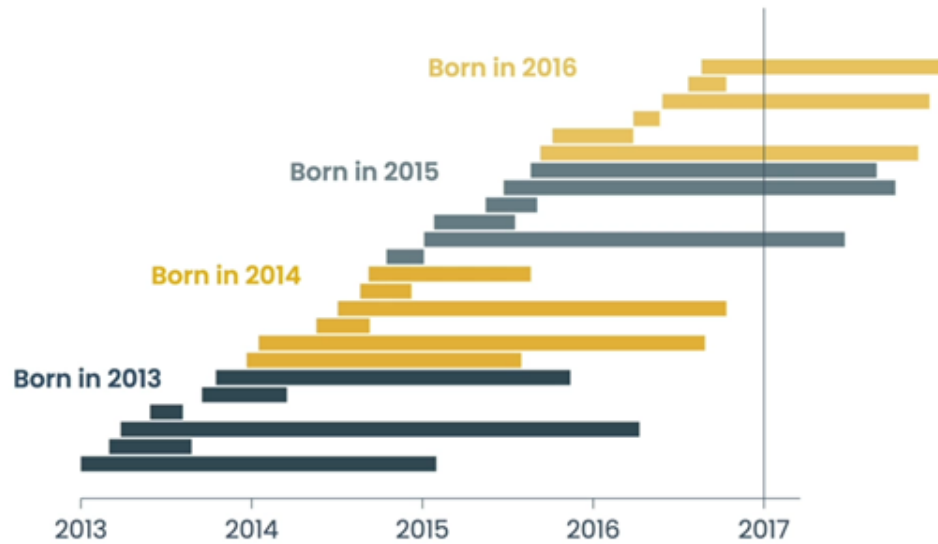
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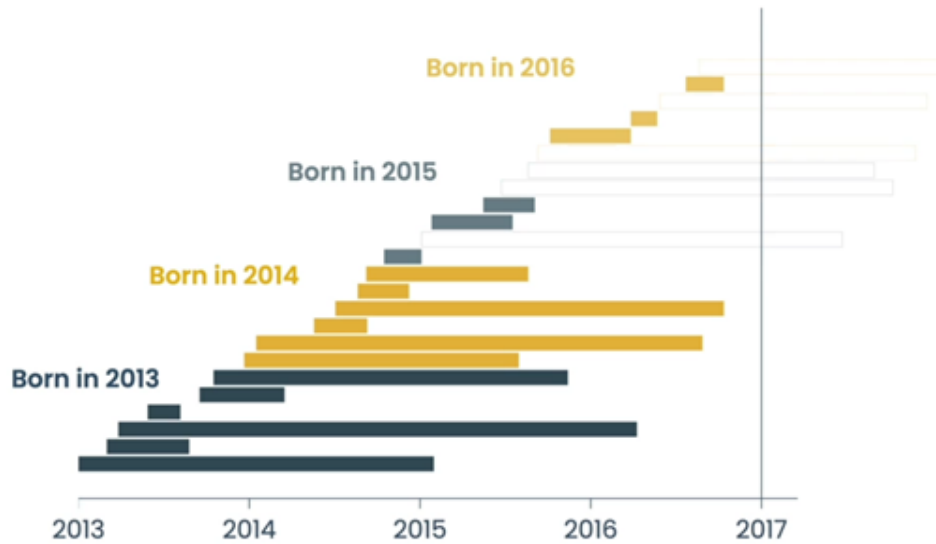
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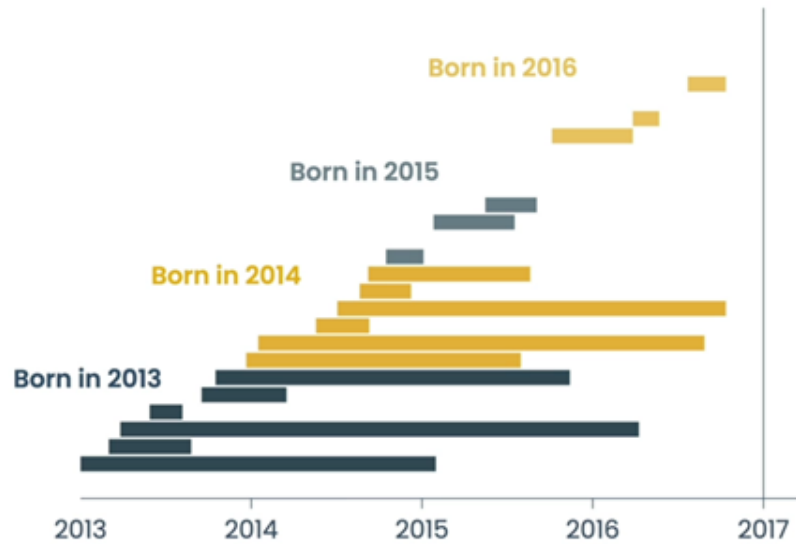
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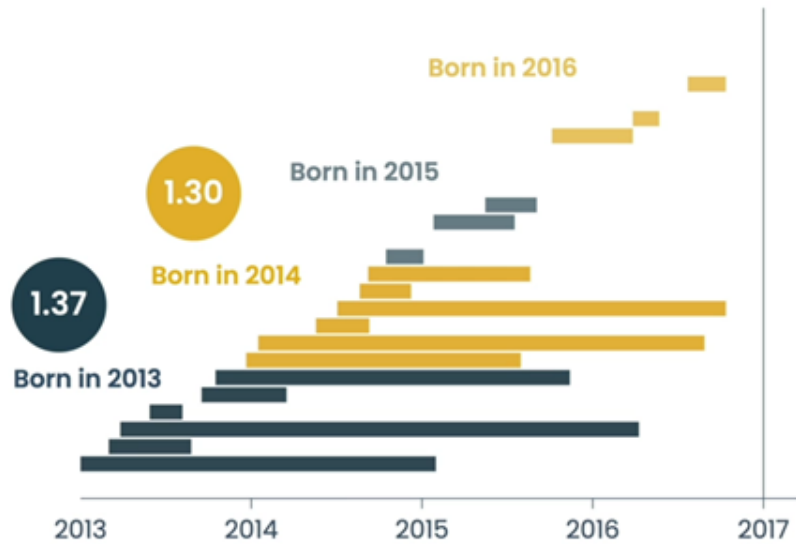
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Attrition bias and chameleons



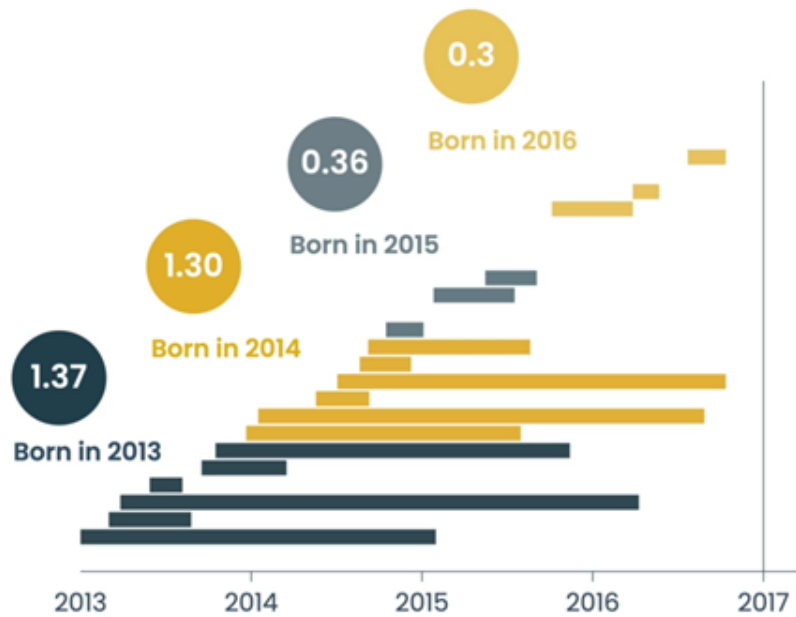
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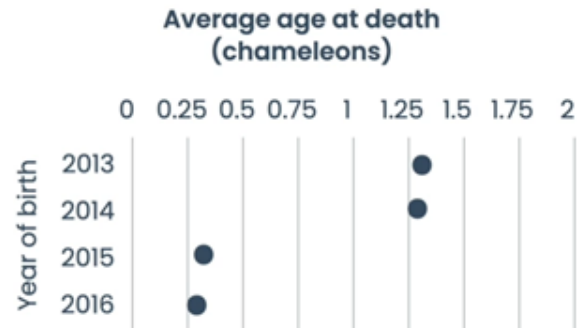
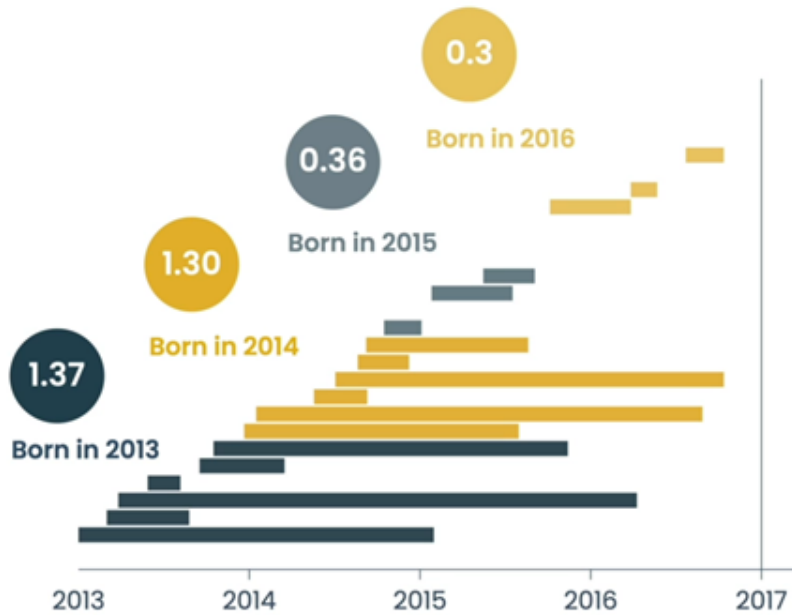
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Attrition bias and chameleons



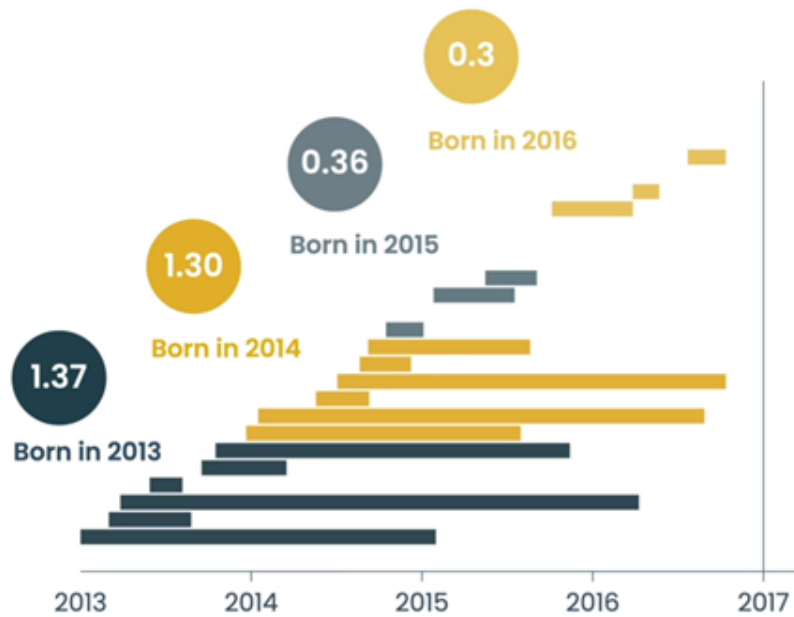
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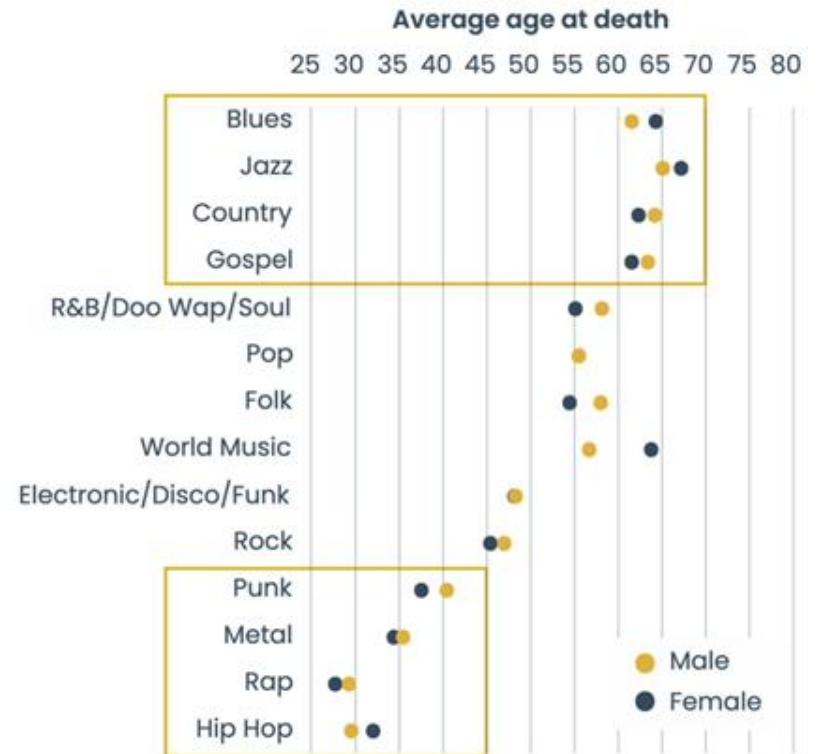
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Attrition bias and chameleons



SOURCE: REDRAWN. ORIGINAL: CALLING BULLSHIT, C.T. BERGSTROM & J.D. WEST

Attrition bias and chameleons



26- importance of the Context

26. The Importance of Context

Quoting data out of context

To be truthful and revealing, data graphics must bear on the question at heart of quantitative thinking:

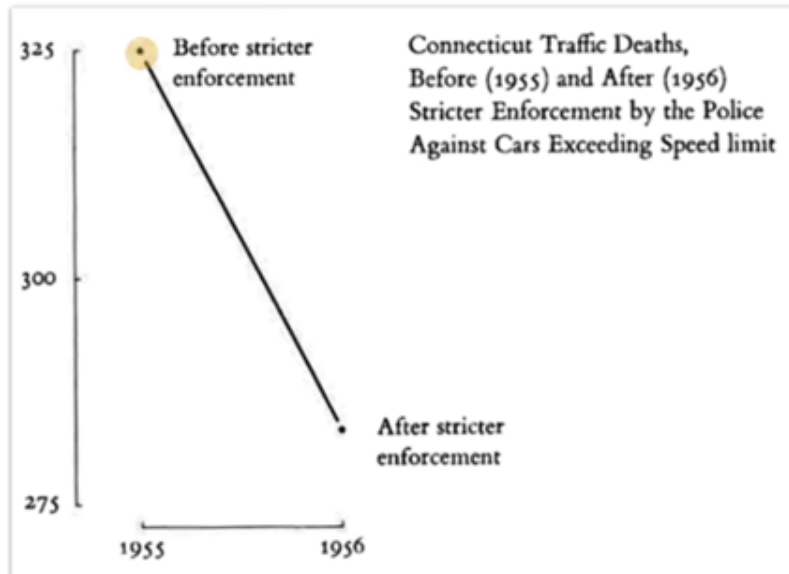
COMPARED TO WHAT?

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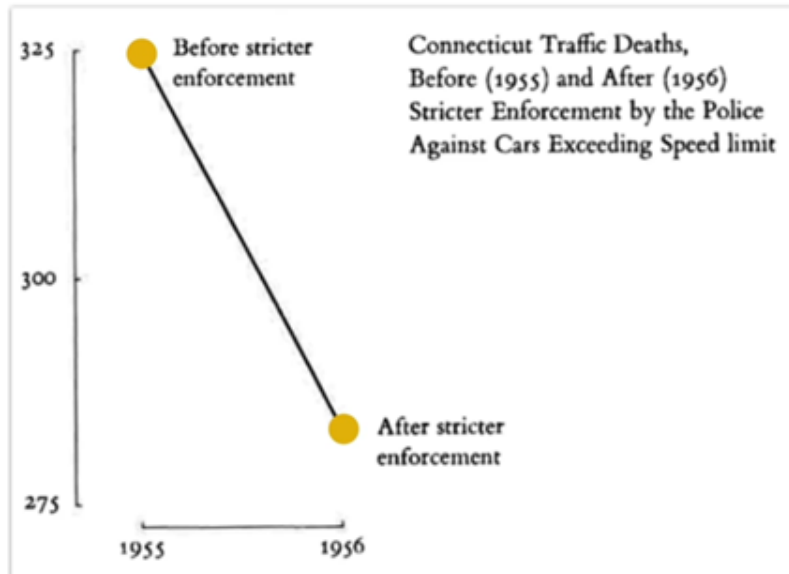
SOURCE: THE VISUAL DISPLAY OF QUANTITATIVE INFORMATION, E. TUFTS

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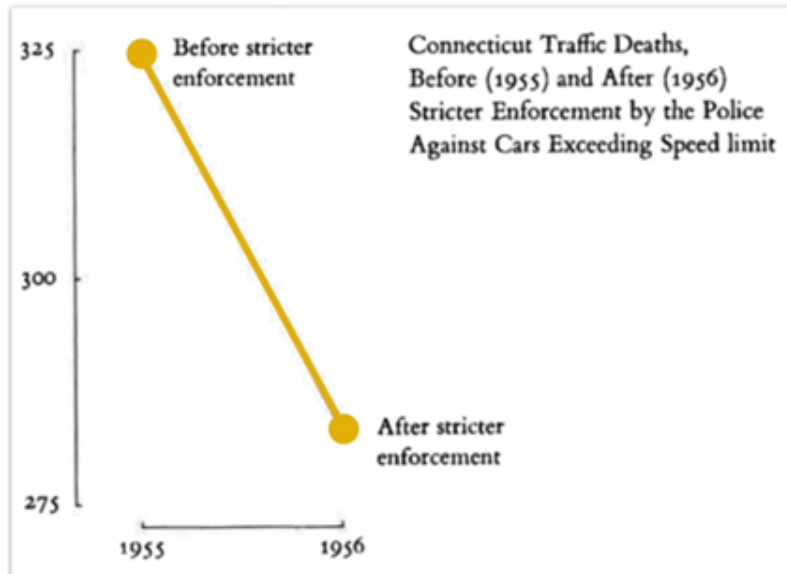
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SOURCE: THE VISUAL DISPLAY OF QUANTITATIVE INFORMATION, E. TUFTS

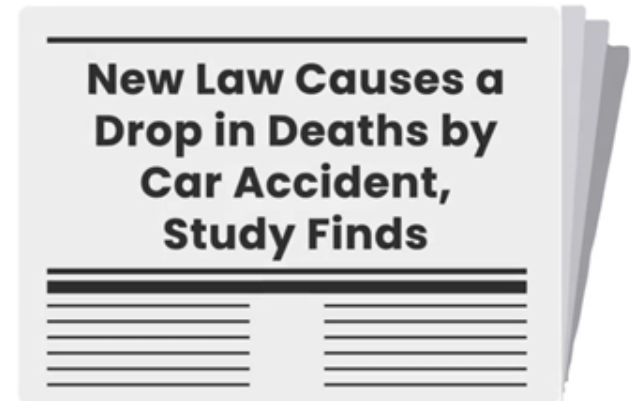
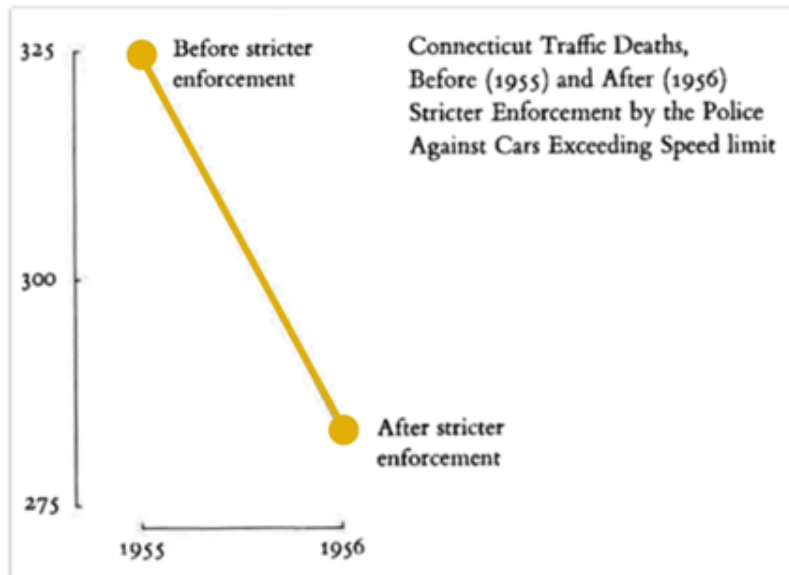
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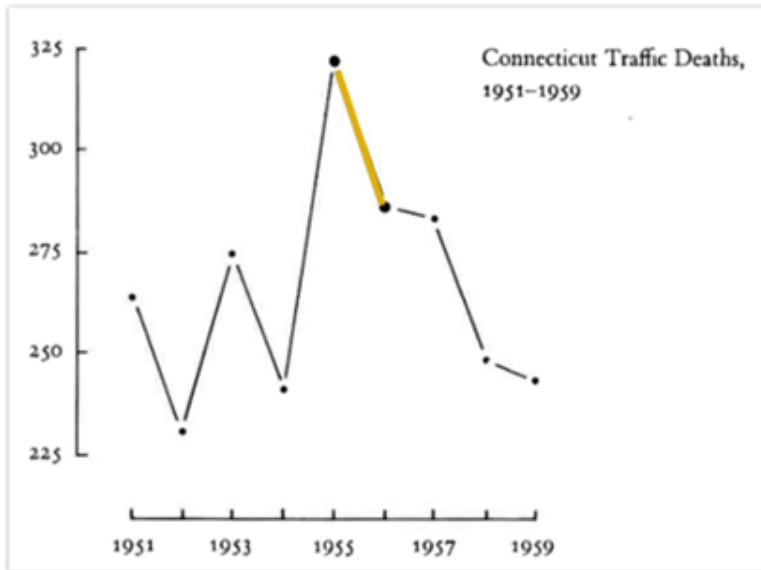


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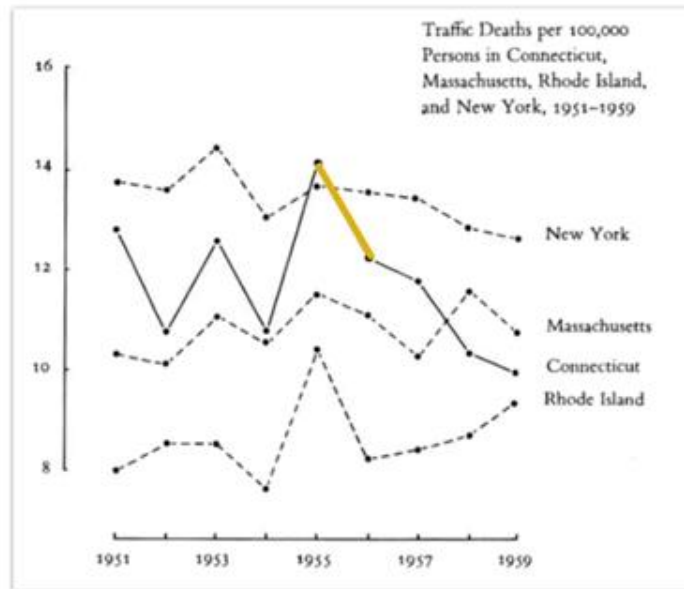


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SOURCE: THE VISUAL DISPLAY OF QUANTITATIVE INFORMATION, E. TUFTS

1/28/2025 7:20:29 PM

26. The Importance of Context

Quoting data out of context > The Challenger disaster



26. The Importance of Context

Quoting data out of context > The Challenger disaster



26. The Importance of Context

Quoting data out of context > The Challenger disaster



31°F
-0.5°C



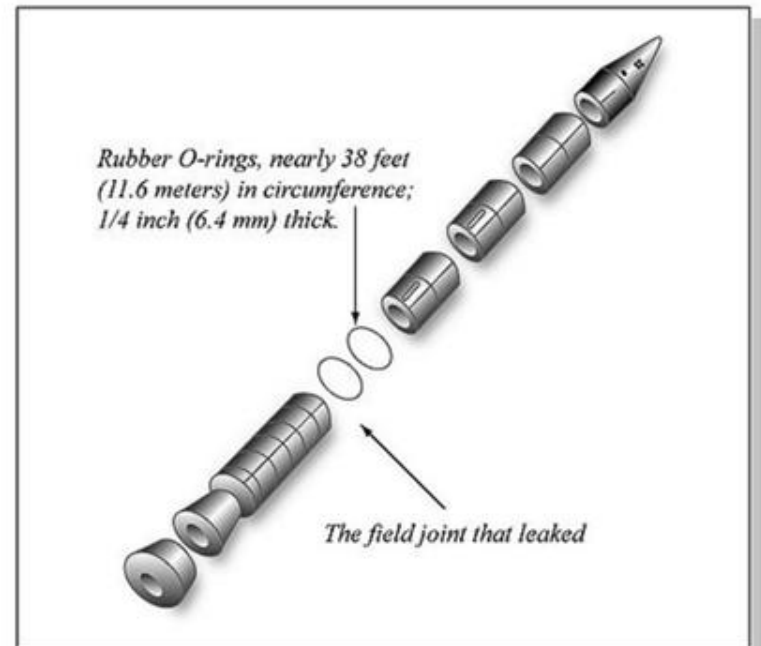
SOURCE: NBC NEWS

26. The Importance of Context

Quoting data out of context > The Challenger disaster

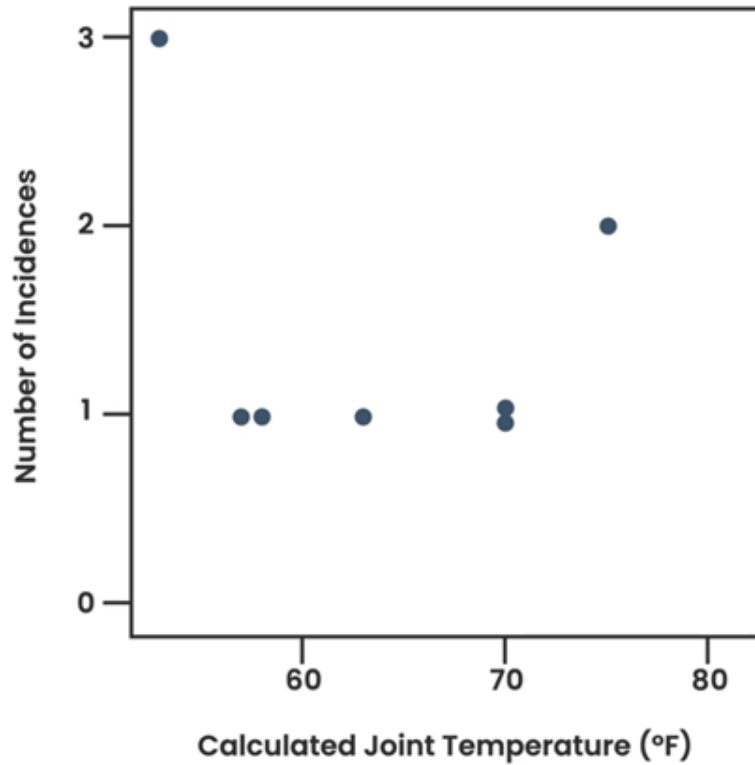


31°F
-0.5°C



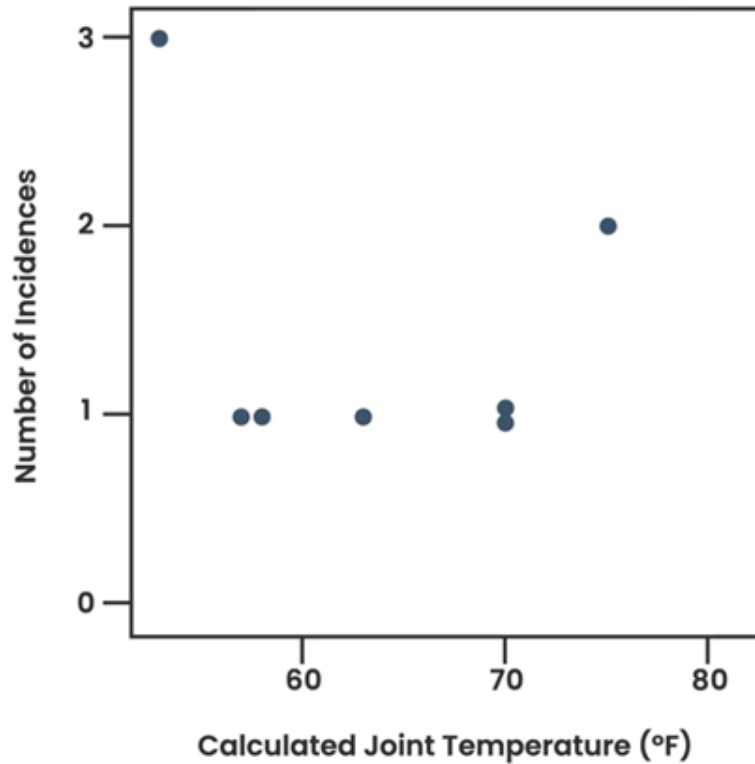
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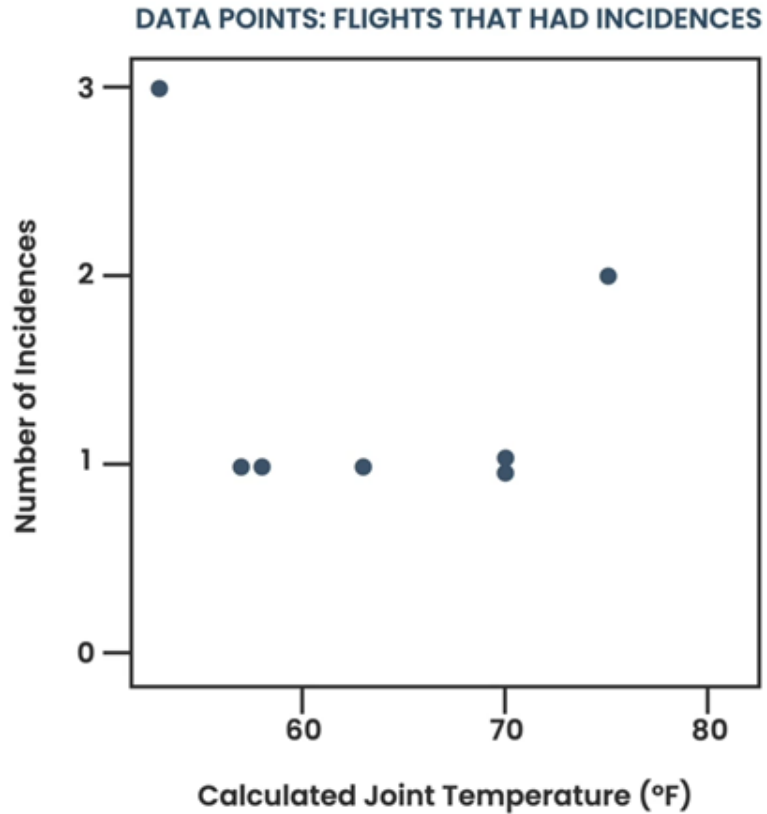
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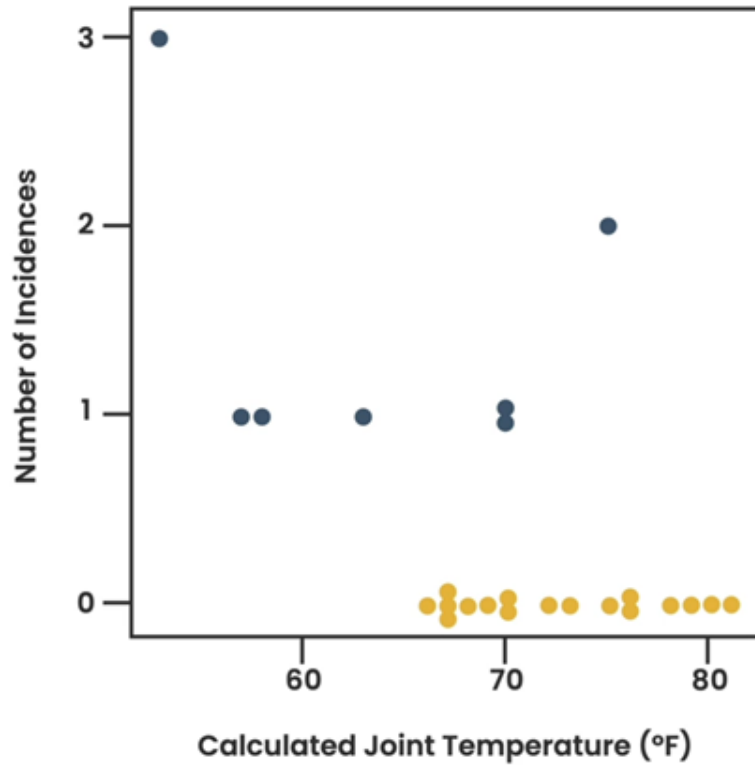
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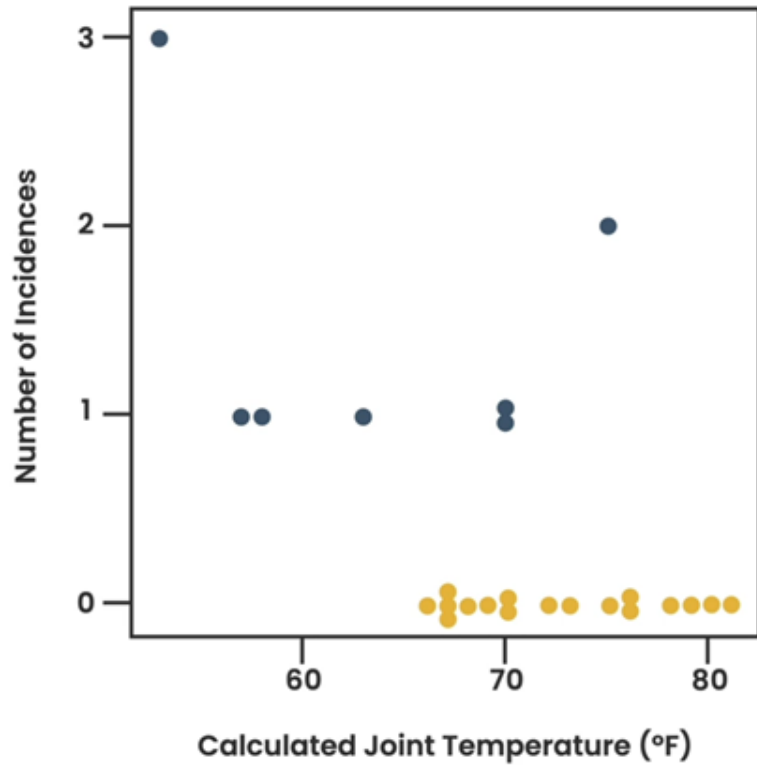
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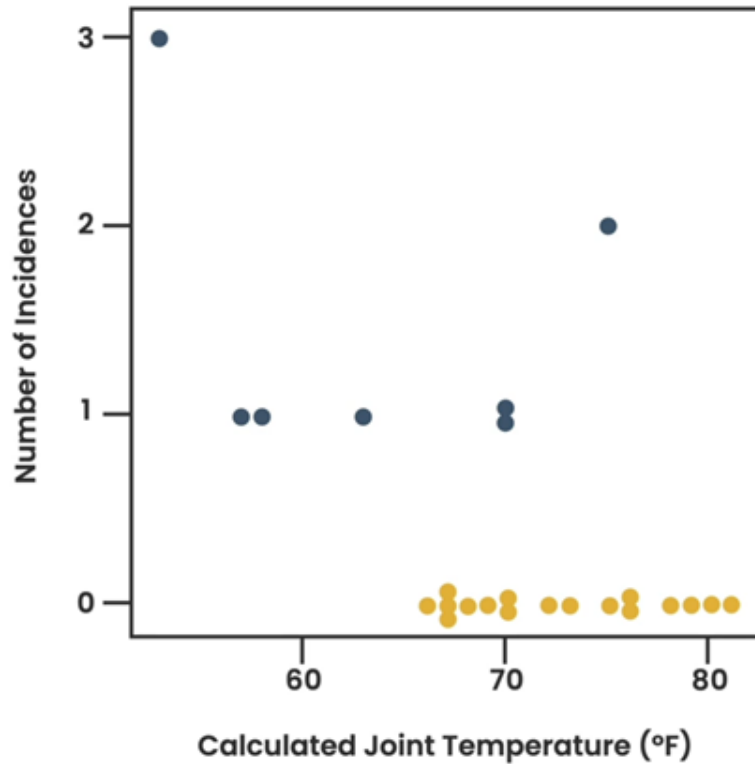
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Quoting data out of context > The Challenger disaster



THERE IS
a relationship between
temperature and
number of incidences

STATISTICAL TRAPS

Incorrect Normalization of Data



Incorrect **normalization** of data

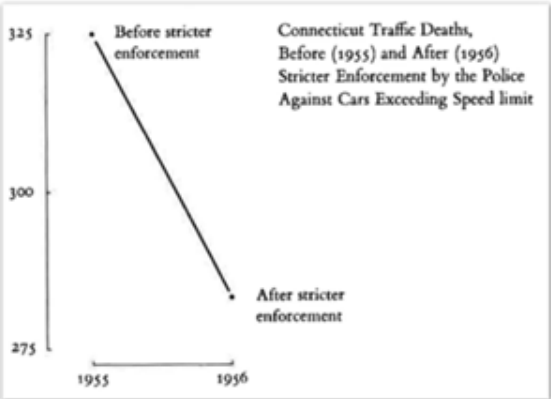
27. The Incorrect Normalization of the Data

Incorrect normalization of the data



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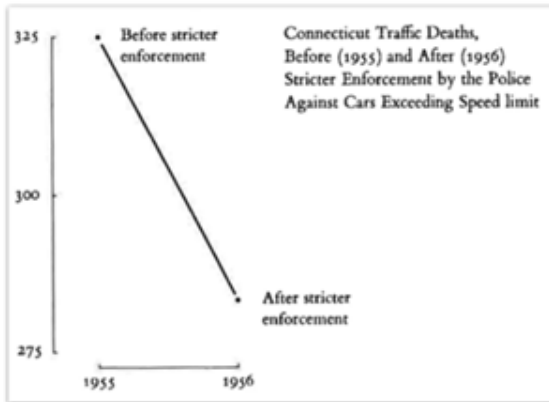
Incorrect normalization of the data



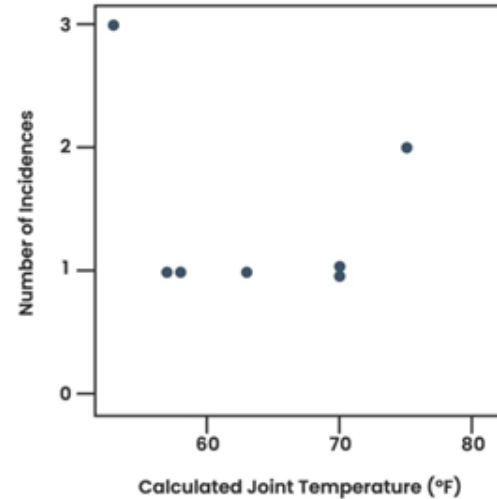
SOURCE: THE VISUAL DISPLAY OF QUANTITATIVE INFORMATION, E. TUFTE

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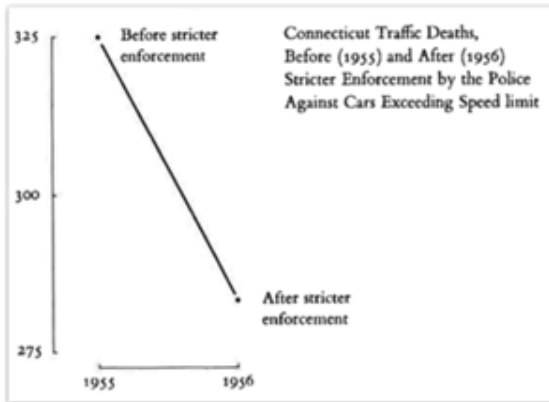
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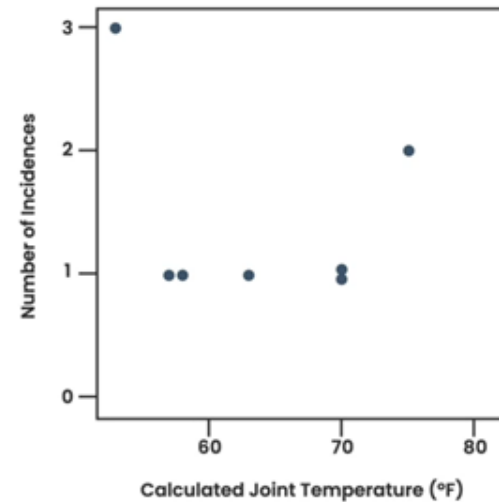
SOURCE: REDRAWN. ORIGINAL: THE ELEMENTS OF GRAPHING DATA, WILLIAM S. CLEVELAND

27. The Incorrect Normalization of the Data

Incorrect normalization of the data



SOURCE: THE VISUAL DISPLAY OF QUANTITATIVE INFORMATION, E. TUFTE

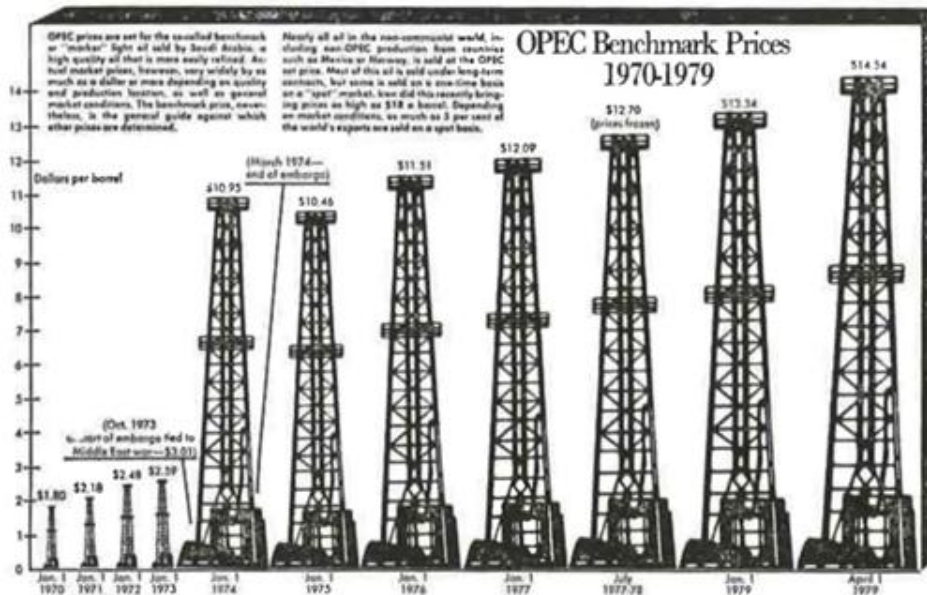


SOURCE: REDRAWN. ORIGINAL: THE ELEMENTS OF GRAPHING DATA, WILLIAM S. CLEVELAND

If you plot your data in order to see a particular effect, you must make sure that **there are not additional effects on your data.**

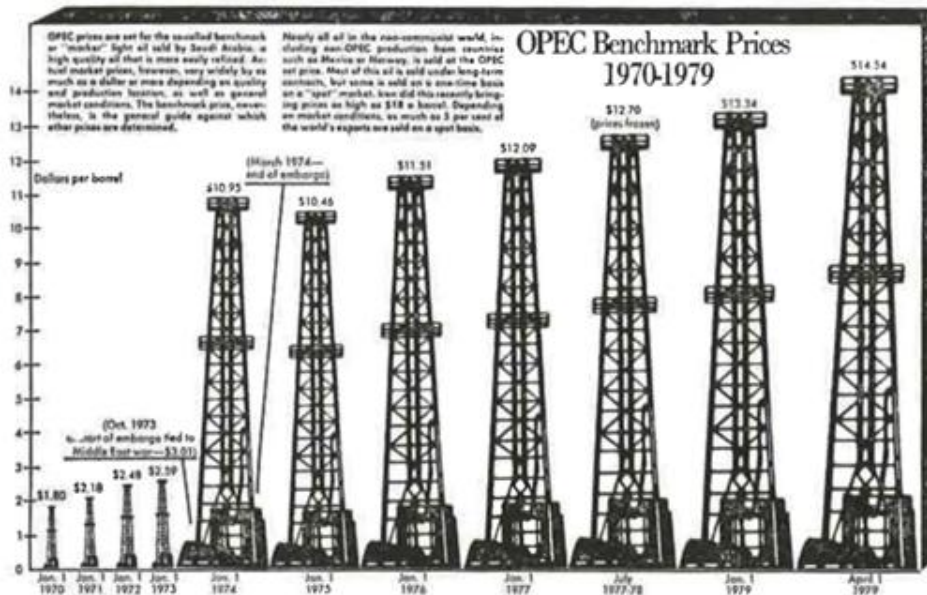
27. The Incorrect Normalization of the Data

Incorrect normalization of the data



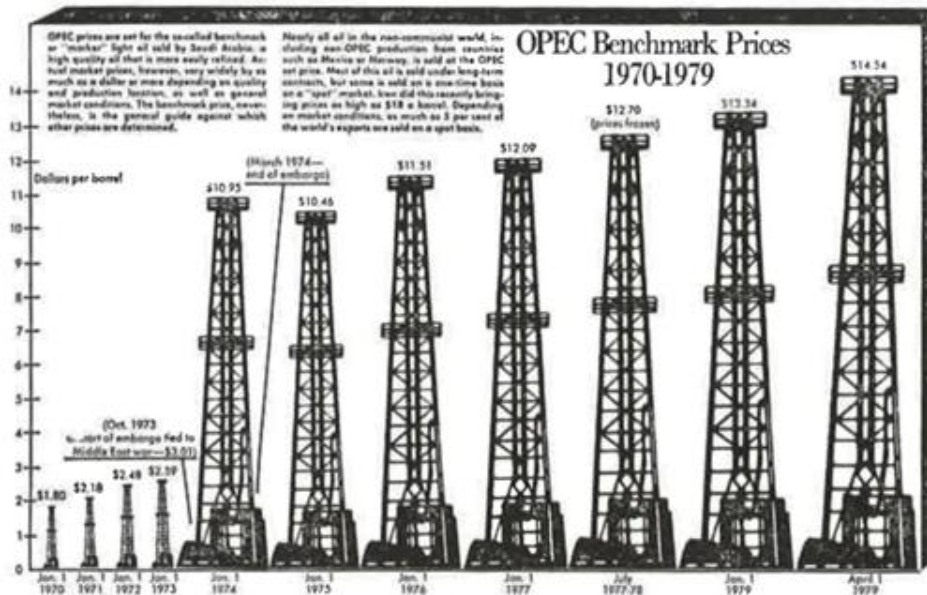
SOURCE: THE WASHINGTON POST (1979) VIA THE VISUAL DISPLAY OF QUANTITATIVE INFORMATION, E. TUFTE.

27. The Incorrect Normalization of the Data Incorrect normalization of the data



SOURCE: THE WASHINGTON POST (1979) VIA
THE VISUAL DISPLAY OF QUANTITATIVE INFORMATION, E. TUFTE.

27. The Incorrect Normalization of the Data Incorrect normalization of the data



VISIBLE PROBLEMS:

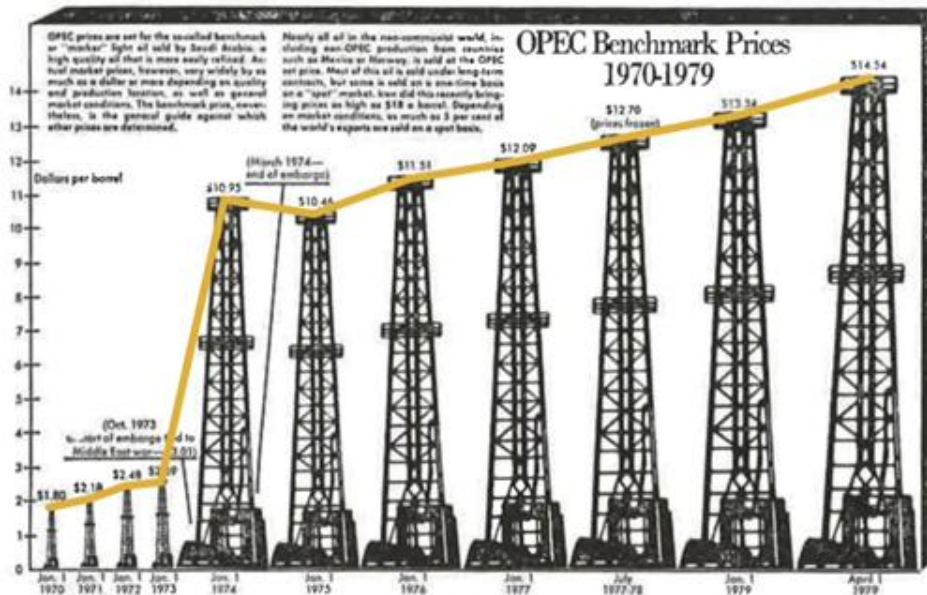
2-D INSTEAD OF 1-D

LIE FACTOR

SOURCE: THE WASHINGTON POST (1979) VIA
THE VISUAL DISPLAY OF QUANTITATIVE INFORMATION, E. TUFTE.

27. The Incorrect Normalization of the Data

Incorrect normalization of the data



VISIBLE PROBLEMS:

2-D INSTEAD OF 1-D

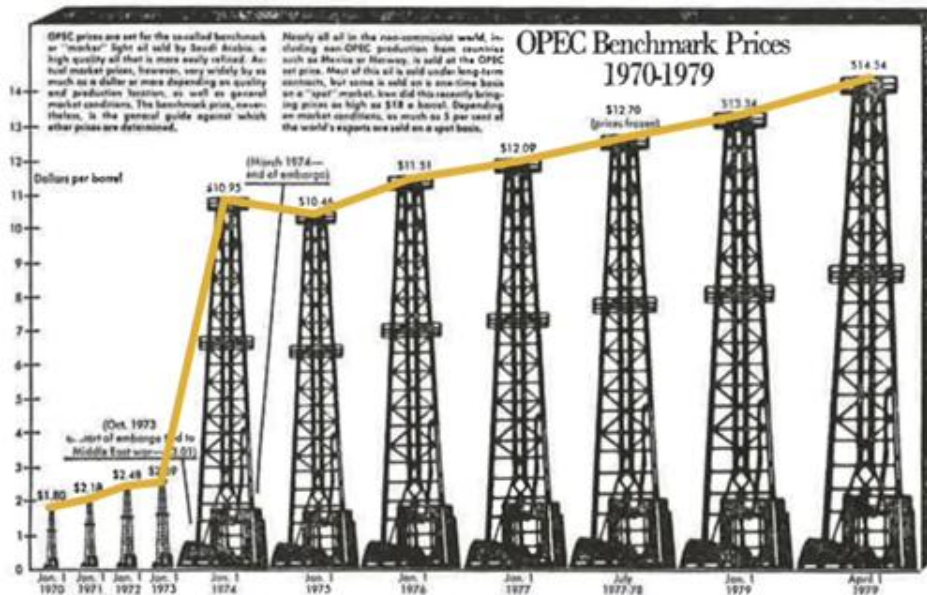
LIE FACTOR

LINE PLOT

INVISIBLE PROBLEMS:

SOURCE: THE WASHINGTON POST (1979) VIA THE VISUAL DISPLAY OF QUANTITATIVE INFORMATION, E. TUFTE.

27. The Incorrect Normalization of the Data Incorrect normalization of the data



VISIBLE PROBLEMS:

2-D INSTEAD OF 1-D

LIE FACTOR

LINE PLOT

INVISIBLE PROBLEMS:

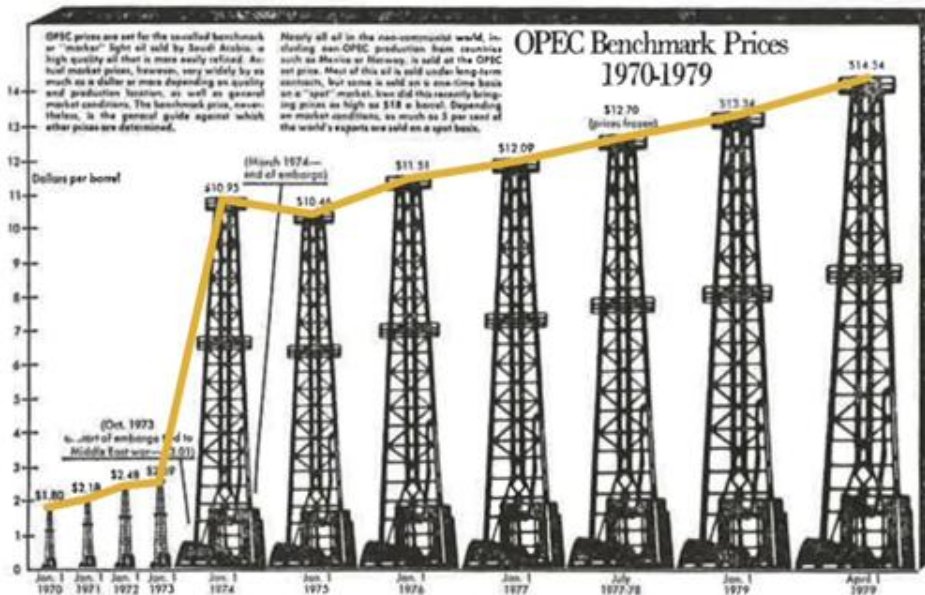
DATA IS NOT NORMALIZED

CORRECTLY

SOURCE: THE WASHINGTON POST (1979) VIA
THE VISUAL DISPLAY OF QUANTITATIVE INFORMATION, E. TUFTE.

27. The Incorrect Normalization of the Data

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SOURCE: THE WASHINGTON POST (1979) VIA THE VISUAL DISPLAY OF QUANTITATIVE INFORMATION, E. TUFTS.

VISIBLE PROBLEMS:

- 2-D INSTEAD OF 1-D
- LIE FACTOR
- LINE PLOT

INVISIBLE PROBLEMS:

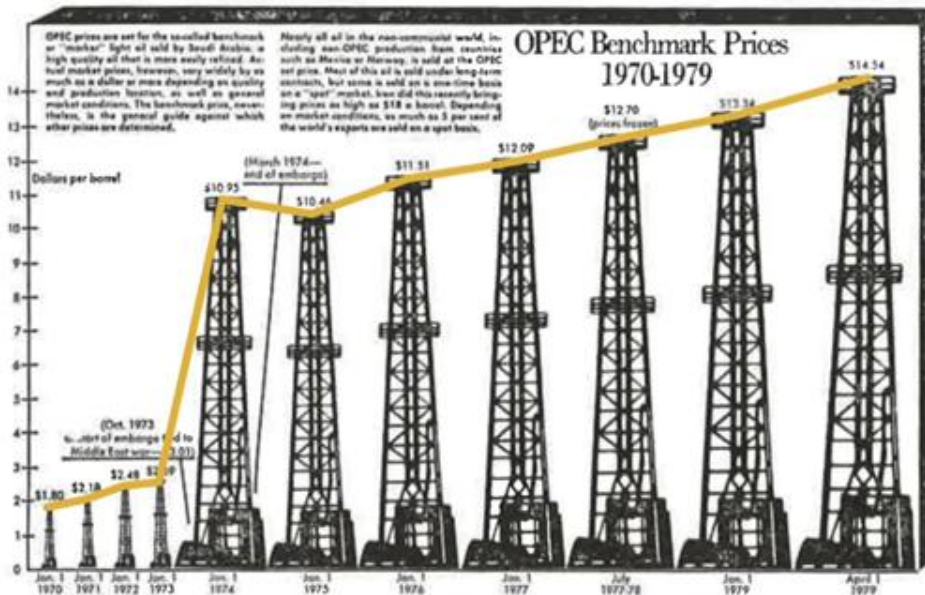
- DATA IS NOT NORMALIZED
- CORRECTLY



1913

27. The Incorrect Normalization of the Data

Incorrect normalization of the data



SOURCE: THE WASHINGTON POST (1979) VIA THE VISUAL DISPLAY OF QUANTITATIVE INFORMATION, E. TUFTS.

VISIBLE PROBLEMS:

2-D INSTEAD OF 1-D

LIE FACTOR

LINE PLOT

INVISIBLE PROBLEMS:

DATA IS NOT NORMALIZED

CORRECTLY



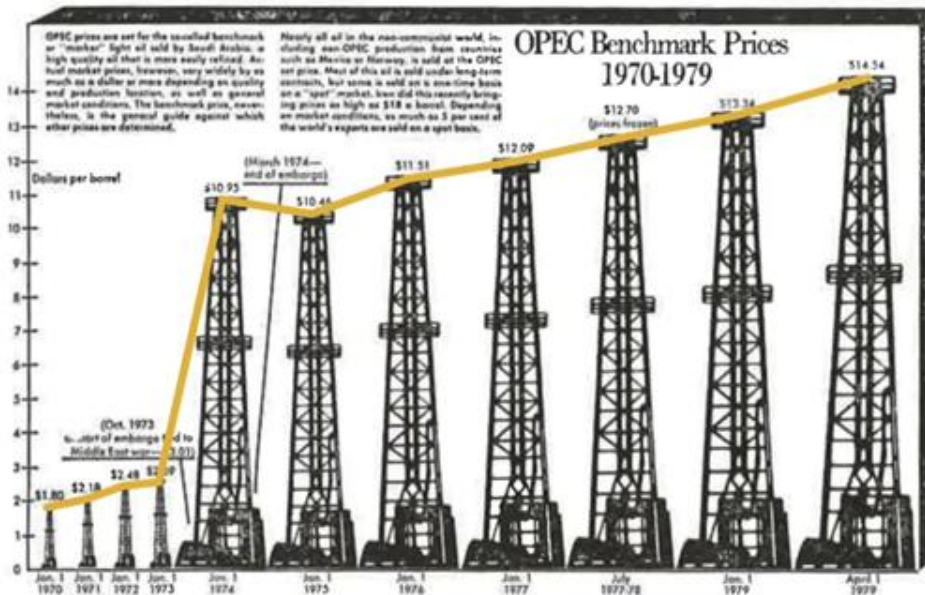
1913



2020

27. The Incorrect Normalization of the Data

Incorrect normalization of the data



SOURCE: THE WASHINGTON POST (1979) VIA THE VISUAL DISPLAY OF QUANTITATIVE INFORMATION, E. TUFTS.

VISIBLE PROBLEMS:

- 2-D INSTEAD OF 1-D
- LIE FACTOR
- LINE PLOT



1913



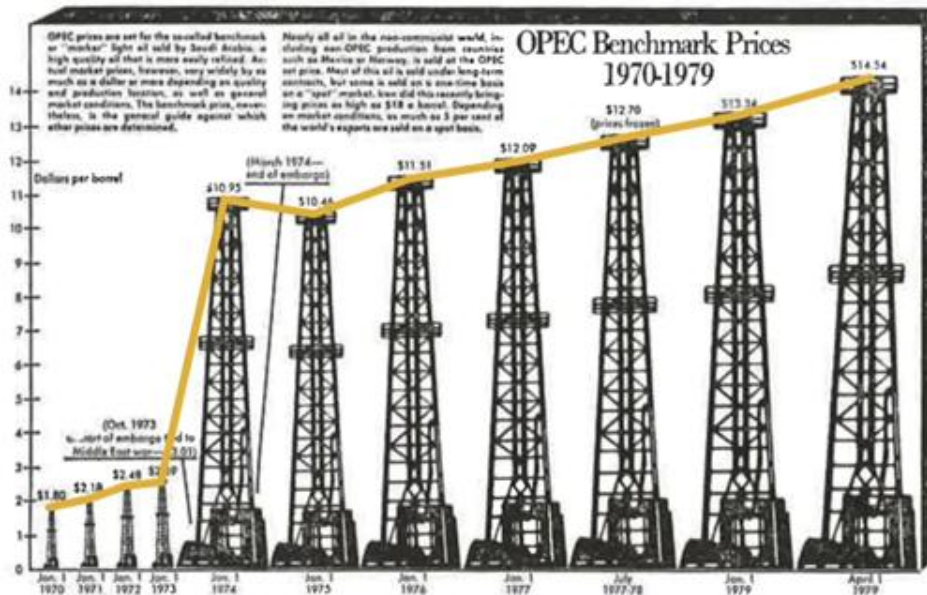
2020

INVISIBLE PROBLEMS:

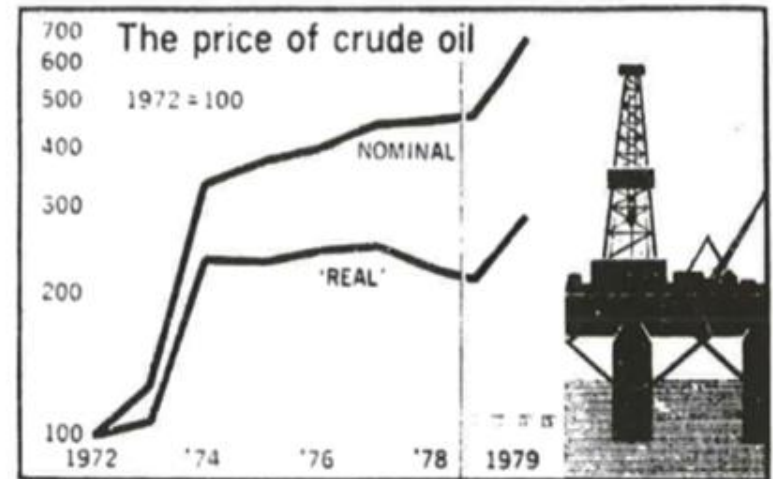
- DATA IS NOT NORMALIZED
- CORRECTLY

27. The Incorrect Normalization of the Data

Incorrect normalization of the data



SOURCE: THE WASHINGTON POST (1979) VIA THE VISUAL DISPLAY OF QUANTITATIVE INFORMATION, E. TUFT.



SOURCE: THE SUNDAY TIMES (1979) VIA THE VISUAL DISPLAY OF QUANTITATIVE INFORMATION, E. TUFT.

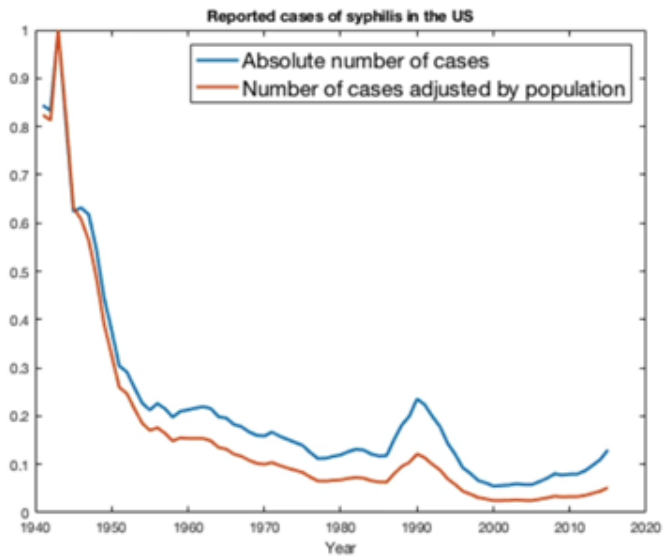
27. The Incorrect Normalization of the Data

Incorrect normalization of the data > **Reporting COVID-19**



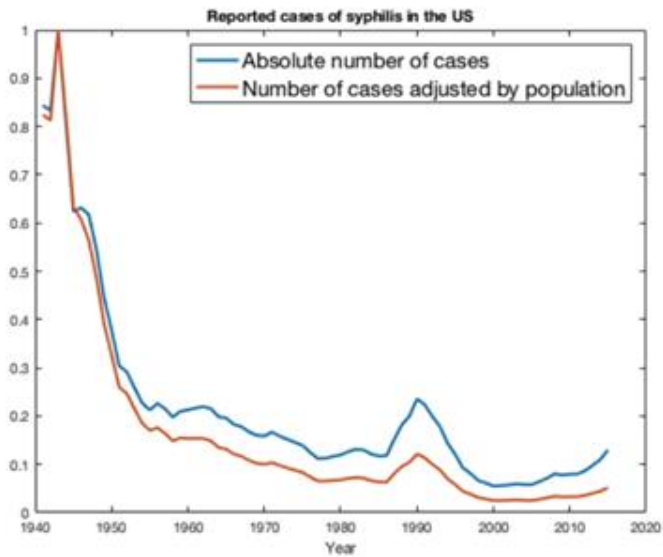
27. The Incorrect Normalization of the Data

Incorrect normalization of the data > Reporting COVID-19



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Incorrect normalization of the data > Reporting COVID-19

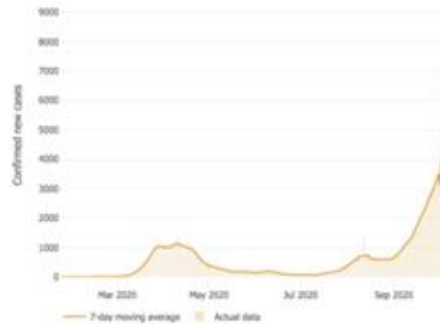


NETHERLANDS

New cases confirmed each day (7-day-average)



The first case of COVID-19 in Netherlands was reported 227 days ago on 27/02/2020. Since then, the country has reported 180,288 cases, and 6,642 deaths.

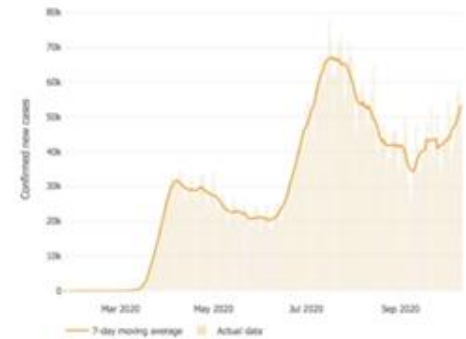


US

New cases confirmed each day (7-day-average)



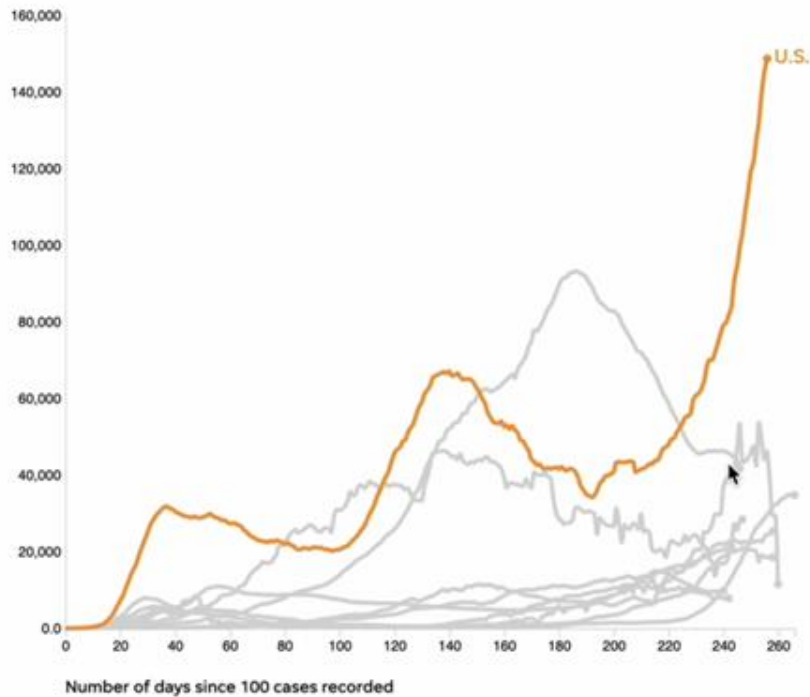
The first case of COVID-19 in US was reported 263 days ago on 22/01/2020. Since then, the country has reported 7,762,546 cases, and 214,768 deaths.



SOURCE: CORONAVIRUS RESOURCE CENTER, JOHN HOPKINS UNIVERSITY

27. The Incorrect Normalization of the Data

Incorrect normalization of the data > Reporting COVID-19

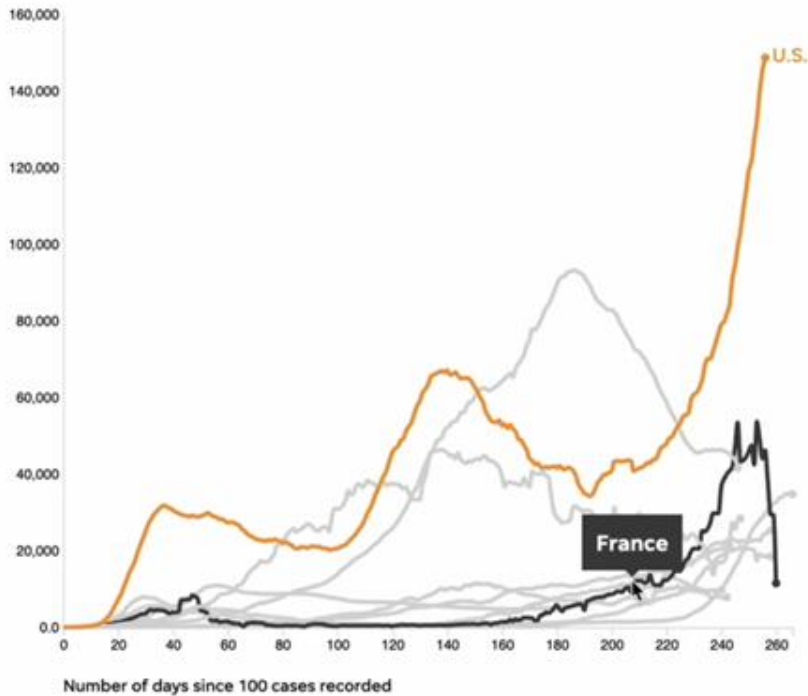


Data as of: 11/15/20
SOURCE Johns Hopkins University

SOURCE: USA TODAY &
JOHN HOPKINS UNIVERSITY

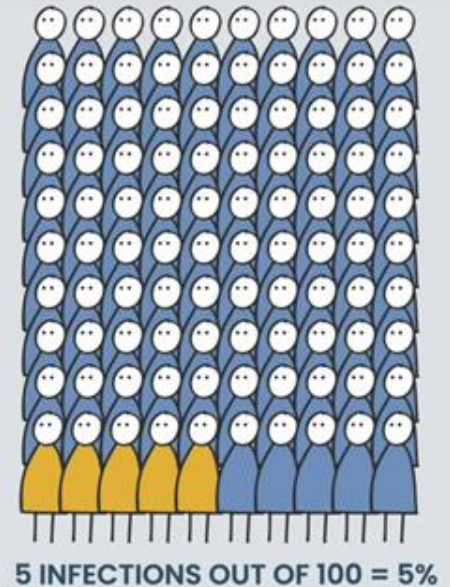
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Incorrect normalization of the data > Reporting COVID-19



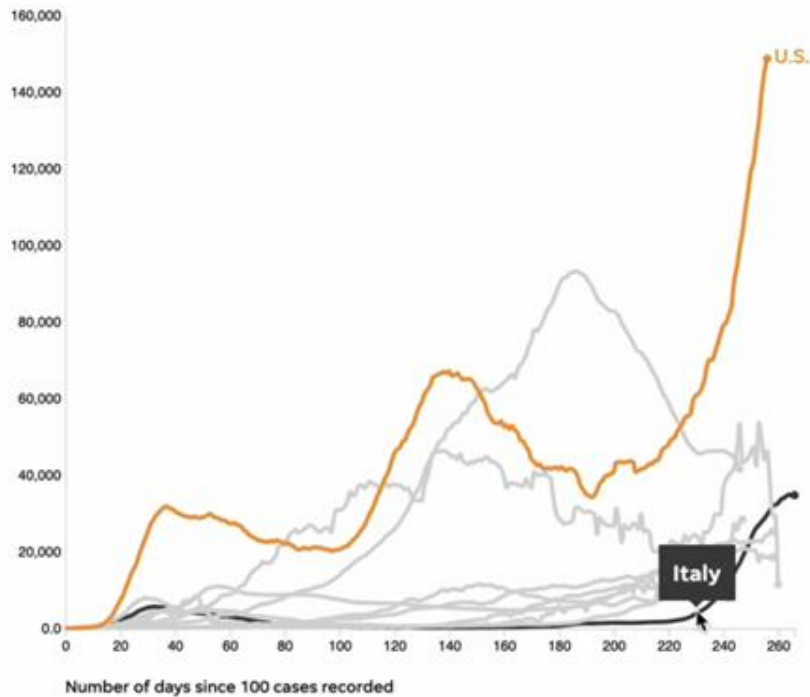
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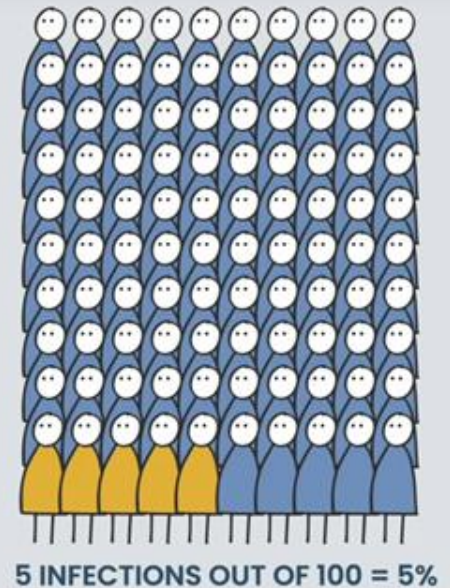
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Incorrect normalization of the data > Reporting COVID-19



Data as of: 11/15/20
SOURCE Johns Hopkins University

SOURCE: USA TODAY &
JOHN HOPKINS UNIVERSITY



Incorrect normalization of the data > Reporting COVID-19

Daily number of new positives (Spain)



SOURCE: [GOOGLE.COM](https://www.google.com) VISUALIZATION,
DATA FROM WIKIPEDIA

Incorrect normalization of the data > Reporting COVID-19

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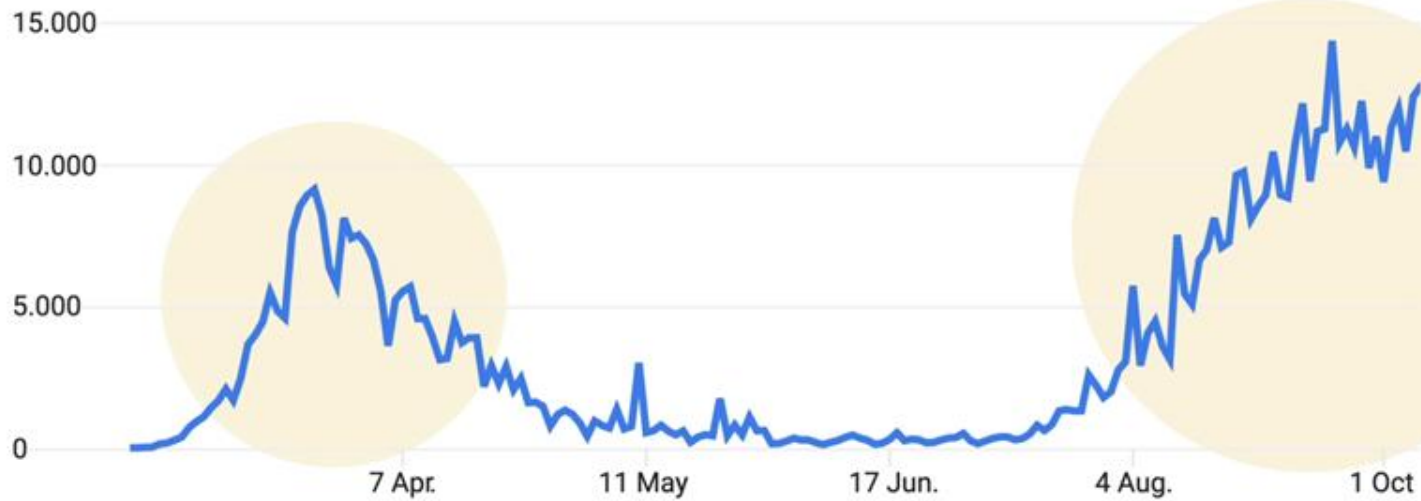
Daily number of new positives (Spain)



SOURCE: [GOOGLE.COM](https://www.google.com) VISUALIZATION,
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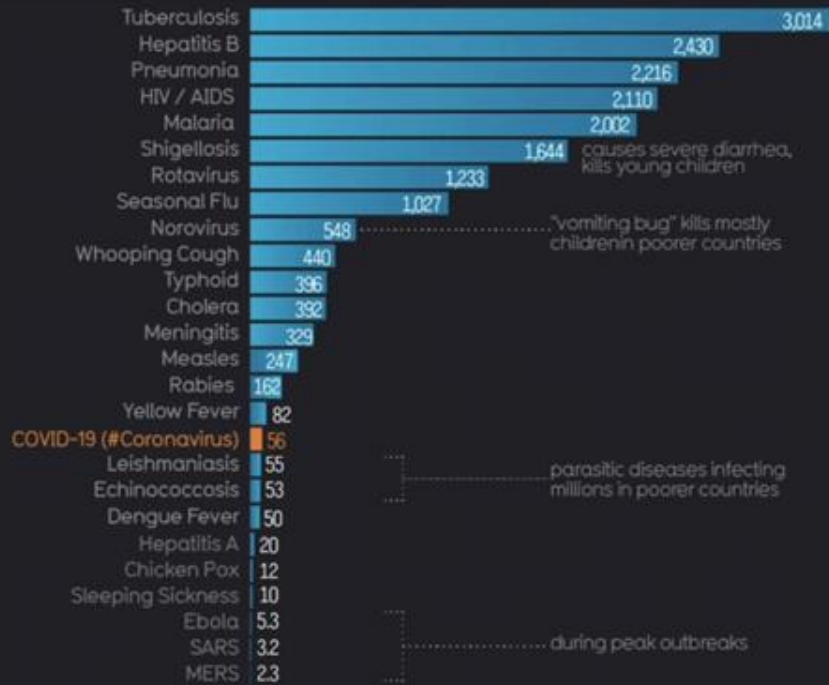
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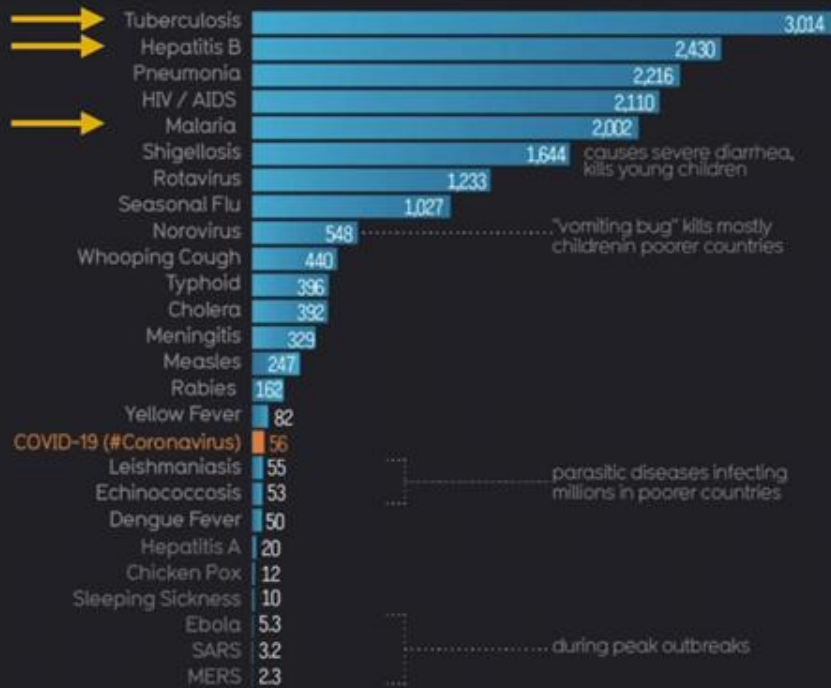
Disease Deaths per Day Worldwide



sources: Centres for Disease Control, WHO, The Lancet

27. The Incorrect Normalization of the Data

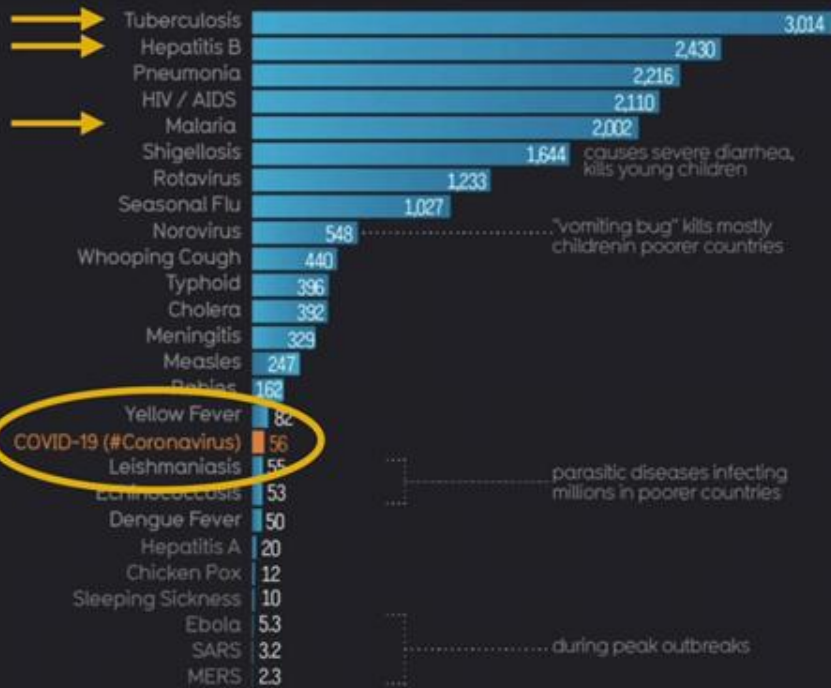
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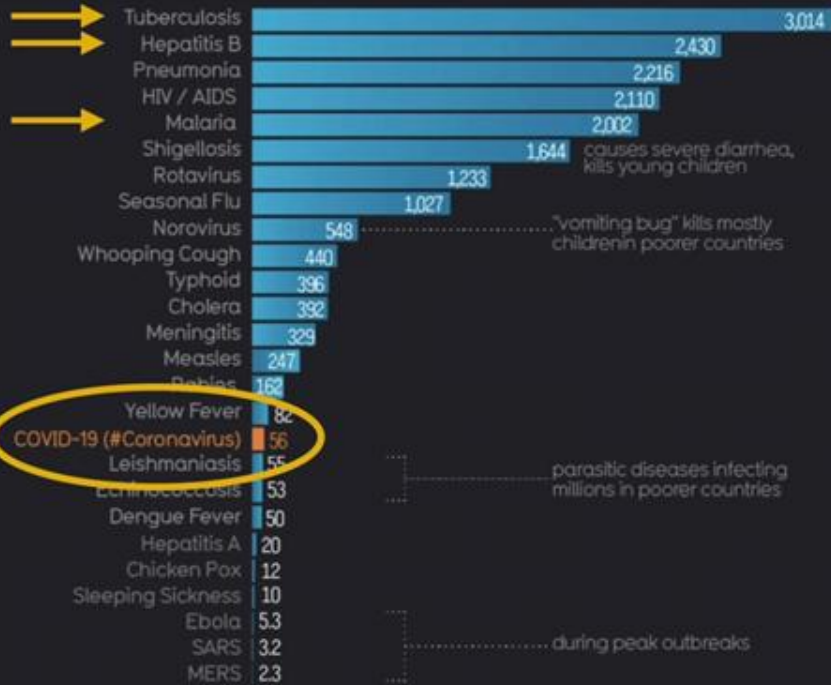
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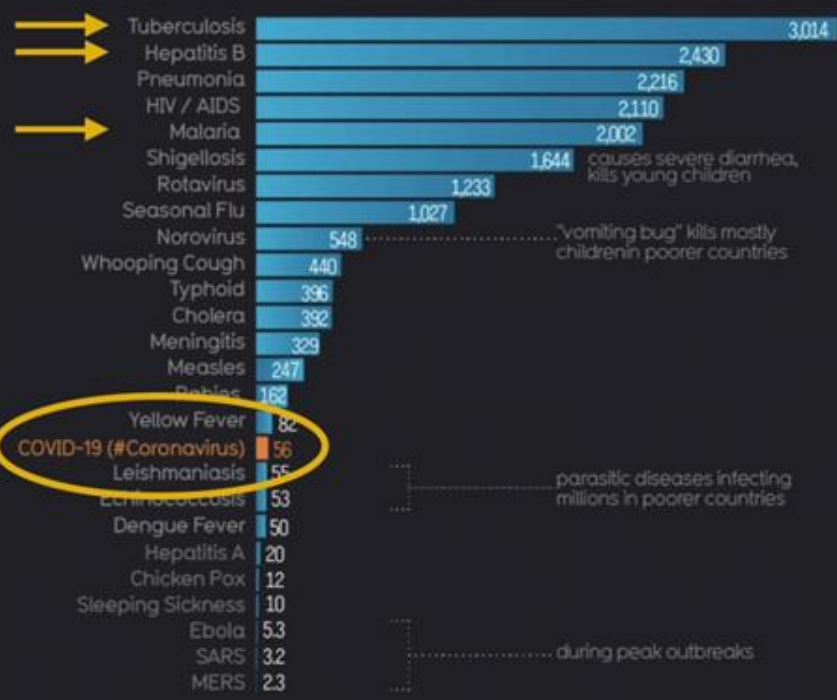
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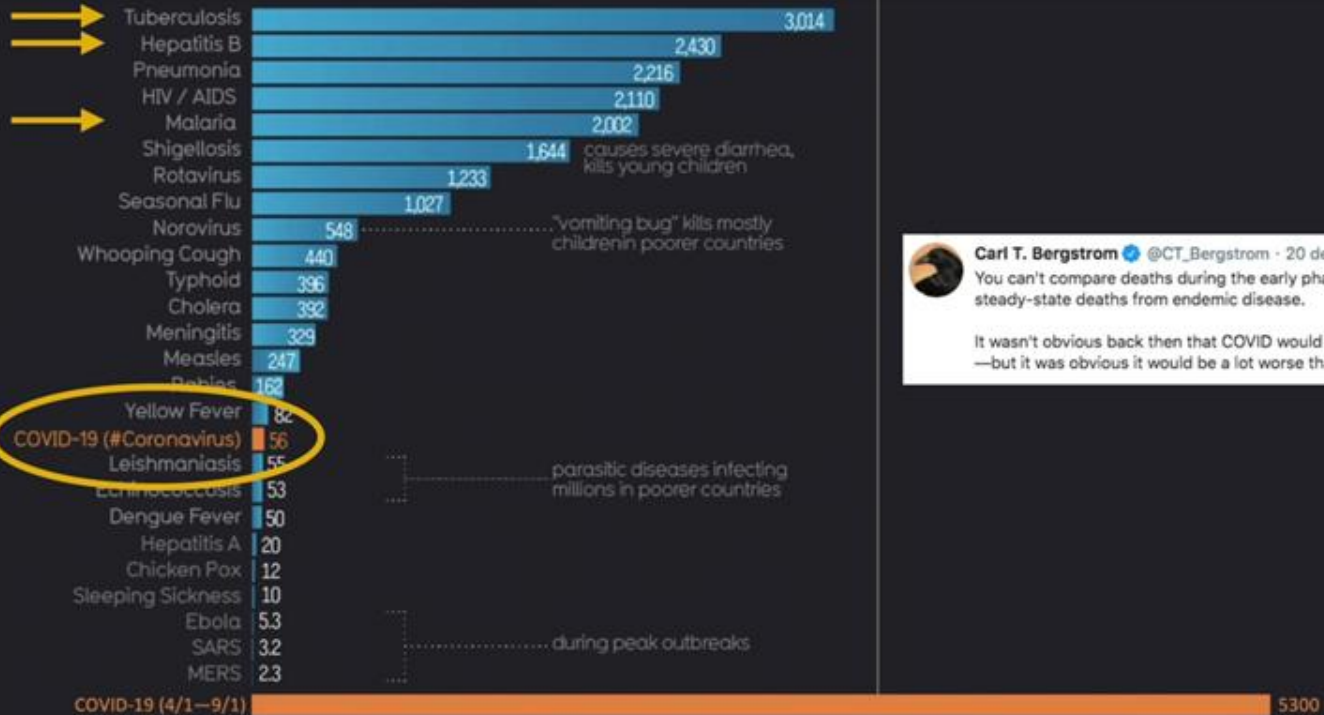
Carl T. Bergstrom @CT_Bergstrom · 20 de set.

You can't compare deaths during the early phase of an epidemic with steady-state deaths from endemic disease.

It wasn't obvious back then that COVID would become the leading cause—but it was obvious it would be a lot worse than shown.

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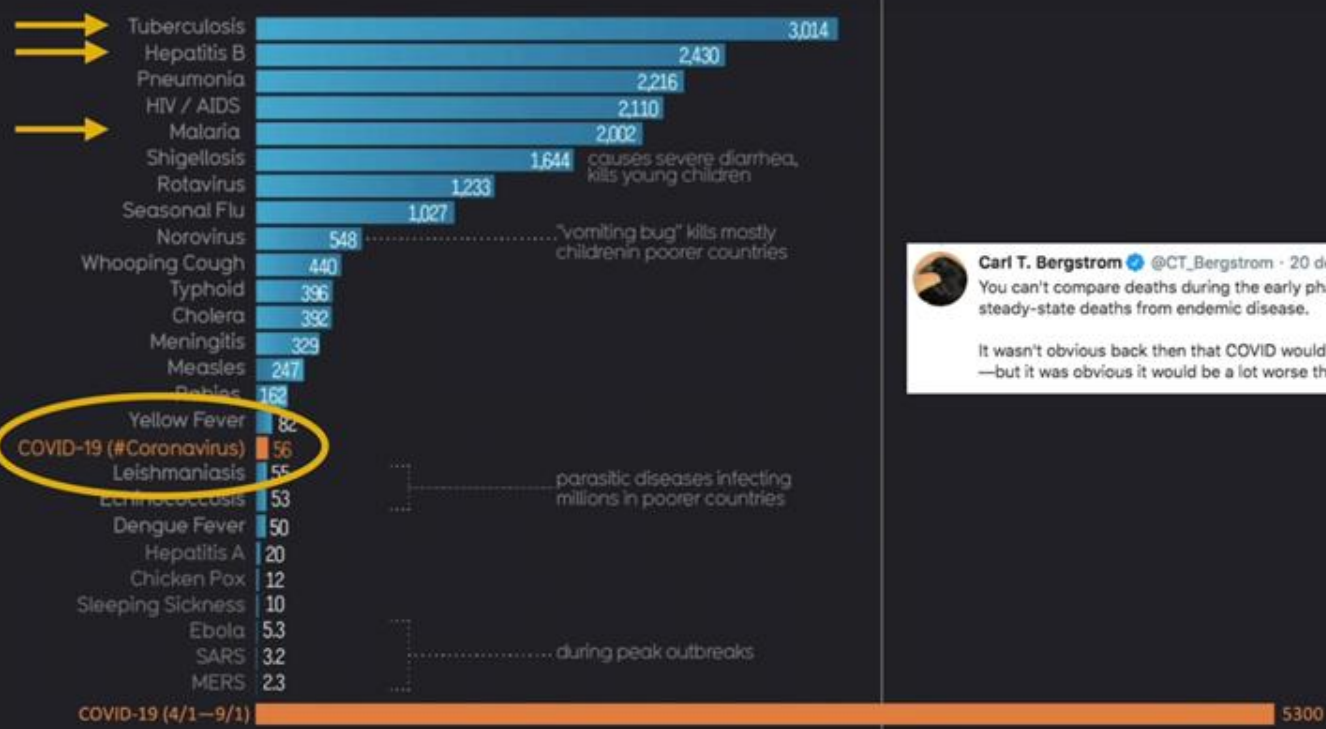
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The Simpson's paradox

28. The Simpson's Paradox

The Simpson's paradox

Simpson's paradox, or the Yule–Simpson effect, is a phenomenon in probability and statistics, in which a trend appears in several different groups of data but disappears or reverses when these groups are combined.

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UC Berkeley admission rates for men and women (1973)

	Applicants	Admitted
Men	8442	44 %
Women	4321	35 %

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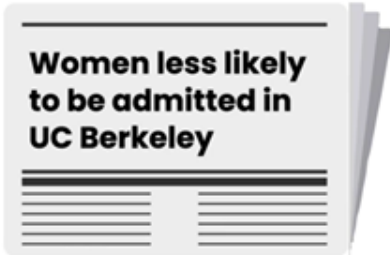
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By departments:

Department	Men		Women	
	Applicants	Admitted	Applicants	Admitted
A	825	62 %	108	82 %
B	560	63 %	25	68 %
C	325	37 %	593	34 %
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Total applicants = 1000

400 men (40%)

600 women (60%)

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600 women (60%)

Total positions = 100

Department A

90 positions available

28. The Simpson's Paradox

The Simpson's paradox

Total applicants = 1000

Total positions = 100

400 men (40%)

250 m

Department A

90 positions available

600 women (60%)

Department B

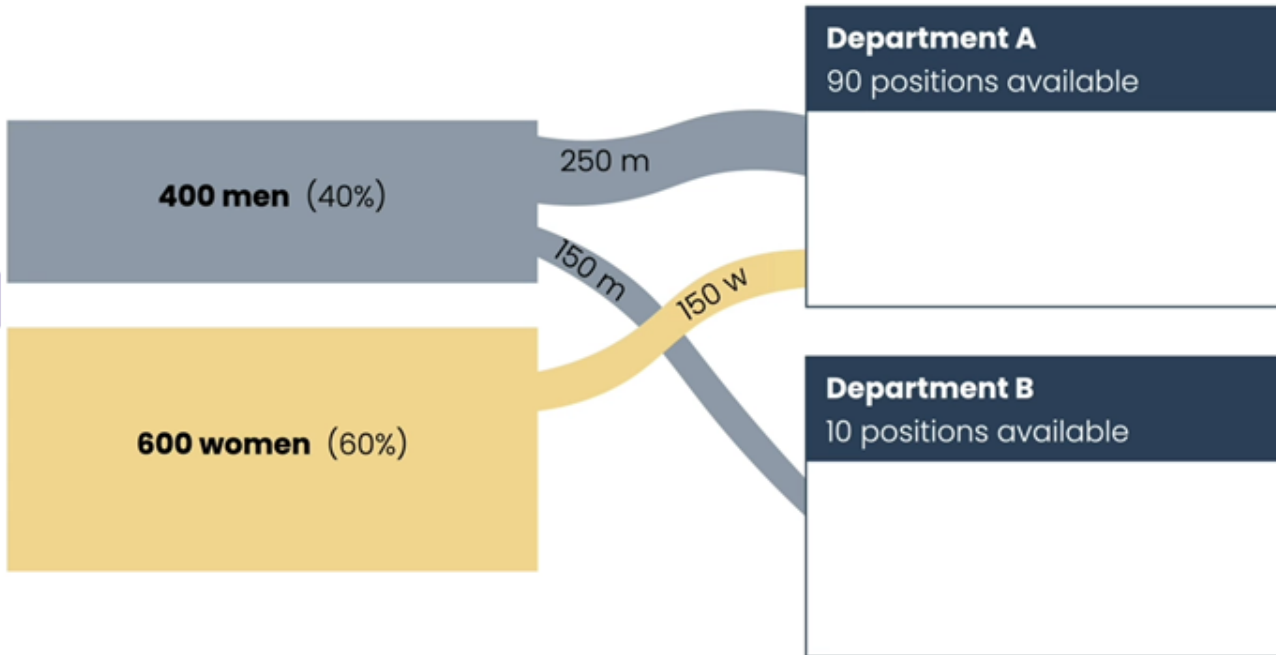
10 positions available

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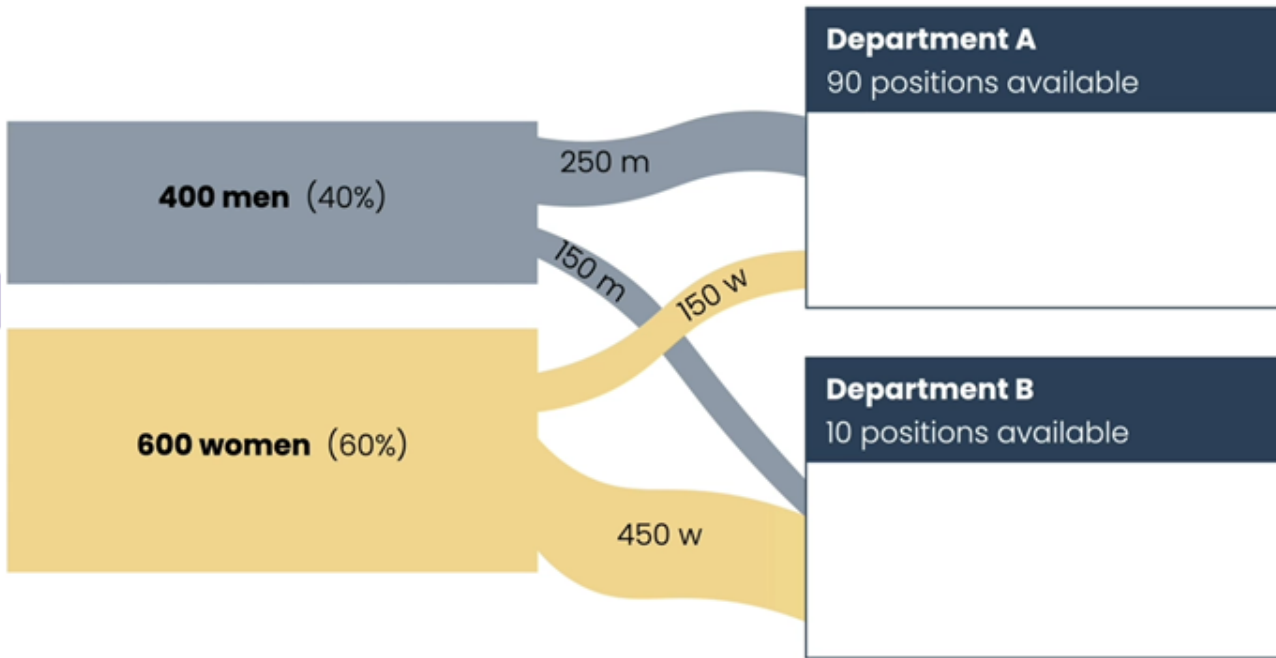


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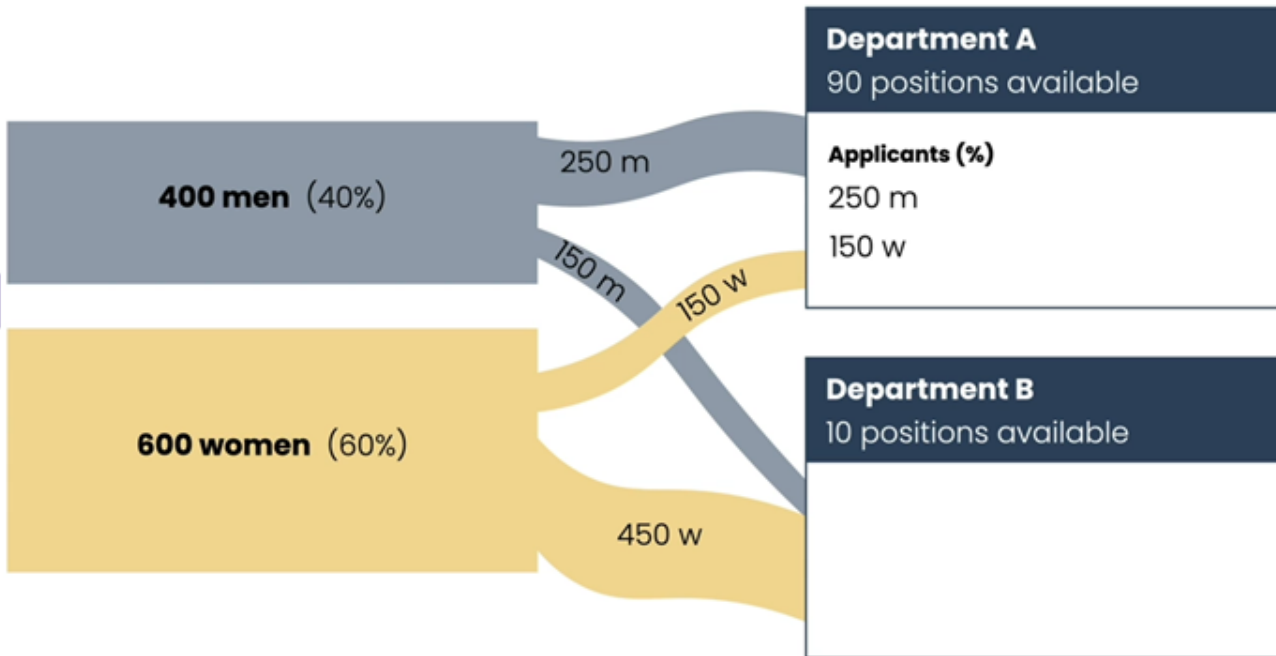


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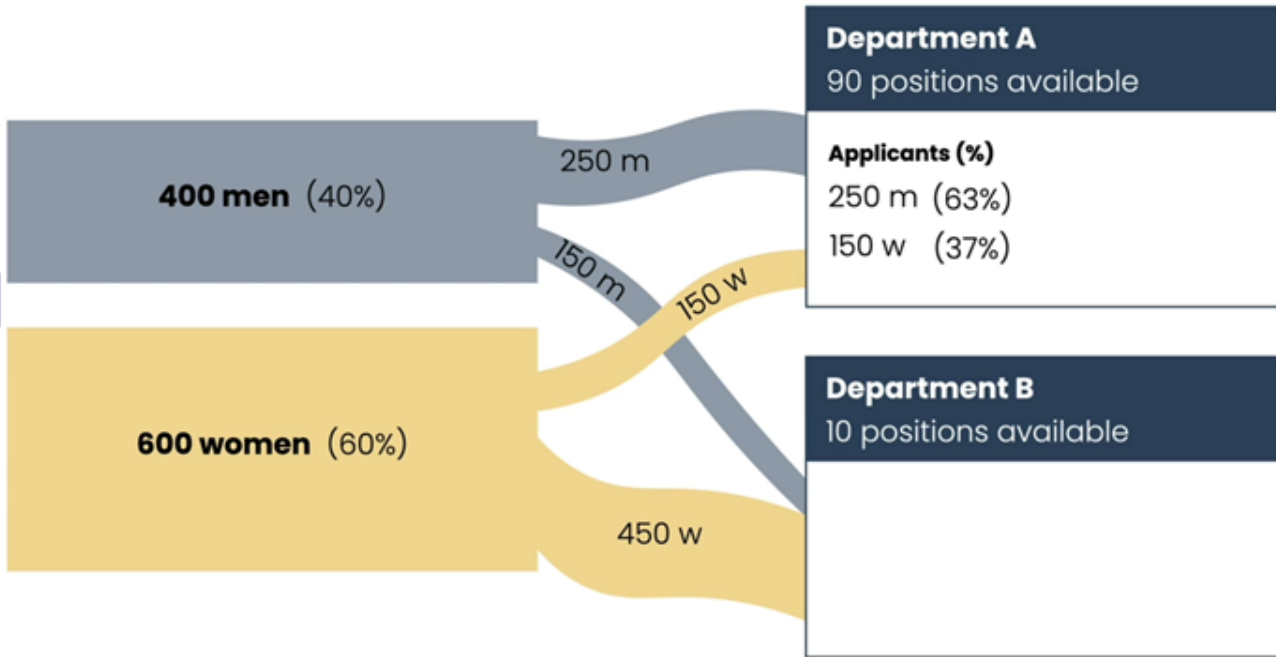


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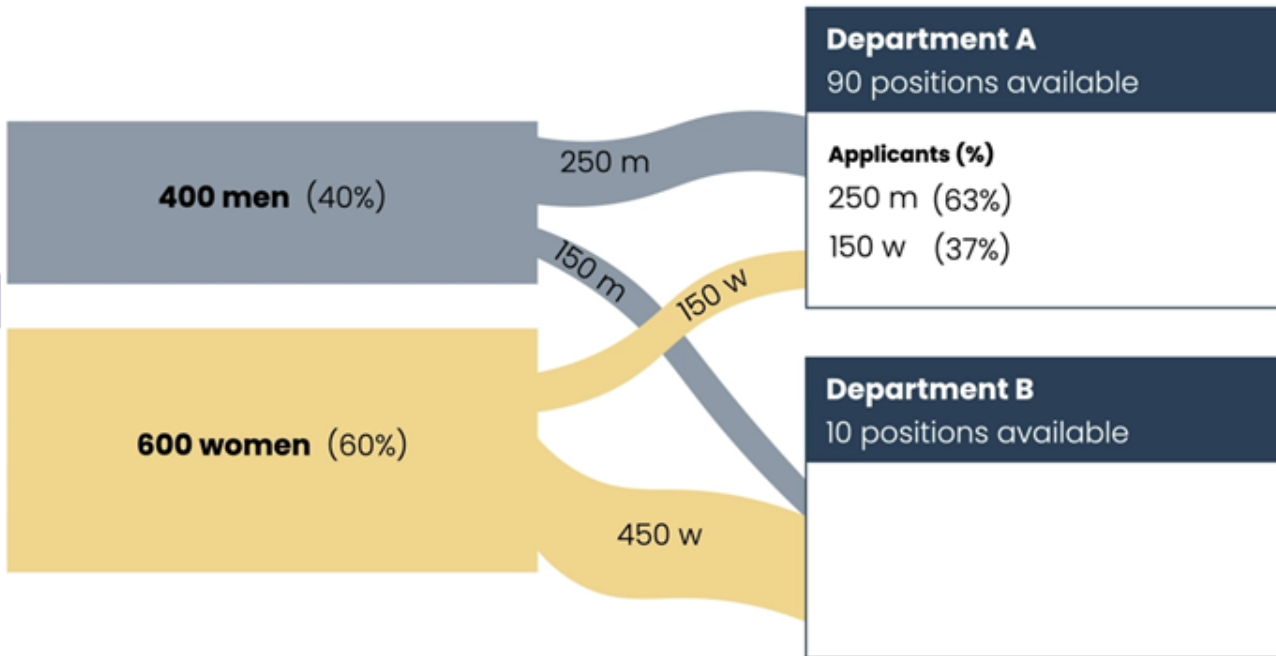


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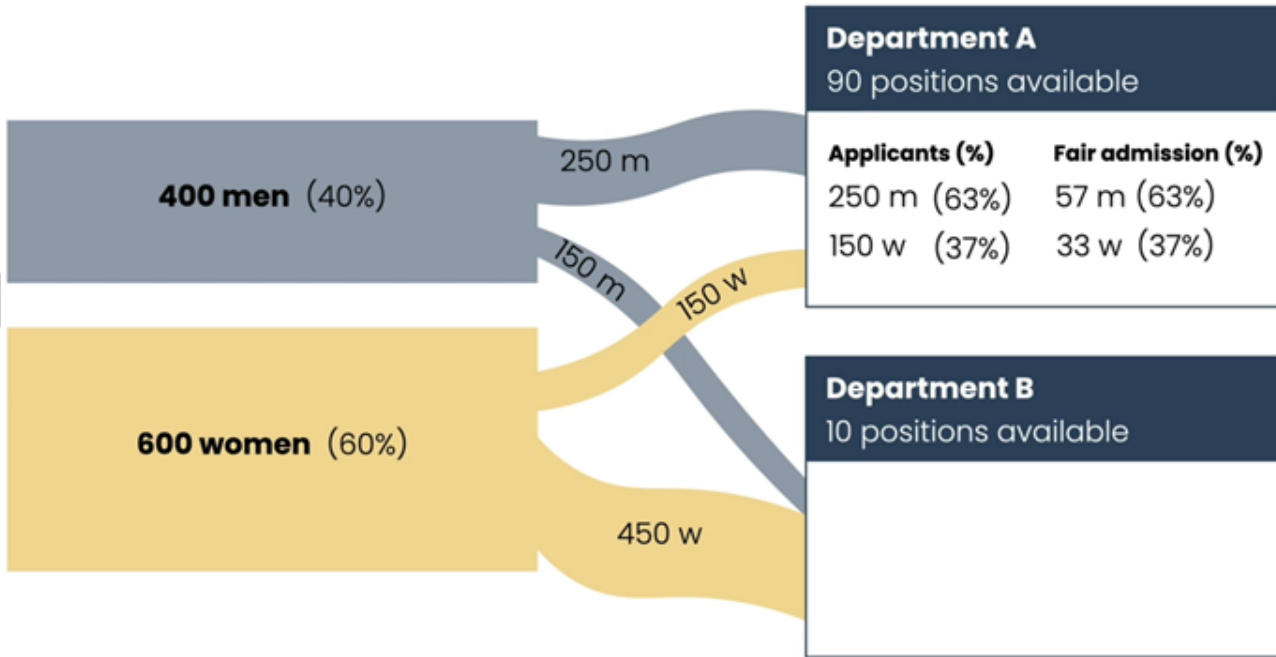


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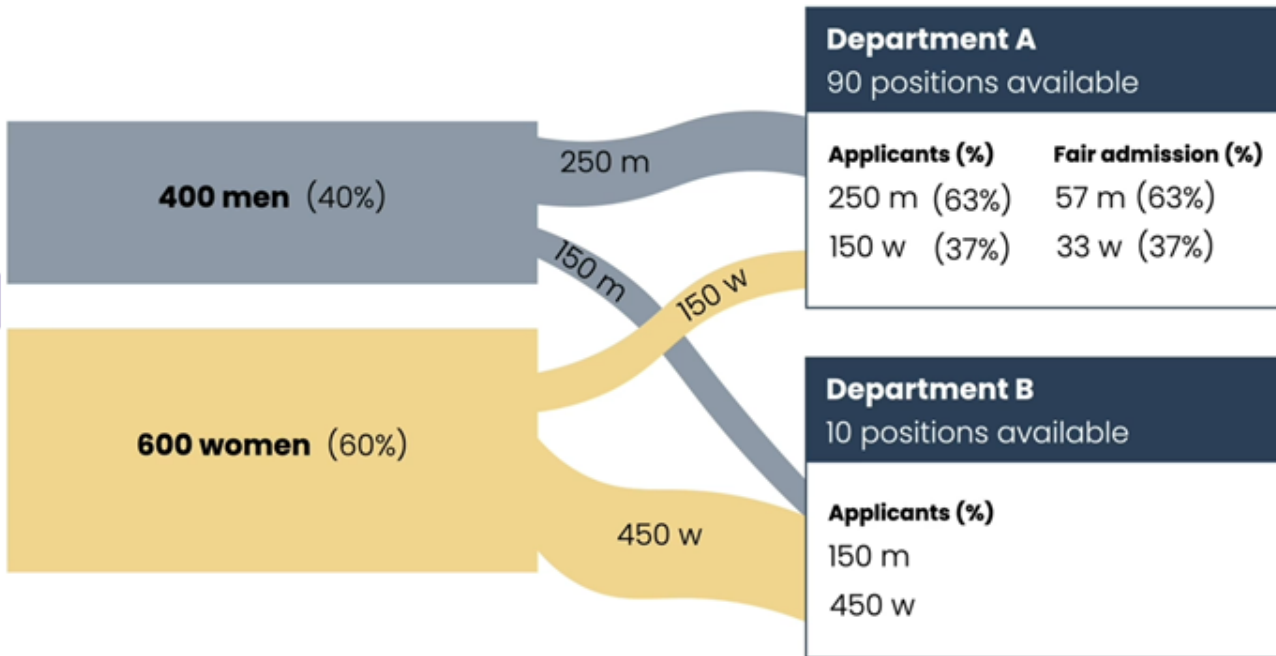


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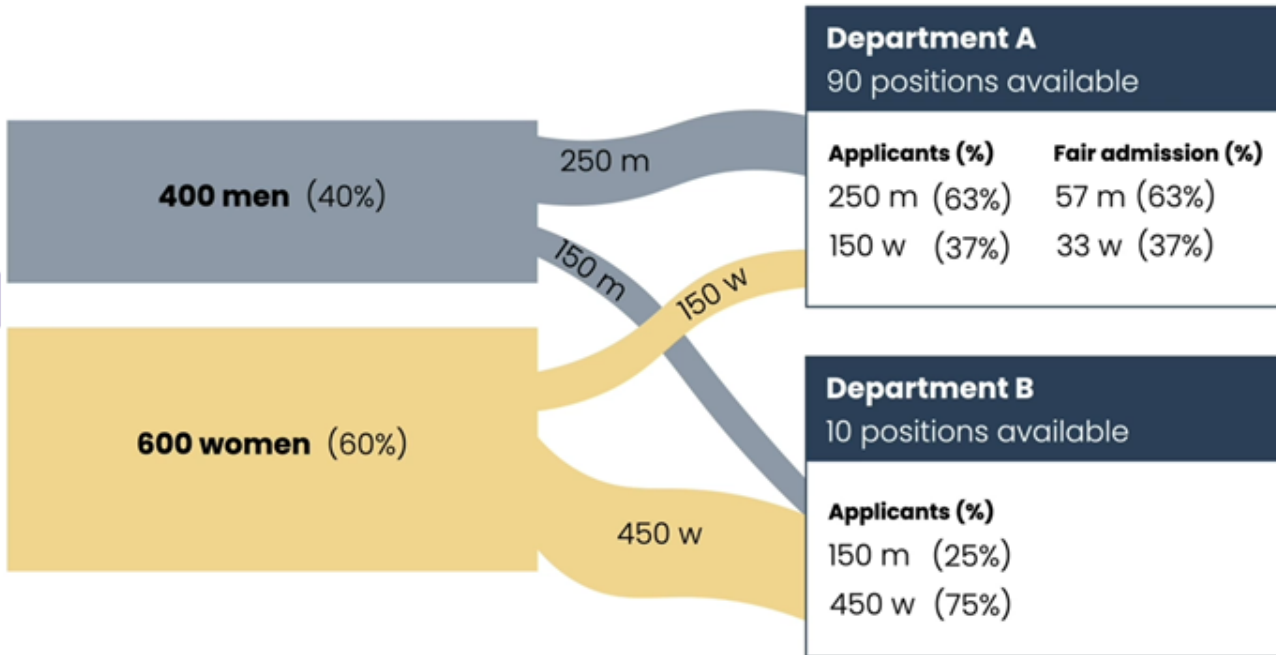


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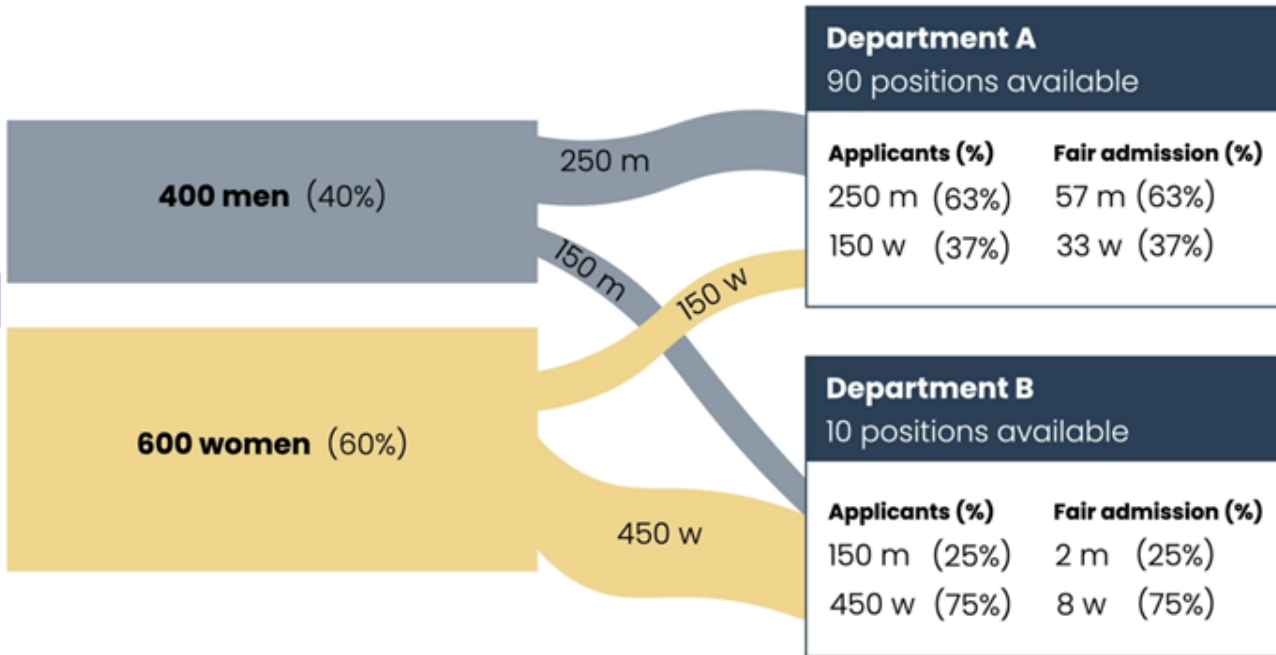


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Total positions = 100

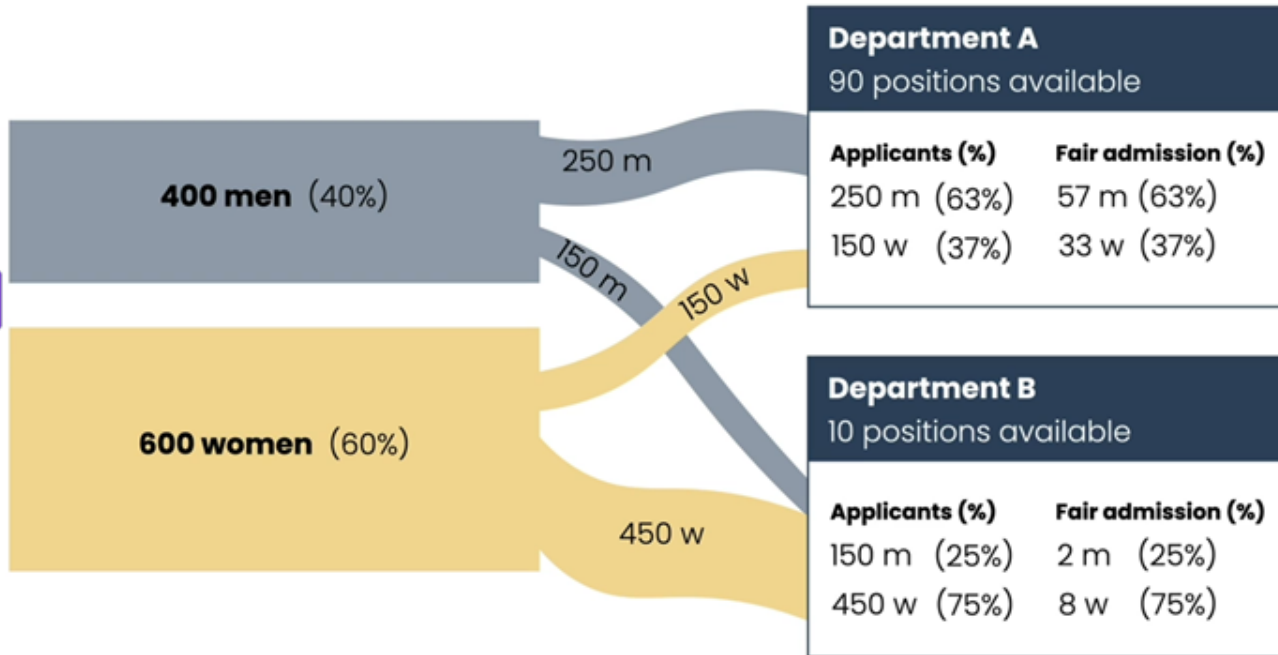


28. The Simpson's Paradox

The Simpson's paradox

Total applicants = 1000

Total positions = 100

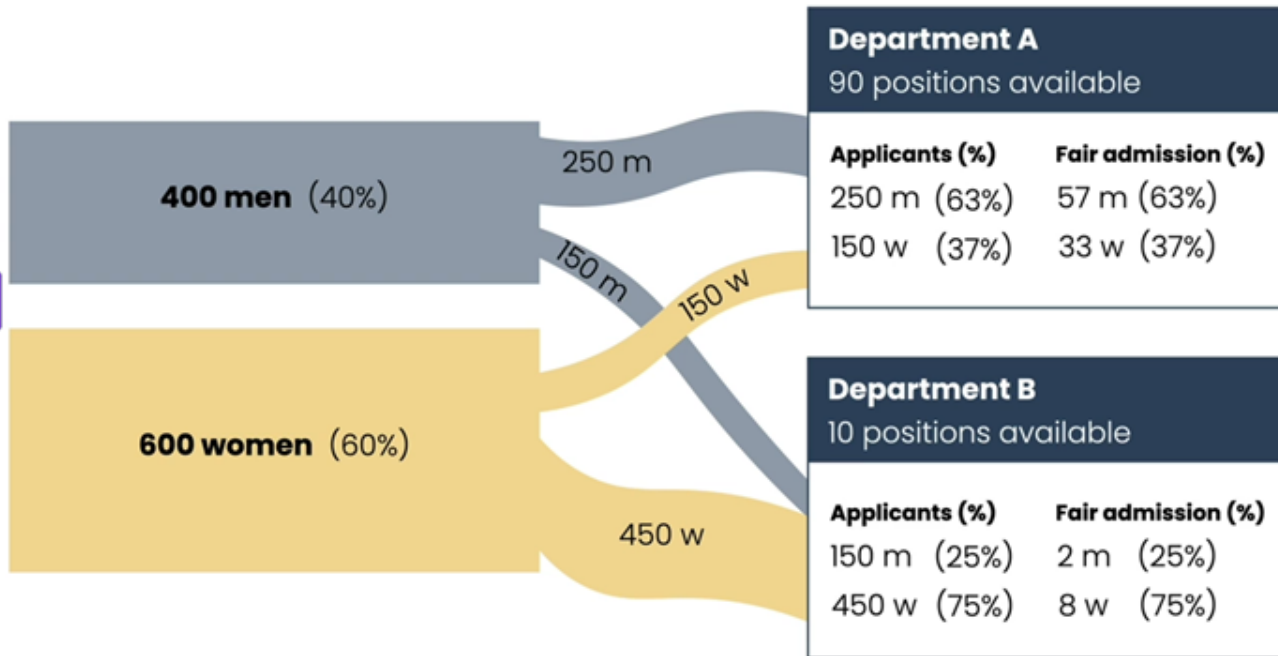


28. The Simpson's Paradox

The Simpson's paradox

Total applicants = 1000

Total positions = 100



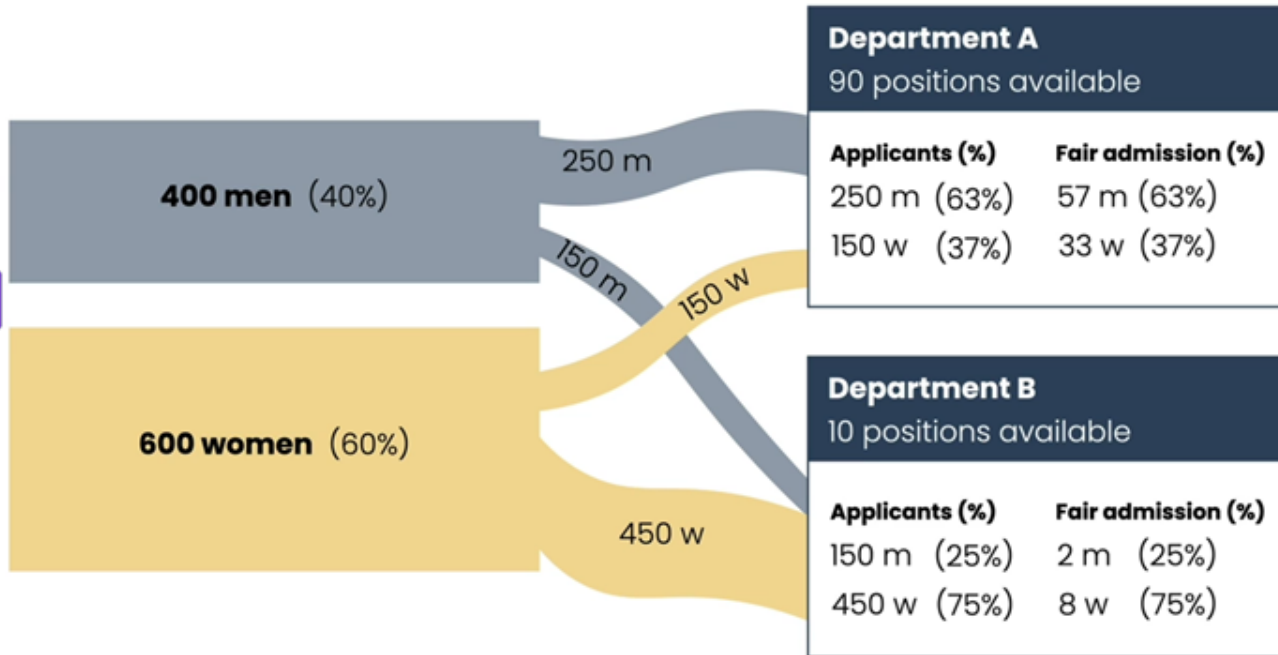
Total
Admitted men:
A: 57 m
B: 2 m
<hr/>
59 m

28. The Simpson's Paradox

The Simpson's paradox

Total applicants = 1000

Total positions = 100



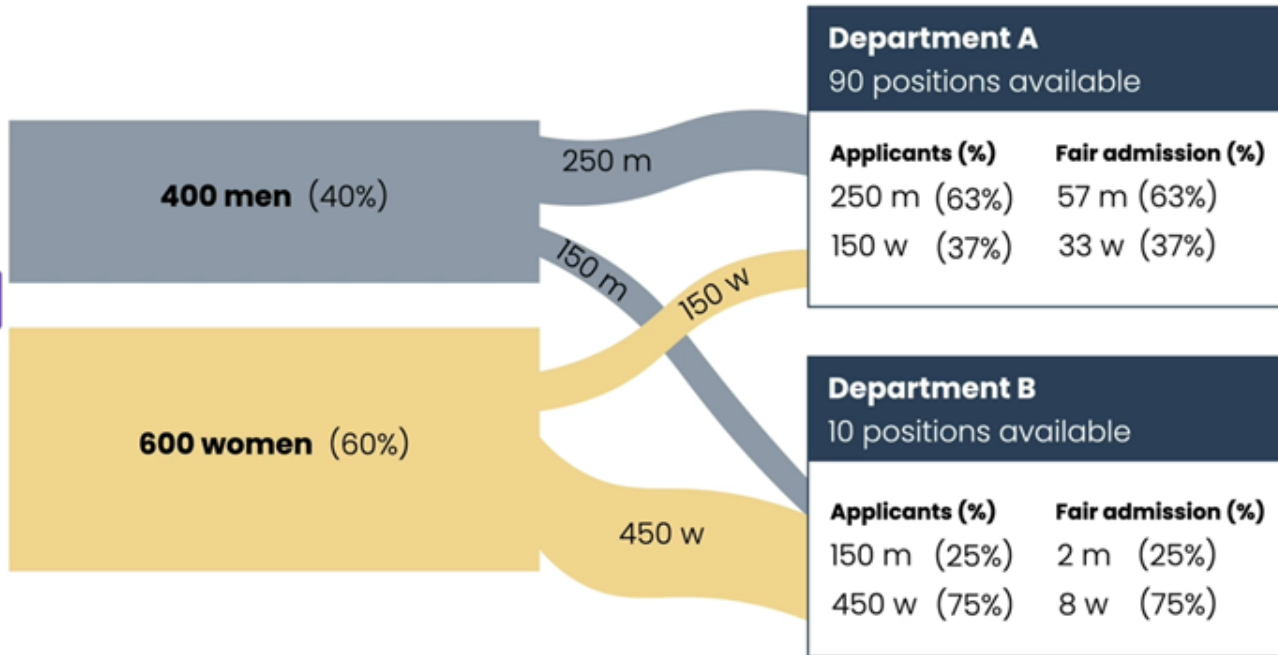
Total	
Admitted men:	Admitted women:
A: 57 m	A: 33 w
B: 2 m	B: 8 w
<hr/> 59 m	<hr/> 41 w

28. The Simpson's Paradox

The Simpson's paradox

Total applicants = 1000

Total positions = 100



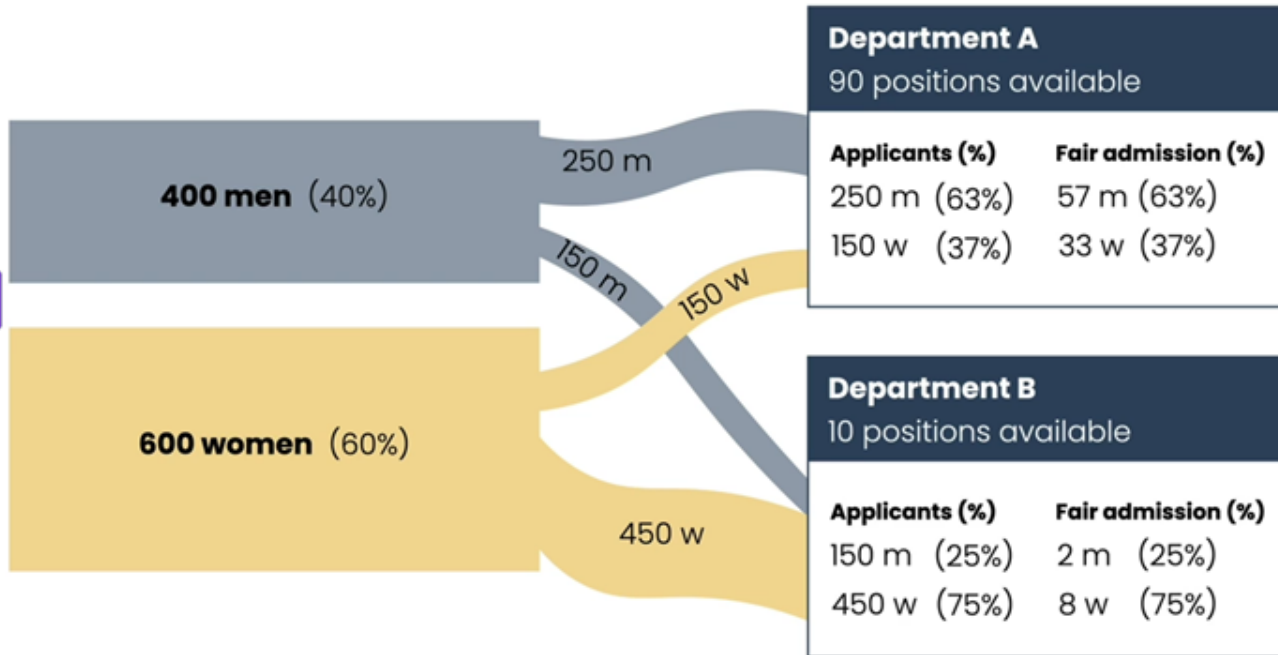
Total	
Admitted men:	Admitted women:
A: 57 m	A: 33 w
B: 2 m	B: 8 w
<hr/> 59 m	<hr/> 41 w
59%	41%

28. The Simpson's Paradox

The Simpson's paradox

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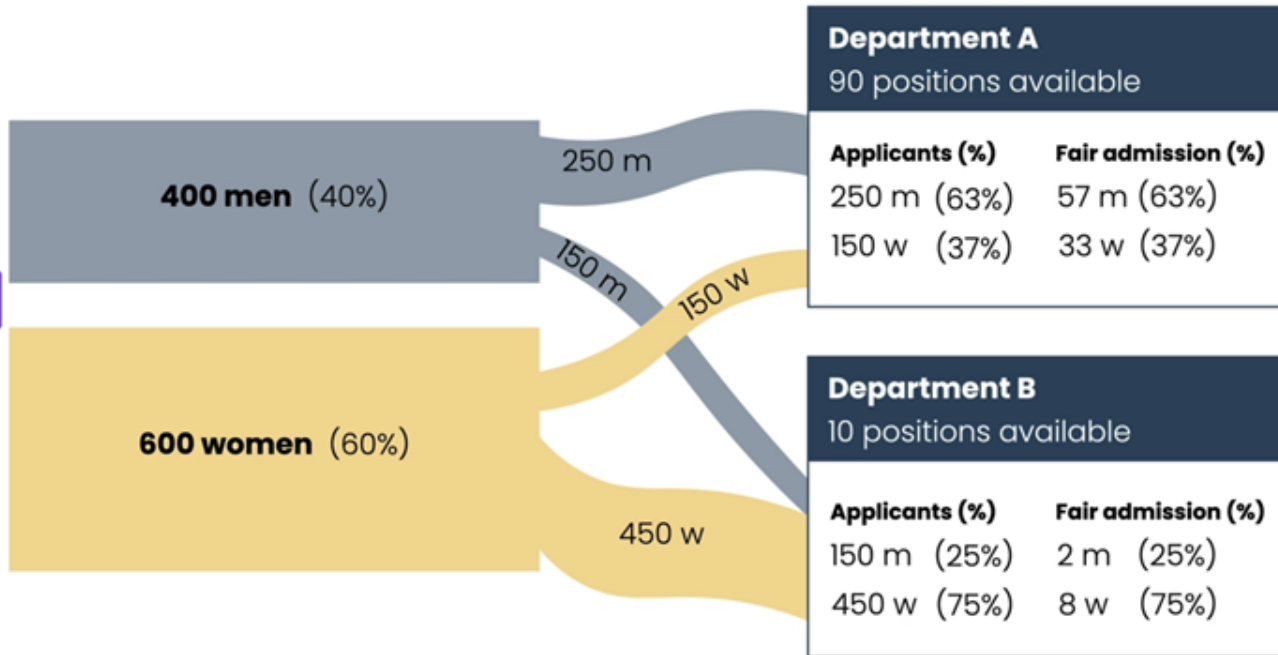
Total	
Admitted men:	Admitted women:
A: 57 m	A: 33 w
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The Simpson's paradox

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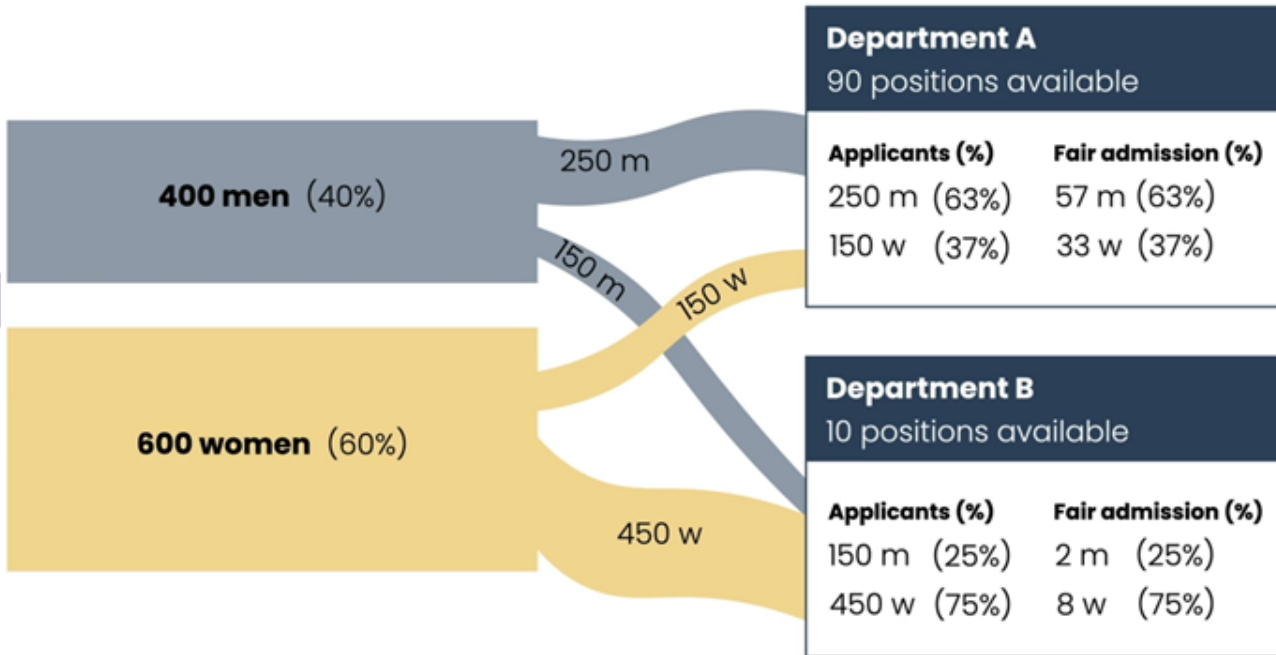
Total	
Admitted men:	Admitted women:
A: 57 m	A: 33 w
B: 2 m	B: 8 w
<hr/> 59 m	<hr/> 41 w
59%	41%
What did we expect?	
Applicant men:	Applicant women:
40%	60%

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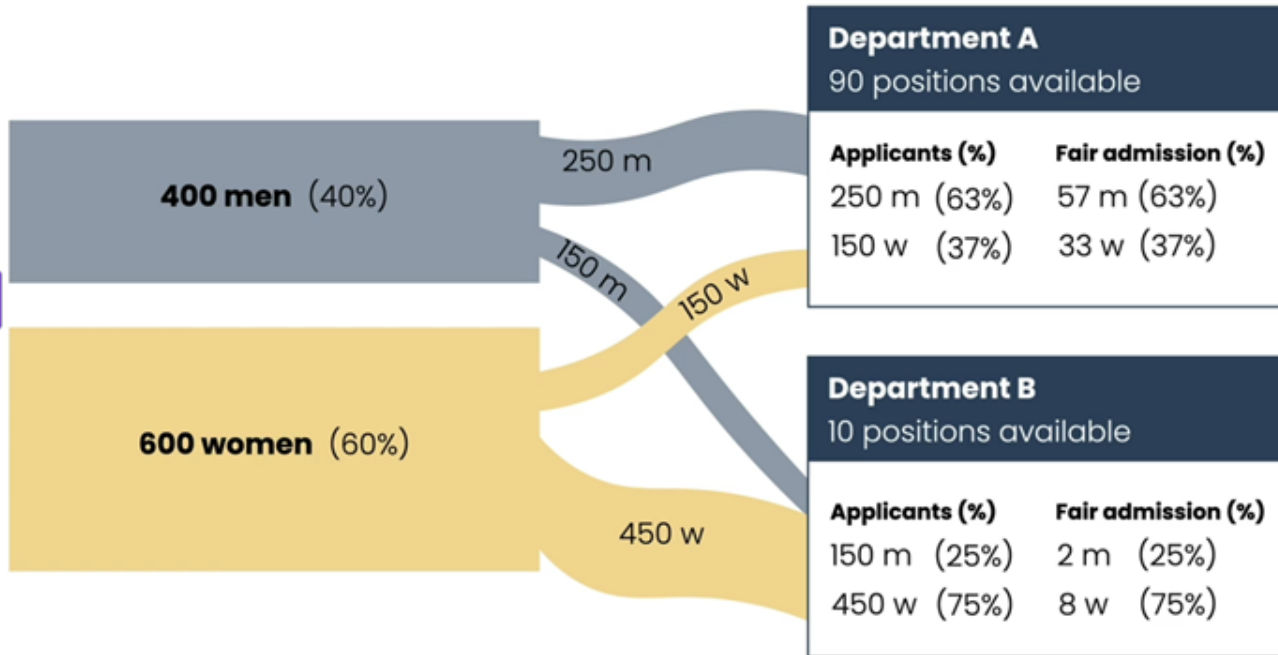
Total	
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What did we expect?	
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Be careful when analyzing aggregated data!

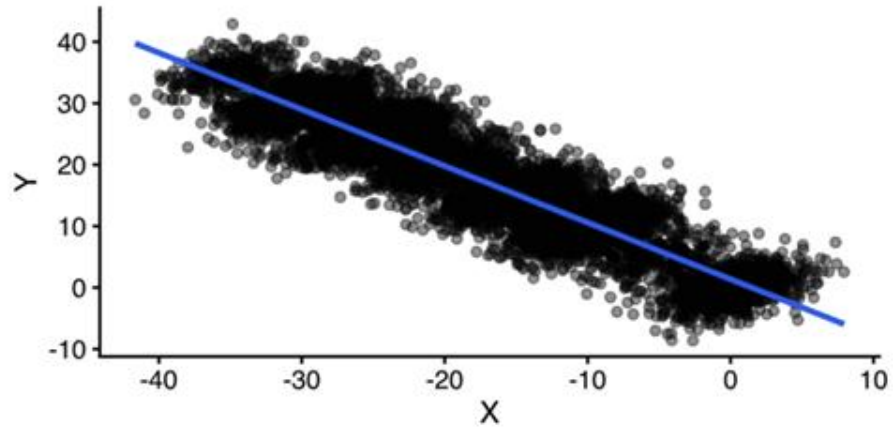
28. The Simpson's Paradox

The Simpson's paradox



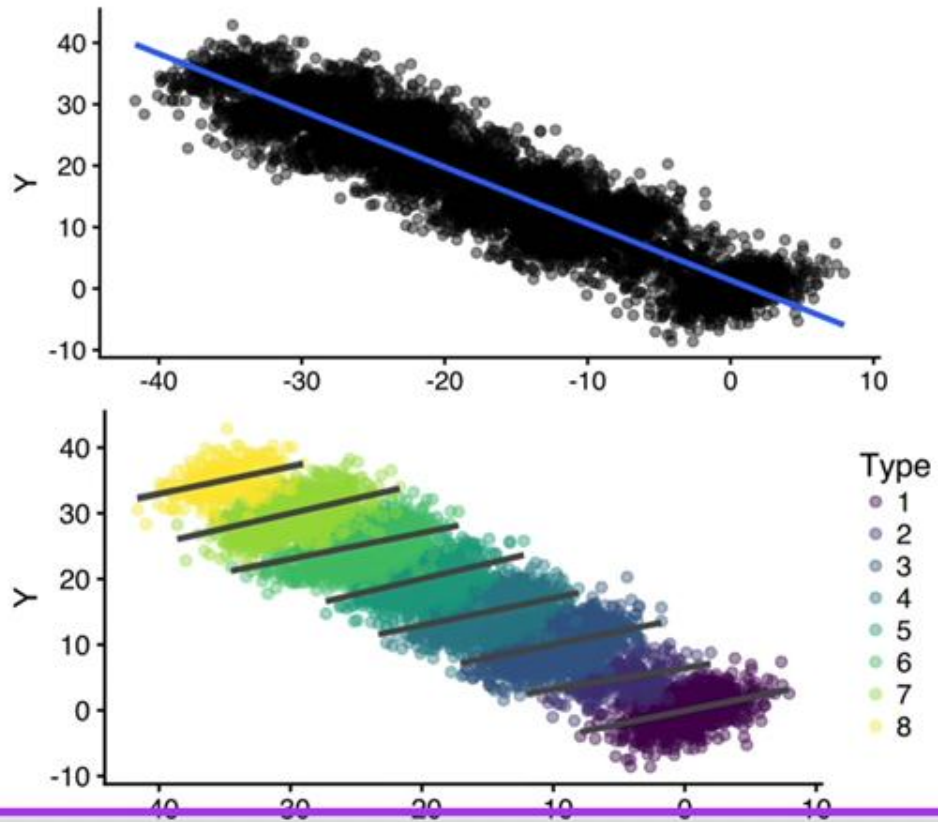
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