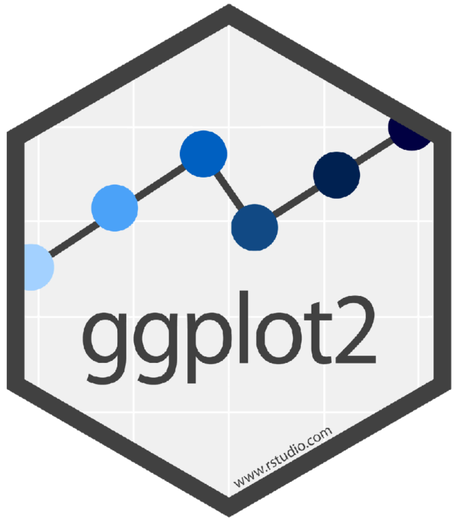
Programme for today

- Introductory lecture
- Hands-on dataviz tutorial
- Individual exercises



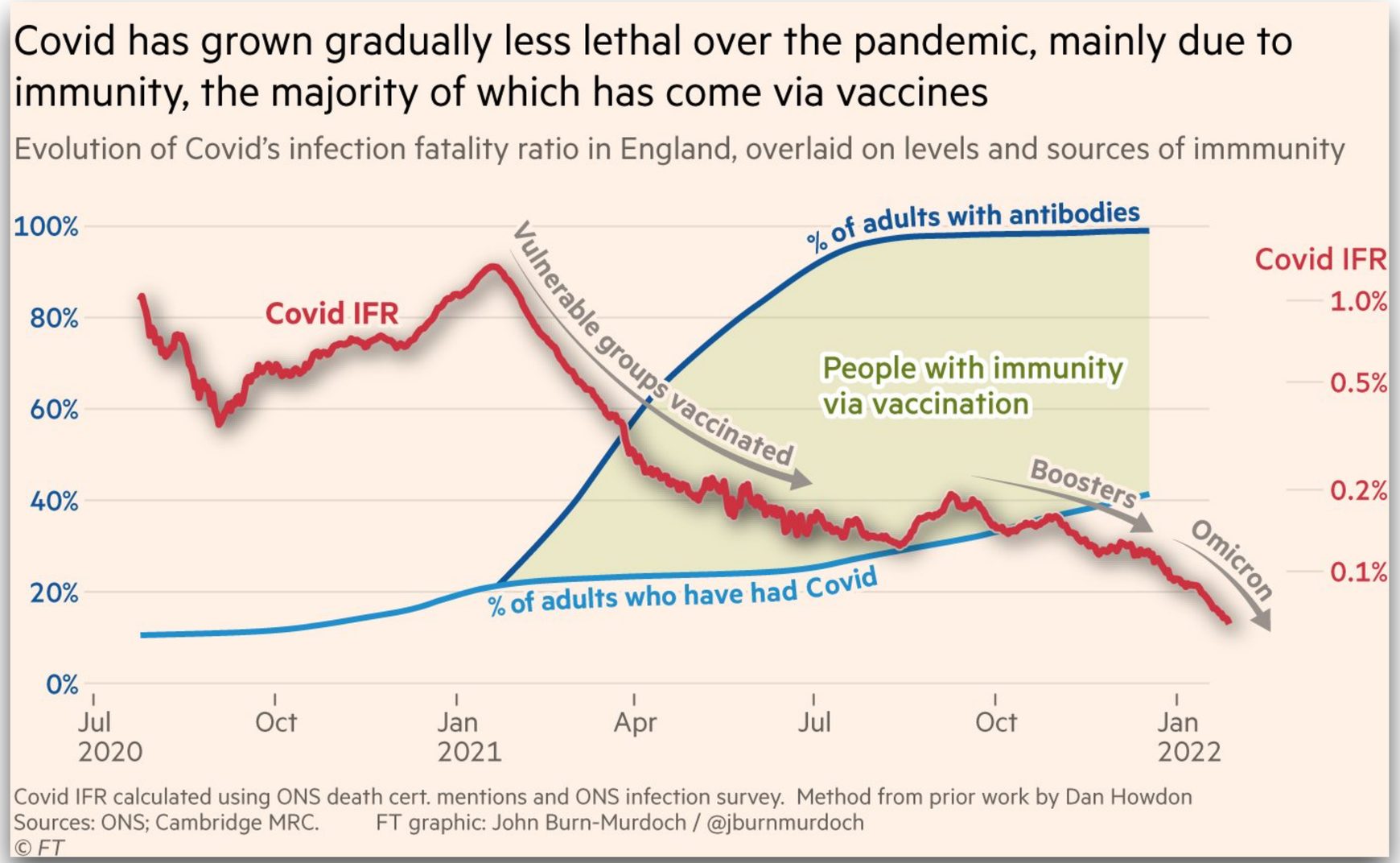
At the end of the day you should be familiar with making visualisations in R using the ggplot2 package


The greatest value of a picture is when it forces us to notice what we never expected to see.
John Tukey
quotefancy

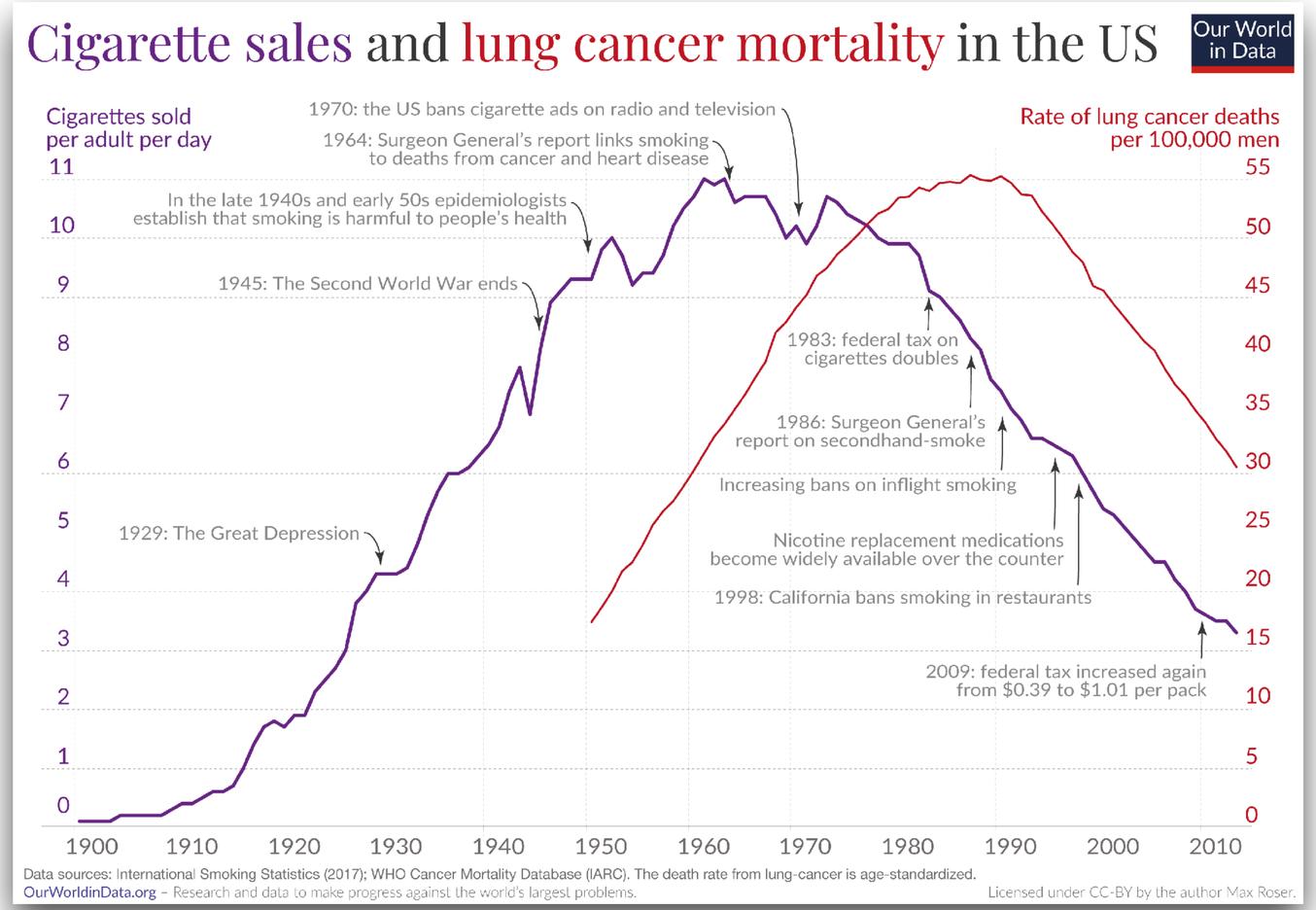
Data visualisation - Telling a story with data

iso_code,continent,location,date,total_cases,new_cases,new_cases_smoothed,total_deaths,new_deaths,new_deaths_smoothed,total_cases_per_million,new_cases_per_million,new_cases_smoothed_per_million,total_deaths_per_million,new_deaths_per_million,new_deaths_smoothed_per_million,reproduction_rate,icu_patients,icu_patients_per_million,hosp_patients,hosp_patients_per_million,weekly_icu_admissions,weekly_icu_admissions_per_million,weekly_hosp_admissions,weekly_hosp_admissions_per_million,new_tests,total_tests,total_tests_per_thousand,new_tests_per_thousand,new_tests_smoothed,new_tests_smoothed_per_thousand,positive_rate,tests_per_case,tests_units,total_vaccinations,people_vaccinated,people_fully_vaccinated,total_boosters,new_vaccinations,new_vaccinations_smoothed,total_vaccinations_per_hundred,people_vaccinated_per_hundred,people_fully_vaccinated_per_hundred,total_boosters_per_hundred,new_vaccinations_smoothed_per_million,new_people_vaccinated_smoothed,new_people_vaccinated_smoothed_per_hundred,stringency_index,population,population_density,median_age,aged_65_older,aged_70_older,gdp_per_capita,extreme_poverty,cardiovasc_death_rate,diabetes_prevalence,female_smokers,male_smokers,handwashing_facilities,hospital_beds_per_thousand,life_expectancy,human_development_index,excess_mortality_cumulative_absolute,excess_mortality_cumulative,excess_mortality,excess_mortality_cumulative_per_million
AFG,Asia,Afghanistan,2020-02-24,5.0,5.0,,,,,0.126,0.126,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,8.33,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-02-25,5.0,0.0,,,,,0.126,0.0,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,8.33,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-02-26,5.0,0.0,,,,,0.126,0.0,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,8.33,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-02-27,5.0,0.0,,,,,0.126,0.0,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,8.33,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-02-28,5.0,0.0,,,,,0.126,0.0,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,8.33,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-02-29,5.0,0.0,,,,,0.126,0.0,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,8.33,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-01,5.0,0.0,0.714,,,,0.126,0.0,0.018,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,27.78,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-02,5.0,0.0,0.0,,,,0.126,0.0,0.0,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,27.78,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-03,5.0,0.0,0.0,,,,0.126,0.0,0.0,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,27.78,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-04,5.0,0.0,0.0,,,,0.126,0.0,0.0,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,27.78,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-05,5.0,0.0,0.0,,,,0.126,0.0,0.0,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,27.78,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-06,5.0,0.0,0.0,,,,0.126,0.0,0.0,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,27.78,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-07,8.0,3.0,0.429,,,,0.201,0.075,0.011,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,27.78,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-08,8.0,0.0,0.429,,,,0.201,0.0,0.011,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,27.78,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-09,8.0,0.0,0.429,,,,0.201,0.0,0.011,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,27.78,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-10,8.0,0.0,0.429,,,,0.201,0.0,0.011,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,27.78,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-11,11.0,3.0,0.857,,,,0.276,0.075,0.022,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,27.78,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-12,11.0,0.0,0.857,,,,0.276,0.0,0.022,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,27.78,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-13,11.0,0.0,0.857,,,,0.276,0.0,0.022,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,27.78,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-14,14.0,3.0,0.857,,,,0.351,0.075,0.022,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,38.89,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-15,20.0,6.0,1.714,,,,0.502,0.151,0.043,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,38.89,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-16,25.0,5.0,2.429,,,,0.628,0.126,0.061,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,38.89,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-17,26.0,1.0,2.571,,,,0.653,0.025,0.065,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,38.89,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-18,26.0,0.0,2.143,,,,0.653,0.0,0.054,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,41.67,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-19,26.0,0.0,2.143,,,,0.653,0.0,0.054,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,41.67,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-20,24.0,,,,,,0.602,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,41.67,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-21,24.0,0.0,,,,,0.602,0.0,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,41.67,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-22,34.0,10.0,,,,,0.854,0.251,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,41.67,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-23,40.0,6.0,,1.0,1.0,,1.004,0.151,,0.025,0.025,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,41.67,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-24,42.0,2.0,,1.0,0.0,,1.054,0.05,,0.025,0.0,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,50.93,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-25,74.0,32.0,,1.0,0.0,,1.858,0.803,,0.025,0.0,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,59.26,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-26,80.0,6.0,,2.0,1.0,,2.008,0.151,,0.05,0.025,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,59.26,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-27,91.0,11.0,9.571,2.0,0.0,,2.284,0.276,0.24,0.05,0.0,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,59.26,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-28,106.0,15.0,11.714,2.0,0.0,,2.661,0.377,0.294,0.05,0.0,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,67.59,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-29,114.0,8.0,11.429,4.0,2.0,0.571,2.862,0.201,0.287,0.1,0.05,0.014,1.51,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,67.59,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-30,114.0,0.0,10.571,4.0,0.0,0.429,2.862,0.0,0.265,0.1,0.0,0.011,1.51,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,67.59,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-03-31,166.0,52.0,17.714,4.0,0.0,0.429,4.167,1.305,0.445,0.1,0.0,0.011,1.52,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,67.59,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-04-01,192.0,26.0,16.857,4.0,0.0,0.429,4.82,0.653,0.423,0.1,0.0,0.011,1.52,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,67.59,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-04-02,235.0,43.0,22.143,4.0,0.0,0.286,5.899,1.079,0.556,0.1,0.0,0.007,1.51,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,67.59,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-04-03,269.0,34.0,25.429,5.0,1.0,0.429,6.753,0.854,0.638,0.126,0.025,0.011,1.5,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,67.59,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-04-04,270.0,1.0,23.429,5.0,0.0,0.429,6.778,0.025,0.588,0.126,0.0,0.011,1.49,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,67.59,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-04-05,299.0,29.0,26.429,7.0,2.0,0.429,7.506,0.728,0.663,0.176,0.05,0.011,1.49,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,78.7,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-04-06,337.0,38.0,31.857,7.0,0.0,0.429,8.46,0.954,0.8,0.176,0.0,0.011,1.49,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,78.7,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-04-07,367.0,30.0,28.714,11.0,4.0,1.0,9.213,0.753,0.721,0.276,0.1,0.025,1.48,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,78.7,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-04-08,423.0,56.0,33.0,14.0,3.0,1.429,10.619,1.406,0.828,0.351,0.075,0.036,1.48,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,78.7,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-04-09,444.0,21.0,29.857,15.0,1.0,1.571,11.146,0.527,0.75,0.377,0.025,0.039,1.48,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,78.7,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-04-10,521.0,77.0,36.0,15.0,0.0,1.429,13.079,1.933,0.904,0.377,0.0,0.036,1.47,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,78.7,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-04-11,521.0,0.0,35.857,15.0,0.0,1.429,13.079,0.0,0.9,0.377,0.0,0.036,1.47,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,78.7,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-04-12,555.0,34.0,36.571,18.0,3.0,1.571,13.932,0.854,0.918,0.452,0.075,0.039,1.47,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,84.26,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-04-13,607.0,52.0,38.571,19.0,1.0,1.714,15.238,1.305,0.968,0.477,0.025,0.043,1.47,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,84.26,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-04-14,665.0,58.0,42.571,22.0,3.0,1.571,16.694,1.456,1.069,0.552,0.075,0.039,1.47,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,84.26,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-04-15,770.0,105.0,49.571,25.0,3.0,1.571,19.33,2.636,1.244,0.628,0.075,0.039,1.47,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,84.26,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-04-16,794.0,24.0,50.0,29.0,4.0,2.0,19.932,0.602,1.255,0.728,0.1,0.05,1.46,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,84.26,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-04-17,845.0,51.0,46.286,30.0,1.0,2.143,21.212,1.28,1.162,0.753,0.025,0.054,1.46,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,84.26,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-04-18,908.0,63.0,55.286,30.0,0.0,2.143,22.794,1.582,1.388,0.753,0.0,0.054,1.46,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,84.26,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-04-19,933.0,25.0,54.0,30.0,0.0,1.714,23.421,0.628,1.356,0.753,0.0,0.043,1.46,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,84.26,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-04-20,996.0,63.0,55.571,33.0,3.0,2.0,25.003,1.582,1.395,0.828,0.075,0.05,1.47,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,84.26,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-04-21,1026.0,30.0,51.571,36.0,3.0,2.0,25.756,0.753,1.295,0.904,0.075,0.05,1.48,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,84.26,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,
AFG,Asia,Afghanistan,2020-04-22,1092.0,66.0,46.0,36.0,0.0,1.571,27.413,1.657,1.155,0.904,0.0,0.039,1.49,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,84.26,39835428.0,54.422,18.6,2.581,1.337,1803.987,,597.029,9.59,,,37.746,0.5,64.83,0.511,,,,

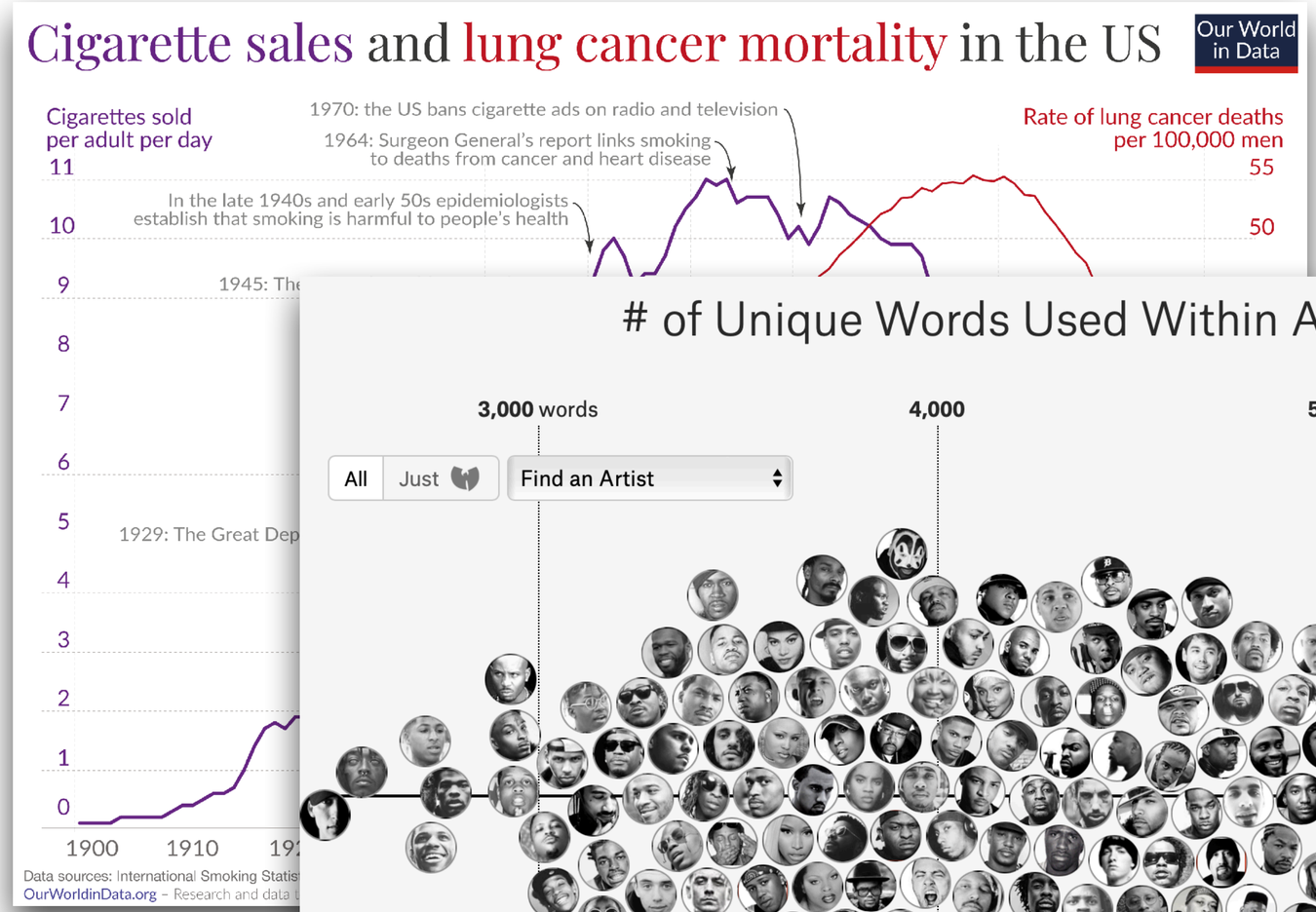
Data visualisation - Telling a story with data



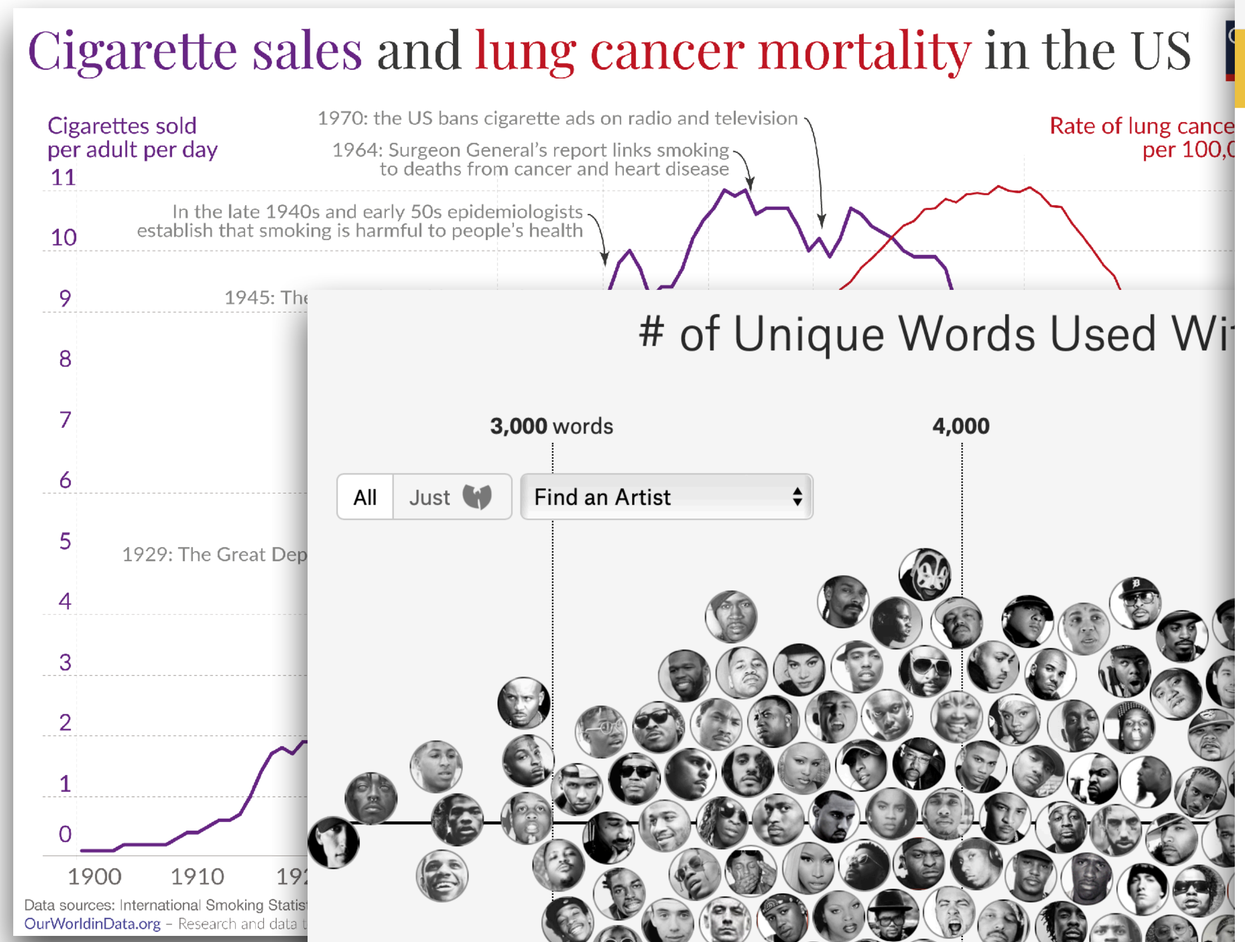
Data visualisation - Telling a story with data



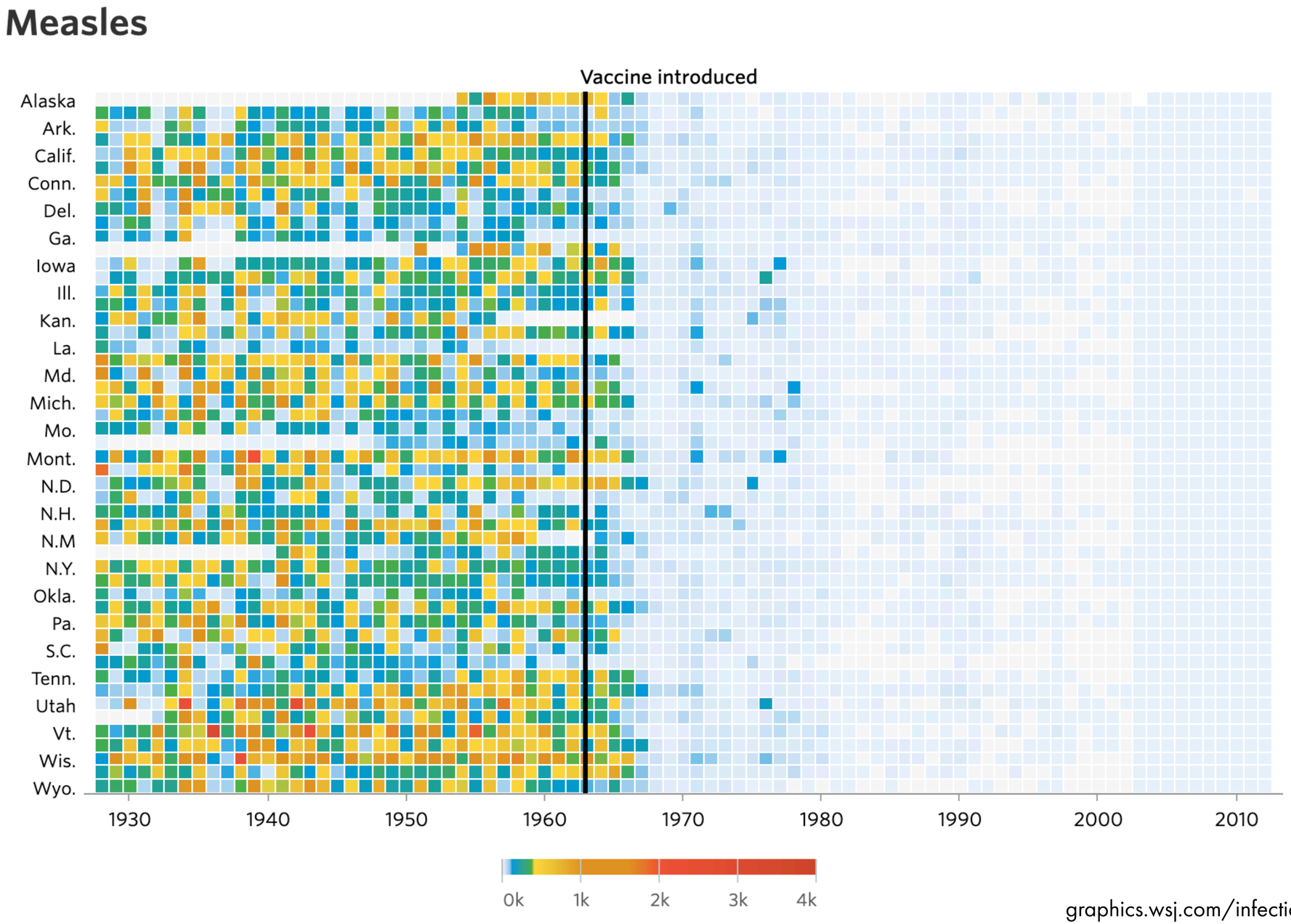
Data visualisation - Telling a story with data



Data visualisation - Telling a story with data

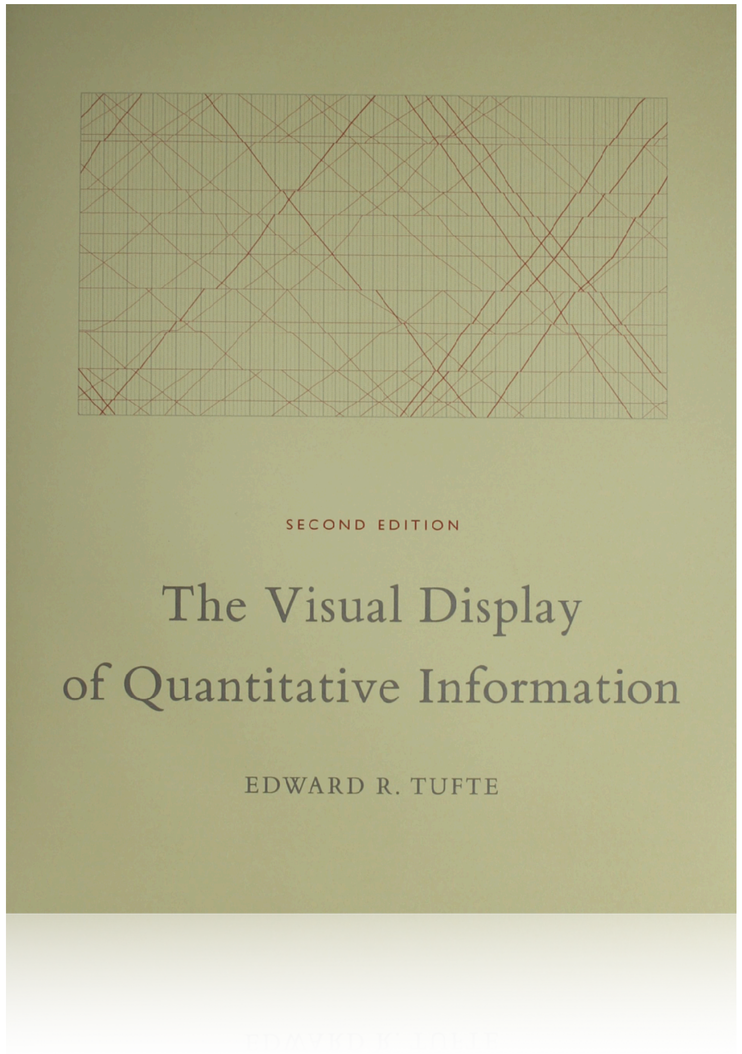


The impact of vaccines on infectious diseases



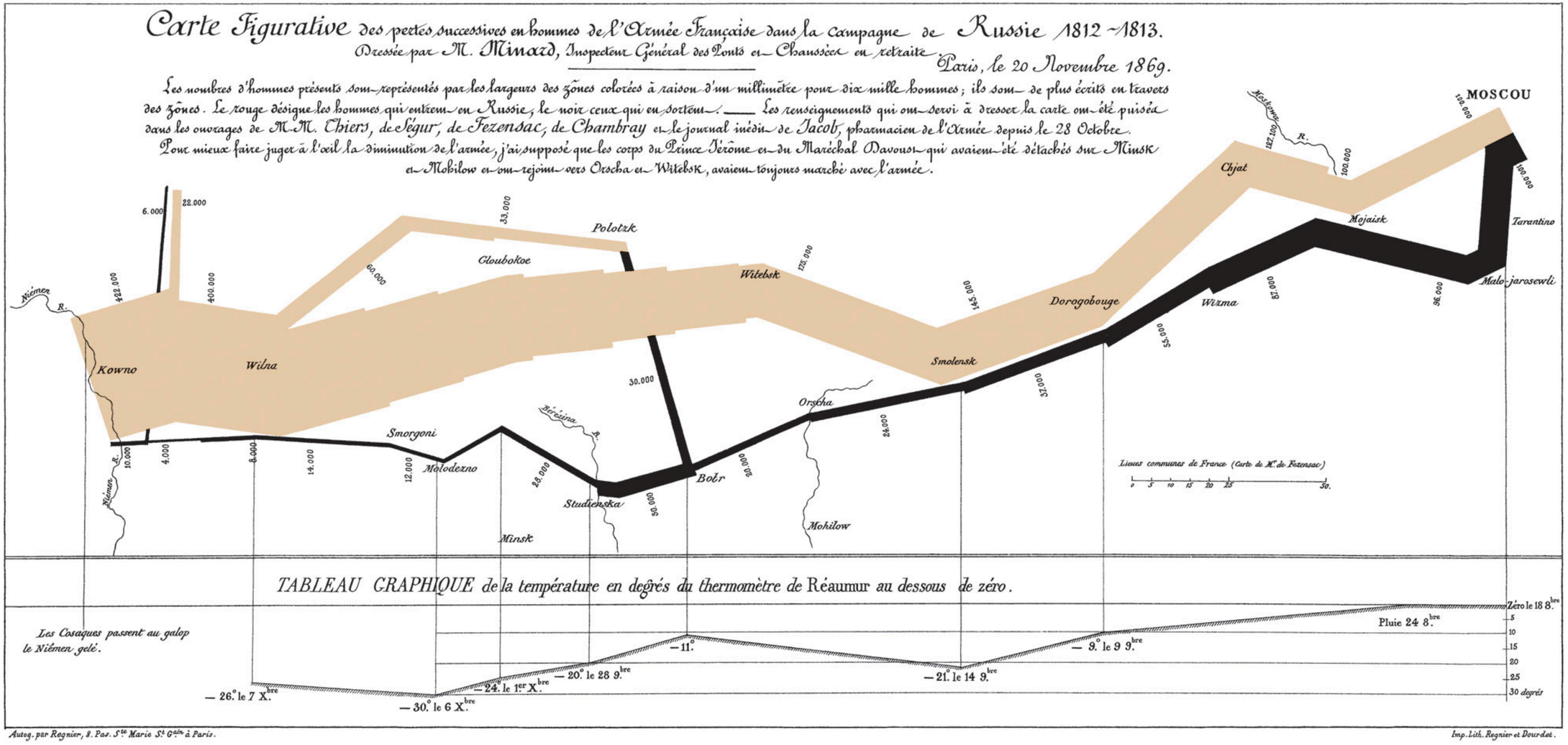
graphics.wsj.com/infectious-diseases-and-vaccines/

Pioneers of data visualisation - Edward Tufte (“ET”)



www.edwardtufte.com

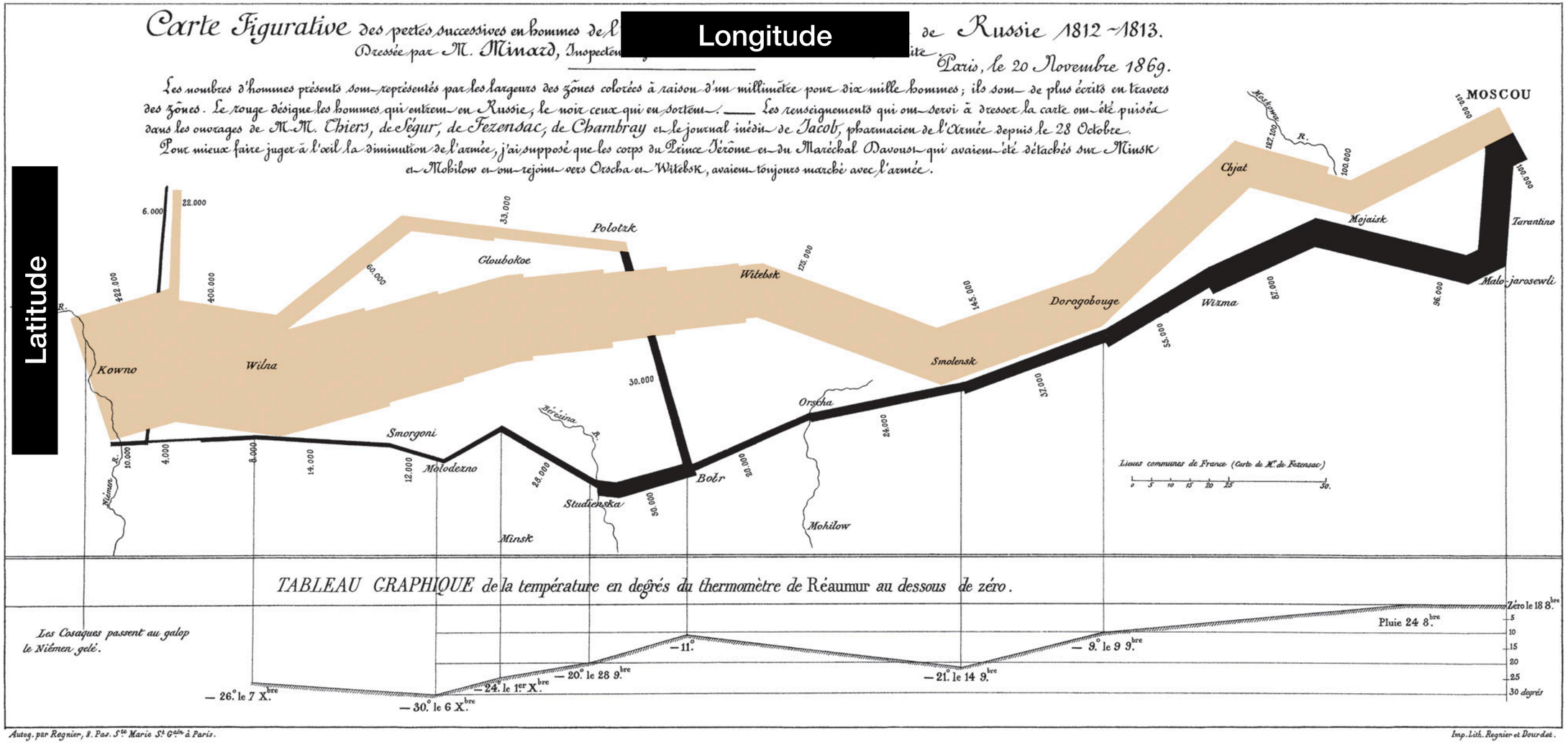
“The best statistical graph ever drawn”



Charles Joseph Minard

“Carte figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812–1813”

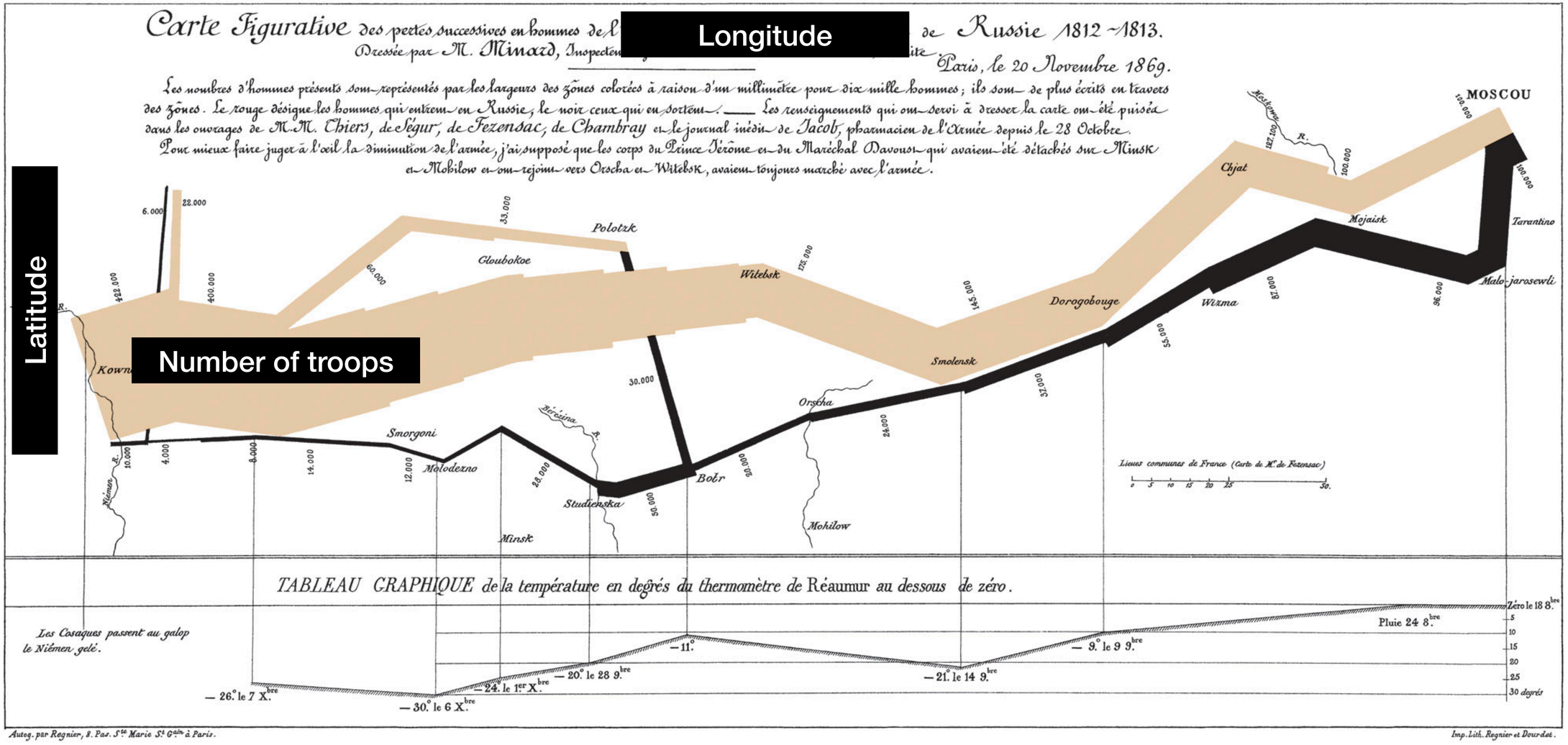
“The best statistical graph ever drawn”



Charles Joseph Minard

“Carte figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812–1813”

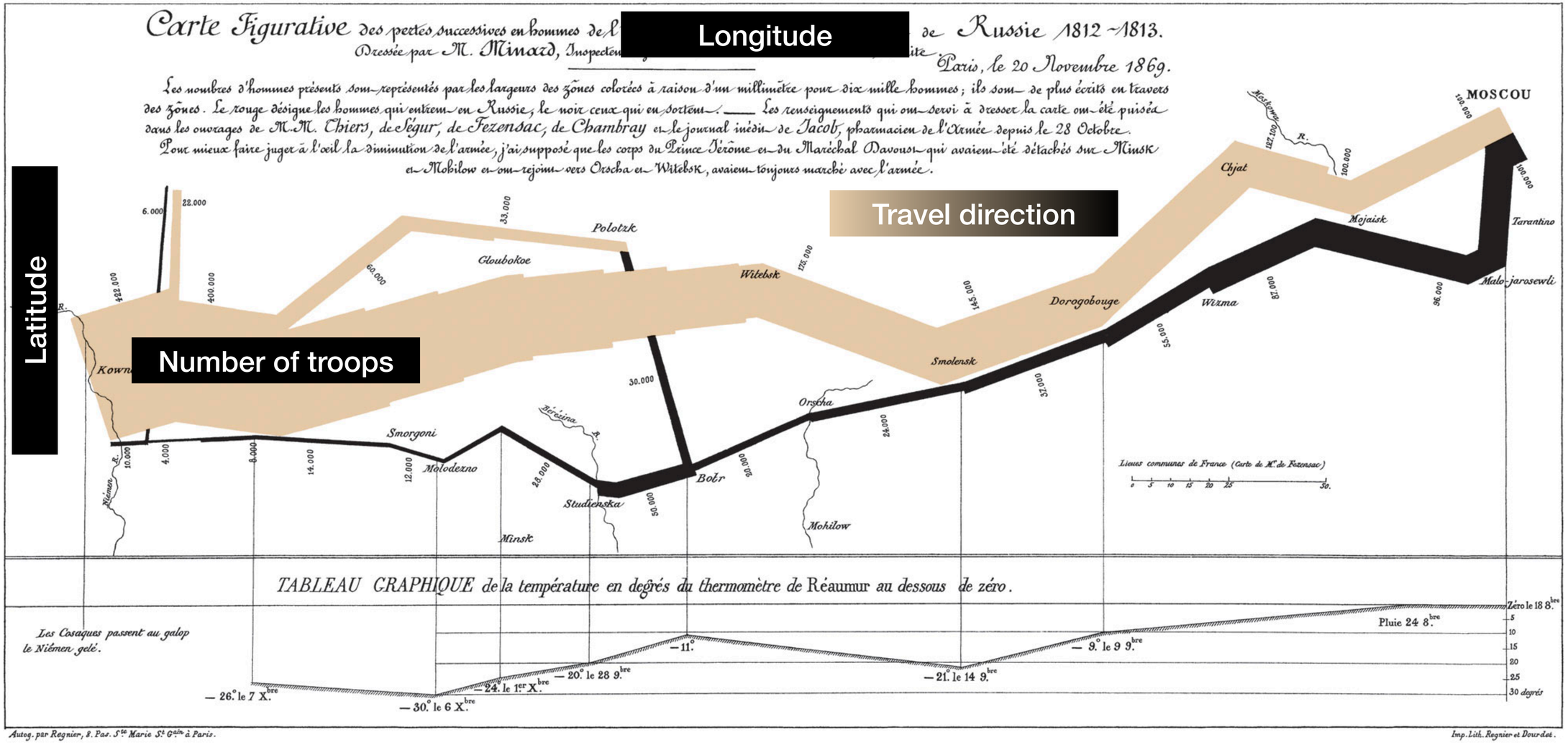
“The best statistical graph ever drawn”



Charles Joseph Minard

“Carte figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812–1813”

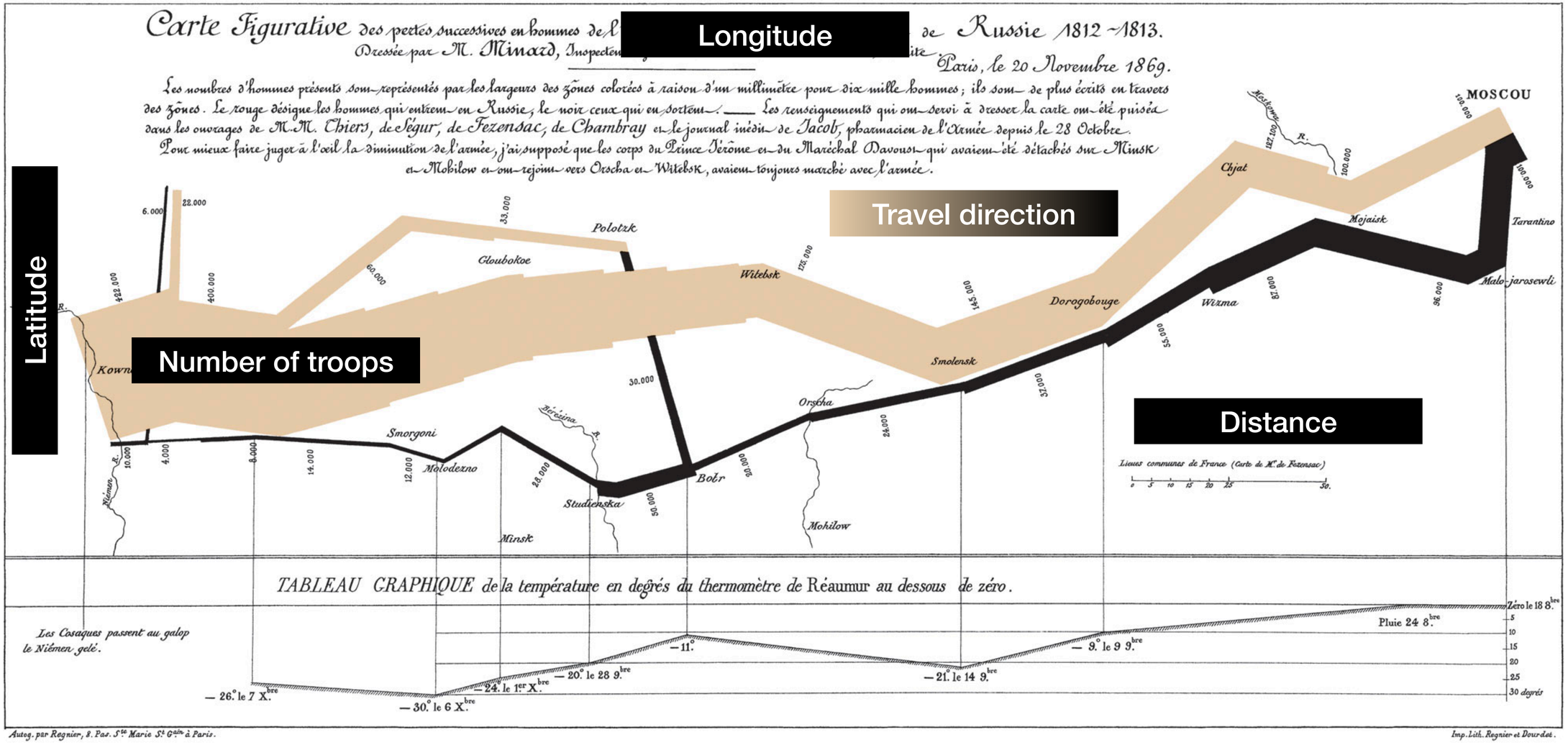
“The best statistical graph ever drawn”



Charles Joseph Minard

“Carte figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812–1813”

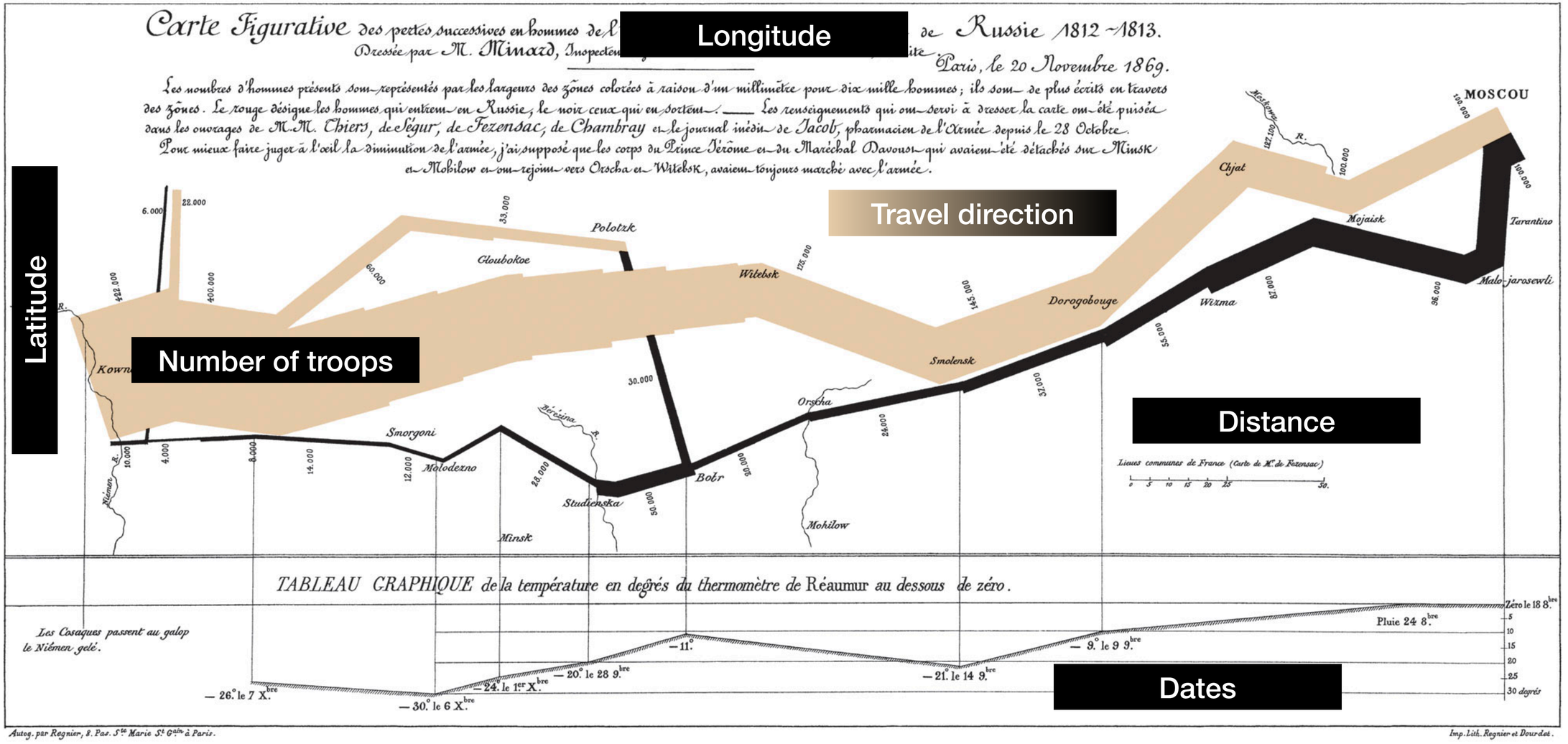
“The best statistical graph ever drawn”



Charles Joseph Minard

“Carte figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812–1813”

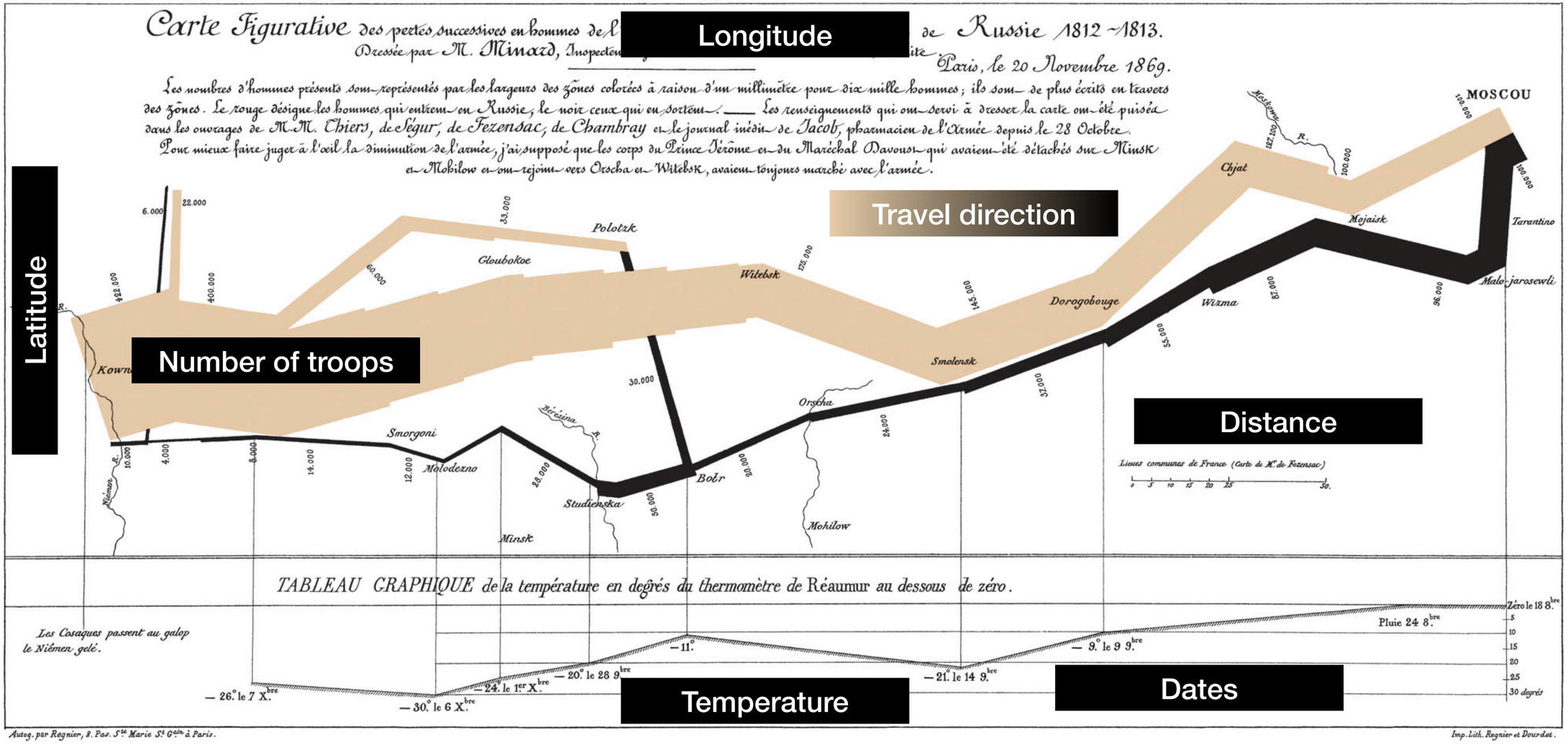
“The best statistical graph ever drawn”



Charles Joseph Minard

“Carte figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812–1813”

“The best statistical graph ever drawn”

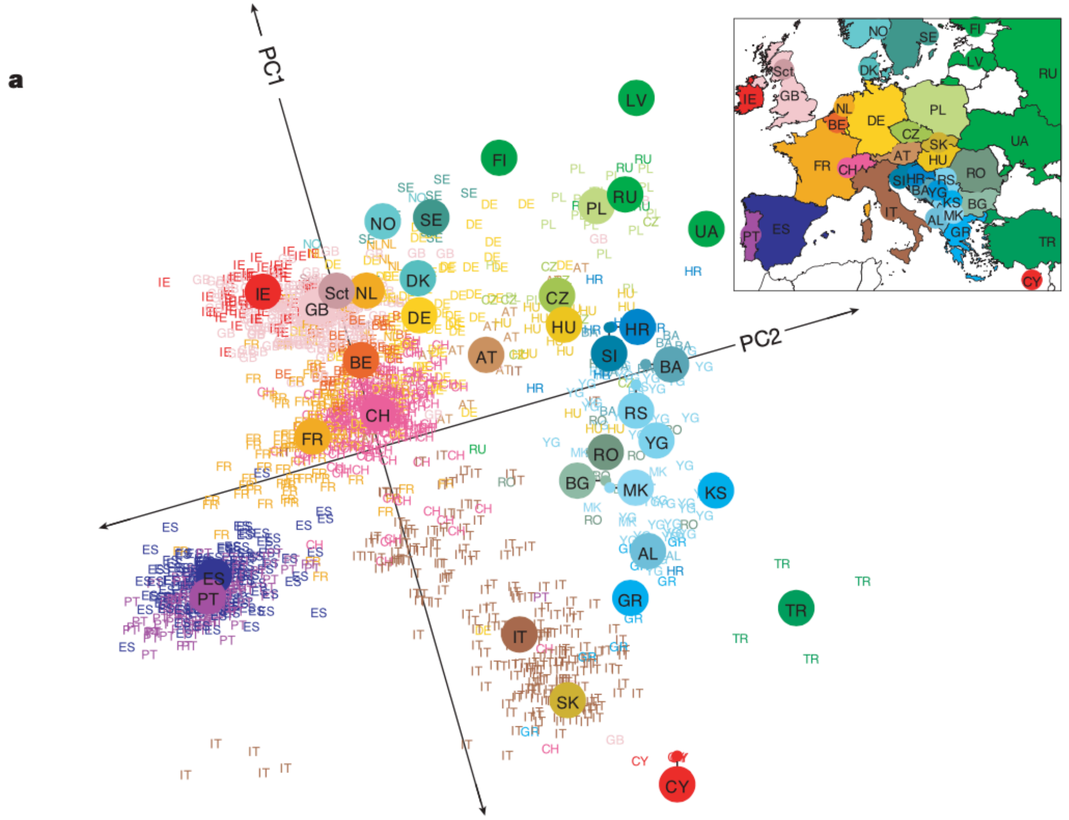


Charles Joseph Minard

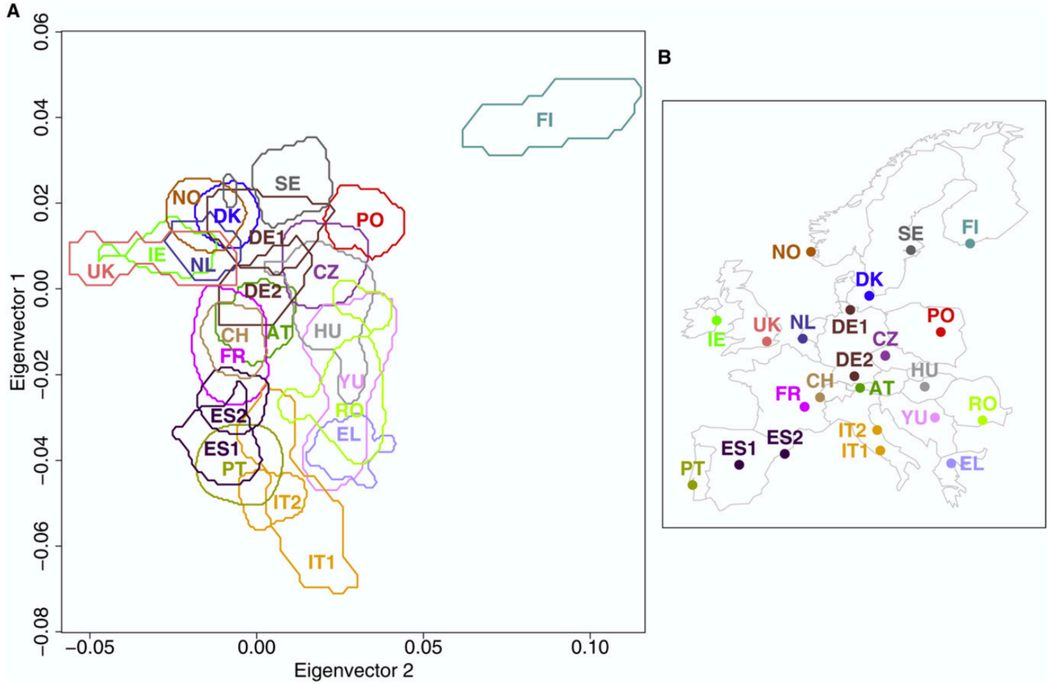
“Carte figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812–1813”

A tale of two visualisations

Novembre et al 2008



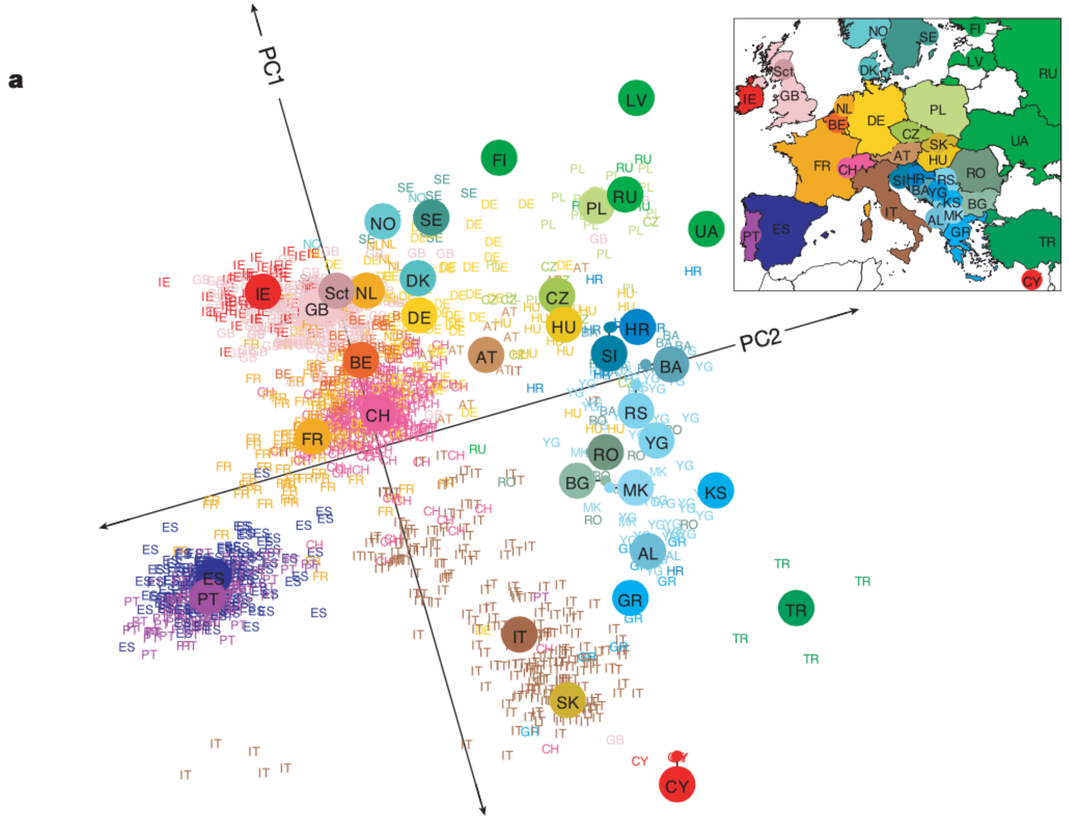
Lao et al 2008



Which visualisation do you prefer?

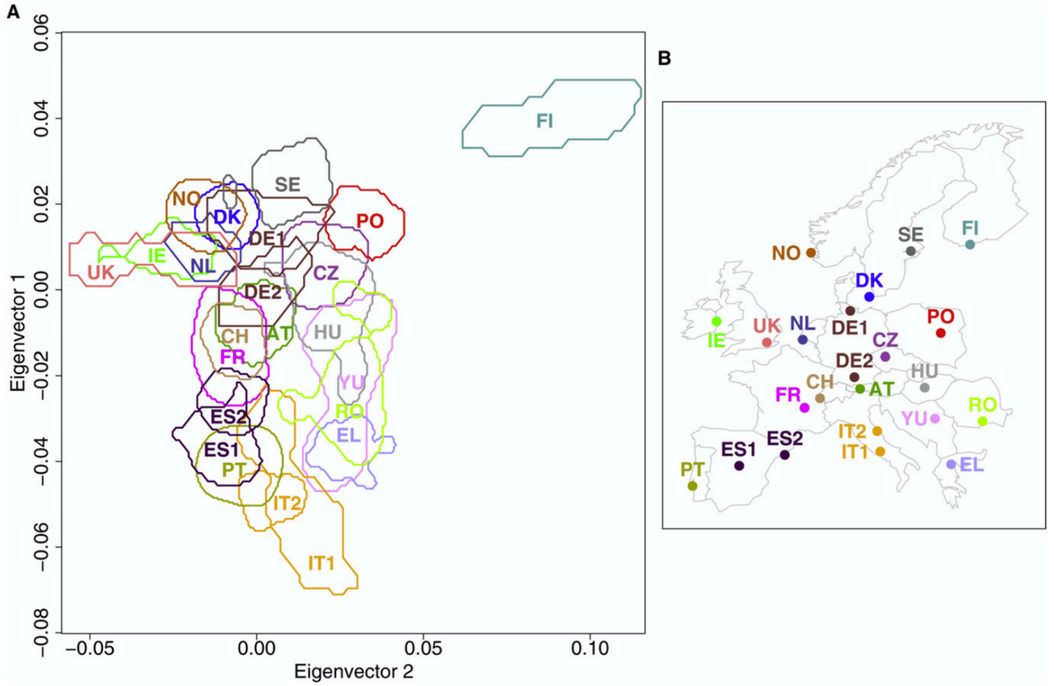
A tale of two visualisations

Novembre et al, 31/8/2008
"Genes mirror geography in Europe"



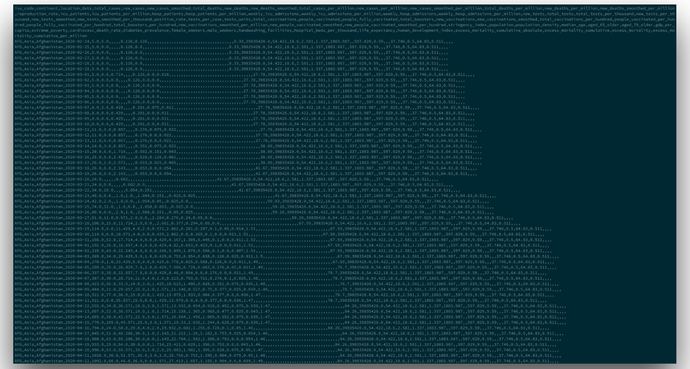
1,883 citations (Nature)

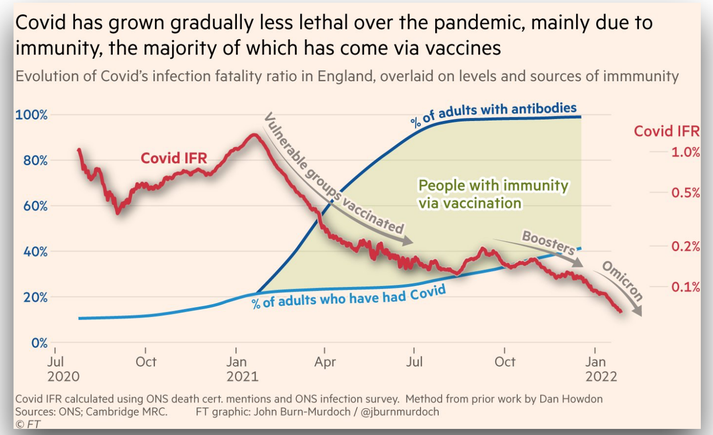
Lao et al, 26/8/2008
"Correlation between Genetic and Geographic Structure in Europe"



630 citations (Current Biology)

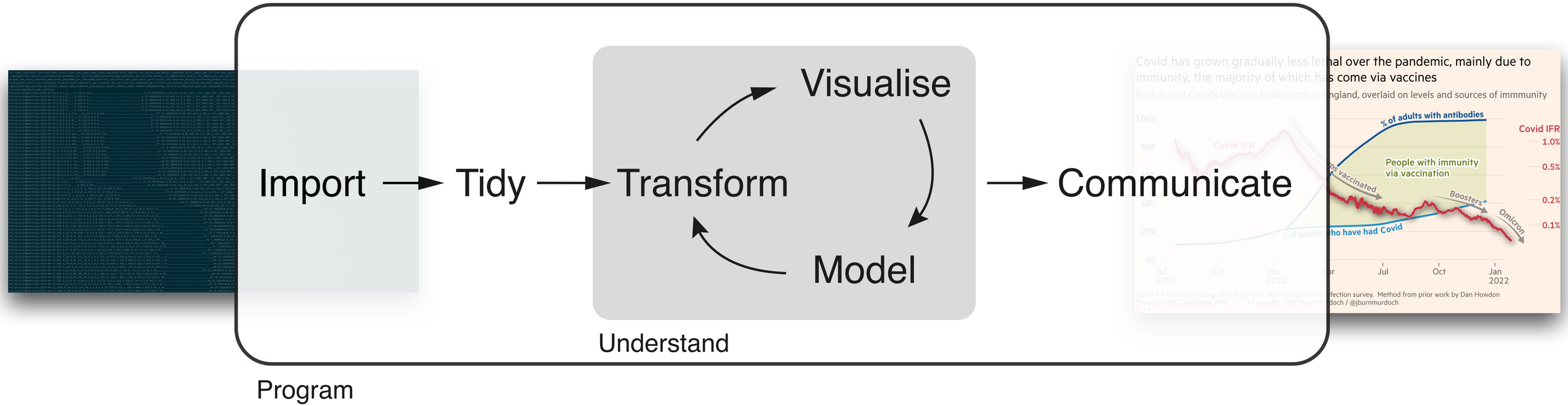
A data science project workflow





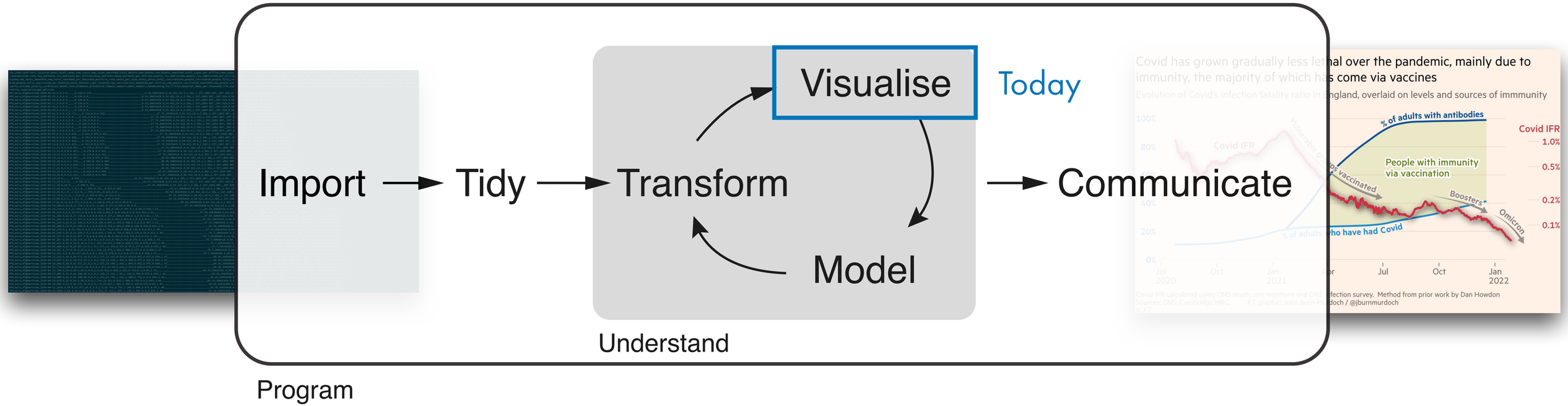
https://r4ds.had.co.nz/introduction.html

A data science project workflow



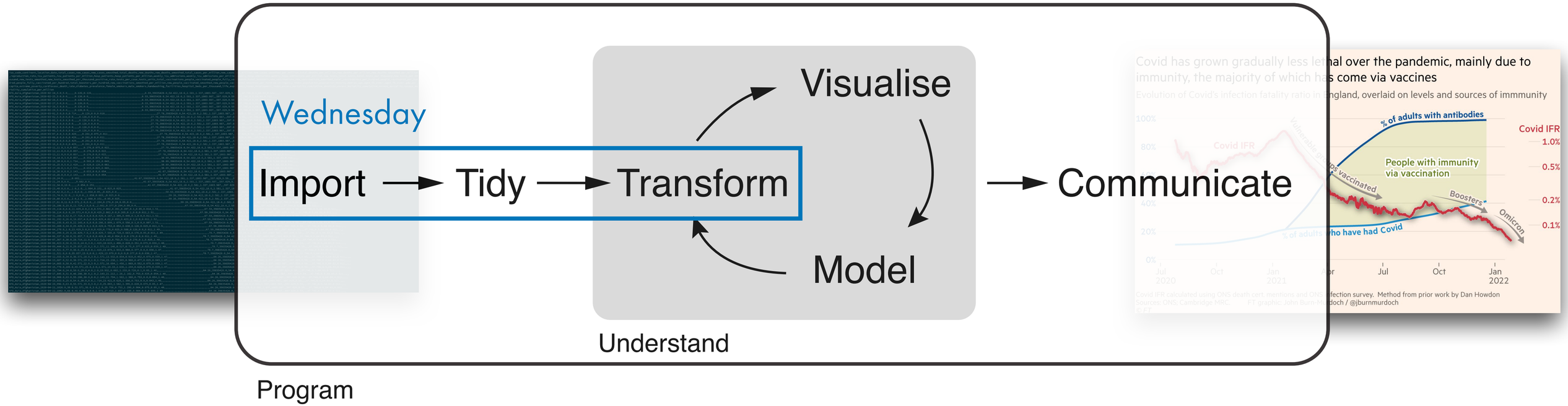
https://r4ds.had.co.nz/introduction.html

A data science project workflow



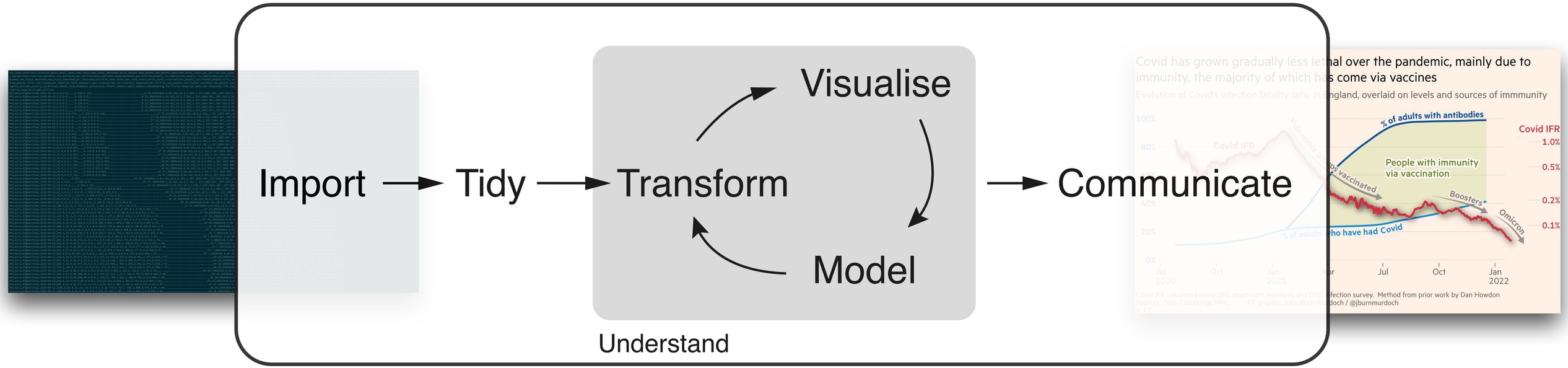
https://r4ds.had.co.nz/introduction.html

A data science project workflow



https://r4ds.had.co.nz/introduction.html

A data science project workflow

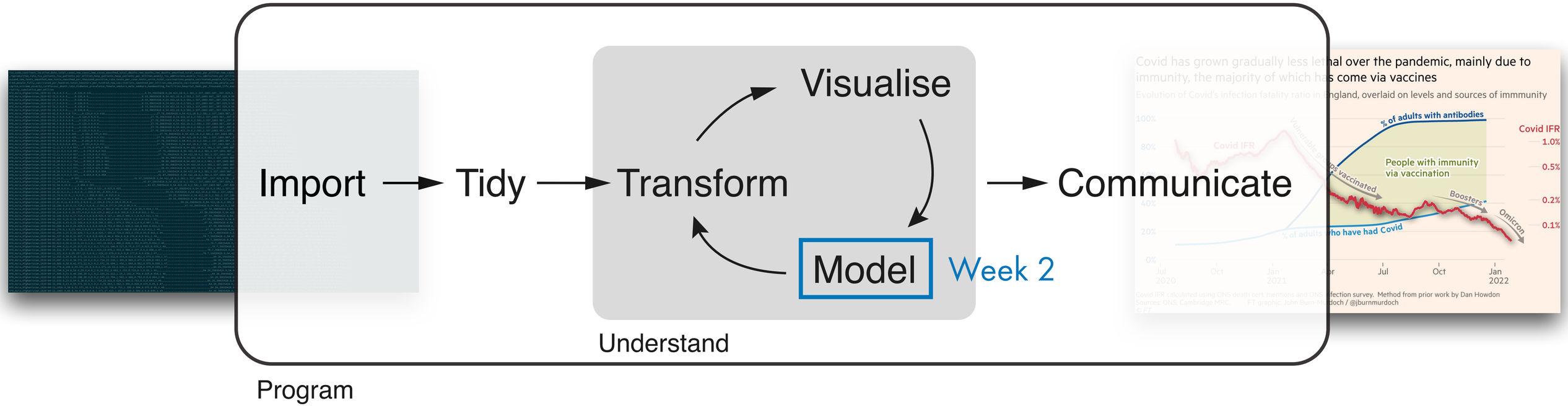


Program

Thursday / Friday

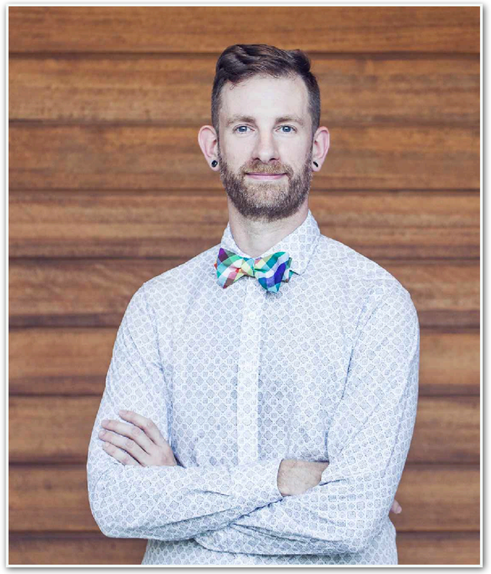
https://r4ds.had.co.nz/introduction.html

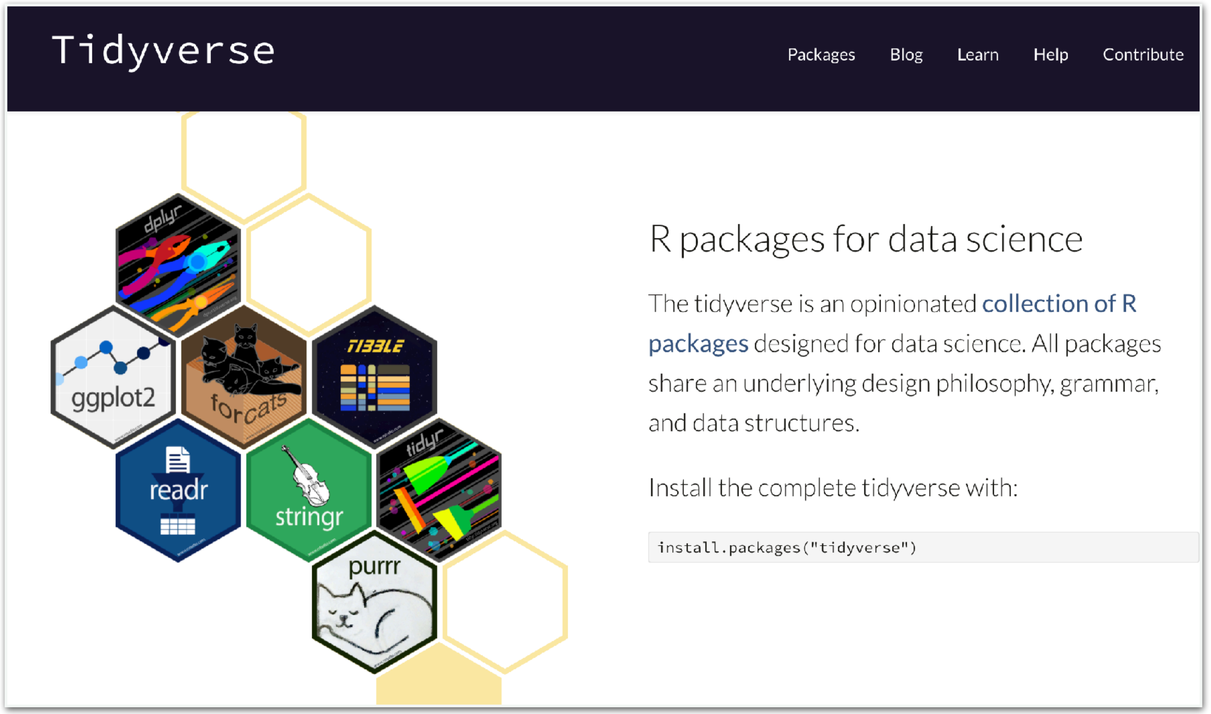
A data science project workflow



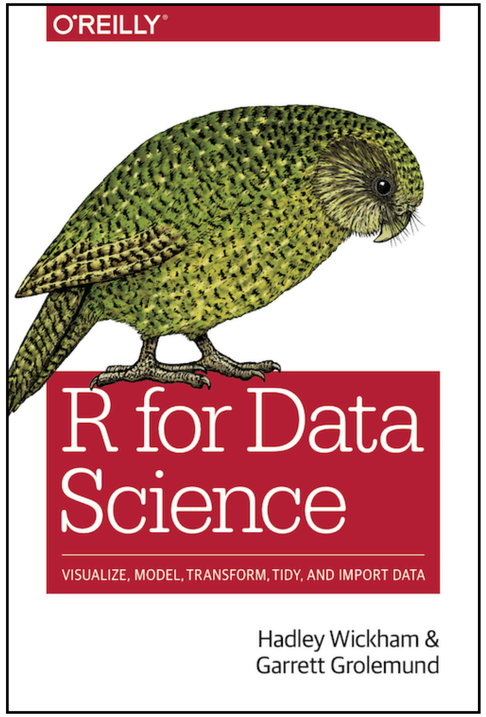
https://r4ds.had.co.nz/introduction.html

The tidyverse



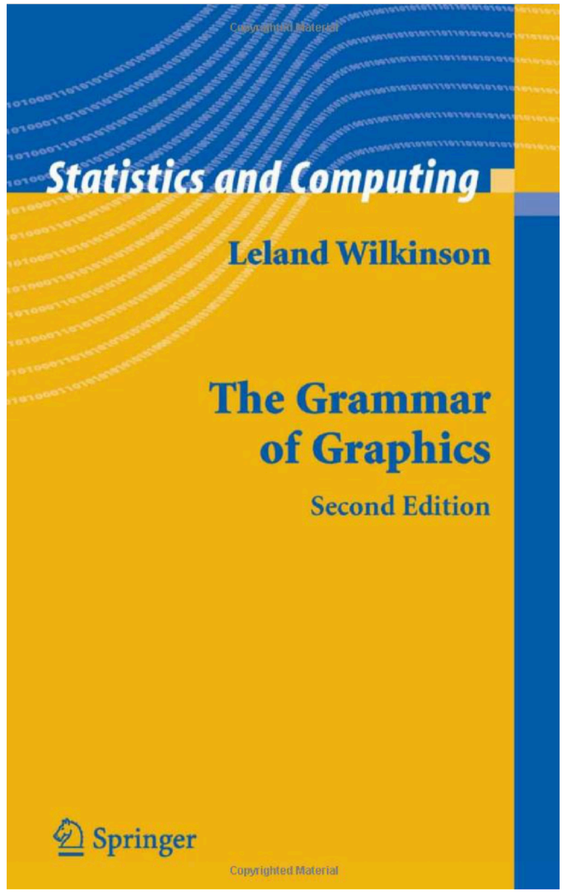


www.tidyverse.org

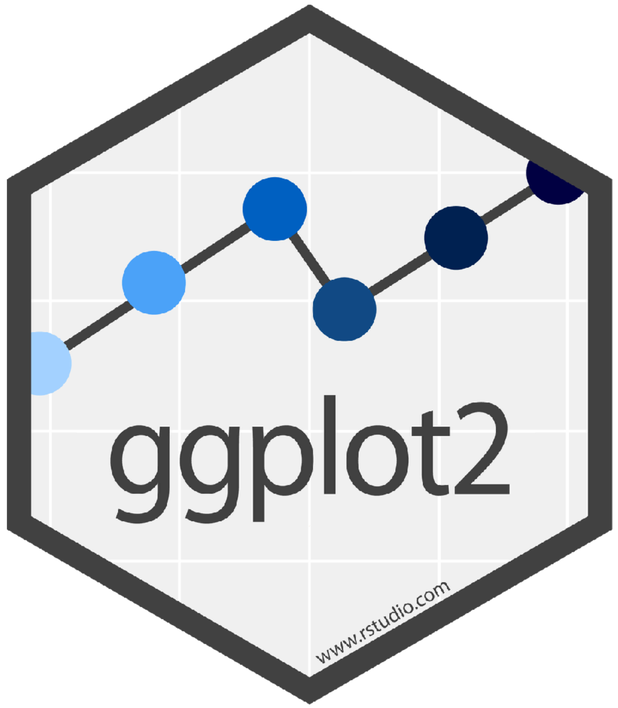


r4ds.had.co.nz

A layered grammar of graphics



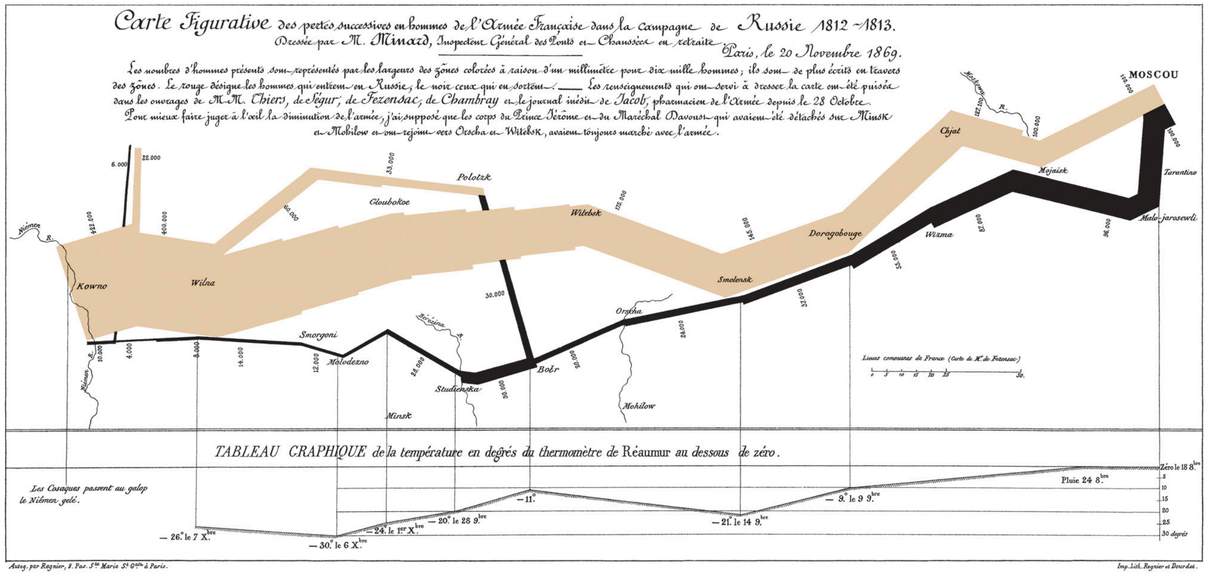
A description of the fundamental features that underlie all statistical graphics

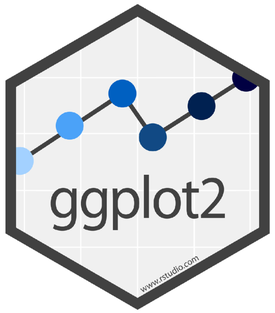


A toolkit implementing the grammar of graphics in R

A layered grammar of graphics

Original

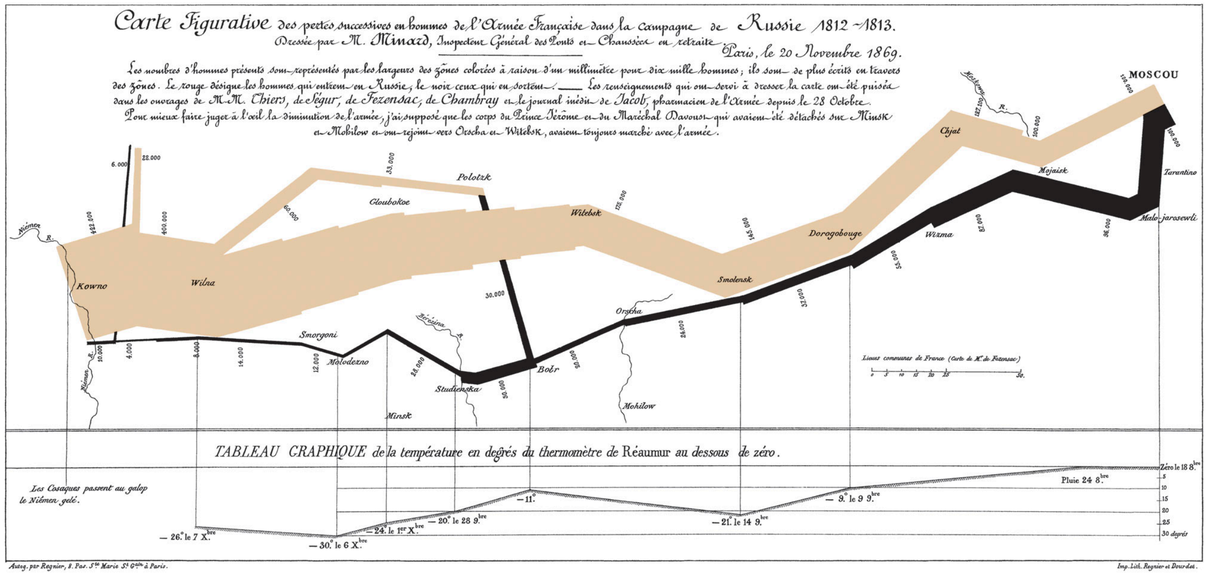




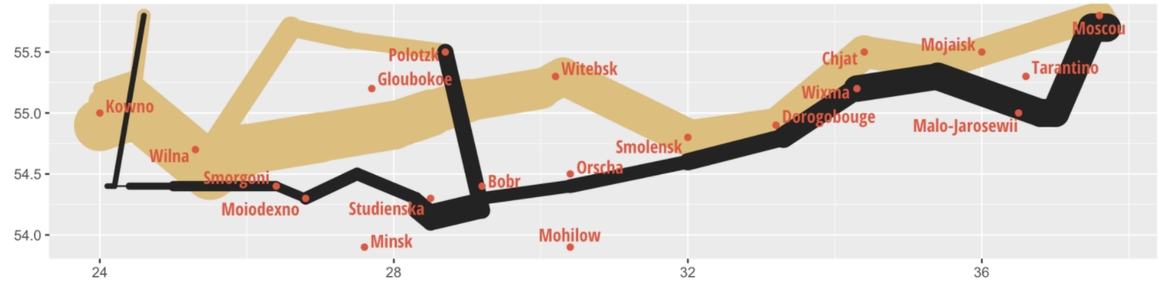
https://www.andrewheiss.com/blog/2017/08/10/exploring-minards-1812-plot-with-ggplot2/

A layered grammar of graphics

Original



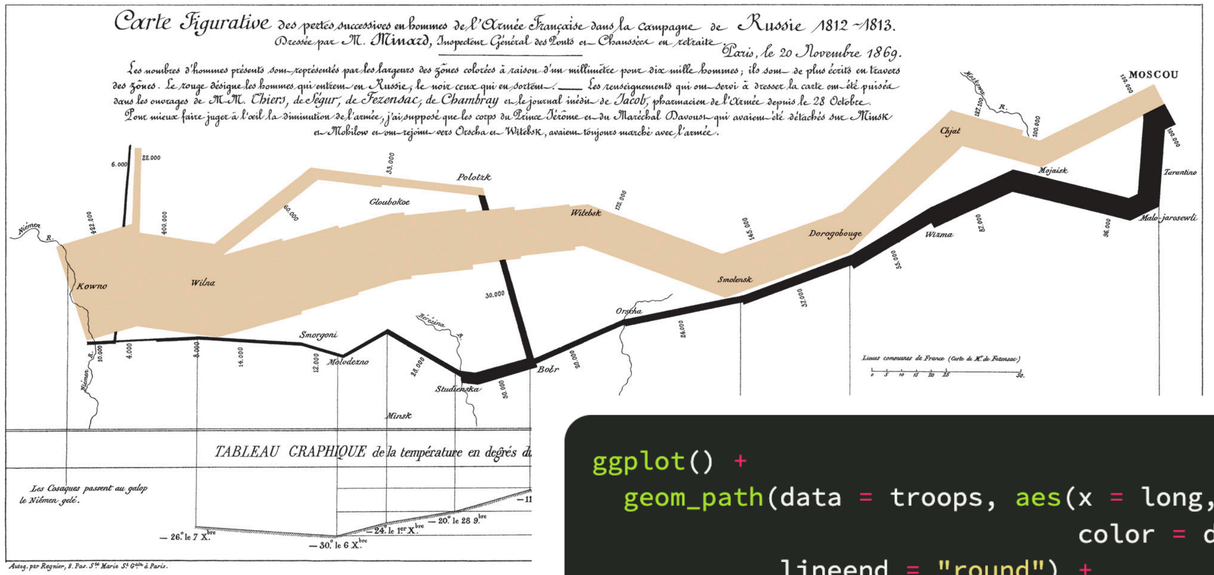
ggplot2 version



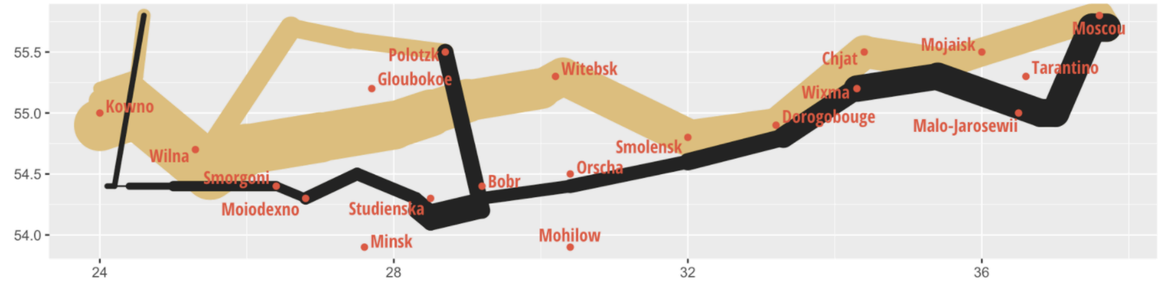
https://www.andrewheiss.com/blog/2017/08/10/exploring-minards-1812-plot-with-ggplot2/

A layered grammar of graphics

Original



ggplot2 version

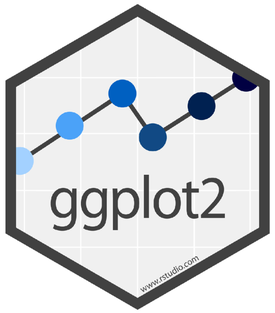



```
ggplot() +
  geom_path(data = troops, aes(x = long, y = lat, group = group,
                               color = direction, size = survivors),
            lineend = "round") +
  geom_point(data = cities, aes(x = long, y = lat),
             color = "#DC5B44") +
  geom_text_repel(data = cities, aes(x = long, y = lat, label = city),
                  color = "#DC5B44", family = "Open Sans Condensed Bold") +
  scale_size(range = c(0.5, 15)) +
  scale_colour_manual(values = c("#DFC17E", "#252523")) +
  labs(x = NULL, y = NULL) +
  guides(color = FALSE, size = FALSE)
```

https://www.andrewheiss.com/blog/2017/08/10/exploring-minards-1812-plot-with-ggplot2/

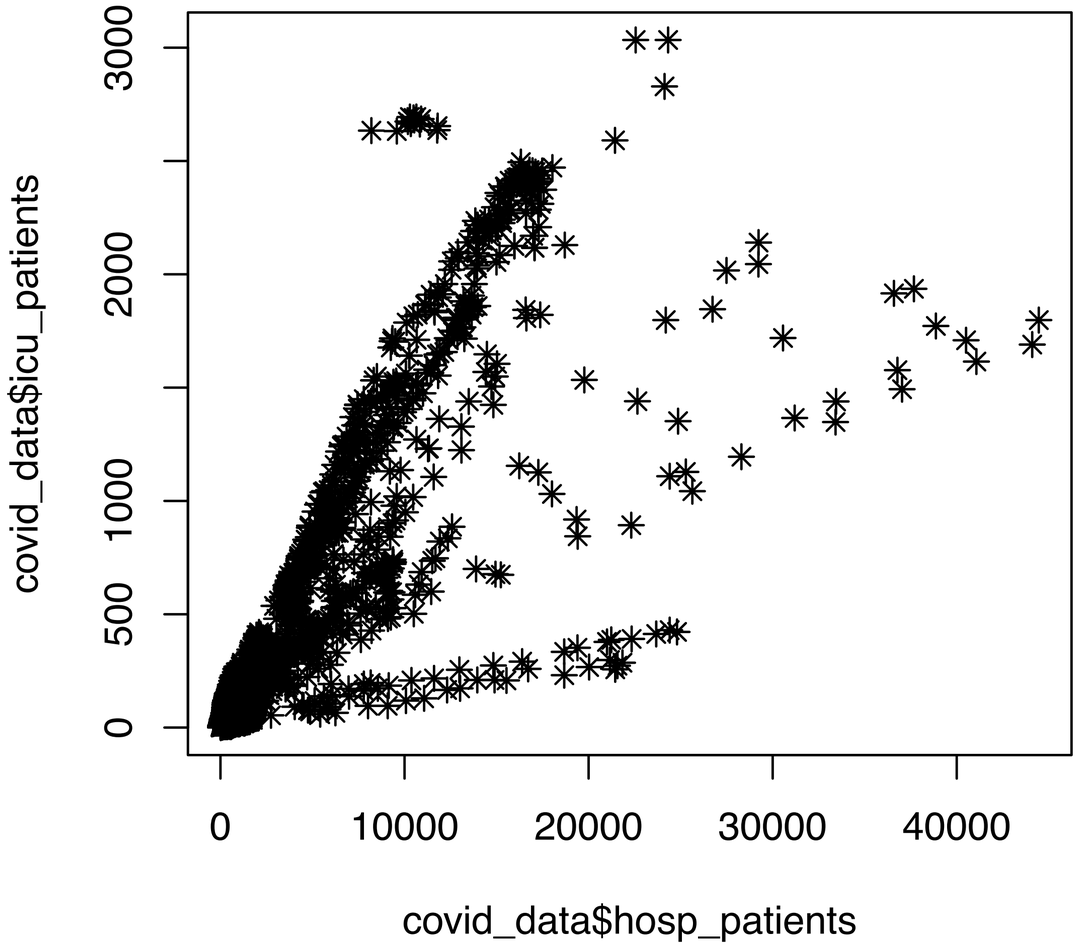
A layered grammar of graphics

data MAPPED TO **aes**thetic properties OF **geom**etric objects



https://rfortherestofus.com/2019/07/a-short-overview-of-the-grammar-of-graphics/

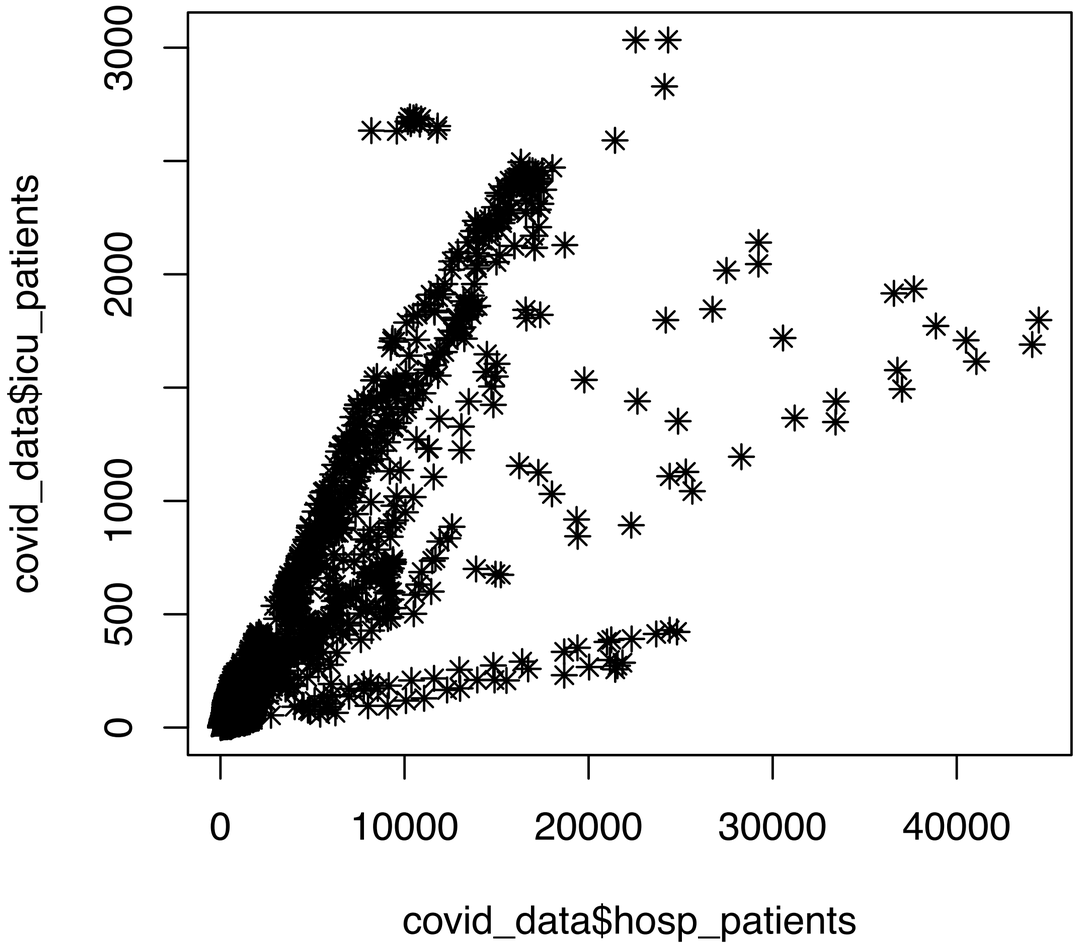
Anatomy of a scatter plot



data MAPPED TO **aes**thetic properties OF **geom**etric objects

```
plot(x = covid_data$hosp_patients,
     y = covid_data$icu_patients,
     pch = 8,
     type = “p”)
```

Anatomy of a scatter plot

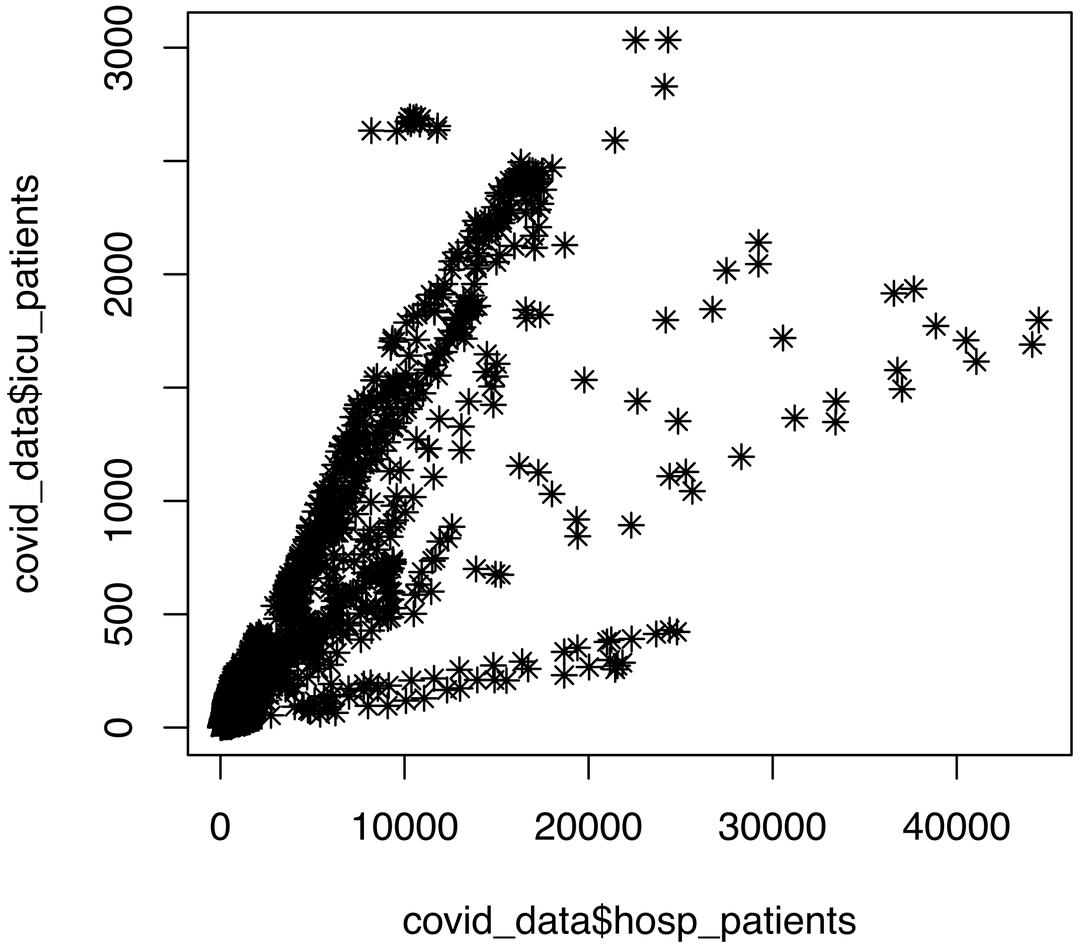


data MAPPED TO **aes**thetic properties OF **geom**etric objects

Data

```
plot(x = covid_data$hosp_patients,
     y = covid_data$icu_patients,
     pch = 8,
     type = “p”)
```

Anatomy of a scatter plot



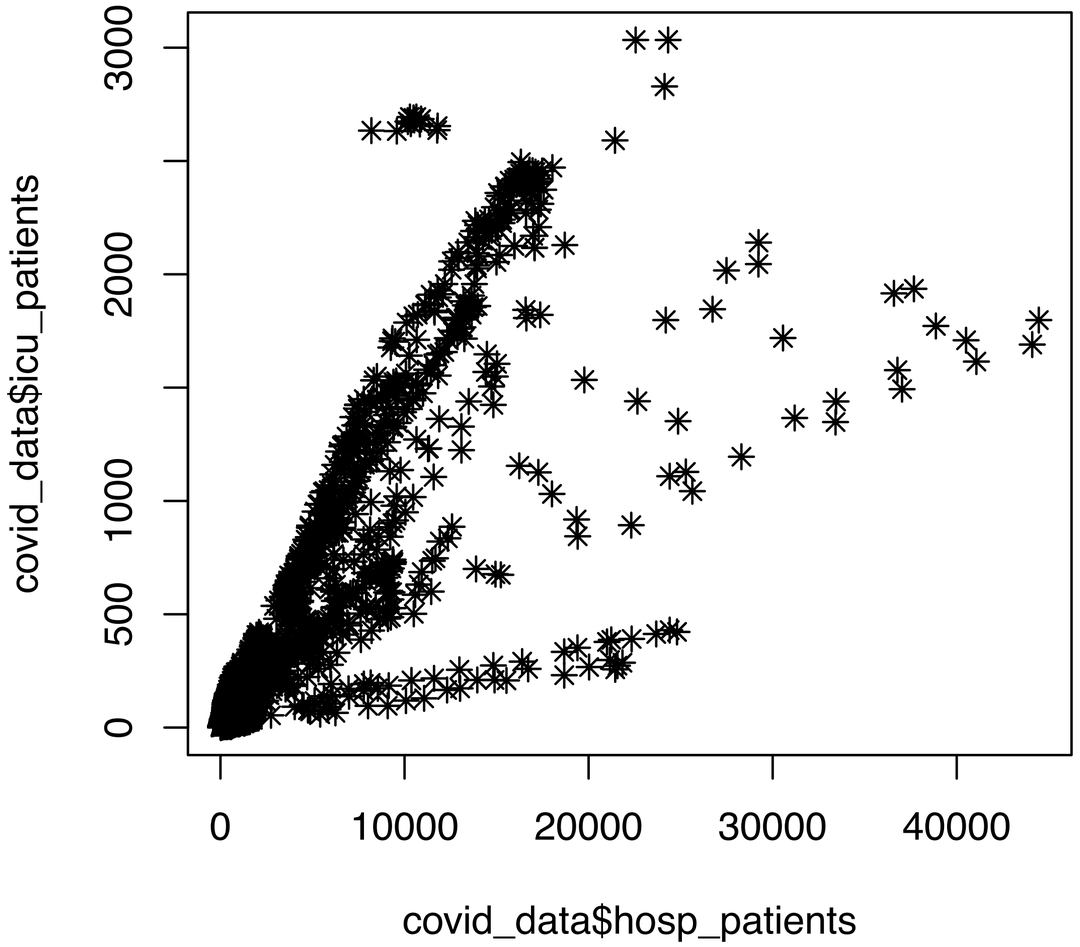
data MAPPED TO **aes**thetic properties OF **geom**etric objects

Data

Aesthetic properties

```
plot(x = covid_data$hosp_patients,
     y = covid_data$icu_patients,
     pch = 8,
     type = "p")
```

Anatomy of a scatter plot



data MAPPED TO **aes**thetic properties OF **geom**etric objects

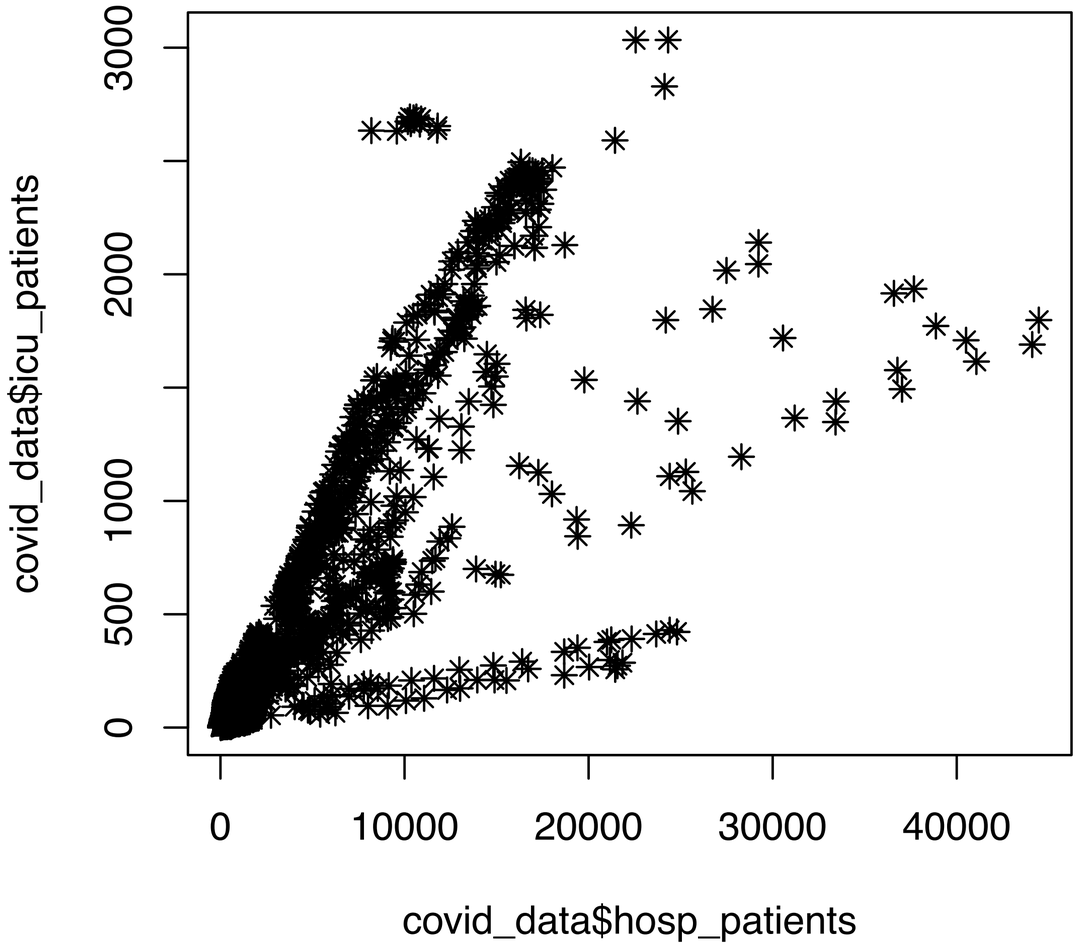
Data

```
plot(x = covid_data$hosp_patients,
     y = covid_data$icu_patients,
     pch = 8,
     type = "p")
```

Aesthetic properties

Variables

Anatomy of a scatter plot



data MAPPED TO **aes**thetic properties OF **geom**etric objects

Data

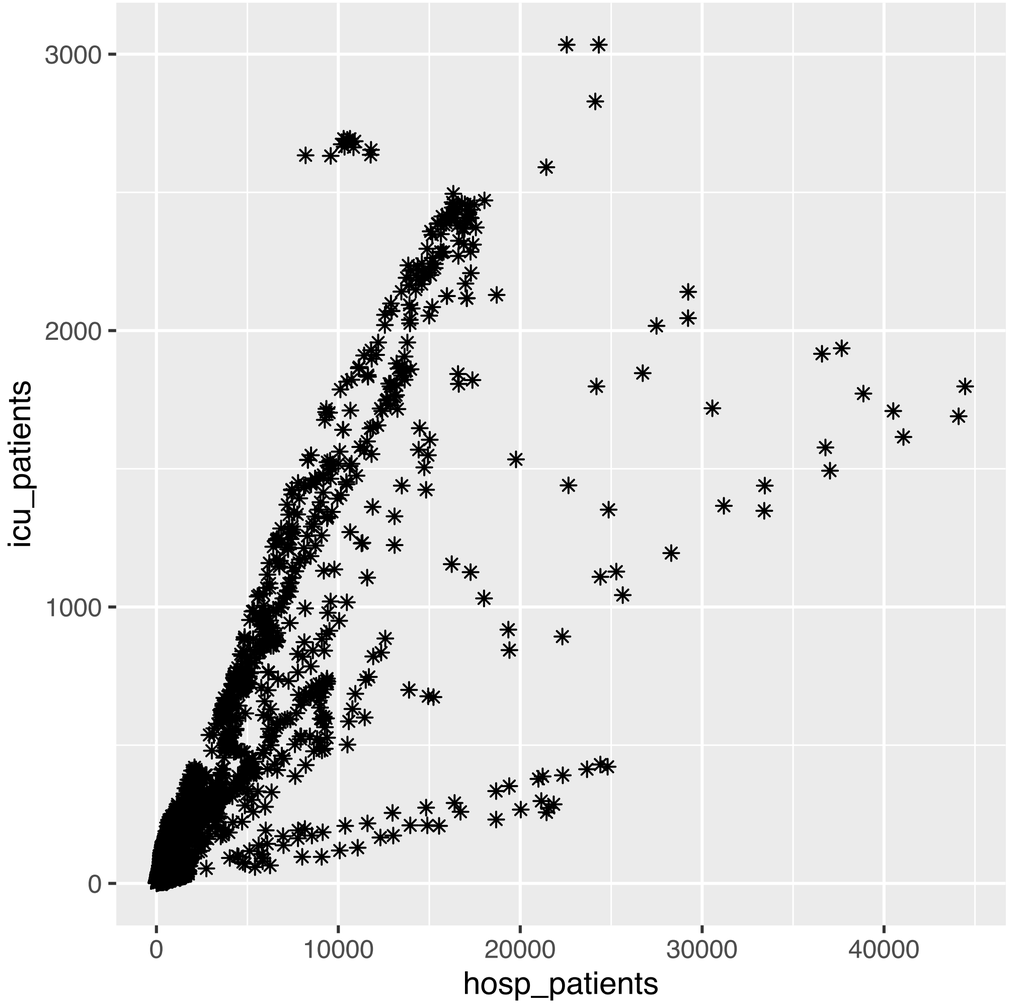
```
plot(x = covid_data$hosp_patients,
     y = covid_data$icu_patients,
     pch = 8,
     type = "p")
```

Aesthetic properties

Variables

Geometric object

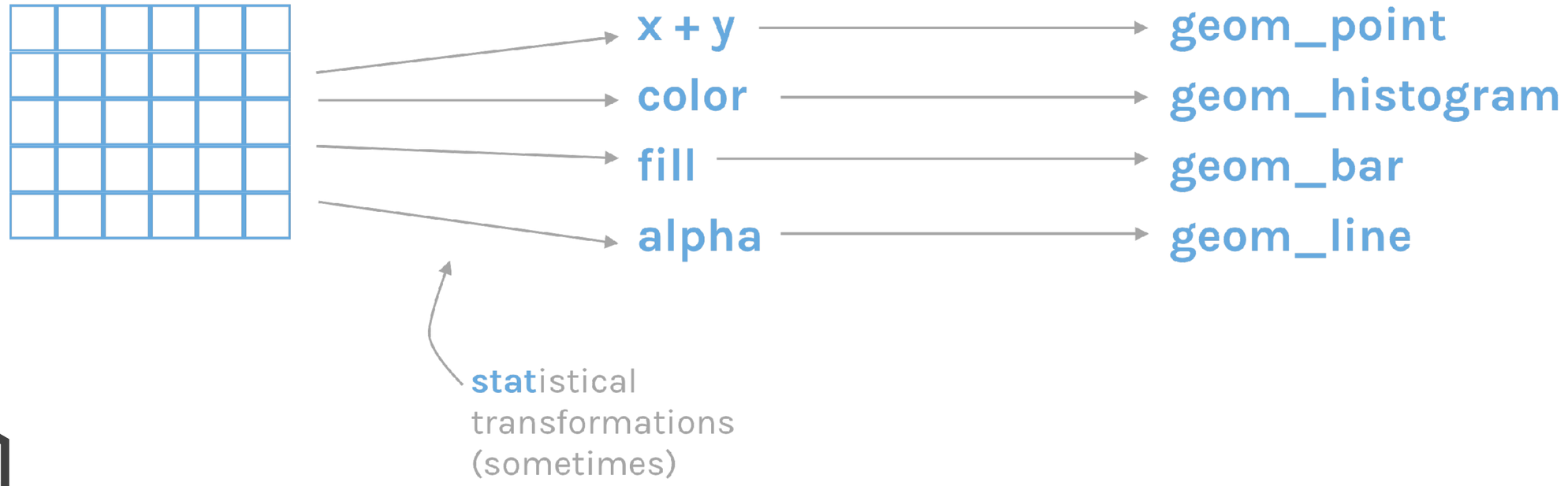
Anatomy of a simple scatter plot

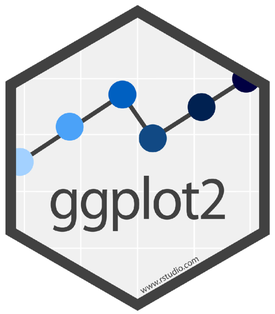


data MAPPED TO **aes**thetic properties OF **geom**etric objects

```
ggplot(
  data = covid_data,
  mapping = aes(
      x = hosp_patients,
      y = icu_patients)
  ) +
geom_point(shape = 8)
```

A layered grammar of graphics





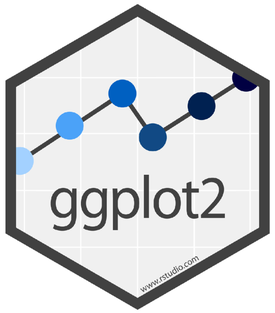
https://rfortherestofus.com/2019/07/a-short-overview-of-the-grammar-of-graphics/

Aesthetics

Geometric shapes

Scales

Themes

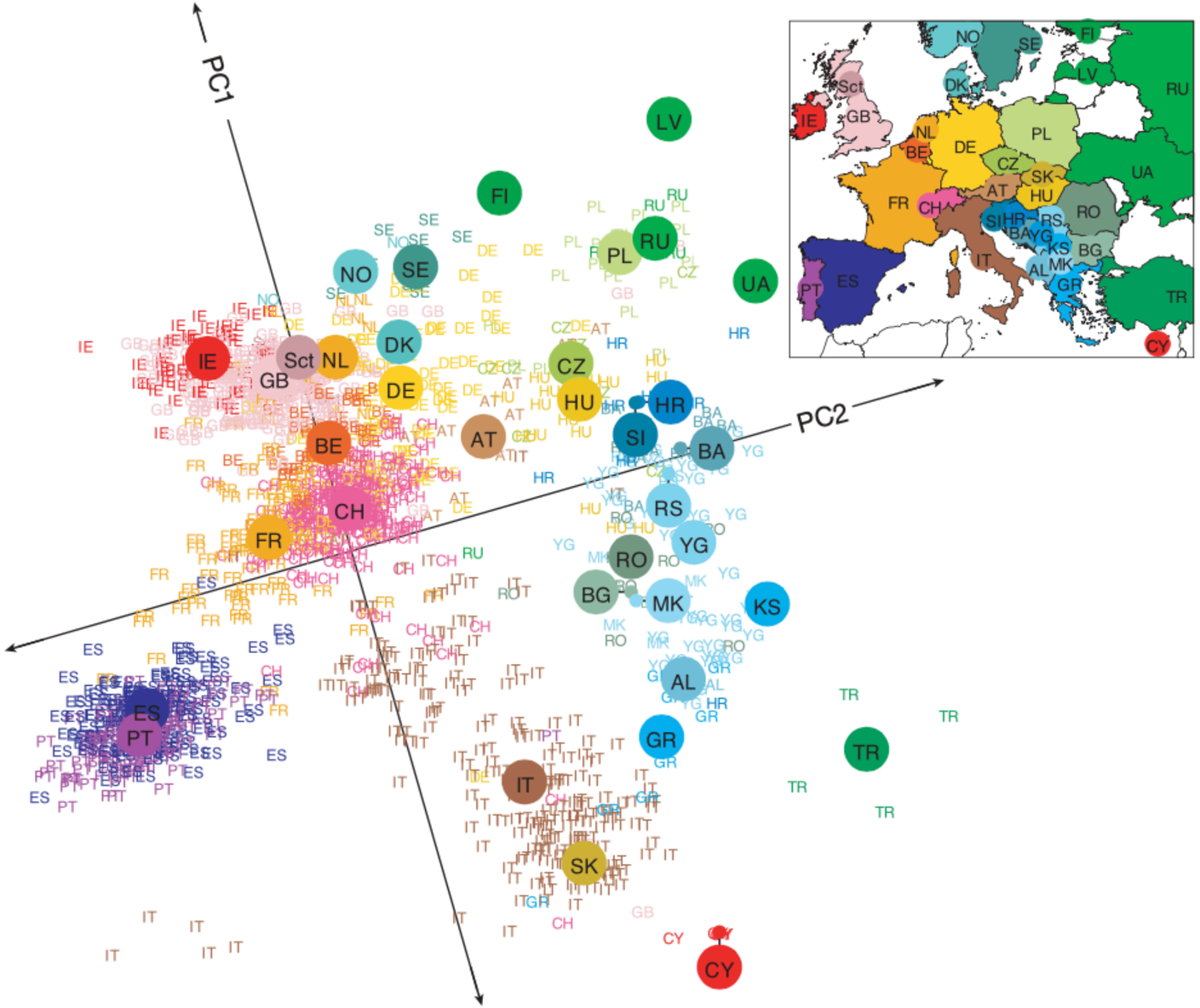


Aesthetics

Geometric shapes

Scales

Themes



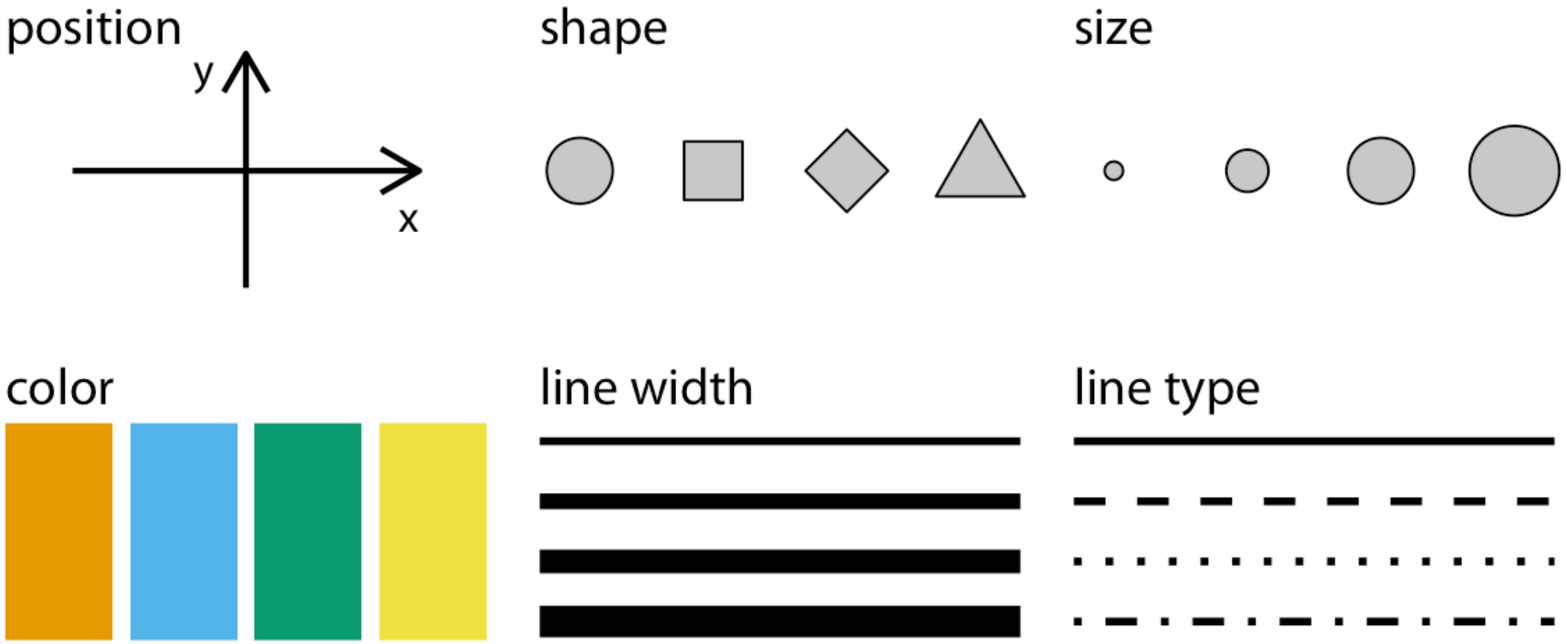
Which aesthetic attributes are used here to visualise attributes of the dataset?

Aesthetics

Geometric shapes

Scales

Themes



Commonly used aesthetics

https://clauswilke.com/dataviz/aesthetic-mapping.html#aesthetics-and-types-of-data

Aesthetics

Geometric shapes

Scales

Themes

Aes Common aesthetic values.

color and **fill** - string ("red", "#RRGGBB")

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

lineend - string ("round", "butt", or "square")

linejoin - string ("round", "mitre", or "bevel")

size - integer (line width in mm)

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

Values for commonly used aesthetics

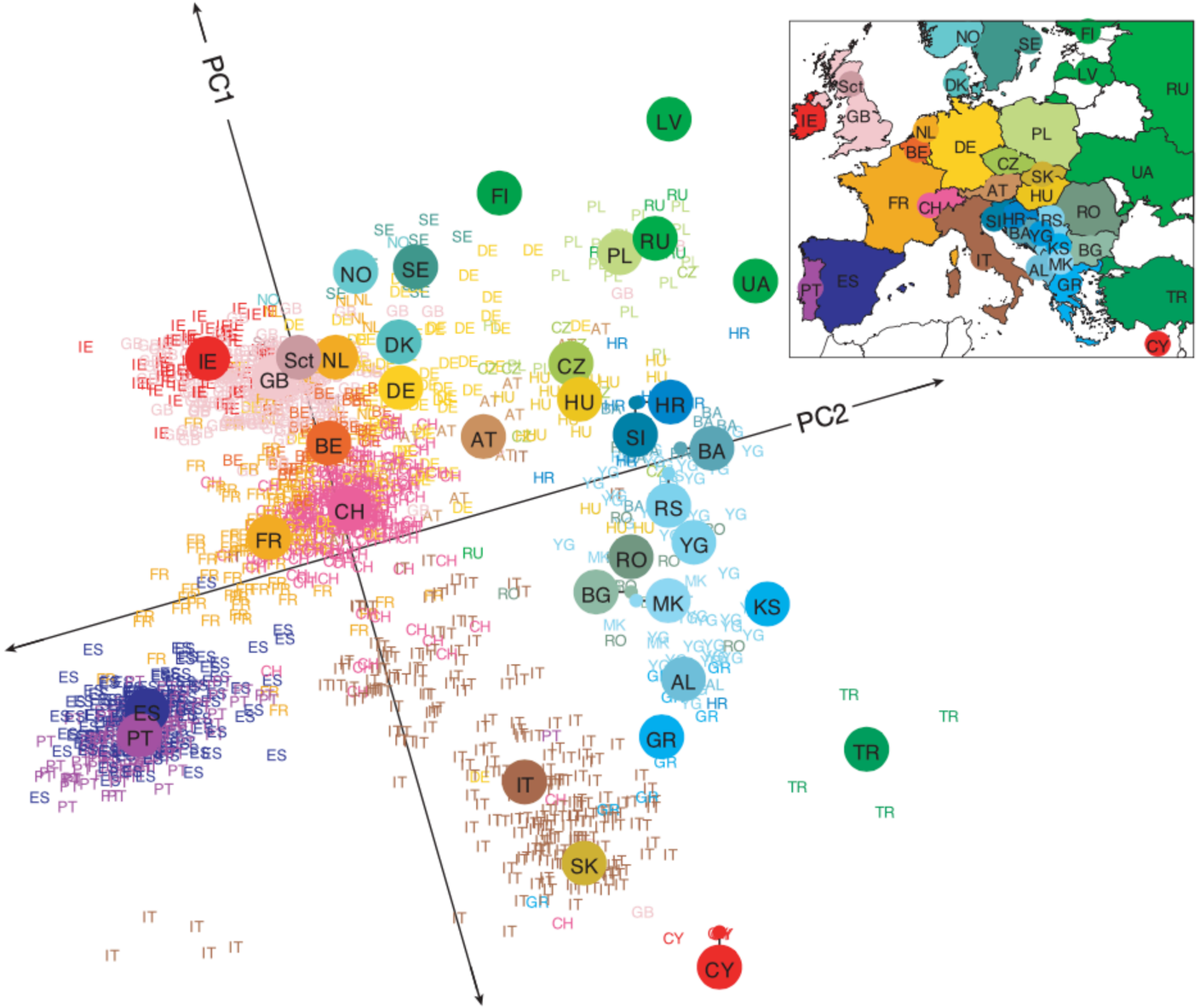
https://posit.co/wp-content/uploads/2022/10/data-visualization-1.pdf

Aesthetics

Geometric shapes

Scales

Themes



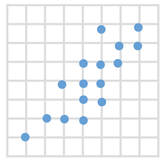
Which geometric shapes are used here to visualise attributes of the dataset?

Aesthetics

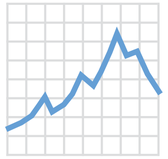
Geometric shapes

Scales

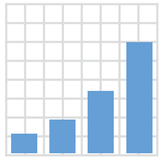
Themes



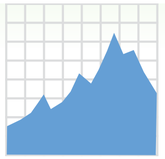
e + geom_point()
x, y, alpha, color, fill, shape, size, stroke



i + geom_line()
x, y, alpha, color, group, linetype, size



f + geom_col()
x, y, alpha, color, fill, group, linetype, size



c + geom_area(stat = "bin"**)**
x, y, alpha, color, fill, linetype, size

Individual geoms - one distinct object per data point

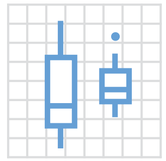
https://posit.co/wp-content/uploads/2022/10/data-visualization-1.pdf

Aesthetics

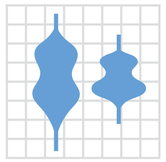
Geometric shapes

Scales

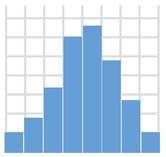
Themes



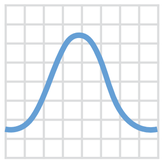
f + geom_boxplot()
x, y, lower, middle, upper, ymax, ymin, alpha,
color, fill, group, linetype, shape, size, weight



f + geom_violin(scale = “area"**)**
x, y, alpha, color, fill, group, linetype, size, weight

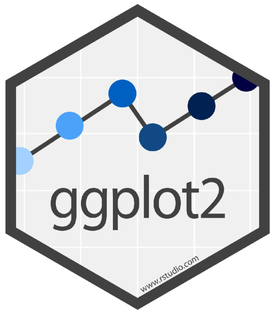


c + geom_histogram(binwidth = 5**)**
x, y, alpha, color, fill, linetype, size, weight



c + geom_density(kernel = "gaussian"**)**
x, y, alpha, color, fill, group, linetype, size, weight

Collective geoms - one distinct object for multiple data points

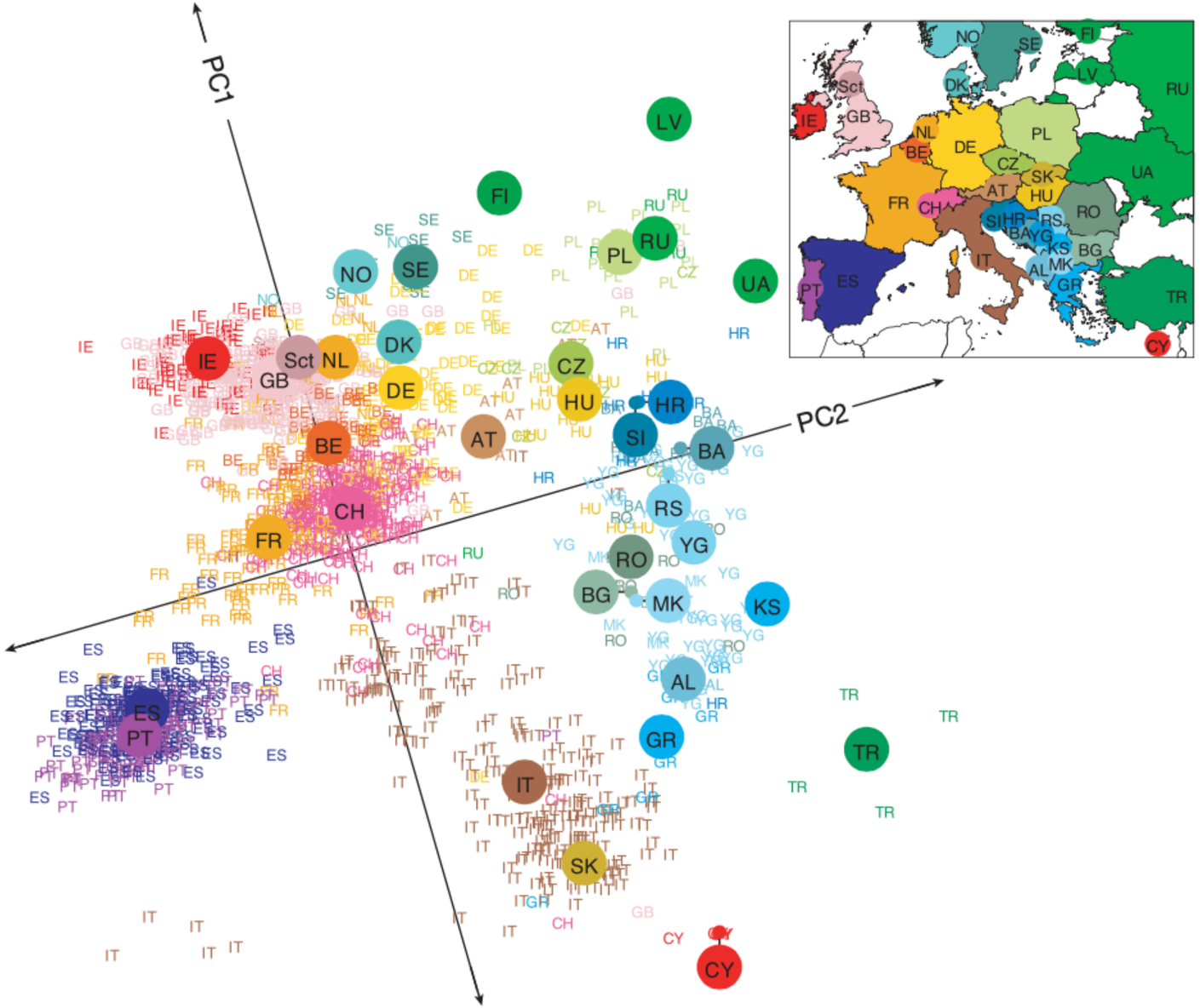


Aesthetics

Geometric shapes

Scales

Themes



Which scales are used here to visualise attributes of the dataset?

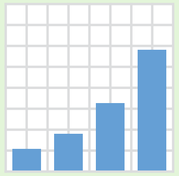
Aesthetics

Geometric shapes

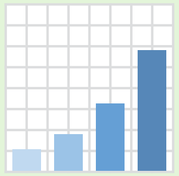
Scales

Themes

Scales map data values to the visual values of an aesthetic. To change a mapping, add a new scale.



```
n <- d + geom_bar(aes(fill = fl))
```



```
n + scale_fill_manual(
    values = c("skyblue", "royalblue", "blue", "navy"),
    limits = c("d", "e", "p", "r"), breaks =c("d", "e", "p", “r"),
    name = "fuel", labels = c("D", "E", "P", "R"))
```

scale_

aesthetic to adjust

prepackaged scale to use

scale-specific arguments

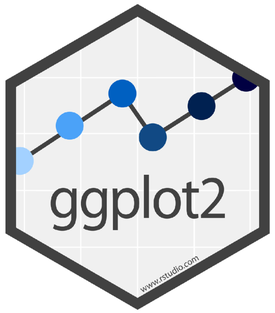
range of values to include in mapping

title to use in legend/axis

labels to use in legend/axis

breaks to use in legend/axis

Example of manually setting a scale for aesthetic `fill`



https://posit.co/wp-content/uploads/2022/10/data-visualization-1.pdf

Aesthetics

Geometric shapes

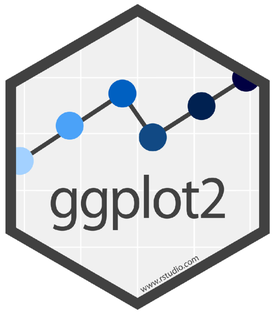
Scales

Themes

scale_*_continuous() - Map cont' values to visual ones.
scale_*_discrete() - Map discrete values to visual ones.
scale_*_binned() - Map continuous values to discrete bins.
scale_*_identity() - Use data values as visual ones.
scale_*_manual(values = c()**)** - Map discrete values to manually chosen visual ones.

scale_x_log10() - Plot x on log10 scale.
scale_x_reverse() - Reverse the direction of the x axis.
scale_x_sqrt() - Plot x on square root scale.

Examples of different scales



https://posit.co/wp-content/uploads/2022/10/data-visualization-1.pdf

Aesthetics

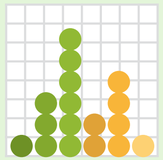
Geometric shapes

Scales

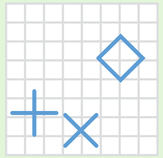
Themes

o + scale_fill_gradient(low="red", high="yellow"**)**

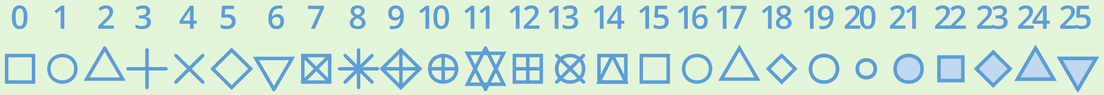
o + scale_fill_gradient2(low = "red", high = "blue", mid = "white", midpoint = 25**)**

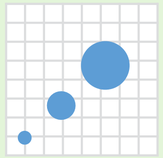


o + scale_fill_gradientn(colors = topo.colors(6)**)**
Also: rainbow(), heat.colors(), terrain.colors(), cm.colors(), RColorBrewer::brewer.pal()



p + scale_shape() + scale_size()
p + scale_shape_manual(values = c(3:7)**)**





p + scale_radius(range = c(1,6)**)**
p + scale_size_area(max_size = 6**)**

Examples of different scales

https://posit.co/wp-content/uploads/2022/10/data-visualization-1.pdf

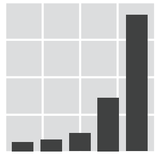
Aesthetics

Geometric shapes

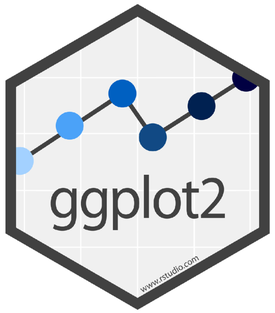
Scales

Themes

r + theme() Customize aspects of the theme such as axis, legend, panel, and facet properties.



r + theme_gray()
Grey background
(default theme).



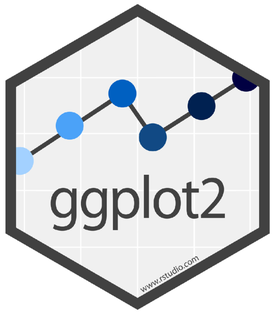
Themes control the non-data elements of a plot

Aesthetics

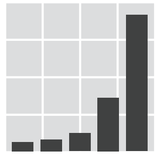
Geometric shapes

Scales

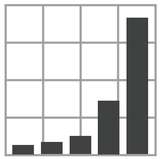
Themes



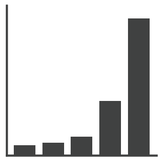
r + theme() Customize aspects of the theme such as axis, legend, panel, and facet properties.



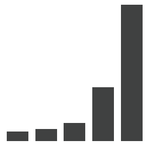
r + theme_gray()
Grey background
(default theme).



r + theme_bw()
White background
with grid lines.



r + theme_classic()



r + theme_void()
Empty theme.

Examples of available pre-defined themes

https://ucph.padlet.org/martinsikora4/data_analysis_2025_dataviz