

ANALYSING (BIG) DATA

Summerschool Utrecht 2022

(Environmental) SSI and SDGs

- Socioscientific Issues (SSI) are controversial social issues which relate to science.
- They are ill-structured, open-ended problems which have multiple solutions. (*wikipedia*)

SUSTAINABLE DEVELOPMENT GOALS



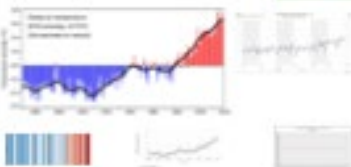
Student teachers get experience in dealing with environmental socio-scientific issues involving data



We take two examples from the SDG (Climate Action)

Global Warming

The target of 1.5°C is possible but would require "deep emissions reductions"



- Compare the graphs on climate change.
- Which one appeals to you, why?
- What does each graphic evoke? What story?
- For which target group do you think which graph is appropriate?



Sustainable Development Goals
(United Nations)



Ecological Footprint

We need 1.8 planets to sustain current consumption patterns ...



Step 1 – Look at a large data set (in Excel)

- Open Excel and choose a country
- Make a step-by-step plan together to make a graph in Excel for that country, just like in the lesson (homework)
- If there is enough time: make the chart

Step 2 – Go to: www.lookupindicators.org

- Click on 'dive into data'.
- Find the graph of the country you have chosen.
- Also look at the underlying data (learn more)

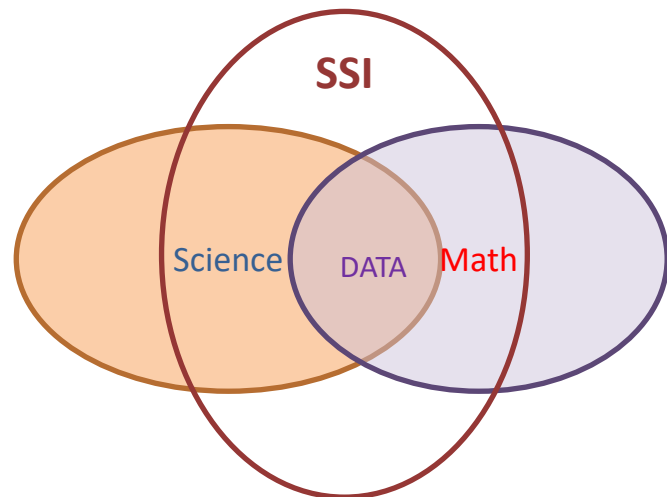
Learning outcomes

Students will

- Get experience in dealing with environmental socio-scientific issues involving data
- Develop understanding of the way data can be used to reason about SSI
- Understand how different visualisations influence the 'story the data tells'.
- Acquire knowledge about the role of (big) data, algorithms and data-analysis in dealing with environmental socio-scientific issues
- Expand their skills on how to explore, analyse and visually represent (big) data
- Become aware that dealing with environmental socio-scientific issues can be linked to the goals of statistics education
- Become aware of the possibilities and necessity to connect environmental SSI and statistics (analysing data) in their (math) teaching

Dealing with large data sets:

- How do you teach your pupils to look at a large database in an open way?
- Do you give your pupils a step-by-step plan?
- Do the pupils go straight into the data or not?



Theme 1

Global Warming

Climate change and global warming - background

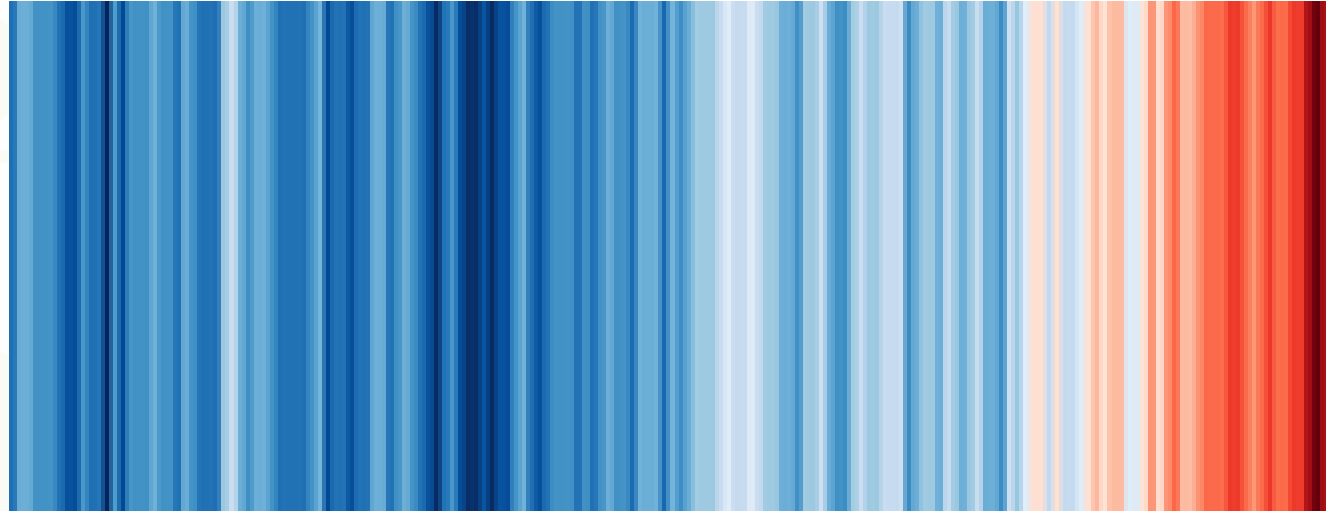
‘Climate Action’ is one of the sustainable development goals of the UN. The EU adopted these goals and Eurostat (the European bureau of statistics) is monitoring progress towards the SDGs in an EU context.

Climate action is needed because our climate is changing and the global temperature is rising.



“Data talk”

- What do you notice?
- What do you wonder?
- What is going on in this data visualization?



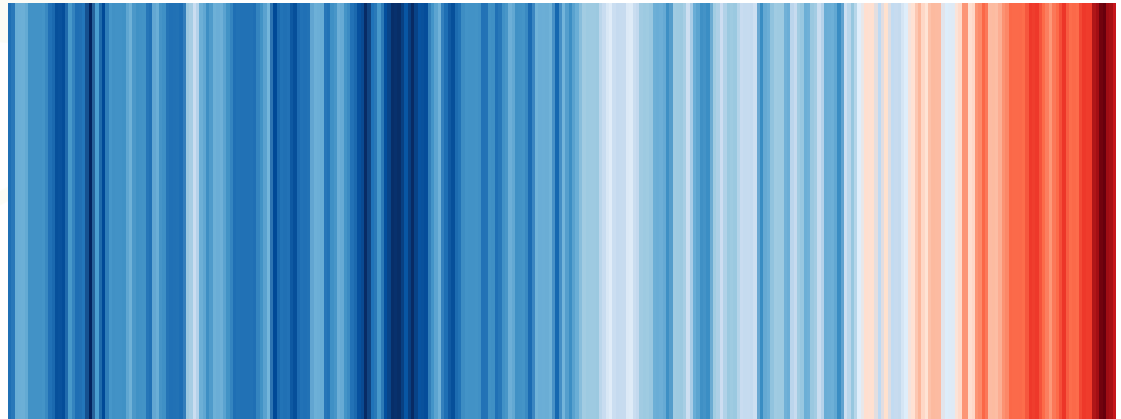
Hawkins, Ed, [2018 visualisation update / Warming stripes for 1850-2018 using the WMO annual global temperature dataset](#). *Climate Lab Book* (4 December 2018).

Archived from [the original](#) on 17 April 2019. "LICENSE / Creative Commons License / These blog pages & images are licensed under a Creative Commons Attribution-ShareAlike 4.0 International License."

Questions to discuss

- What is the (temperature) range of the color scales?
- What story does this graphic tell?
- What feelings does it evoke for you?

Warming stripes of the annual global temperatures from 1850-2018



Hawkins, Ed, [2018 visualisation update / Warming stripes for 1850-2018 using the WMO annual global temperature dataset.](#) *Climate Lab Book* (4 December 2018).

Archived from [the original](#) on 17 April 2019. "LICENSE / Creative Commons License / These blog pages & images are licensed under a Creative Commons Attribution-ShareAlike 4.0 International License."

Activity in small groups (15 minutes)

- Discuss the 5 graphs in the handout :
 - What data are behind the graphs?
 - How are these data collected and processed?

- What story does each graph tell?
- For which audience would you use each of these graphs?

Make notes and be ready to share your answers!

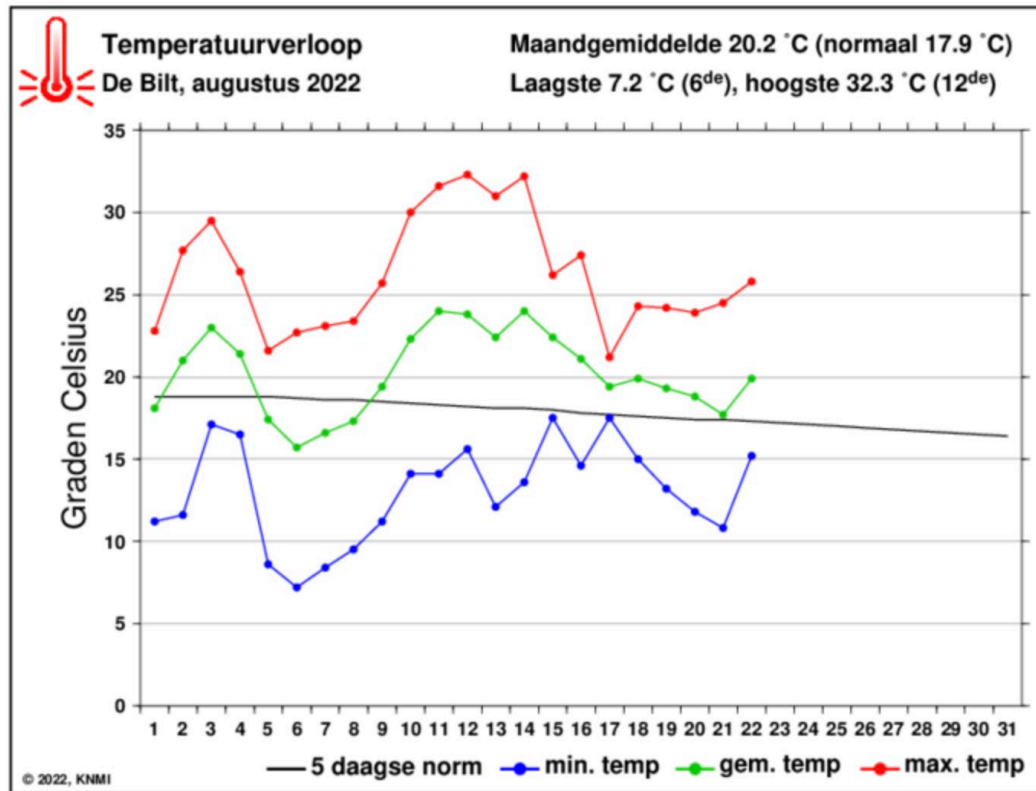
Extra task

**National temperature change
compared to global temperature change**

Dutch royal meteorological institute KNMI

<https://knmi.nl/nederland-nu/weer/waarnemingen>

Station	Weer	Temp (°C)	RV (%)	Wind (bft)	Wind (m/s)	Windstoot (km/uur)	Zicht (m)	Druk (hPa)
Lauwersoog		26.2	51	Z 3	3	17		
Nieuw Beerta		25.9	45	ZZO 2	3	18		
Terschelling		23.1	76	ZZW 3	4	19	19000	1015.7
Vlieland	geheel bewolkt	22.4	73	W 2	3	17	40000	1015.5
Leeuwarden	licht bewolkt	24.8	58	Z 2	2	15	35000	1015.5
Stavoren	zwaar bewolkt	23.9	67	ZW 1	1	10	19000	
Houtribdijk				ZW 2	2	11		
Eelde	licht bewolkt	26.3	50	ZZO 2	2	14	22000	1015.6
Hoogeveen	half bewolkt	25.4	52	ZZO 1	1	11	50000	1015.8
Heino		26.9	45	O 1	1	9		
Twente	licht bewolkt	28.5	35	ZZO 1	2	14	33000	1015.8
Deelen	licht bewolkt	28.3	33	Z 3	4	21	32000	1015.4
Hupsel		28.5	35	OZO 2	2	13		
Herwijnen		26.4	50	ZW 2	2	15		1015.7
Marknesse		25.5	54	Z 1	1	6	7000	
Lelystad	geheel bewolkt	25.1	53	ZW 1	1	11	30000	1015.6
De Bilt	licht bewolkt	26.4	49	ZZO 2	2	14	26000	1015.5
Cabauw		26.9	50	ZZW 2	2	14	35000	1015.7
Den Helder	geheel bewolkt	22.8	73	W 2	2	11	35000	1015.4
Texelhors				W 1	1	11		
Berkhout		25.5	61	ZW 1	1	11	35000	
Ulmuiden				WZW 2	2	12		
Wijk aan Zee		22.7	71					
Schiphol	geheel bewolkt	24.6	59	ZZW 2	3	19	35000	1015.5
Voorschoten	half bewolkt	25.0	62	ZZW 1	1	9	29000	1015.5
Rotterdam	zwaar bewolkt	25.9	53	Z 3	4	29	28000	1015.6
Hoek van Holland		24.1	63	WZW 3	4	16		1015.7
Wilhelminadorp		25.3	53	ZZW 3	4	27		1015.5
Viissingen	geheel bewolkt	22.3	78	W 3	5	24	35000	1015.6
Westdorpe		25.9	54	ZW 3	5	25	50000	1015.7
Woensdrecht	half bewolkt	25.9	53	Z 3	4	25	26000	1015.4
Gilze Rijen	onbewolkt	27.0	48	Z 3	5	27	35000	1015.6
Volkel	geheel bewolkt	26.7	43	ZW 2	3	19	32000	1015.7
Eindhoven	licht bewolkt	26.4	49	WZW 2	3	19	35000	1015.9
Eil	licht bewolkt	27.0	46	ZW 2	2	11	50000	
Arcen		27.6	44	ZW 1	1	8		
Maastricht-Aachen Airport	licht bewolkt	26.5	45	ZW 2	3	18	30000	1016.3



(Homework) task: National temperature change

- Explore the website of your national meteorological institute.
 - What weather data is collected, how much, how often?
 - How is data analysed and visualised?
- Write a summary and include at least one graphic of how your national temperature-change relates to the global temperature change.

Theme 2

The ecological footprint

Ecological footprint

*The ecological footprint is a metric that compares the ecological resource demand of individuals, governments, and businesses against Earth's capacity for biological regeneration. Humans use as much **ecological resources*** as if we lived on 1.6 Earths.*

**) can you name some examples?*

How fair is your ecological footprint?

How fair do you think is your **personal** (ecological) consumption compared with other people all around the world?

- Take position: *fair – neutral – unfair.*
- What knowledge and feelings have you used to decide on your position?
- What data would you need to be better able to determine your own position?

Activity: In small groups (20 min)

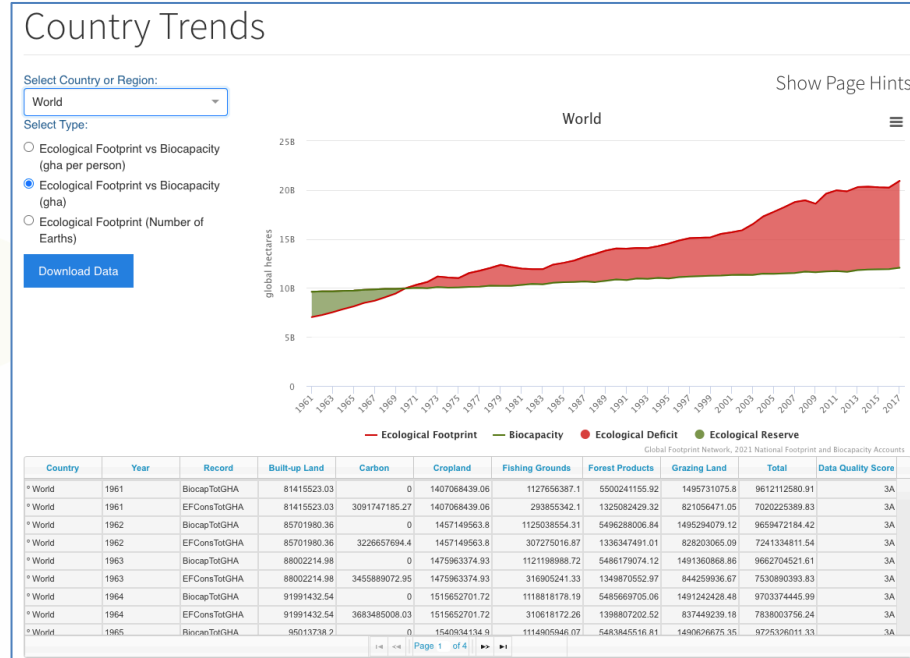
Go to

<https://data.footprintnetwork.org>

Explore and compare the footprints of the countries of the group members.

Prepare a 1 minute pitch in about your findings.

See next slide for the questions to guide you.



Questions to guide the discussion

- What are the similarities and differences between the trends in the countries explored?
- How fair is the consumption of each of these countries compared to the world?
- What can you tell about the data used on this website? Try to imagine the structure and size of the database underlying this website.

Data talk and investigation on SSIs

examples
see also handout

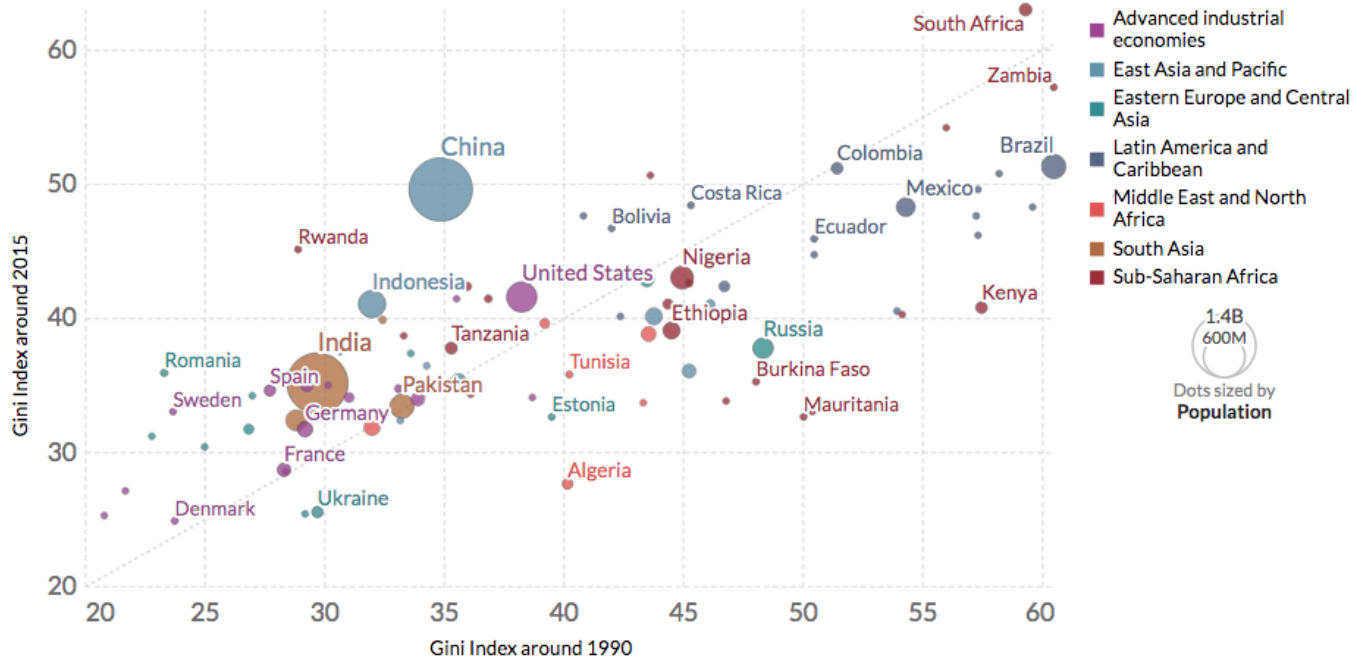
Our metric of income inequality is the **Gini index** which is higher in a country with higher inequality.¹

What specific questions can you think of?

Inequality in 1990 vs 2015

A higher Gini index represents higher inequality.

Select countries Hide countries < 1 million people



Source: Povcal (2018), The Chartbook of Economic Inequality (2017), Kandbur et al. (2017) Table 1.B
Note: Estimates are based on household survey data of either incomes or consumption. All countries for which comparable surveys within five years of each reference year were available are shown.

Visual Explanation of the Gini Coefficient

The bar chart on the left shows a simple distribution of incomes. The total population is split up in 5 parts and ordered from the poorest to the richest 20%. The bar chart shows how much income each 20% part of the income distribution earns.

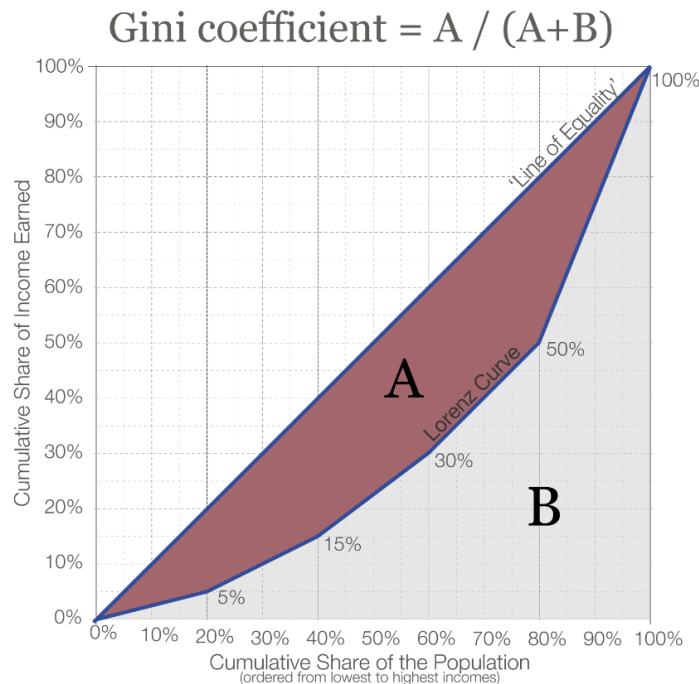
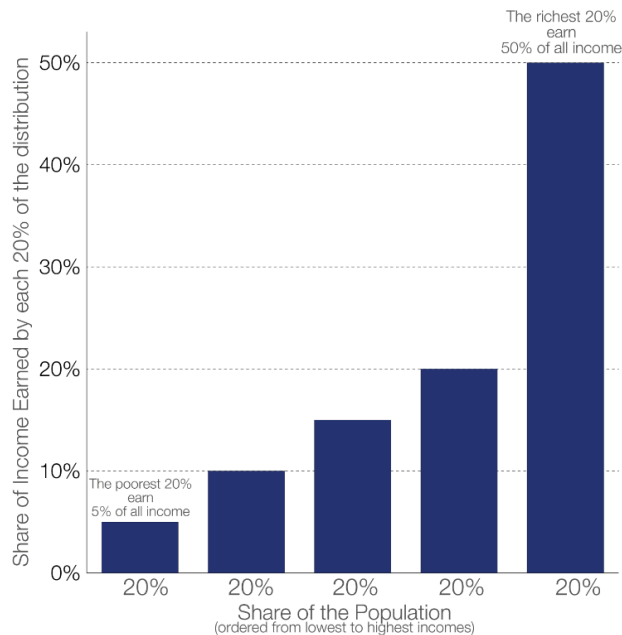
The chart on the right shows the same information in a different way, both axis show the cumulative shares:

The poorest 20% of the population earn 5% of the total income, the next 20% earn 10% – so that the poorest 40% of the population earn 15% etc. The curve resulting from this way of displaying the data is called the Lorenz Curve.

If there was no income inequality the resulting Lorenz Curve would be a straight line – the ‘Line of Equality’.

A larger area (A) between the Lorenz Curve and the Line of Equality means a higher level of inequality.

The ratio of A/(A+B) is therefore a measure of inequality and is referred to as the Gini coefficient, Gini index, or simply the Gini.



General questions to apply

(Task 1) Which story does the diagram tell?

(Task 2) Let's get deeper (e.g. into the variables)

(Task 3) Let's get critical

(Task 4) Let's get creative!

Combine

(Task 5) Combine the stories: a glimpse on complexity

(Task 6) Different visualizations for different stories: ground your choices!

Go online

<https://ourworldindata.org/income-inequality-since-1990>

GINI INDEX AROUND 2015 (1990-2015 COUNTRIES)

Variable time span	2015 - 2015
Data published by	Povcal (2018); Atkinson, Hasell, Morelli, and Roser (2017), "The Chartbook of Economic Inequality"; Kanbur, R., & Wang, Y. 2017. The great Chinese inequality turnaround. ECINEQ Working Paper Series WP 2017 - 433
Data publisher's source	Household income or consumption surveys
Link	http://iresearch.worldbank.org/PovcalNet/povOnDemand.aspx ; https://www.chartbookofeconomicinequality.com
Retrieved	01/10/2018


GINI INDEX AROUND 1990 (1990-2015 COUNTRIES)


Variable time span	2015 - 2015
Data published by	Povcal (2018); Atkinson, Hasell, Morelli, and Roser (2017), "The Chartbook of Economic Inequality"; Kanbur, R., & Wang, Y. 2017. The great Chinese inequality turnaround. ECINEQ Working Paper Series WP 2017 - 433
Data publisher's source	Household income or consumption surveys

CHART TABLE SOURCES **DOWNLOAD**

Select country

Chart

Image (PNG)
Suitable for most uses, widely compatible. 

Vector graphic (SVG)
For high quality prints, or further editing the chart in graphics software. 

Data


Full data (CSV)
The full dataset used in this chart. 

CHART TABLE SOURCES **DOWNLOAD**

Whole group reflection

How to teach analysing and visualising data on SSI
in your math lessons?

sources

<https://icse.eu/ensite/>