Composite Indicators. History and Present

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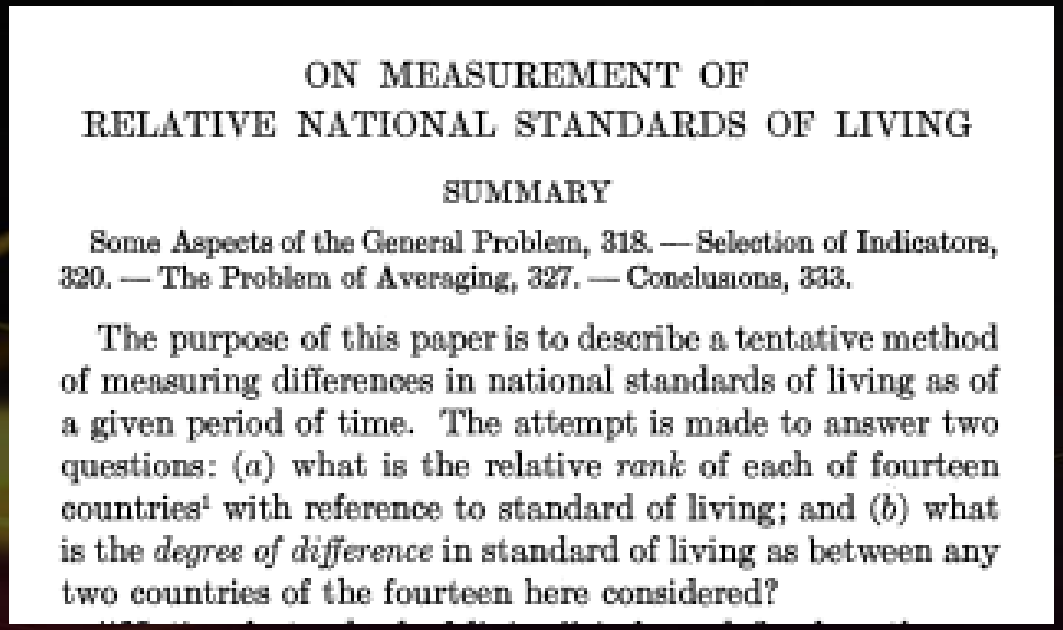
OECD Glossary of Statistical Terms (2008)

Composite Indicator is formed when individual indicators are compiled into a single index, on a basis of an underlying model of the multi-dimensional concept that is being measured.

Merrill Kelley Bennett (1897-1969)



ON MEASUREMENT OF
RELATIVE NATIONAL STANDARDS OF LIVING

SUMMARY

The purpose of this paper is to describe a tentative method of measuring differences in national standards of living as of a given period of time. The attempt is made to answer two questions: (*a*) what is the relative *rank* of each of fourteen countries[1] with reference to standard of living; and (*b*) what is the *degree of difference* in standard of living as between any two countries of the fourteen here considered?

The Quarterly Journal of Economics, Vol. 51, No. 2 (Feb. 1937), 317-336

TABLE 1.—INDICATORS OF RELATIVE STANDARDS OF LIVING IN FOURTEEN COUNTRIES (CRUDE DATA), EXPRESSED MAINLY AS ANNUAL AVERAGES ABOUT 1924–33*

Country	A. Professional Service					B. Transport and Communication					C. Luxury Food Consumption			
	Indicator number (see "Key" below)													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
United States	11.5	19.5	5.2	61.2	207	148.2	62.8	1.61	52	190	49.4	2.70	7.66	26.8
British Isles	12.3	17.2	4.4	53.9	142	41.3	19.8	1.23	48	37	45.6	1.70	11.48[b]	16.2
France	16.6	17.9	4.0[a]	46.4	151	27.9	11.3	.99	50	45	25.9	1.82	5.22	7.4
Germany	11.7	17.7	4.1	64.4	156	50.0	22.9	.44	37	14	24.6	1.80	3.29	5.9
Italy	15.5	26.2	3.0	35.5	57	9.2	2.7	.74	14	8	9.1	1.16	1.27	10.7
Spain	18.3	29.2	2.0[a]	24.8	33	9.5	4.2	.62	16	8	11.2	1.37	1.40	16.9
Portugal	17.9	30.7	1.6	20.0	25	5.6	1.9	.40	15[a]	5	11.1	.44	.73	16.9[a]
Belgium	13.2	18.6	3.6	56.5	165	38.5	17.5	1.06	49	22	27.3	3.46	6.43	8.0
Holland	9.9	22.9	6.5	53.6	142	41.7	6.0	.65	17	17	41.1	3.33	12.64	10.5
Switzerland	12.1	17.2	5.3	46.0	186	72.1	22.6	.68	31	26	37.6	1.83	5.21	8.1
Denmark	11.2	18.9	5.5	50.8	149	100.4	27.8	.63	33	36	54.3	1.71	8.31	4.7
Norway	10.9	17.8	3.5	49.0	113	67.7	22.0	1.23	21	18	27.0	.87	6.70	8.1
Sweden	12.1	15.9	3.8	44.1	134	85.5	20.2	.65	35	27	41.7	.99	7.73	5.1
Finland	13.9	21.2	1.7	37.0	81	34.8	8.4	.25	21	9	23.3	.86	4.66	1.3
Mean	13.3	20.8	3.9	45.9	124	52.3	17.9	.80	31	33	30.7	1.72	5.91	10.5

* Basic data concerning all indicators from successive *International Yearbooks of Agricultural Statistics, Commerce Yearbooks, Statistical Abstracts,* and *Yearbooks of Agriculture.* [a] Estimated; data not available. [b] Net imports of tea counted as of double weight.

KEY

1. Deaths per 1,000 inhabitants (number).
2. Births per 1,000 inhabitants (number).
3. Percentage of occupied population engaged in professional service (per cent).
4. Percentage of population aged 5–20 attending elementary and secondary schools (per cent).
5. Pieces of mail per capita (number).
6. Telephone instruments per 1,000 inhabitants (number).
7. Telephone and telegraph wire per 100,000 inhabitants (thousand miles).
8. Telegraph messages sent per capita (number).
9. Railway locomotives per 100,000 inhabitants (number).
10. Motor vehicles per 1,000 inhabitants (number).
11. Production plus net imports or minus net exports of raw sugar per capita (kilograms).
12. Production plus net imports or minus net exports of raw tobacco per capita (kilograms).
13. Net imports of tea, coffee, and cocoa per capita (kilograms).
14. Production plus net imports or minus net exports of all citrus fruits and bananas per capita (kilograms).

TABLE 2.— RANK AND SCORE OF FOURTEEN COUNTRIES WITH REFERENCE TO FOURTEEN INDICATORS OF RELATIVE NATIONAL STANDARDS OF LIVING*

Country	INDICATORS[a]																Total score
	A. PROFESSIONAL SERVICE						B. TRANSPORT AND COMMUNICATION						C. LUXURY FOOD CONSUMPTION				
	1	2	3	4	5	Total	6	7	8	9	10	Total	11	12	13	14	Total	
United States	11	6	11	13	14	55	14	14	14	14	14	70	13	12	10	14	49	174
British Isles	7	12.5	10	11	7.5	48	7	8	12.5	11	12	50.5	12	7	13	11	43	141.5
Denmark	12	7	13	9	9	50	13	13	5	8	11	50	14	8	12	2	36	136
Switzerland	8.5	12.5	12	6	13	52	11	11	8	7	9	46	9	11	6	7.5	33.5	131.5
Holland	14	4	14	10	7.5	49.5	8	4	6.5	4	6	28.5	10	13	14	9	46	124
Belgium	6	8	6	12	12	44	6	7	11	12	8	44	8	14	8	6	36	124
Sweden	8.5	14	7	5	6	40.5	12	9	6.5	9	10	46.5	11	4	11	3	29	116
Germany	10	11	9	14	11	55	9	12	3	10	5	39	5	9	4	4	22	116
Norway	13	10	5	8	5	41	10	10	12.5	5.5	7	45	7	3	9	7.5	26.5	112.5
France	3	9	8	7	10	37	4	6	10	13	13	46	6	10	7	5	28	111
Finland	5	5	2	4	4	20	5	5	1	5.5	4	20.5	4	2	5	1	12	52.5
Italy	4	3	4	3	3	17	2	2	9	1	2.5	16.5	1	5	2	10	18	51.5
Spain	1	2	3	2	2	10	3	3	4	3	2.5	15.5	3	6	3	12.5	24.5	50
Portugal	2	1	1	1	1	6	1	1	2	2	1	7	2	1	1	12.5	16.5	29.5

* Basic data in Table 1. Highest rank with reference to each indicator is represented by the number 14, next highest by 13, and so on to lowest rank represented by 1.

[a] See "key" to numbers in footnote to Table 1.

Julian Perkal (1913-1965)

„O wskaźnikach antropologicznych” (On Antropological Indicies), *Przegląd Antropologiczny (Antropological Review)*, 1953, 19, 209-221

Summarizing Indicator

$$w_i = \frac{1}{n} \sum_{j=1}^{n} \frac{x_{ij} - \bar{x}_{\cdot j}}{\sigma_j}$$

Jan Drewnowski (1908-2000)

„The Level of Living Index”, *Ekistics*, vol. 25, No. 149,
Population Dynamics (April 1968), 266-275 (with Wolf Scott)

„The Level of Living Index”, 1969, United Nations Research Institute for Social Development (UNRISD), Geneva
(A Revision of UNRISD Report No 4, parts 1 and 2 of September, 1966)

5/ UNRISD Report No. 4, The Level of Living Index, Geneva, 1966 (an UNRISD publication): UNRISD Report No.7, Cost-Benefit Analysis of Social Projects, Geneva, 1966 (an UNRISD publication) as well as the following UNRISD working papers: "The Level of Living Index in the Netherlands 1921-1965"; "The Level of Living Index in the United Kingdom 1921-1965", "Level of Living in Czechoslovakia" prepared by Jaroslav Krejci: "The Japanese Level of Living 1925-1965, prepared by T. Schara of the Social Development Research Institute, Tokyo; "Measuring the Level of Living in Poland" prepared by the Central School of Planning and Statistics, Institute of Social Research, Warsaw.

UNITED NATIONS RESEARCH INSTITUTE FOR SOCIAL DEVELOPMENT

STUDIES IN THE MEASUREMENT OF LEVELS OF LIVING AND WELFARE

I. Measuring Social Variables in Real Terms

II. The Level of Living Index - New Version

III. The Level of Welfare Index

Jan Drewnowski

Jan Drewnowski, former staff member of UNRISD is now Professor of Social and Economic Planning at the Institute of Social Studies, The Hague, Netherlands.

The Problem of the Unitary Index

Arguments against

- *… it is not necessary. A numer of selected social indicators measure welfare (…) Nothing is added to what we know if by some mathematical manipulation we transform it into a unitary index*
- *… the operation (…) is highly controversial because of the difficulty of establishing a generally acceptable system of weights. As the method is controversial so is the result.*

The Problem of the Unitary Index

Arguments in favour

- *…there is a great need for it. So much so that we cannot do without it (…) A unitary level of living index fulfils the need for a synthetic measure of the achievements of development. There is nothing new in it: calculating averages and computing indices has always the same purpose: to present the information in a more convenient form.*
- *… its construction is difficult, is it, however feasible. (…) the weighting of social aims happens in practice all the time (…) decisions are made which imply weighting the social aims against each other*

The problem of weights

Three levels of weighting:

- critical points (0 and M)
- aggregating variables into component indices
- aggregating component indices into overall one

Three systems:

- weights derived from explicit social aims – *agreement among policy-makers on national or international level*
- weights derived from implicite social aims – *extract them from statement of intent or actual actions of authorities responsible for development*
- conventional system – *the weights have to be determined by the maker of the index*

Essential features of level of living index

- Pertinence – *should measure the level of living and nothing else*
- Comprehensiveness – *should cover all the needs*
- Even coverage – *each class of human needs should be represented only once*
- Simplicity – simple structure, easy to compute
- Flexibility
- Measurement in real terms – no monetary values

The principle of transformation

If the observed value of the indicator i is less than or equal to the value of "0 point" then I = 0, and the problem ends at that.

If the observed value of the indicator i is more than the value corresponding to the "0 point" then

$$I = \frac{i - i_o}{i_M - i_o} \cdot 100 \cdot d$$

where: i is the observed value of the indicator (which is expressed per head of population)

i_o is the indicator value at 0 point

i_M is the indicator value at M point

d is the distribution coefficient[1/]

I is the indicator index (definitive adjusted) corresponding to i

Zdzisław Hellwig (1925-2013)

„Procedure of Evaluating High Level Manpower Data and Typology of Countries by Means of the Taxonomic Method”, UNESCO, Unpublished Report, 1967

„Zastosowanie metody taksonomicznej do typologicznego podziału krajów ze względu na poziom ich rozwoju oraz zasoby i strukturę wykwalifikowanych kadr” (The application of taxonomic method to cluster countries based on their development and labour force), *Przegląd Statystyczny (Statistical Review)*, 1968, 4, 307-327

Multivariate Comparative Analysis

Hellwig's Method

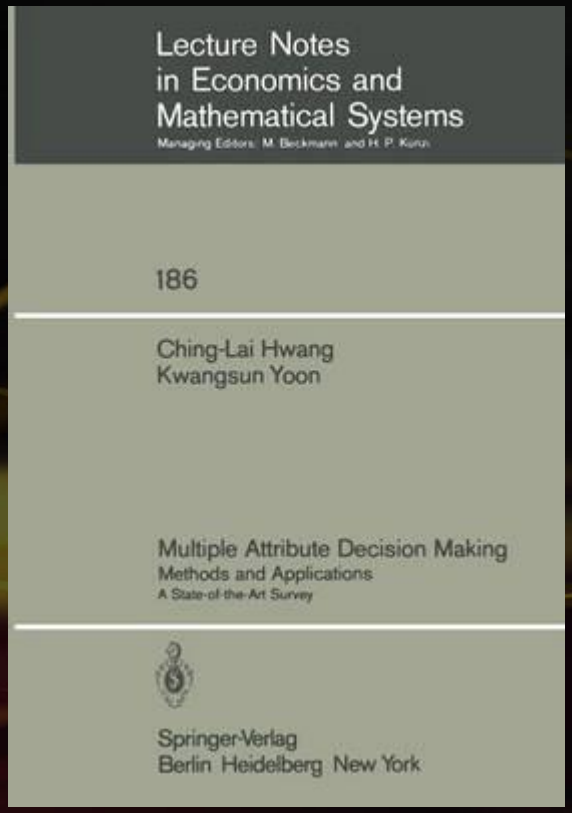
- Stimulants – „the bigger, the better"
- Destimulants – „the smaller the better"
- Development pattern
- Distance of each point to the development pattern (d_{i0})
- Reference: $d_0 = \bar{d}_{i0} + 2S_{d_{i0}}$
- Measure of development level: $W_i = 1 - \frac{d_{i0}}{d_0}$

$$\mathrm{MHDI}_i = 1 - \frac{d_i}{\bar{d} + 2s_d}$$

J. Int. Dev. **10**, 589–605 (1998)

TOPSIS Method

(Technique for Order Performance by Similarity to Ideal Solution)



- Normalization: $z_{ij} = {x_{ij}} \Big/ \sqrt{\sum_{i=1}^{n} {x_{ij}}^2}$
- Pattern: best values
- Anti-patter, ; worst values
- Euclidean distances to pattern $({d^+}_{i0})$ and anti-pattern $({d^-}_{i0})$
- Aggregate index: $W_i = \frac{{d^-}_{i0}}{{d^+}_{i0} + {d^-}_{i0})}$

Handbook on Constructing Composite Indicators

METHODOLOGY AND USER GUIDE

OECD

JRC
EUROPEAN COMMISSION

Pros

- Can summarise complex, multi-dimensional realities with a view to supporting decison-makers
- Are easier to interpret than a battery of many separate indicators
- Can assess progress of countries over time
- Reduce the visible size of a set of indicators without droping the underlying information base
- Thus make it possible to include more information within the existing size limit
- Place issues of country performance and progress at the centre of the policy arena
- Facilitate communication with general public and promote accountability
- Help to construct/underpin narratives for lay and literate audiences
- Enable users to compare complex dimensions effectively

Cons

- May send misleading policy messages if poorly constructed or misinterpreted
- May invite simplistic policy conclusions
- May be misused, e.g. to support a desired policy, if the construction process is not transparent and/or lacks sound statistical or conceptual principles
- The selection of indicators and weights could be the subject of political dispute
- May disguise seroius failings in some dimensions and increase the difficulty of identifying proper remedial action, if the construction process is not transparent
- May lead to inappropriate policies if dimensions of performance that are difficult to measure are ignored

OECD Steps

- Theoretical framework
- Data selection
- Imputation of missing data
- Multivariate analysis
- Normalization
- Weighting and aggregation
- Robustness and sensitivity
- Back to the real data
- Links to other variables
- Presentation and visualization

Some other ideas

- Szczotka (1972) – transposition of objects
- Shimura (1973) – fuzzy sets
- Cieślak (1974) – normalizing by standard deviation
- Grabiński (1974) – first principal component
- Bartosiewicz (1976) – sum of ratios to minimum
- Pluta (1976) – fixed pattern [-3] or [-2]
- Borys (1978) – nonlinear aggregating function
- Strahl (1978) – quasi-optimal pattern
- Kapur, Kesavan (1992) – Kullback-Leibler entropy
- Despotis (2005) – DEA
- De Muro, Mazziotta, Pareto (2009) – penalizing difference in characteristics variability
- Zhou, Fan, Zhou (2010) – minimum information loss
- Młodak (2010) – standardization with Weber's median
- Sokołowski, Harańczyk (2015) – ordering on a circle
- Nermed (2017) – Vector Measure Construction Method
- Walesiak (2017) – MDS
- Markowska (2019) – choosing the best index

My recipe (part 1)

- Objects to be ranked
- General criterion
- Sub-criteria
- Initial list of variables (available, logically connected with general criterion, non-correlated)
- Final list of variables (group variables, choose representatives)

My recipe (part 2)

- Variable character (stimulant, destimulant, nominant)
- Making variables comparable (normalization, standardization, ratios, ranks, points, distances, others)
- Weighting:

  - best – expert weights

  - most popular – no weights

  - worst – weights calculated from the data

My recipe (part 3)

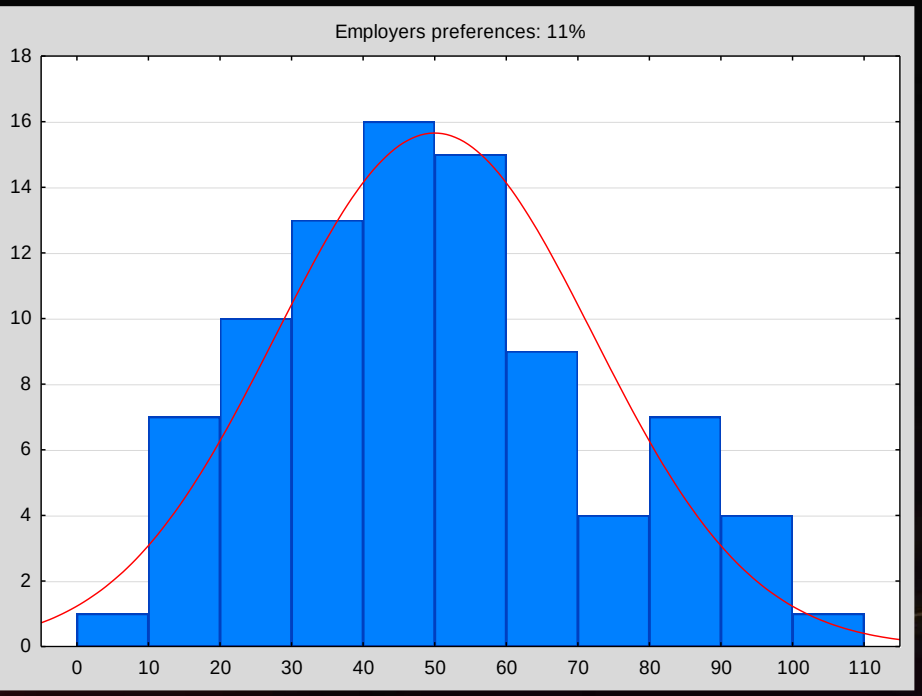
- Aggregation
  - additive - arithmetic average with scaling factor
  - multiplicative - geometric average
- Ranking
- Picture / Graph

Step-wise ranking procedure

Sokolowski A., Markowska M. (2017) Iteracyjna metoda liniowego porządkowania obiektów wielocechowych. *Przegląd Statystyczny*, R. LXIV, z. 2, 153-162

Polish University Ranking

1 Higher education institution	2 Employers preferences	3 International recognition
Uniwersytet Jagielloński	92,62	69,43
Uniwersytet Warszawski	98,24	100,00
Uniwersytet im. Adama Mickiewicza w Poznaniu	80,82	11,57
Politechnika Warszawska	100,00	24,82
Politechnika Wrocławska	92,53	10,89
Akademia Górniczo-Hutnicza im. Stanisława Staszica w Krakowie	93,40	13,75
Uniwersytet Wrocławski	83,70	22,53
Warszawski Uniwersytet Medyczny	78,74	1,90
Uniwersytet Mikołaja Kopernika w Toruniu	72,20	22,53
Gdański Uniwersytet Medyczny	55,22	1,57
Politechnika Łódzka	69,25	2,93
Szkoła Główna Handlowa w Warszawie	85,15	24,41
Uniwersytet Medyczny im. Karola Marcinkowskiego w Poznaniu	44,92	1,69
Politechnika Poznańska	81,38	2,91
Uniwersytet Medyczny im. Piastów Śląskich we Wrocławiu	61,61	0,88
Uniwersytet Łódzki	65,61	16,48
Politechnika Gdańska	57,73	0,89
Uniwersytet Gdański	66,74	2,68
Uniwersytet Medyczny w Łodzi	62,52	1,18
Uniwersytet Śląski w Katowicach	65,12	4,95
Uniwersytet Ekonomiczny w Poznaniu	81,27	1,61
Politechnika Śląska w Gliwicach	84,22	4,37
Uniwersytet Medyczny w Białymstoku	46,84	1,22
Akademia Leona Koźmińskiego w Warszawie	50,61	43,17
Uniwersytet Medyczny w Lublinie	26,14	1,30
Uniwersytet Marii Curie-Skłodowskiej w Lublinie	71,29	0,00
Pomorski Uniwersytet Medyczny w Szczecinie	19,79	1,22
Szkoła Główna Gospodarstwa Wiejskiego w Warszawie	82,09	2,92
Uniwersytet Przyrodniczy w Poznaniu	69,66	0,84
Uniwersyte Przyrodniczy we Wrocławiu	57,99	1,37
Śląski Uniwersytet Medyczny w Katowicach	33,98	1,40
Katolicki Uniwersytet Lubelski Jana Pawła II	64,00	1,65
Uniwersytet Ekonomiczny we Wrocławiu	53,03	1,32
Zachodniopomorski Uniwersytet Technologiczny w Szczecinie	32,78	2,02
Uniwersytet Warmińsko Mazurski w Olsztynie	59,71	2,43
Wojskowa Akademia Techniczna im. Jarosława Dąbrowskiego w Warszawie	54,30	1,68
Uniwersytet Kardynała Stefana Wyszyńskiego w Warszawie	65,44	1,83
Politechnika Krakowska im. Tadeusza Kościuszki	70,64	3,81
Uniwersytet Rolniczy im.Hugona Kołłątaja w Krakowie	58,66	1,26


Employers preferences: 11%
18
16
14
12
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8
6
4
2
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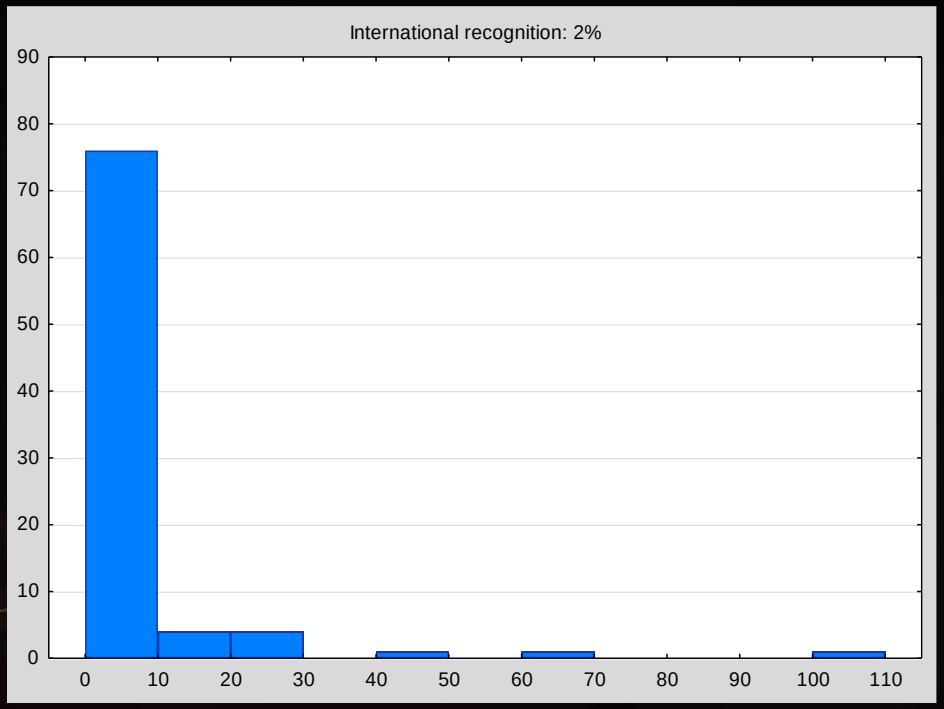
70
80
90
100
110


International recognition: 2%
90
80
70
60
50
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30
20
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20
30
40
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60
70
80
90
100
110

1. Calculate min and max
2. Find the best object using classical procedure
3. Assign rank
4. Eliminate this object from the lot
5. Go to (1)
6. Assign last three ranks based on last three objects

How to calculate composite index?

Finding i-th rank calculate

$$D_{(i+1)} = \frac{W^i_{(i+1)}}{W^i_{(i)}}$$

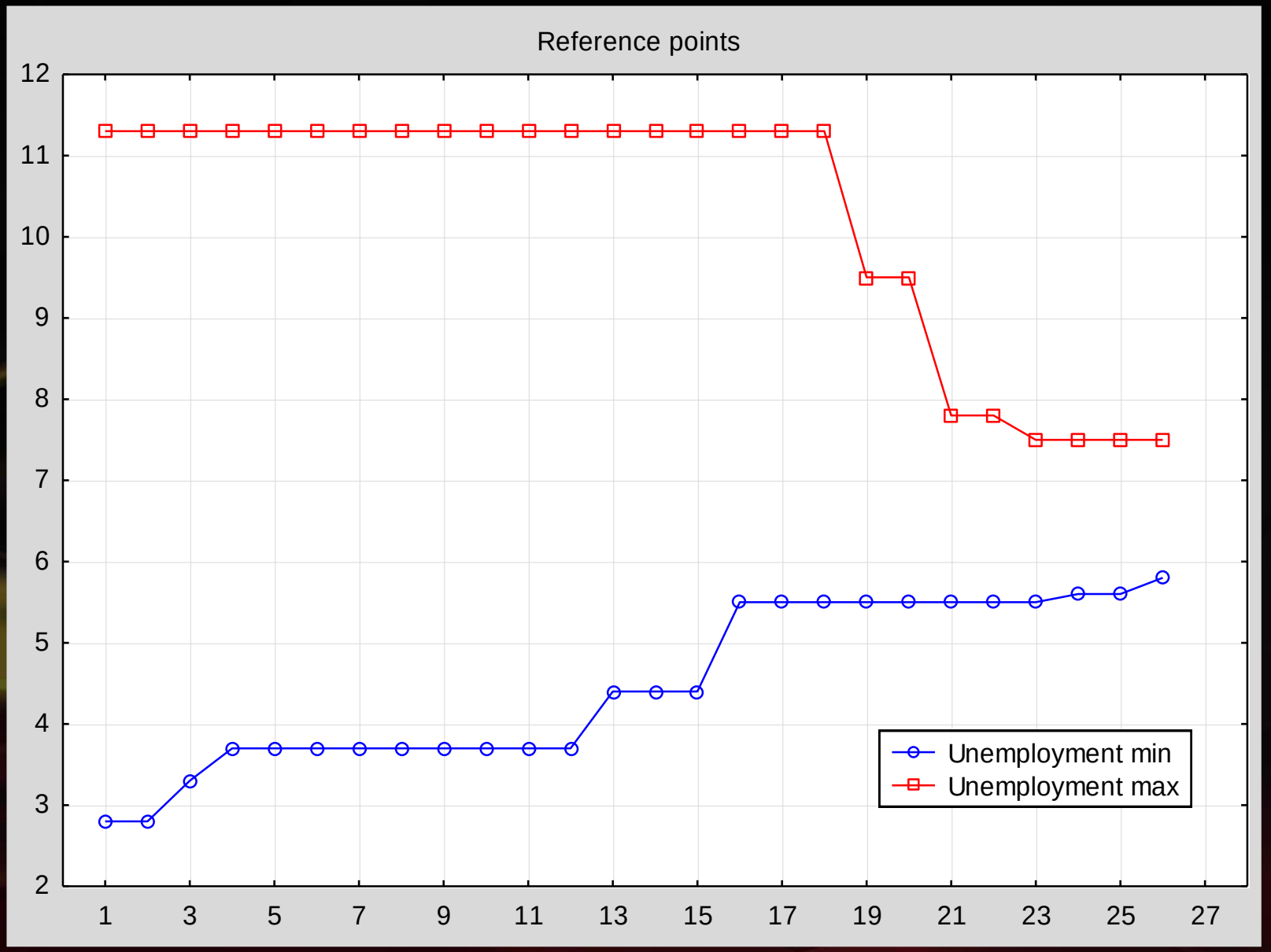
where: D – diminishing rate; W^i - local indicator

Overall composite index

$$W_{(k)} = W^1_{(1)} \prod_{i=2}^{k} D_{(i)}$$

27 EU countries - 2008

- GDP per capita at current market prices (EUR)
- Annual average inflation rate (all items) (%)
- Male live expectancy at birth (years)
- Infant mortality (per 1000 live births)
- Unemployment rate (%)
- At-risk-of poverty rate after social transfers, male (%)


Reference points
12
11
10
9
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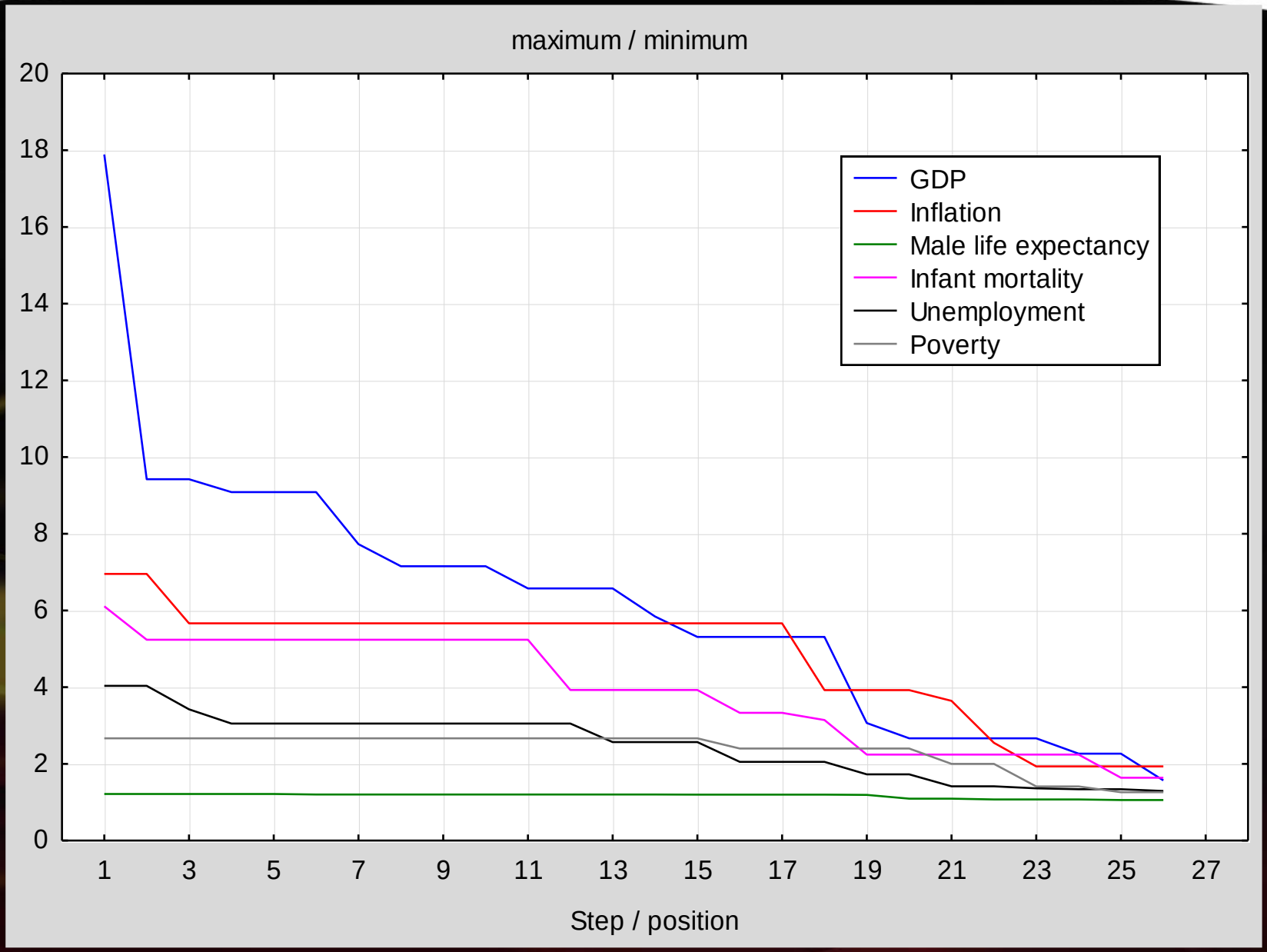
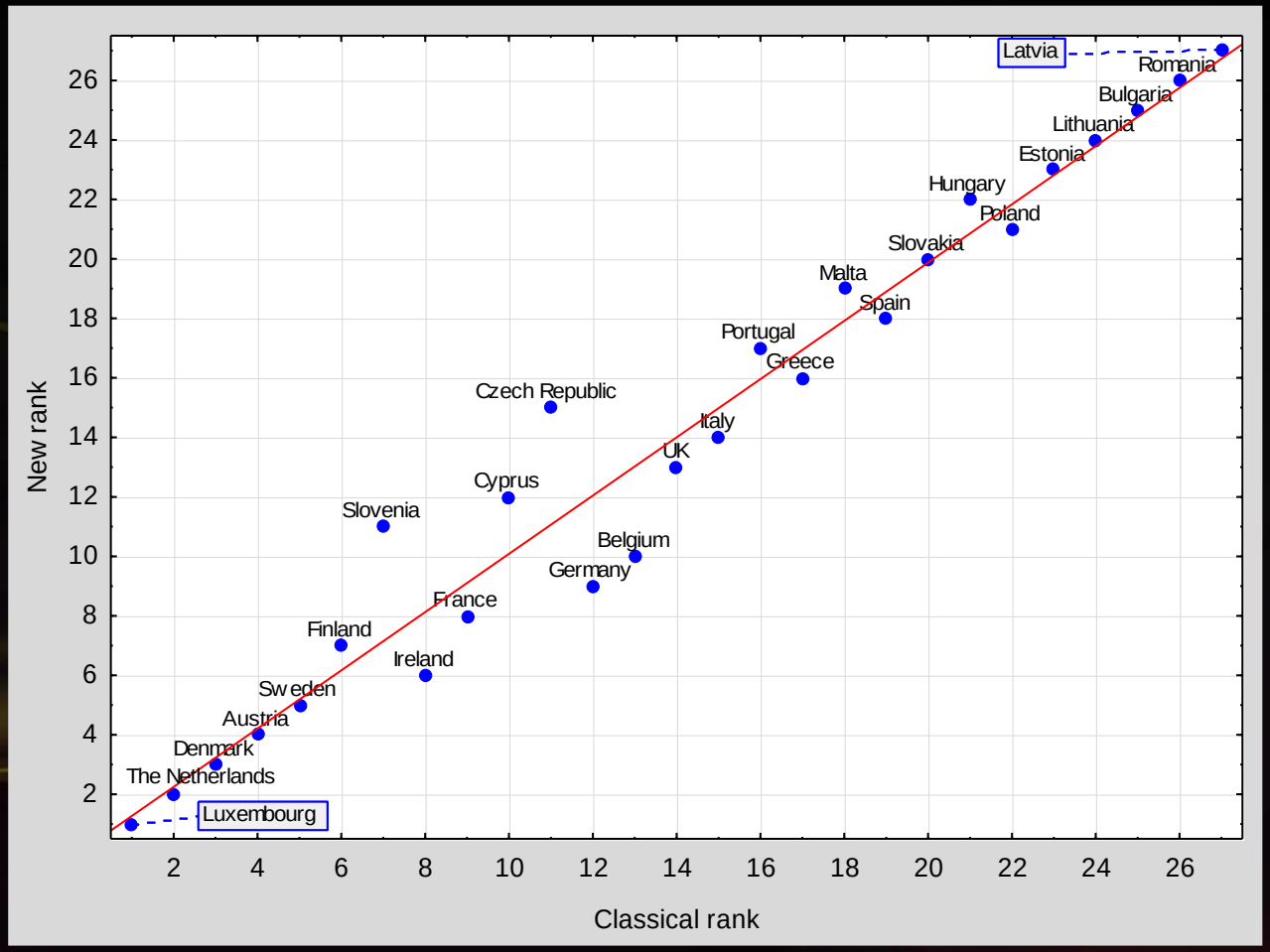
27
Unemployment min
Unemployment max


maximum / minimum
20
18
16
14
12
10
8
6
4
2
0
1
3
5
7
9
11
13
15
17
19
21
23
25
27
Step / position
GDP
Inflation
Male life expectancy
Infant mortality
Unemployment
Poverty

Country	Rank difference
Czech Republic	4
Slovenia	4
Cyprus	2
Hungary	1
Malta	1
Portugal	1
Finland	1
Bulgaria	0
Denmark	0
Estonia	0
Latvia	0
Lithuania	0
Luxembourg	0
The Netherlands	0
Austria	0
Romania	0
Slovakia	0
Sweden	0
Greece	-1
Spain	-1
France	-1
Italy	-1
Poland	-1
UK	-1
Ireland	-2
Belgium	-3
Germany	-3



Human Development Index

HDI

TABLE 1

Human Development Index and its components

TABLE 1

HDI rank	Human Development Index (HDI) Value 2017	SDG 3 Life expectancy at birth (years) 2017	SDG 4.3 Expected years of schooling (years) 2017[a]	SDG 4.6 Mean years of schooling (years) 2017[a]	SDG 8.5 Gross national income (GNI) per capita (2011 PPP $) 2017	GNI per capita rank minus HDI rank 2017	HDI rank 2016
VERY HIGH HUMAN DEVELOPMENT							
1 Norway	0.953	82.3	17.9	12.6	68,012	5	1
2 Switzerland	0.944	83.5	16.2	13.4	57,625	8	2
3 Australia	0.939	83.1	22.9 [b]	12.9	43,560	18	3
4 Ireland	0.938	81.6	19.6 [b]	12.5 [c]	53,754	8	4
5 Germany	0.936	81.2	17.0	14.1	46,136	13	4
6 Iceland	0.935	82.9	19.3 [b]	12.4 [c]	45,810	13	6
7 Hong Kong, China (SAR)	0.933	84.1	16.3	12.0	58,420	2	8
7 Sweden	0.933	82.6	17.6	12.4	47,766	9	7
9 Singapore	0.932	83.2	16.2 [d]	11.5	82,503 [e]	–6	8
10 Netherlands	0.931	82.0	18.0	12.2	47,900	5	10
11 Denmark	0.929	80.9	19.1 [b]	12.6 [f]	47,918	3	10
12 Canada	0.926	82.5	16.4 [c]	13.3	43,433	10	12
13 United States	0.924	79.5	16.5	13.4	54,941	–2	12
14 United Kingdom	0.922	81.7	17.4	12.9 [f]	39,116	13	14
15 Finland	0.920	81.5	17.6	12.4	41,002	10	15
16 New Zealand	0.917	82.0	18.9 [b]	12.5	33,970	18	16
17 Belgium	0.916	81.3	19.8 [b]	11.8	42,156	6	16
17 Liechtenstein	0.916	80.4 [g]	14.7	12.5 [h]	97,336 [e,i]	–15	16
19 Japan	0.909	83.9	15.2	12.8 [j]	38,986	9	19
20 Austria	0.908	81.8	16.1	12.1	45,415	0	20
32 Cyprus	0.869	80.7	14.6	12.1	31,568	4	32
33 Poland	0.865	77.8	16.4	12.3	26,150	12	34
34 United Arab Emirates	0.863	77.4	13.6	10.8 [j]	67,805	–27	33

In its 2010 Human Development Report, the UNDP began using a new method of calculating the HDI. The following three indices are used:

1. Life Expectancy Index (LEI) $= \frac{\mathrm{LE} - 20}{85 - 20}$

   LEI is 1 when Life expectancy at birth is 85 and 0 when Life expectancy at birth is 20.

2. Education Index (EI) $= \frac{\mathrm{MYSI} + \mathrm{EYSI}}{2}$

   2.1 Mean Years of Schooling Index (MYSI) $= \frac{\mathrm{MYS}}{15}$ [5]

   Fifteen is the projected maximum of this indicator for 2025.

   2.2 Expected Years of Schooling Index (EYSI) $= \frac{\mathrm{EYS}}{18}$ [6]

   Eighteen is equivalent to achieving a master's degree in most countries.

3. Income Index (II) $= \frac{\ln(\mathrm{GNIpc}) - \ln(100)}{\ln(75,000) - \ln(100)}$

   II is 1 when GNI per capita is $75,000 and 0 when GNI per capita is $100.

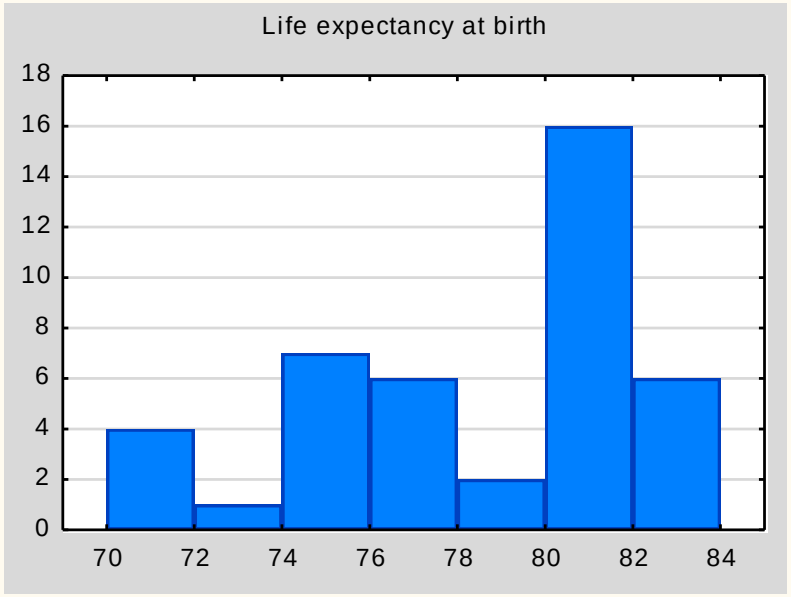
Finally, the HDI is the geometric mean of the previous three normalized indices:
$\mathrm{HDI} = \sqrt[3]{\mathrm{LEI} \cdot \mathrm{EI} \cdot \mathrm{II}}.$

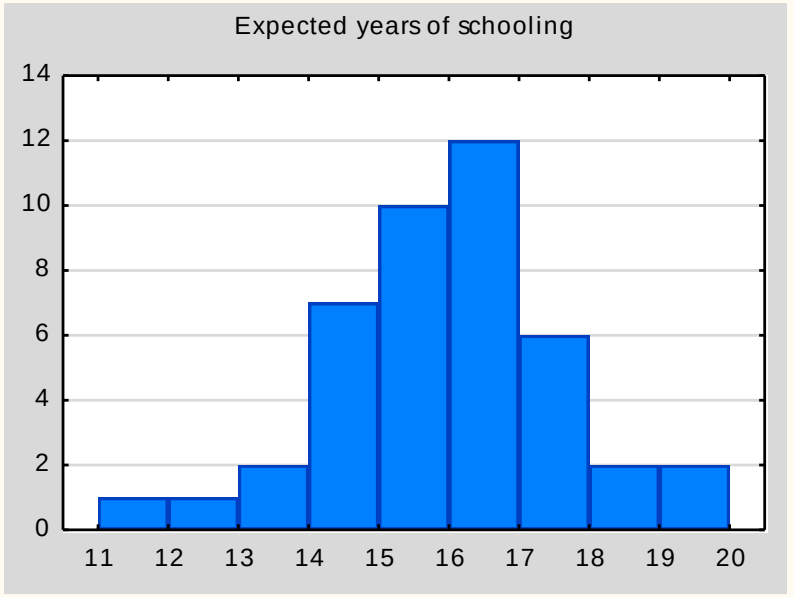
LE: Life expectancy at birth

MYS: Mean years of schooling (i.e. years that a person aged 25 or older has spent in formal education)

EYS: Expected years of schooling (i.e. total expected years of schooling for children under 18 years of age)

GNIpc: Gross national income at purchasing power parity per capita


Life expectancy at birth
18
16
14
12
10
8
6
4
2
0
70
72
74
76
78
80
82
84


Expected years of schooling
14
12
10
8
6
4
2
0
11
12
13
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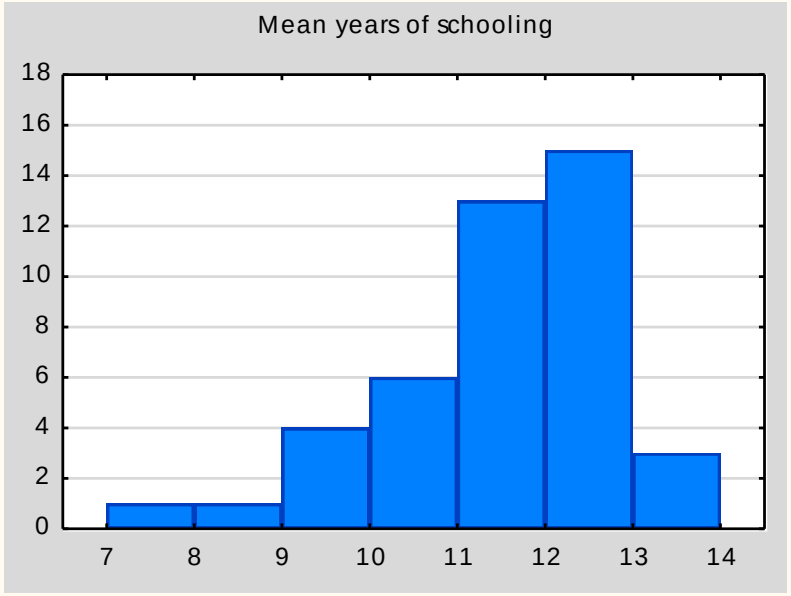
16
17
18
19
20


Mean years of schooling
18
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14
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10
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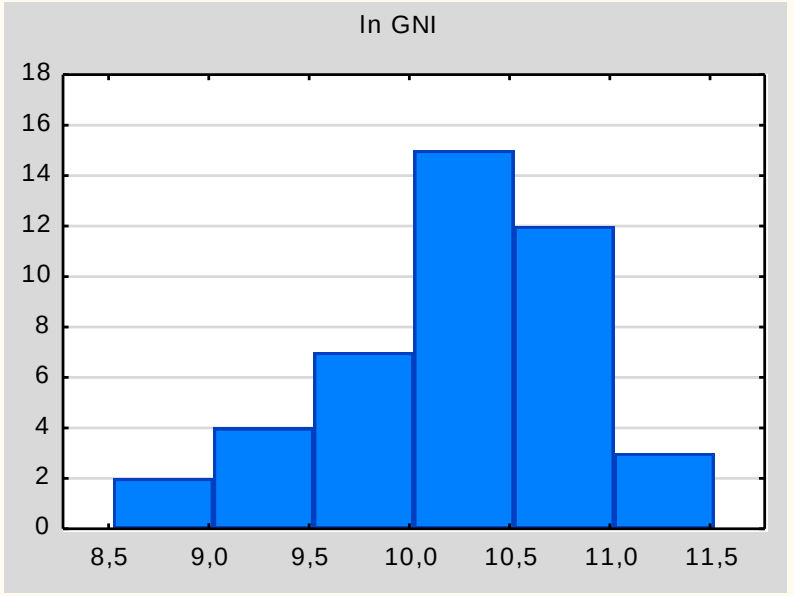
8
9
10
11
12
13
14


ln GNI
18
16
14
12
10
8
6
4
2
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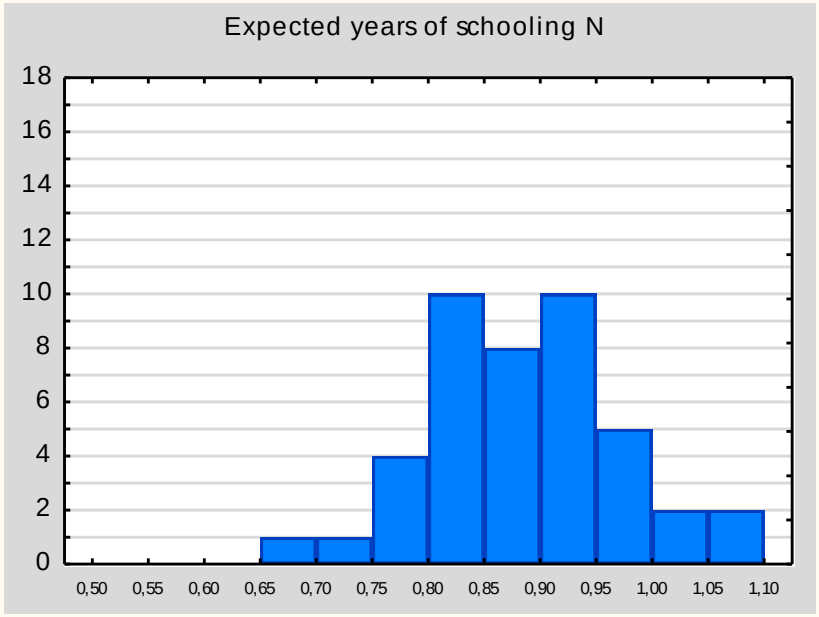
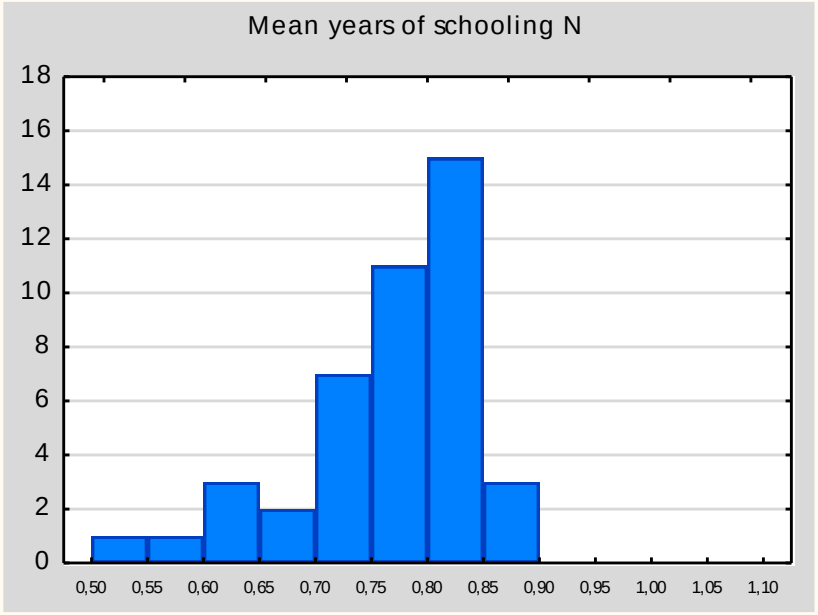
8,5
9,0
9,5
10,0
10,5
11,0
11,5


LIfe expectancy N
18
16
14
12
10
8
6
4
2
0
0,50 0,55 0,60 0,65 0,70 0,75 0,80 0,85 0,90 0,95 1,00 1,05 1,10


Expected years of schooling N
18
16
14
12
10
8
6
4
2
0
0,50 0,55 0,60 0,65 0,70 0,75 0,80 0,85 0,90 0,95 1,00 1,05 1,10


Mean years of schooling N
18
16
14
12
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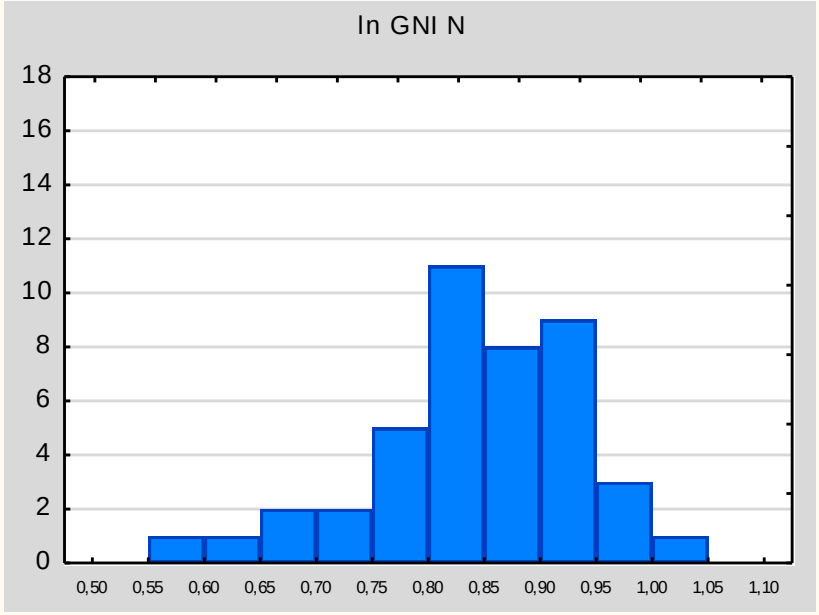
0,50 0,55 0,60 0,65 0,70 0,75 0,80 0,85 0,90 0,95 1,00 1,05 1,10


ln GNI N
18
16
14
12
10
8
6
4
2
0
0,50 0,55 0,60 0,65 0,70 0,75 0,80 0,85 0,90 0,95 1,00 1,05 1,10

Characteristics of normalized variables

Variable	Mean	Min	Q lower	Median	Q upper	Max	SD	V
LE N	0.90	0.76	0.85	0.93	0.95	0.97	0.060	6.7
EYS N	0.88	0.66	0.82	0.89	0.93	1.07	0.087	9.9
MYS N	0.76	0.53	0.72	0.78	0.82	0.89	0.081	10.6
GNI N	0.84	0.59	0.80	0.84	0.92	1.00	0.090	10.6

Four versions of HDI

- HDI World (UNDP) (multiplicative)
- HDI Europe (multiplicative)
- HDI classical (additive – reference points calculated from data)
- HDI iterative (top-down – changing reference points)

Variable	World	Europe
LE	20-85	65-80
EYS	0-18	11-20
MYS	0-15	7-14
GNI	100-75000	5000-76000

Country	HDI	HDI E	HDI C	HDI I
Norway	1	1	1	1
Switzerland	2	2	2	2
Germany	**3**	**7**	**7**	**7**
Denmark	4	3	4	4
Netherland	5	6	6	6
Ireland	6	5	5	5
Island	**7**	**4**	**3**	**3**
Sweden	8	8	8	8
Lichtenstein	9	9	9	10
Great Britain	10	10	10	9
Luxemburg	11	11	11	12
France	12	12	12	11
Belgium	13	13	15	14
Finland	14	15	16	16
Austria	15	14	14	14
Slovenia	16	17	18	18
Italy	**17**	**16**	**13**	**14**
Spain	18	18	17	17
Czechia	19	19	19	19
Greece	20	20	21	20
Estonia	21	23	23	23
Andorra	22	22	20	21

Country	HDI	HDI E	HDI C	HDI I
Malta	23	21	22	22
Poland	24	24	25	25
Lithuania	25	27	27	28
Slovakia	26	26	26	26
Portugal	27	25	24	24
Hungary	28	28	29	29
Latvia	29	30	30	30
Croatia	30	29	28	27
Montenegro	31	31	31	31
Russia	32	34	34	34
Romania	33	32	32	32
Belarus	34	35	36	37
Bulgaria	36	33	33	33
Kazakhstan	36	37	38	39
Serbia	37	36	37	38
Turkey	38	38	39	36
Albania	**39**	**39**	**35**	**35**
Bosnia & Herc	40	41	40	40
Macedonia	41	40	41	41
Ukraine	42	42	42	42
Moldova	43	43	43	43

Jobs in US

CAREERCAST

The 2018 Jobs Rated Report

Core Criteria	Variables
Work Environment	Emotional factors (4 variables) Physical factors (5 variables)
Income	Growth potential Beginning income (10th percentile) Midlevel income (median) Top level income (90th percentile)
Growth Outlook	Employment growth Income growth potential Unemployment
Stress	(11 variables)

The worst jobs of 2019

Job	Overall Rating	Median Salary in $
1. Taxi Driver	832	25 980
2. Logging Worker	827	40 650
3. Newspaper Reporter	812	43 490
4. Retail Salesperson	792	24 340
5. Enlisted Military Personnel	779	26 802
6. Correctional Officer	766	44 400
7. Disc Jockey	733	31 990
8. Nuclear Decontamination Technician	729	42 030
9. Advertising Sales Person	728	51 740
10. Broadcaster	722	62 910

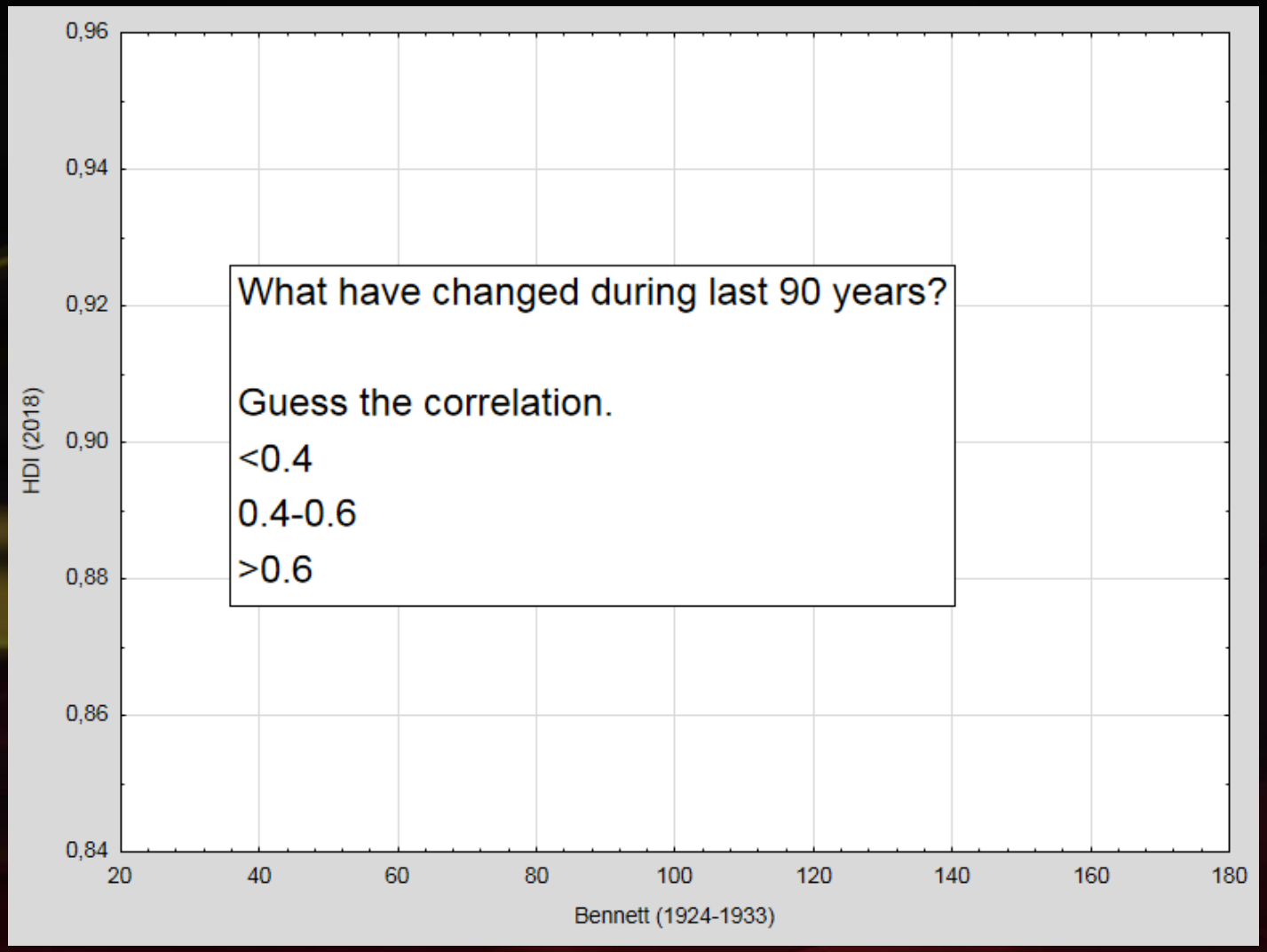
Max = 4*220 = 880

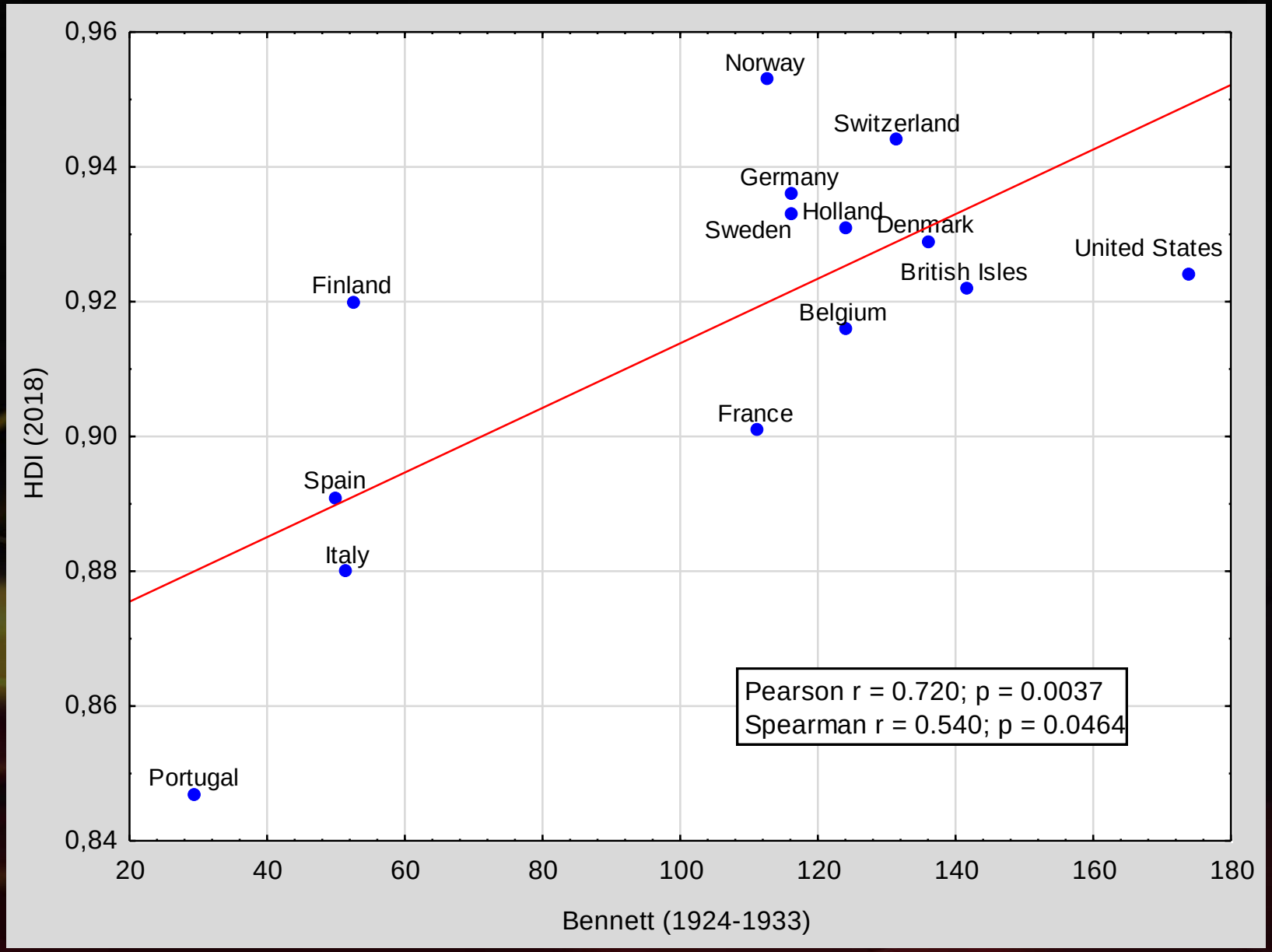
The best jobs of 2019

Job	Overall Rating	Median Salary in $
1. Data Scientist	97	114 520
2. Statistician	110	84 760
3. University Professor	112	76 000
4. Occupational Therapist	116	83 200
5. Genetic Counceler	119	77 480
6. Medical Service Manager	120	98 350
7. Information Security Analyst	126	95 510
8. Mathematician	127	84 760
9. Operations Research Analyst	128	81 390
10. Actuary	141	101 560

Genetic Counselors work with patients expecting children to assess and evaluate risk of genetic disorders and birth defects. They also advise patients at risk of congenital disorders.

Quiz




0,96
0,94
0,92
0,90
0,88
0,86
0,84
HDI (2018)
20
40
60
80
100
120
140
160
180
Bennett (1924-1933)
Norway
Switzerland
Germany
Holland
Sweden
Denmark
United States
British Isles
Finland
Belgium
France
Spain
Italy
Portugal
Pearson r = 0.720; p = 0.0037
Spearman r = 0.540; p = 0.0464

Recommendations

- There is no „Gold Standard” in composite indicators
- Decide the weighting system before you switch on your computer
- Don’t use too many variables
- Carefully consider reference points
- Mind the undesired, hidden weighting
- Don’t use coefficient of variance
- Code Likert scale as {1, 2, 4, 6, 7}
- Try step-wise procedure
- Point systems are not so bad despite theoretical drawbacks
- Defend your ranking

Some open problems

- Robustness – against what? (changing the list of variables, changing the list of objects, outliers, random disturbances, missing data, normalization method, aggregation method, …)
- Data levels (variables, sub-indicies, composite indicators, macro-indicators, meta-analysis)
- Identification of hidden weighting
- More reference points (1,2,3, …, ?)
- Non-linear orders
- Ordered classes
- „Best” distribution for individual variable
- Symbolic data
- Voting and point systems
- Flexible list of variables
- …

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TOP 30

29 czerwca 2019 / June 29, 2019

Last week	This week		Weeks in chart	Highest position
(1)	1	OLD TOWN ROAD – Lil Nas X	10	1
(2)	2	I DON'T CARE – Ed Sheeran & Justin Bieber	7	1
(7)	3	CROSS ME – Ed Sheeran & Chance The Rapper	5	3
(9)	4	SOMEONE YOU LOVED – Lewis Capaldi	22	4
(12)	5	PIECE OF YOUR HEART – Meduza feat. Goodboys	13	2
(5)	6	HOLD ME WHILE YOU WAIT – Lewis Capaldi	6	5
(21)	7	DON'T FEEL LIKE CRYING – Sigala	16	3
(11)	8	SOS – Avicii feat. Aloe Blacc	9	2
(26)	9	STAY (DON'T GO AWAY) – David Guetta feat. Raye	5	9
(-)	10	MAD LOVE – Mabel	1	10
(28)	11	FIND U AGAIN – Mark Ronson feat. Camila Cabello	3	11
(-)	12	YOU NEED TO CALM DOWN – Taylor Swift	1	12
(-)	13	BOUNCE BACK – Little Mix	1	
(3)	14	ONE TOUCH – Jess Glynne & Jax Jones	3	3
(4)	15	EASIER – 5 Seconds of Summer	3	4
(8)	16	LATE NIGHT FEELINGS – Mark Ronson feat. Lykke Li	5	8
(10)	17	BAD GUY – Billie Eilish	12	2
(14)	18	ALL DAY AND NIGHT (JAX JONES & MARTIN SOLVEIG PRESENT EUROPA) – Jax Jones & Martin Solveig feat. Madison	11	1
(24)	19	WHAT I LIKE ABOUT YOU – Jonas Blue feat. Theresa Rex	6	12
(-)	20	SEÑORITA – Shawn Mendes & Camilla Cebello	1	20
(-)	21	PANINI – Lil Nas X	1	21
(-)	22	PROMISES – Calvin Harris feat. Sam Smith	19	1
(13)	23	IF I CAN'T HAVE YOU – Shawn Mendes	7	2
(15)	24	HERE WITH ME – Marshmello feat. CHVRCHES	13	4
(16)	25	WISH YOU WELL – Sigala x Becky Hill	3	16
(17)	26	3 NIGHTS – Dominic Fike	4	17
(18)	27	GREAZE MODE – Skepta feat. Nafe Smaliz	3	18
(19)	28	VOSSI BOP – Stormzy	8	5
(27)	29	I'M SO TIRED – Lauv & Troye Sivan	16	10
(-)	30	NO GUIDANCE – Chris Brown feat. Drake	1	30

Thank you very much …