SIX GUIDING STEPS FOR SUCCESS

- Building the Concept
- Building the Framework
- Data Collection & Index Calculation
- Validating Results
- Communicating Results & Building Initiative
- Assessment & Impact

Decision 3: What data do we use? Solely secondary sources, reprocessing of primary data, collecting primary information?

Using the best available data – for the best possible model.

- Is there enough information to measure concepts that matter?
- Is this information credible and consistent?
- Are we measuring outcomes?
- Can we monitor those indicators on a regular basis?

Building the Concept

Building the Framework

Data Collection & Index Calculation

AGENDA

RECORD THE SESSION

9 – 9.05 Introduction, agenda – 5 minutes

9.05 – 9.35 Indicator ice-breaker – 30 minutes

9.35 – 10.20 Methodology – missing values, outliers 45 mins

Until 10.30 – BREAK 10 minutes

10.30 – 11.25 Transformations – 55 mins

11.25 – 12.00 Aggregation - 45 minutes

CASE STUDY 2: SOCIAL PROGRESS, A NEW DEVELOPMENT PARADIGM IN THE AMAZON REGION

- Same indicator
- Close definitiion
- Best available proxy
- New indicator

Social Progress Index

Basic Human Needs

Nutrition and Basic Medical Care
- Undernourishment
- Morbidity due to under nutrition
- Maternal mortality rate
- Child mortality rate
- Mortality due to infectious diseases

Water and Sanitation
- Access to piped water
- Access to improved sanitation facilities
- Rural access to improved water facilities

Shelter
- Availability of affordable housing
- Access to electricity
- Trash collection

Personal Safety
- Adult homicide rate
- Traffic deaths
- Exposure to violence

Foundations of Wellbeing

Access to Basic Knowledge
- Adult literacy rate
- Primary school enrollment
- Secondary school enrollment
- Quality of education

Access to Information and Communications
- Mobile telephone subscriptions
- Mobile internet users

Health and Wellness
- Life expectancy
- Deaths from cancer, cardiovascular diseases, and diabetes
- Obesity rate
- Morbidity due to respiratory diseases
- Suicide rate

Ecosystem Sustainability
- Forest coverage
- Deforestation rate
- Protected areas
- Degraded areas
- Water stress

Opportunity

Personal Rights
- Political pluralism
- Mobility
- Property rights over land

Personal Freedom and Choice
- Child labor
- Children and teen pregnancies
- Access to culture and recreation
- Familial vulnerability

Tolerance and Inclusion
- Violence against women
- Violence against indigenous
- Inequality between whites and blacks

Access to Advanced Education
- Tertiary school enrollment
- Women's mean years in school
- Young people studying college degrees

European Regional Social Progress Index Framework

Basic Human Needs

Nutrition and Basic Medical Care
1. Premature mortality (<65)
2. Infant mortality
3. Unmet medical needs
4. Insufficient food

Water and Sanitation
5. Satisfaction with water quality
6. Lack of toilet in dwelling
7. Uncollected sewage
8. Sewage treatment

Shelter
9. Burdensome cost of housing
10. Satisfaction with housing
11. Overcrowding
12. Lack of adequate heating

Personal Safety
13. Homicide rate
14. Safety at night
15. Traffic deaths

Foundations of Wellbeing

Access to Basic Knowledge
16. Upper-secondary enrolment rate
17. Lower secondary completion only
18. Early school leavers

Access to Information and Communications
19. Internet at home
20. Broadband at home
21. Online interaction with public authorities

Health and Wellness
22. Life expectancy
23. General health status
24. Standardized cancer death rate
25. Standardized heart disease death rate
26. Unmet dental needs
27. Satisfaction with air quality

Environmental Quality
28. Air pollution-pm10
29. Air pollution-pm2.5
30. Air pollution-ozone
31. Pollution or grime
32. Protected land (Natura 2000)

Opportunity

Personal Rights
33. Trust in the political system
34. Trust in the legal system
35. Trust in the police
36. Quality of public services

Personal Freedom and Choice
37. Freedom over life choices
38. Teenage pregnancy
39. Young people not in education, employment or training
40. Corruption index

Tolerance and Inclusion
41. Impartiality of government services
42. Tolerance for immigrants
43. Tolerance for minorities
44. Attitudes toward people with disabilities
45. Tolerance for homosexuals
46. Gender employment gap
47. Community safety net

Access to Advanced Education
48. Tertiary education attainment
49. Tertiary enrolment
50. Lifelong learning

INDICATOR SELECTION CRITERIA

Does the indicator measure an economic, social or environmental concept?

This is a social or environmental indicator.

Does this indicator measure an input or an outcome?

It measures an economic concept (including employment).

Eliminate this variable.

This indicator measures a concept that we are interested in because it is good or bad for its own sake.

What is the source of this indicator?

This indicator is important mainly because it signals something else and is therefore an input indicator.

Eliminate this variable.

This source is widely reputable and the methods it uses are sound.

How old is the data?

This source is unknown, uses biased methods, or lacks rigorous data collection.

Eliminate this variable.

Data is reasonably current.

How many geographic regions does this indicator cover?

Most data points are 2-3 years old, some potentially older.

Eliminate this variable.

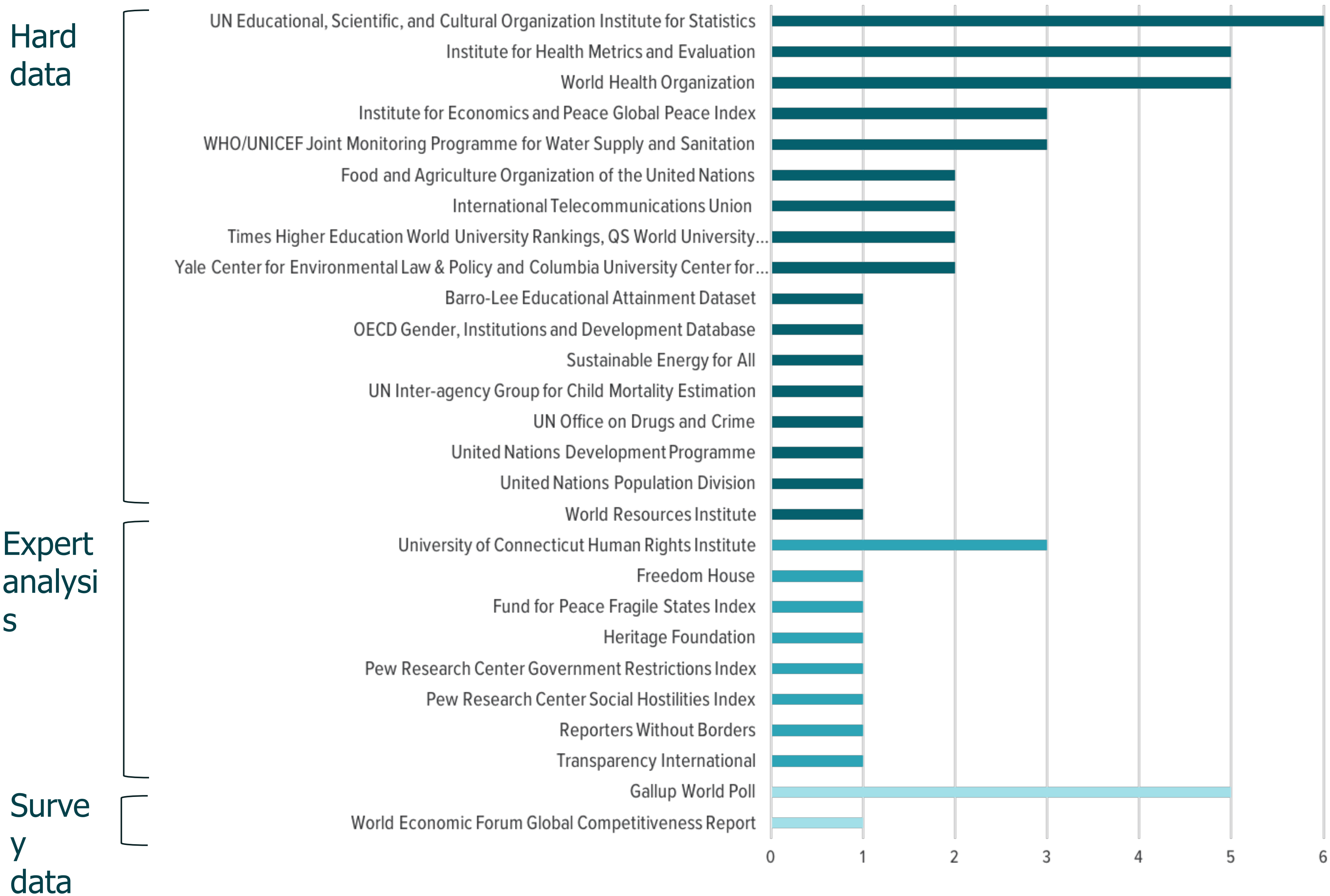
95-100% of geographic regions.

This indicator can be included in the Index.

Fewer than 95% of the geographic regions in the Index.

Eliminate this variable.

INDICATOR DATA SOURCES



CLASSWORK ☺

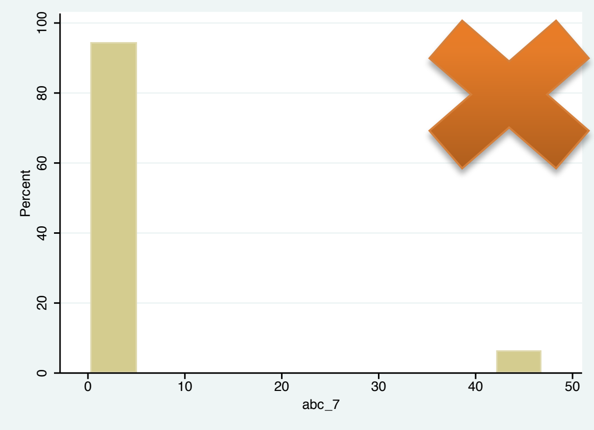
Using the excel:

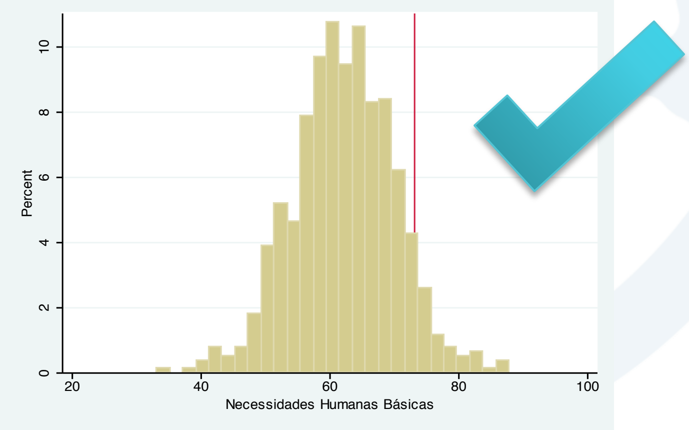
1) Construct the framework of Social Progress Index – i.e. organize components within the three dimensions
2) Organize the indicators accordingly under appropriate components

THE BEST AVAILABLE DATA – FOR THE BEST POSSIBLE MODEL

We need to look for some simple but essential **statistical characteristics**:

- ✓ Have more observation units than indicators. (>30)
- ✓ Have indicators with good distributions
- ✓ Avoid perfect correlations between indicators
- ✓ Look for outliers





PREPARATIONS BEFORE INDEX CALCULATIONS

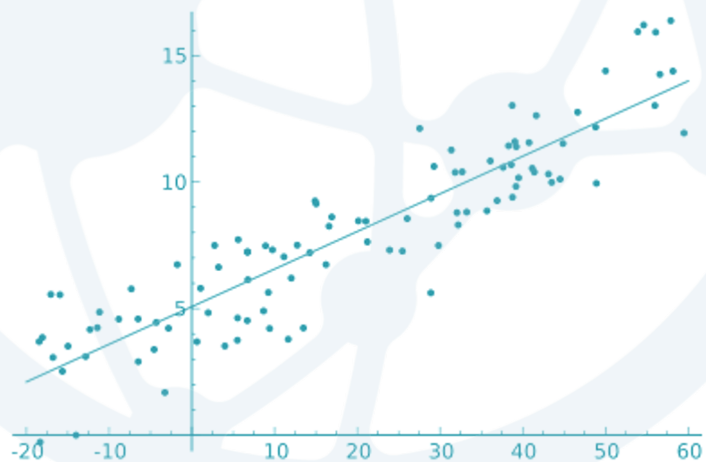
Imputation of missing data

Identify outliers

Make scale adjustments and transform highly skewed indicators (capping, bucketing)

Invert indicators that are negatively related to Social Progress

Standardisation (z-scores)



Identify blanks and zeros
- **Look for patterns**
- **Are zeros actually zeros?**

Identify extreme values, aka outliers
- **Are these true or potentially mistakes?**

In 1870, a German chemist named Erich von Wolf was researching the nutritional benefits of spinach. In his notes, he accidentally printed the decimal point in the vegetable's iron content in the wrong spot. Wolf accidentally increased the vegetable's iron level to 10 times the actual amount — 3.5 grams of iron suddenly became 35 grams, an extremely high amount of iron.

While the story has since been debated, and the error is likely to be due to poor scientific methods rather than a mistakenly placed decimal point, it helps to demonstrate that **extreme values need to be carefully scrutinized**.

MISSING VALUES

Check why a value is missing

- **Irrelevance of measure**
- **Suppressed values**

If the value is simply missing….

- Assess all missing values on case by case basis rather than apply one size fits all approach.
- Be clear and transparent about the imputation method and why we selected it.
- Not interpret and directly compare imputed values as and with recorded values.

Bearing in mind that SPI is used to inform policy and decision-making, and this needs to be taken into account when deciding on the best imputation method. Sometimes this can also mean that the indicator must be excluded if there are any missing values, because any type of imputation would not be acceptable to policy-makers.

IMPUTATION METHODS

Historical or more recent values
Averaging all, or neighbouring units
Higher level of geography
Regression

Each imputed data point should be assessed to ensure accuracy. In case the imputed value does not meet expectations alternative imputation methods need to be considered and tested.

CLASSWORK ☺

Using the excel:

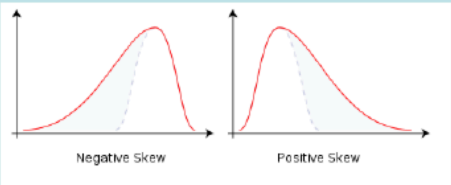
1) Three indicators in the spreadsheet are highlighted – why?
2) How would you deal with the why – i.e. the reason they are highlighted ☺

INDICATOR TRANSFORMATIONS

Identification of outliers

Distribution
- capping
- log tr.

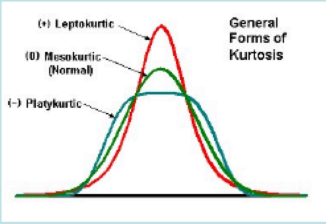
Skewness and Kurtosis



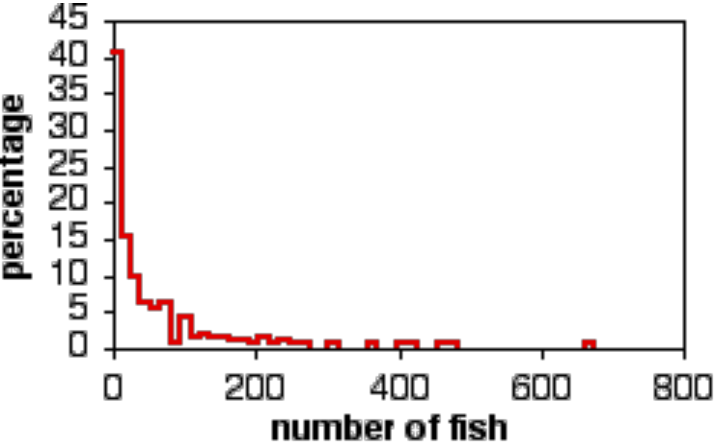
Skewness: measure of the asymmetry of a distribution;
= 0 in the Normal distribution

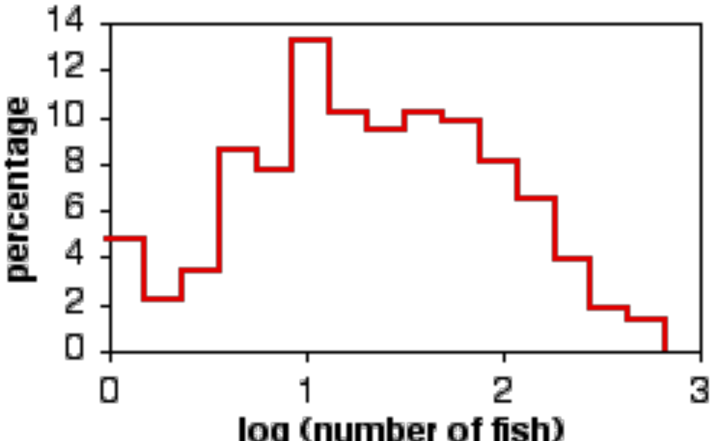
(+) higher peak around the mean and fatter tails

(-) fatter around the mean and thinner tails



Kurtosis: measure of the thickness of the tails of a distribution;
= 3 in the Normal distribution





INDICATOR TRANSFORMATIONS

- Inversion
- Z-score
- Min-max standardization
  (*performed at the level of components*)

INDICATOR TRANSFORMATION: INVERSION

- for the index construction, all indicators are supposed to go in the same direction, i.e. higher values should indicate better performance
- some indicators (such as mortality indicators) are negatively related to Social Progress: higher values of maternal mortality indicate lower/worse performance (and vice versa)
- a simple way to deal with this: we invert such an indicator by multiplying all its values by -1

INDICATOR TRANSFORMATION: Z-SCORE STANDARDIZATION

- to standardize the data so that they are measured them on the same scale

- to get a z-score for an observation, substract the mean from a raw value for that observation and divide the difference by the standard deviation:

$$z = \frac{Observation\ - Mean}{Standard\ Deviation}$$

- the result is a standard score (= z-score) that measures the number of standard deviations that a given data point is from the mean (the z-scores can take positive as well as negative values)

UTOPIAS AND DYSTOPIAS

Before calculating the index, it is important to determine the values that would represent the absolute best case (**utopia**) and the absolute worst case (**dystopia**) for each indicator. In the dataset, two fictitious units should be created to represent all the best case scenarii and all the worst case scenarii.

The utopia and dystopia values will be used to transform scores to the 0-100 scale, where 0 is the worst possible score and 100 is the best possible score (refer to "Calculating component, dimension and index scores").

This makes the final scores more easily interpretable and comparable across components.

INDICATOR TRANSFORMATION: MIN-MAX STANDARDIZATION

$$\frac{(X_j - Worst\ Case)}{(Best\ Case - Worst\ Case)} * 100$$

to re-scale values to 0-100 scores because of better comparability & clearer interpretation

(*the min-max standardization is performed* ***only after the indicators are aggregated into components***)

CLASSWORK ☺

Using the excel:

1) Define utopias and dystopias for each indicator
2) Identify which indicators need to be inverted
3) Calculate z-scores for each indicator

AGENDA

RECORD THE SESSION

9 – 9.10 Q&As, agenda – 10 minutes

9.10 – 10.00 Weighting and aggregation– 50 minutes

10.00 – 11.45 Indicator identification – work in groups

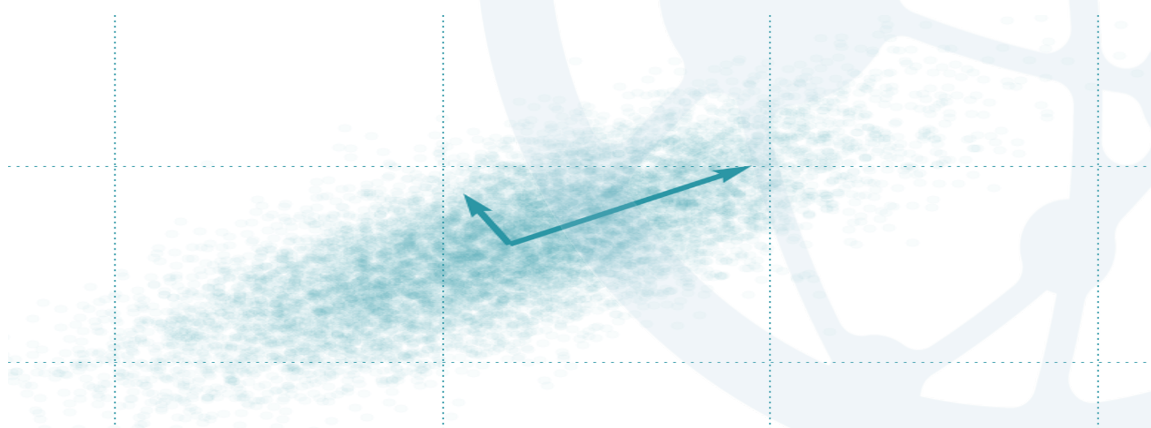
Break between as needed

11.45 – 12.00 wrap up

APPLYING THE PRINCIPAL COMPONENTS ANALYSIS

Principal Components Analysis (PCA) is used to evaluate the fit of indicators within components and determine indicator **weights** within components. If indicators are chosen well to reflect a component, this method help us to identify **robust and consistent** combinations of indicators for each component.

To create indexes with **variables that measure similar things** (conceptually). To get a small set of variables (preferably uncorrelated) from a large set of variables (most of which are correlated to each other)



WEIGHTING AND AGGREGATION

The individual component scores are calculated by summing the weighted scores of indicators to reach the component.

$$Component_c = \sum_i (w_i * indicator_i)$$

$$\frac{(X_j - Worst\ Case)}{(Best\ Case - Worst\ Case)} * 100$$

For comparability, we **now** re-scale the components to 0-100 scores using the min-max method

AGGREGATION METHODS

Arithmetic mean – global SPI
Generalized weighted mean – EU RSPI, YPI
Geometric mean – US SPI

ARITHMETIC MEAN

The simplest, most obvious and most widespread aggregation method => widely known and easy to understand

- the quantity obtained by summing two or more numbers or variables and then dividing by the quantity (#) of numbers or variables

$$\frac{1}{n}\sum_{i=1}^{n} x_i$$

Perfect substitutability – compensates bad performance in one with good in another

GEOMETRIC MEAN

Indicates the central tendency or typical value of a set of numbers by using the product of their values (as opposed to the arithmetic mean which uses their sum).

- The geometric mean is defined as the nth root of the product of *n* numbers:

$$\sqrt[n]{\prod_{i=1}^{n} x_i}$$

- **Partial substitutability** - compensates up to a point/rewards balanced performance/penalises low performance in any of the elements to be aggregated

GENERALIZED WEIGHTED MEAN

Across the components and, even more, across the dimensions the effect of compensability is generally more accentuated. An inequality-adverse type of aggregation is then adopted to mitigate this effect. It is a well-known principle that deficiency in one component should lead to a general failure, given that acceptable social progress levels are ensured if a region performs well enough across all the different social aspects.

$$I_j = \begin{cases} \left(\frac{1}{q}\sum_{i=1}^{q} x_i^{\beta}\right)^{1/\beta} & \beta \neq 0 \\ \left(\prod_{i=1}^{q} x_i\right)^{1/q} & \text{for } \beta = 0 \quad \text{(geometric mean)} \end{cases}$$

Full compensability can be avoided, or at least mitigated, by adopting a type of aggregation which stands in between an arithmetic and the geometric average, the generalised weighted mean (Annoni and Weziak- Bialowolska, 2016; Decancq and Lugo 2013; Ruiz 2011).

Under this assumption that $0 < \beta < 1$, the generalised mean is said to be inequality-adverse: a rise in the level of one component in the lower tail of the distribution will increase the mean value by more than a similar rise in the upper tail, thus giving more importance to low levels (Ruiz 2011). The closer β is to 0, the higher this effect will be. Consequently, the order β plays the important role of balancing the achievements between two components.

STATA: ARITHMETIC MEAN

Dimension scores

```
gen score_bhn=(score_nbmc+score_ws+score_s+score_ps)/4
gen score_fwb=(score_k+score_i+score_hw+score_env)/4
gen score_opp=(score_pr+score_pf+score_ti+score_ed)/4
```

SPI score

```
gen score_spi=(score_bhn+score_fwb+score_opp)/3
```

STATA: GENERALIZED WEIGHTED MEAN

Dimension scores

```
gen score_bhn
=((score_nbmc^0.5+score_ws^0.5+score_s^0.5+score_ps^0.5)/4)^(1/0.5)

gen score_fwb
=((score_k^0.5+score_i^0.5+score_hw^0.5+score_eq^0.5)/4)^(1/0.5)

gen score_opp

=((score_pr^0.5+score_pc^0.5+score_ti^0.5+score_ed^0.5)/4)^(1/0.5)
```

Index Score

```
gen score_spi =((score_bhn^0.5+score_fwb^0.5+score_opp^0.5)/3)^(1/0.5)
```

STATA: GEOMETRIC MEAN

Dimension score

```
gen score_bhn=(score_nbmc*score_ws*score_s*score_ps)^(1/4)

gen score_fwb=(score_k*score_i*score_hw*score_eq)^(1/4)

gen score_opp=(score_pr*score_pc*score_ti*score_ed)^(1/4)
```

Index score

```
gen score_spi=(score_bhn*score_fwb*score_opp)^(1/3)
```

CLASSWORK ☺

Using the excel:

1) Calculate a score for each component scaled 0-100
2) Calculate a score for Basic Human Needs using arithmetic, geometric and generalized mean

5) Rank the wards, compare the ranks from geometric and arithmetic means
6) Congratulations! You've calculated 1/3 of SPI ☺

METHODOLOGY SUMMARY

- 0) indicator identification and data collection
- 1) quality check of indicators – missing values and zeros, distribution and outliers
- 2) setting utopias and dystopias
- 3) indicator transformations – skewness, capping, inversion, z-score
- 4) application of principal component analysis to ensure uni-dimensionality and derive weights
- 5) application of min-max standardization to achieve 0-100 scale
- 6) aggregation to an overall dimension and index score

Decision 4: How do we validate the results?
Relying on statistical robustness, benchmarking, reality check?

- Is the model robust and stable enough?
- With whom do we want to compare our performance?
- Does this picture of social progress reflect the current state of human wellbeing in this given context, at this specific time?

Building the Concept

Building the Framework

Data Collection & Index Calculation

Validating Results

INTERNAL CONSISTENCY

Cronbach's alpha provides a measure of **internal consistency** across indicators. An applied practitioner's rule of thumb is that the alpha value should be above 0.7 for any valid grouping of variables.

To evaluate the **"fit between"** the individual indicators within a component, by calculating Cronbach's alpha for the indicators in each component.

$$\alpha > 0.7$$

APPLYING THE PRINCIPAL COMPONENTS ANALYSIS

After performing the factor analysis in each component, assess this goodness of fit using the Kaiser Meyer Olkin measure of sampling adequacy. In general, KMO scores should be above 0.5.

KMO > 0.5

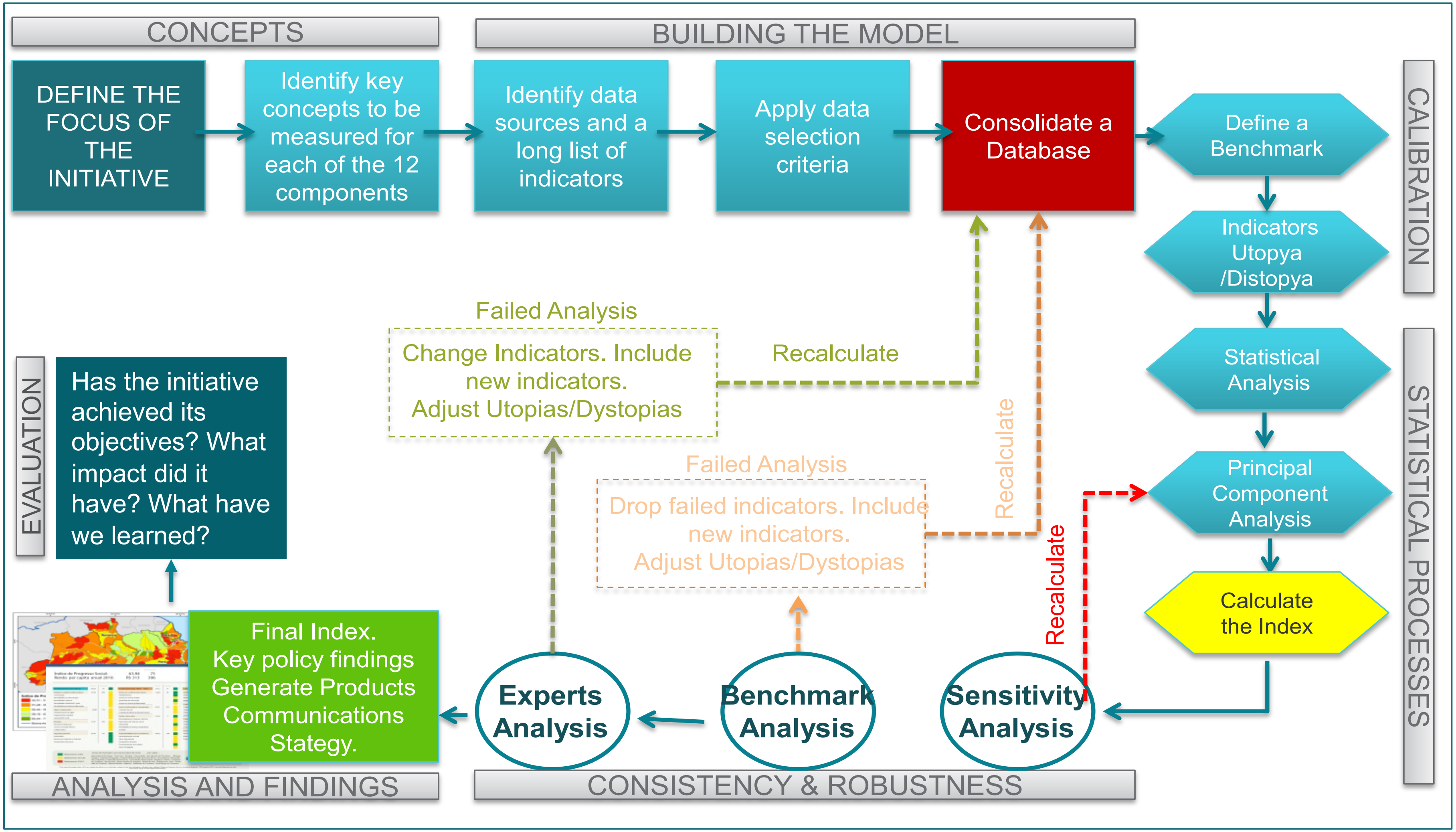
WEIGHTING AND AGGREGATION

Each dimension is simply the average of the four components that make up that dimension; and the overall index is calculated as the simple average of the three dimensions.

$$Dimension_d = \frac{1}{4} \sum_c Component_c$$

$$SPI = \frac{1}{3} \sum_d Dimension_d$$

INDEX CYCLE



CONCEPTS
BUILDING THE MODEL
DEFINE THE FOCUS OF THE INITIATIVE
Identify key concepts to be measured for each of the 12 components
Identify data sources and a long list of indicators
Apply data selection criteria
Consolidate a Database
Define a Benchmark
Indicators Utopya /Distopya
Statistical Analysis
Principal Component Analysis
Calculate the Index
CALIBRATION
STATISTICAL PROCESSES
Failed Analysis
Change Indicators. Include new indicators. Adjust Utopias/Dystopias
Recalculate
Failed Analysis
Drop failed indicators. Include new indicators. Adjust Utopias/Dystopias
Recalculate
Recalculate
EVALUATION
Has the initiative achieved its objectives? What impact did it have? What have we learned?
Final Index. Key policy findings Generate Products Communications Stategy.
Experts Analysis
Benchmark Analysis
Sensitivity Analysis
ANALYSIS AND FINDINGS
CONSISTENCY & ROBUSTNESS