Summer School on Multidimensional Poverty Analysis

11–23 August 2014

Oxford Department of International Development
Queen Elizabeth House, University of Oxford
Review of the Course

Sabina Alkire
22 August 2014
Oxford University, UK
OPHI at a glance

• **Global team:**
  - 4 post-docs + 1 director + 2 outgoing (MC, AC) + part-time
  - 3 core staff (administrator, communications, project assistant)
  - 20 colleagues from many countries (India, Colombia, Mexico, Pakistan, US, S Africa, Argentina, Morocco, Portugal etc.)

• **Advisors:**
  - Sudhir Anand
  - Tony Atkinson
  - Amartya Sen
  - Frances Stewart

• **Purpose:**
  To build a multidimensional economic framework for reducing poverty grounded in people’s experiences and values.
OPHI’s research – two themes

• Multidimensional Metrics
  – Developing & publishing rigorous new measures
  – Applying these to real problems (WEAI, MPI, etc)
  – Developing methodologies of analysis and evaluation

• Missing Dimensions
  – Developing modules for inclusion in internationally comparable household surveys.
  – Relevant to post-2015 discussion of potential MDGs like work, safety from violence, or empowerment.
Hi from whole the OPHI team
“Human lives are battered and diminished in all kinds of different ways.”

Amartya Sen

UNDP’s Million Voices: ‘The clear message is: Eradicating poverty and hunger, achieving gender equality, and improving health and education services remain foremost in people’s priorities.’

Helen Clark, 23 Sept 2013
Why the new emphasis on measurement?

_We can:_ Technical

1) Data availability  
2) Computational and Methodological developments

_We need to:_ Empirical

3) Monetary and Non-Monetary Household Deprivation Levels  
4) Income poverty trends  
5) Associations across non-monetary deprivations  
6) Economic Growth and Non-income Deprivations

_We are willing to:_ Policy

7) National and international policy ‘demand’  
8) Political space for new metrics
Mismatches: Income poverty and material deprivations in Europe

In Europe, while 20% of people are persistently income poor, and 20% are persistently materially deprived, only 10% of people are both persistently income poor and materially deprived.

See also: Nolan and Whelan 2011
## Economic Growth and Non-income Deprivations

### Table 1.1 Comparison of India’s Performance with Bangladesh and Nepal

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>Bangladesh</th>
<th>Nepal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>1,193</td>
<td>741</td>
<td>716</td>
</tr>
<tr>
<td>2011</td>
<td>3,203</td>
<td>1,569</td>
<td>1,106</td>
</tr>
</tbody>
</table>

**Growth (p.a.)**

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>Bangladesh</th>
<th>Nepal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>0.7%</td>
<td>0.5%</td>
<td>0.3%</td>
</tr>
<tr>
<td>2011</td>
<td>0.7%</td>
<td>0.5%</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

**Under-5 Mortality Rate**

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>Bangladesh</th>
<th>Nepal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>114</td>
<td>139</td>
<td>135</td>
</tr>
<tr>
<td>2011</td>
<td>61</td>
<td>46</td>
<td>48</td>
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**Change**

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>Bangladesh</th>
<th>Nepal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>-53</td>
<td>-93</td>
<td>-87</td>
</tr>
<tr>
<td>2011</td>
<td>-53</td>
<td>-93</td>
<td>-87</td>
</tr>
</tbody>
</table>

**Maternal Mortality Ratio**

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>Bangladesh</th>
<th>Nepal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>600</td>
<td>800</td>
<td>770</td>
</tr>
<tr>
<td>2010</td>
<td>200</td>
<td>240</td>
<td>170</td>
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</tbody>
</table>

**Change**

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>Bangladesh</th>
<th>Nepal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>-400</td>
<td>-560</td>
<td>-600</td>
</tr>
<tr>
<td>2010</td>
<td>-400</td>
<td>-560</td>
<td>-600</td>
</tr>
</tbody>
</table>

**Infant Immunization (DPT) (%)**

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>Bangladesh</th>
<th>Nepal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>59</td>
<td>64</td>
<td>44</td>
</tr>
<tr>
<td>2011</td>
<td>72</td>
<td>96</td>
<td>92</td>
</tr>
</tbody>
</table>

**Change**

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>Bangladesh</th>
<th>Nepal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>13</td>
<td>32</td>
<td>48</td>
</tr>
<tr>
<td>2011</td>
<td>13</td>
<td>32</td>
<td>48</td>
</tr>
</tbody>
</table>

**Female Literacy Rate, Age 15-24 Years (%)**

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>Bangladesh</th>
<th>Nepal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>49</td>
<td>38</td>
<td>33</td>
</tr>
<tr>
<td>2010</td>
<td>74</td>
<td>78</td>
<td>78</td>
</tr>
</tbody>
</table>

**Change**

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>Bangladesh</th>
<th>Nepal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>25</td>
<td>40</td>
<td>45</td>
</tr>
<tr>
<td>2010</td>
<td>25</td>
<td>40</td>
<td>45</td>
</tr>
</tbody>
</table>

“those attempting to guide the economy and our societies are like pilots trying to steering a course without a reliable compass. …

“We are almost blind when the metrics on which action is based are ill-designed or when they are not well understood. For many purposes, we need better metrics.”
Review: Unidimensional Methods

Variable – income
Identification – poverty line
Aggregation – Foster-Greer-Thorbecke (1984)

Example  Incomes = (7,3,4,8) poverty line z = 5

Deprivation vector $g^0 = (0,1,1,0)$

Headcount ratio $P_0 = \mu(g^0) = 2/4$

Normalized gap vector $g^1 = (0, 2/5, 1/5, 0)$

Poverty gap $P_1 = \mu(g^1) = 3/20$

Squared gap vector $g^2 = (0, 4/25, 1/25, 0)$

FGT Measure $P_2 = \mu(g^2) = 5/100$

$\mu$ is a mean operator
Axioms of Multidimensional Poverty

• Most are **Natural Extensions** from unidimensional axioms (i.e. symmetry, replication invariance, scale invariance, poverty focus, deprivation focus, monotonicity, dimensional monotonicity, transfer)

• In multidimensional space, axioms are **joint restrictions** on identification and aggregation methodologies.
Classification of Properties

- **Invariance Properties** - focus, ordinality
- **Dominance Properties** - dim monotonicity
- **Subgroup Properties** - group, dim breakdown
- **Technical Properties** - normalization, non-triviality

- **Two types**
  - Natural extensions of the unidimensional properties
  - Axioms specific to the multidimensional context
Methods of Multidimensional Poverty Measurement & Analysis

- Dashboard
- Dominance
- Composite
- Venn
- Counting
- Axiomatic
- Fuzzy Set
- Statistical Methods

Not mutually exclusive: overlaps exist
Methods of Multidimensional Poverty Measurement

**Bourguignon & Chakravarty (2003)**
\[
P_{SC1}(X;Z) = \frac{1}{n} \sum_{i=1}^{n} \sum_{j=1}^{d} w_j g_{ij}^0 \text{ with } a_j \geq 1.
\]

**Chakravarty & D’Ambrosio (2006)**
\[
P_{SC2}(X;Z) = \frac{1}{n} \sum_{i=1}^{n} \sum_{j=1}^{d} w_j g_{ij}^0
\]

**Bossert, Chakravarty & D’Ambrosio (2009)**
\[
P_{AUC}(X;Z) = \left( \frac{1}{n} \sum_{i=1}^{n} \sum_{j=1}^{d} w_j g_{ij}^0 \right)^{1/b}
\]

**Alkire & Foster (2007, 2011)**
\[
M_{\alpha}(X;Z) = \frac{1}{n} \sum_{i=1}^{n} \sum_{j=1}^{d} w_j g_{ij}^0(k) \text{ with } \alpha > 0
\]

**Descriptive Methods**
- Cluster Analysis
  - Principal Component Analysis (PCA)
  - Multiple Correspondence Analysis (MCA)

**Model-Based Methods**
- Latent Class Analysis (LCA)
- Factor Analysis (FA)
- Structural Equation Models (SEM)

**Statistical Methods**
- Cluster Analysis
- Principal Component Analysis (PCA)
- Multiple Correspondence Analysis (MCA)

**Stage 1**
- Achievement matrix ($X$)

**Stage 2**
- Reduced matrix of “combined” achievements

**Stage 3**
- Vector of person specific achievement values (Full aggregation across dimensions)

**Overall assessment of the “society”**

**Venn Diagram**
- Venn diagram illustrating the relationship between sets A and B.
AF Example: the global MPI?

• The MPI 2014 is an internationally comparable index of poverty for 108 developing countries.
• MPI was launched in 2010 in the Human Development Report, and updated in each HDR.
• The MPI methodology can be adapted for national or local poverty measures – you choose your own indicators, weights and cutoffs.
MPI: Dimensions, Indicators, & Weights

Three Dimensions of Poverty

Health
- Nutrition
- Child Mortality

Education
- Years of Schooling
- Children enrolled

Living Standard
- Cooking Fuel
- Sanitation
- Water
- Electricity
- Floor
- Assets
Global Multidimensional Poverty Index

UNDP Human Development Report 2014 & Alkire Conconi and Seth 2014

Formula: $\text{MPI} = M_0 = H \times A$

Grace is Deprived In

$\kappa = 33\%$
What’s new? MPI has Incidence and Intensity

Poorest Countries, Highest MPI

The size of the bubbles is a proportional representation of the total number of MPI poor in each country.

Average Intensity of Poverty (A)

Percentage of People Considered Poor (H)

High Income
Upper-Middle Income
Lower-Middle Income
Low Income

China
India
Pakistan
Bangladesh
Nepal
Cambodia
Indonesia
Thailand
Vietnam
Laos
Myanmar
Cambodia
Philippines
Malaysia
Singapore
Brunei
Japan
Australia
New Zealand

The size of the bubbles is a proportional representation of the total number of MPI poor in each country.

0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
MPI Headcount ratio (why?)

$1.25/day poverty

MPi Poor • $1.25 a day

Percentage of the Population

MPI

Oxford Poverty & Human Development Initiative
Most poor people (71%) live in middle-income countries (how?)

Total Population by Income Category
- Upper Middle Income, 39.2%
- Lower Middle Income, 58.3%
- Low Income, 28.9%
- High Income, 3.4%

MPI Poor Population
- Upper Middle Income, 12.7%
- Low Income, 28.9%
- Lower Middle Income, 58.3%
- High Income, 0.2%

71% of MPI poor live in Middle Income Countries
Composition of Poverty by group (show pop)

- Hindu: 80.4%
- Muslim: 14.1%
- Christian: 2.3%
- Sikh: 1.7%
- Other:

Legend:
- Schooling
- Attendance
- Mortality
- Nutrition
- Electricity
- Sanitation
- Water
- Housing
- Cooking Fuel
- Assets
AF Methodology: Overview

Identification of poor – Dual cutoffs

Deprivation cutoffs - each deprivation counts

Poverty cutoff - in terms of aggregate deprivation values

Aggregation across the poor – Adjusted FGT

Reduces to FGT in single variable case

Key Measure: Adjusted headcount ratio $M_0 = HA$

$H$ is the share of the population identified as poor, or the *incidence*

$A$ is the average breadth of deprivations people suffer at the same time, or the *intensity*
AF Method: Achievement Matrix

\[ Y = \begin{bmatrix} 13.1 & 14 & 4 & 1 \\ 15.2 & 7 & 5 & 0 \\ 12.5 & 10 & 1 & 0 \\ 20 & 11 & 3 & 1 \end{bmatrix} \]

\[ \zeta = (13, 12, 3, 1) \]
AF Method: Deprivation and Censored Matrix

Deprivation Matrix

\[ g^0 = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} 0 \\ 2 \\ 4 \\ 1 \end{bmatrix} \]

Censored Deprivation Matrix, \( k=2 \)

\[ g^0(k) = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 0 \\ 2 \\ 4 \\ 0 \end{bmatrix} \]
Aggregation: Adjusted FGT Family

Adjusted FGT is $M_\alpha = \mu(g_\alpha(\tau))$ for $\alpha \geq 0$

Domains

$g^\alpha(k) = \begin{bmatrix}
0 & 0 & 0 & 0 & 0 \\
0 & 0.42^\alpha & 0 & 1^\alpha \\
0.04^\alpha & 0.17^\alpha & 0.67^\alpha & 1^\alpha \\
0 & 0 & 0 & 0 & 0
\end{bmatrix}$

Persons

Theorem 1 For any given weighting vector and cutoffs, the methodology $M_{\kappa \alpha} = (\rho_{\kappa}, M_\alpha)$ satisfies: decomposability, replication invariance, symmetry, poverty and deprivation focus, weak and dimensional monotonicity, nontriviality, normalisation, and weak rearrangement for $\alpha \geq 0$; monotonicity for $\alpha > 0$; and weak transfer for $\alpha \geq 1$. 
Informal Glossary of Terms

**Deprivation:** if $y_{id} < z$ person $i$ is **deprived** in $y_d$

**Poverty:** if $c_i \geq k$ person $i$ is poor.

**Deprivation cutoffs:** the $z$ cutoffs for each dimension

**Poverty cutoff:** the overall cutoff $k$

**Dimension:** for AF – a column in the matrix having its own deprivation cutoff (sometimes called an ‘indicator’)

**Joint distribution:** showing the simultaneous or coupled deprivations a person/hh has
What is the Capability Approach?

• Sen’s capability approach proposes that social arrangements should be primarily evaluated according to the extent of freedom people have to promote or achieve functionings they value.

• “The focus here is on the freedom that a person actually has to do this or be that – things that he or she may value doing or being.” Idea of Justice 232
In which space will you measure?

<table>
<thead>
<tr>
<th>Resources</th>
<th>Capability</th>
<th>Functionings</th>
<th>Utility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bike</td>
<td>Able to</td>
<td>Ride around</td>
<td>😊</td>
</tr>
<tr>
<td></td>
<td>ride around</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td>Able to be</td>
<td>Nourished</td>
<td>😊</td>
</tr>
<tr>
<td></td>
<td>nourished</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Eight Essential Choices for your own AF Measure:

1. Purpose
2. Space
3. Unit of Identification or Analysis
4. Dimensions (if helpful)
5. Indicators - columns in the matrix
6. Deprivation Cutoffs for each Indicator
7. Weights/Values for each Indicator
8. Poverty cutoff to identify the poor
Normative Choices in Setting Parameters

Considerations:
1. Purpose of Evaluative Exercise
   • Targeting
   • Evaluation
   • National Poverty Measure
2. Formal Constraints (constitution)
3. Space (capability; resources)
4. Choice Mechanisms (participatory)
5. Robustness tests (for pluralism, diversity)
**Dimensions often a subset of these:**

<table>
<thead>
<tr>
<th>Stiglitz-Sen-Fitoussi</th>
<th>Bhutan’s GNH</th>
<th>Voices of the Poor</th>
<th>Finnis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health</td>
<td>Health</td>
<td>Bodily Wellbeing</td>
<td>Health &amp; Security</td>
</tr>
<tr>
<td>Education</td>
<td>Education</td>
<td>Material Wellbeing</td>
<td>Knowledge</td>
</tr>
<tr>
<td>Economic security</td>
<td>Material Std</td>
<td>Social Wellbeing</td>
<td>Work &amp; Play</td>
</tr>
<tr>
<td>Personal Security</td>
<td>of living</td>
<td>Security</td>
<td>Agency &amp;</td>
</tr>
<tr>
<td>Balance of Time</td>
<td>Time Use</td>
<td>Psychological</td>
<td>empowerment</td>
</tr>
<tr>
<td>Political Voice &amp; Governance</td>
<td>Governance</td>
<td>Wellbeing</td>
<td>Relationships</td>
</tr>
<tr>
<td>Social Connections</td>
<td>Community</td>
<td></td>
<td>Harmony - Art,</td>
</tr>
<tr>
<td>Environmental Conditions</td>
<td>Environment</td>
<td></td>
<td>Religion, Nature</td>
</tr>
<tr>
<td>Subjective measures of quality of life</td>
<td>Culture &amp; spirituality</td>
<td></td>
<td>Inner peace</td>
</tr>
<tr>
<td></td>
<td>Emotional</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Well-being</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
On weights:

No ... magic formula does, of course, exist, since the issue of weighting is one of valuation and judgment, and not one of some impersonal technology. (Sen 1999:79)

Key: make weights explicit and open to scrutiny.
In practice...your paper or report should:

1. Write out the purpose of the measure – what evaluative exercise(s) it will serve
2. Identify the ‘criteria’ used to select indicators/ deprivation cutoffs / weights / poverty cutoff
3. Justify each calibration choice using normative and empirical grounds & the literature
4. Identify plausible alternatives (e.g. a range of possible weights; alternative indicators), which you will then use to test robustness
5. Identify relevant processes (consultation, participation)
6. Caveat: identify systematically the limitations and weaknesses; tests

*Quality difference between two papers/reports with the same final measure & analysis but systematic vs lazy articulation of the calibration choices is very large. Why?*
Total population 2010 (112.6 millions)

- Vulnerable people by social deprivation
  - 32.3 million
  - 28.7%
  - 1.9 deprivations on average
  - Urban = $2,114, Rural = $1,329

- Moderate poor
  - 35.8%
  - (40.3 million)
  - 2.1 deprivations on average
  - Urban = $978, Rural = $684

- Extreme poor
  - 10.4%
  - (11.7 million)
  - 3.7 deprivations on average

- Not poor and not vulnerable
  - 21.8 million
  - 19.3%

- Vulnerable people by income
  - 6.5 million
  - 5.8%

Poverty
- 46.2%
- 52.0 millions
- 2.5 deprivations on average

Source: estimates by CONEVAL based on MCS-ENIGH 2010.
Change in the number of poor people in Mexico, 2008-2010

Income Poverty

Food security 4.1
Extreme income poverty 3.5
Poverty 3.2
Extreme poverty 0.0

Millions of people

Access to Health Care -9.0
Basic Services -9.0
Houseing -2.9
Education -2.3
Social Security -2.5
Social Deprivations

Fuente: estimaciones del CONEVAL con base en el MCS-ENIGH 2008 y 2010
Changes in the number of people in extreme poverty, by state

Miles de personas

<table>
<thead>
<tr>
<th>State</th>
<th>Number of People</th>
</tr>
</thead>
<tbody>
<tr>
<td>México</td>
<td>214</td>
</tr>
<tr>
<td>Veracruz</td>
<td>183</td>
</tr>
<tr>
<td>Jalisco</td>
<td>43</td>
</tr>
<tr>
<td>Yucatán</td>
<td>35</td>
</tr>
<tr>
<td>Querétaro</td>
<td>32</td>
</tr>
<tr>
<td>Sonora</td>
<td>27</td>
</tr>
<tr>
<td>Tamaulipas</td>
<td>23</td>
</tr>
<tr>
<td>Guanajuato</td>
<td>21</td>
</tr>
<tr>
<td>Sinaloa</td>
<td>19</td>
</tr>
<tr>
<td>Nayarit</td>
<td>19</td>
</tr>
<tr>
<td>Zacatecas</td>
<td>16</td>
</tr>
<tr>
<td>Baja California Sur</td>
<td>14</td>
</tr>
<tr>
<td>Campeche</td>
<td>13</td>
</tr>
<tr>
<td>Tlaxcala</td>
<td>8</td>
</tr>
<tr>
<td>Chihuahua</td>
<td>4</td>
</tr>
<tr>
<td>Colima</td>
<td>4</td>
</tr>
<tr>
<td>Distrito Federal</td>
<td>4</td>
</tr>
</tbody>
</table>

Ranks

-3 Baja California
-4 Coahuila
-4 Aguascalientes
-5 San Luis Potosí
-16 Durango
-22 Quintana Roo
-22 Oaxaca
-27 Morelos
-30 Nuevo León
-38 Tabasco
-61 Hidalgo
-69 Guerrero
-72 Chiapas
-98 Michoacán
-170 Puebla

[20% - 40%) 14
[40% - 60%) 14
[60% - 80%) 4
Colombia: Dimensions Cutoffs Weights

- **Education**
  - Educational achievement
    - Literacy
      - School attendance
      - No school lag
      - Access to child care services
      - Absence of child employment
    - 0.1
    - 0.05

- **Childhood & youth conditions**
  - Absence of child employment
  - 0.2

- **Labor**
  - Absence of long-term unemployment
  - Formal employment
  - 0.2
    - 0.1

- **Health**
  - Health insurance
    - Access to health care services when needed
    - 0.2
    - 0.1

- **Public utilities & housing conditions**
  - Access to improved drinking water
  - Adequate elimination of sewer waste
  - Adequate flooring
  - Adequate walls
  - No critical overcrowding
  - 0.2
  - 0.04
Adapted from National Statistics Bureau (2014) ‘Bhutan Multidimensional Poverty Index’, Thimphu: NSB.
Figure 3.8: Comparison between Multidimensional Poverty and Income Poverty by Dzongkhag
Though gains are not uniform, improvements in every province and municipality...
Data Issues in Multidimensional Poverty Measurement

1. Sources of multidimensional data
2. Household surveys
3. Indicators’ design
4. Applicable population
5. Combined measures
6. Missing values, inconsistencies, “don’t know” - Sample drop and bias analysis
Cramer’s $V$ (correlation – binary)

$V$ uses “entire cross-tab”

\[
V = \frac{\sum n_{00} n_{11} - \sum n_{01} n_{10}}{\sqrt{\sum n_{0+} n_{1+} (\sum n_{+0} + \sum n_{+1})}}\]

Association is affected by:

- Extent to which deprivations between variables match (key)
- Values of the headcount ratios and their difference

Dilutes insights for redundancy.
Measure of Redundancy $R^0$

If two deprivation/poverty indicators are not independent, and if at least one of the marginal distributions $n_{1+}$, $n_{+1}$ is different from zero $P$ is defined as:

$$R^0 = \frac{n_{11}}{\min(n_{1+}, n_{+1})} \in [0,1]$$

Sources of information used by $R^0$:

- $n_{11}$ number of people who are deprived in both indicators $\rightarrow$ Joint
- $n_{1+}$, $n_{+1}$ headcount ratios $\rightarrow$ Marginals

**Redundancy**: reflects the strength of the matches, but not the direction
### Example - Bangladesh DHS

#### Case I

<table>
<thead>
<tr>
<th>Years school. (I)</th>
<th>School attendance (J)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non deprived= 0</td>
</tr>
<tr>
<td>Non deprived=0</td>
<td>71.06%</td>
</tr>
<tr>
<td>Deprived= 1</td>
<td>13.76%</td>
</tr>
<tr>
<td>Total</td>
<td>84.82%</td>
</tr>
</tbody>
</table>

\[
V = n\downarrow 00 \ n\downarrow 11 - n\downarrow 01 \\
R^0 = \frac{n\downarrow 11}{\min[ n\downarrow 10 /[n\downarrow 0 + n\downarrow 1 + n\downarrow ]}} \ \frac{n\downarrow 1 + ,n\downarrow +1 ]}{2} = 0.379
\]

Two different countries with completely different patterns of deprivation show the same association coefficient \(V\), but different measures of redundancy \(R^0\).
Decomposition

Decomposition by population subgroup

Breakdown by dimension (post-identification)
Subgroup Decomposition:

<table>
<thead>
<tr>
<th></th>
<th>Income</th>
<th>Years of Education</th>
<th>Housing Index</th>
<th>Mal-nourished</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person 1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Person 2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Person 3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Person 4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

\[ g^0(k) = \]

M₀ for pink group: \( H_1 \times A_1 = 2/8 = 1/4 \)
M₀ for green group: \( H_2 \times A_2 = 4/8 = 1/2 \)
Overall \( M_0 = (1/2) \times (1/2) + (1/2) \times (1/4) = 3/8 = 6/16 \)
Nigeria: MPI = 0.240
Nigeria:
MPI=0.240

Sub-national MPIs range between 0.045 & 0.600
### Censored Headcount Ratios

\[
\bar{g}^0(k) = \begin{bmatrix}
0 & 0 & 0 & 0 & \text{Person 1} \\
0 & 0 & 0 & 0 & \text{Person 2} \\
1 & 2 & 0.5 & 0.5 & \text{Person 3} \\
0 & 2 & 0 & 0 & \text{Person 4}
\end{bmatrix}
\]

- Income: 1/4
- Education: 2/4
- Sanitation: 1/4
- Electricity: 1/4
Dimensional Breakdown:

The **censored headcount** ratio of indicator $d$ is

$$g^0(k) = \begin{array}{cccc}
\text{Income} & \text{Years of Education} & \text{Housing Index} & \text{Mal-nourished} \\
0 & 0 & 0 & 0 \\
1 & 0 & 0 & 1 \\
1 & 1 & 1 & 1 \\
0 & 0 & 0 & 0 \\
\end{array}$$

**Censored $H$**

$$\frac{1}{2} \quad \frac{1}{4} \quad \frac{1}{4} \quad \frac{1}{2}$$

**Contribution of dimension $d$ to $M_0$ poverty is**

$$\left(\frac{w_d}{D}\right) \times \left[\frac{H_d}{M_0(x)}\right]$$
Annualized Absolute Change in MPI_T
Changes in $M_0$, $H$ and $A$

- **Absolute Rate of Change**: is the difference in levels between two periods.

  \[ \Delta M_{\downarrow 0} = M_{\downarrow 0} (X_{\downarrow t} \uparrow 2) - M_{\downarrow 0} (X_{\downarrow t} \uparrow 1) \]

- **Relative Rate of Change**: is the difference in levels across two periods as a percentage of the initial period.

  \[ \mathcal{U}_{\downarrow 0} = M_{\downarrow 0} (X_{\downarrow t} \uparrow 2) - M_{\downarrow 0} (X_{\downarrow t} \uparrow 1) / M_{\downarrow 0} (X_{\downarrow t} \uparrow 1) \times 100 \]

- **Why use both rates?**
In order to reduce the absolute number of poor people, the rate of reduction in the headcount ratio needs to be faster than the population growth.

So, don’t forget to also check if the number of poor people is decreasing over time!

<table>
<thead>
<tr>
<th>Population</th>
<th>Total MPI Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year 1</td>
</tr>
<tr>
<td>------------</td>
<td>---------</td>
</tr>
<tr>
<td>Nepal 2006-2011</td>
<td>25,634</td>
</tr>
<tr>
<td>Peru 2005-2008</td>
<td>27,723</td>
</tr>
<tr>
<td>Rwanda 2005-2010</td>
<td>9,429</td>
</tr>
<tr>
<td>Senegal 2005-2010/11</td>
<td>11,271</td>
</tr>
</tbody>
</table>
Dimensional Changes

- The (annualized) absolute rate of change in $M_{\downarrow 0}$ can be expressed as the weighted average of the (annualized) absolute rates of change in censored headcount ratios:

$$\Delta M_{\downarrow 0} = \sum_{j=1}^{d\uparrow} w_{\downarrow j} \Delta h_{\downarrow j} (k)$$

- When different indicators have different weights, the effects of their changes on the change in $M_0$ reflect these weights.
Dimensional Changes

Nepal 2006 - 2011

What indicator had the biggest contribution to poverty reduction?
The Chronic Poverty Measure is the mean of the set of $T$ deprivation matrices $g_0(k, \tau)$ that have been censored by the cutoffs $k$ and $\tau$.

**This is easy!**
Chronic Poverty Measurement

The Chronic Poverty Measure is the mean of the set of $T$ deprivation matrices $g_0(k, \tau)$ that have been censored by the cutoffs $k$ and $\tau$.

$$M_{\downarrow 0} \uparrow C (X;z)=1/ndT$$

$$\sum_{i=1}^{n} \sum_{j=1}^{d} \sum_{t=1}^{T} w(j) g_{ij}^{0}, t (k, \tau)$$

$$M_{\downarrow 0} \uparrow C (X;z)=H \uparrow C \times A \uparrow C \times D \uparrow C$$
Chronic Poverty

More intuitively, Chronic poverty is the product if $H$, $A$, $D$:

$$M \downarrow 0 \uparrow C = H \uparrow C \times A \uparrow C \times D \uparrow C$$

$H^C$ is the % of people who are multidimensionally poor in $\tau$ or more periods.

$A^C$ is the average intensity among the chronically multidimensionally poor people. $k \leq A^C \leq 1$

$D^C$ is the average duration of chronic poverty – the average % of periods in which people are in chronic poverty.
Dominance and Robustness of parameters

Dominance holds in terms of $M_0$ for all $k$

In the case of sample surveys, statistical tests are required to establish dominance

Source: Batana (2013)
MPI should be robust to range of weights

Robustness to weights

Re-weight each dimension:

- 33%    50%    25%    25%
- 33%    25%    50%    25%
- 33%    25%    25%    50%
# Kendall tau b rank correlations

<table>
<thead>
<tr>
<th>MPI Weights 2</th>
<th>MPI Weights 3</th>
<th>MPI Weights 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>50% Education</td>
<td>50% Education</td>
<td>50% LS</td>
</tr>
<tr>
<td>25% Health</td>
<td>25% Health</td>
<td>25% LS</td>
</tr>
<tr>
<td>25% LS</td>
<td>25% LS</td>
<td>25% LS</td>
</tr>
</tbody>
</table>

Equal weights: 33% each (Selected Measure)

- **MPI Weights 1**
  - Pearson: 0.992
  - Spearman: 0.979
  - Kendall (Taub): 0.893

- **MPI Weights 2**
  - Pearson: 0.995
  - Spearman: 0.987
  - Kendall (Taub): 0.918

- **MPI Weights 3**
  - Pearson: 0.987
  - Spearman: 0.985
  - Kendall (Taub): 0.904

Number of countries: 109

Alkire and Santos (2010, 2014).
What are the main sources of Error?

These could be categorised as: statistical & non statistical

A. Statistical: Sampling Error

B. Non Statistical:

1. Data Entry Error

2. Measurement Error: Sources
   - Recall error (don’t remember correctly)
   - Telescoping (incorrect date recall)
   - Reporting Errors (due to long surveys)
   - Prestige errors (misreport due to social pressures)
   - Conditioning effects (from being in the survey)
   - Respondent effects (respondent identity affects answers)
   - Interviewer effects (facilitator bias; mis-measuring a baby)
   - Non-response rate
   - Inadequate sampling frame (Source: Nestor 1970; Deaton & Grosh 2000)
Standard Error & Confidence Interval

Standard error of a random variable is the sample estimation of its (population) standard deviation. The standard error gives us an idea of the precision of the sample estimation.

Standard deviation, intuitively, is a notion of uncertainty.

Confidence interval contains the true population parameter with some probability that is known as the confidence level. Standard errors are required to compute the confidence interval.
Inequality Among the Poor Described: Deprivation Score Values

Madagascar (2009)
MPI = 0.357, H = 67%, A = 53%

Rwanda (2010)
MPI = 0.350, H = 69% A = 50.8%
Inequality among the Poor

• Two applications:
  – Inequality among the poor

\[ I^q = \frac{\hat{\beta}}{q} \sum_{i=1}^{q} [c_i(k) - A]^2 \]

  – Inequality across population subgroups (regional disparity)

\[ I^n = \hat{\beta} \sum_{\ell=1}^{m} \frac{n^\ell}{n} (M_0(X^\ell) - M_0)^2 \]
What are some vital regression analysis we may wish to study with AF measures?

Micro regressions: use ci vector or 0-1 poverty status vector
a) explore the determinants of poverty at the household level
b) create poverty profiles;

Macro regressions: use level or trend of $M_0$ per group
a) explore the elasticity of poverty to economic growth,
b) understand how macro variables such as average income, public expenditure, decentralization, infrastructure density, information technology relate to multidimensional poverty levels or changes across time.
Probit and Logit models

The simple linear regression model is not adequate as it assumes that the range of the dependent variable lies in the Real line \((-\infty, +\infty)\)

To ensure that the conditional mean stays in the unit interval we need some function that maps \(Y\) to the unit interval.

Any cumulative distribution function could be used for this purpose (the link function).

Often the cumulative distributions of the standard normal distribution or the logistic distribution are used to model binary responses. This leads to what is called as probit or logit models respectively.
Communicating your Results

Building blocks

Audience

Outputs & channels

Media

Curiosity
Clarify your aim

✓ **Goals:** What do we want to achieve?
  ✓ Internally?
  ✓ Locally, Regionally, or Nationally?
  ✓ Internationally?

✓ **Audience:** Who do we need to reach?

✓ **Channels:** How can we reach them?

✓ **Messages:** What are our messages?

✓ **Products:** What do we need to do to reach them?

✓ **Humility:** What is realistic, given our limitations?
Media tactics

Press release

Events

Interview ops

Expert comment

Letters to editor
Find ‘factoids’

E.g. – The Poorest of the Poor
E.g. – India vs Africa
E.g. – MPI in Middle Income Countries
E.g. – GDP per capita vs MPI

“How do I wake them up?”
How to find ‘factoids’

Become very Curious about your results

Play with your data.
Find comparisons that are striking or unexpected
Make sure factoids are 100% accurate and academically defensible.
Pakistan is home to 82.7 million MPI poor people.

15.5 million of these people are each deprived in 70% or more of the MPI dimensions.

Pakistan has a community like Niger inside of it.

Niger is home to 13.4 million MPI poor.

Intensity = 69%.
“Radical social advances are only possible if we understand, with careful observation and analysis, the deep roots of our poverty, and the many shades of inequality within our society. Hence, the urgency of implementing a multidimensional approach in our battle against poverty”

Juan Manuel Santos, President of the Republic of Colombia
High Level Meeting, Berlin, 2014
The Challenge of Targeting
(minimize undercoverage/leakage)
(using census data)
Impact Evaluation with AF methodology

• Use $M_0/H$ as the outcome of interest in the evaluation of the program’s impact:
  – Compute the $M_0/H$ for the treated and control groups;
  – Test whether the difference between the $M_0/H$ of the two groups is statistically significant.

  – Test impact on the raw and censored headcounts

  – Test the impact on the weighted number of deprivations

  – If we have data for multiple points of time, we can compare the change in $M_0/H$ (Difference-in-difference estimator).
Impact – Using time series

Change in H after 1 Period

Change in M0 after 1 Period
Impact – Censored headcounts

Censored headcounts, k=0.25 and t=0

Censored headcounts, k=0.25 and t=1

Censored headcounts, k=0.25 and t=2

Censored headcounts, k=0.25 and t=3
Enter Institutions (and politicians)

• If you have political support at the top ➔ 😊
• If you do not have political support ……..

"My team has created a very innovative solution, but we're still looking for a problem to go with it."

DEFINE THE PROBLEM - REQUIREMENTS!!
Colombia’s Poverty committee
Coordinating and monitoring poverty reduction

▪ Leaders
  – Counselor for the Presidency
  – Social Prosperity
  – National Planning Department

▪ Permanent members
  – Ministry of Health
  – Ministry of Labor
  – Ministry of Housing
  – Ministry of Agriculture
  – Ministry of Education
  – Ministry of Finance

MANDATORY PRESENCE
The President of Colombia
<table>
<thead>
<tr>
<th>Pobreza</th>
<th>Línea Base PND 2008</th>
<th>Dato 2011</th>
<th>Dato 2012</th>
<th>Análisis</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI (Multidimensional Poverty)</td>
<td>34.7%</td>
<td>29.4%</td>
<td>27.0%</td>
<td>22.5%</td>
<td></td>
</tr>
<tr>
<td><strong>A</strong>(1)</td>
<td>Educational achievement (≥15 yrs)</td>
<td>58.8%</td>
<td>54.6%</td>
<td>53.1%</td>
<td>★ 52.8%</td>
</tr>
<tr>
<td></td>
<td>Literacy (≥15 yrs)</td>
<td>14.2%</td>
<td>12.0%</td>
<td>12.1%</td>
<td>★ 12.0%</td>
</tr>
<tr>
<td><strong>B</strong>(2)</td>
<td>School attendance (6-16)</td>
<td>5.4%</td>
<td>4.8%</td>
<td>4.1%</td>
<td>★ 3.5%</td>
</tr>
<tr>
<td></td>
<td>No school lag (7-17)</td>
<td>33.4%</td>
<td>34.1%</td>
<td>33.3%</td>
<td>33.1%</td>
</tr>
<tr>
<td></td>
<td>Access to child care services (0-5)</td>
<td>12.1%</td>
<td>10.8%</td>
<td>9.4%</td>
<td>★ 10.6%</td>
</tr>
<tr>
<td></td>
<td>Children not working (12-17)</td>
<td>5.5%</td>
<td>4.5%</td>
<td>3.7%</td>
<td>★ 2.9%</td>
</tr>
<tr>
<td><strong>C</strong>(3)</td>
<td>Long-term unemployment</td>
<td>9.6%</td>
<td>9.1%</td>
<td>10.0%</td>
<td>★ 9.3%</td>
</tr>
<tr>
<td></td>
<td>Formal employment</td>
<td>80.6%</td>
<td>80.4%</td>
<td>80.0%</td>
<td>★ 74.7%</td>
</tr>
<tr>
<td><strong>D</strong>(4)</td>
<td>Health insurance</td>
<td>24.2%</td>
<td>19.0%</td>
<td>17.9%</td>
<td>0.5%</td>
</tr>
<tr>
<td></td>
<td>Access to health services</td>
<td>8.9%</td>
<td>8.2%</td>
<td>6.6%</td>
<td>2.4%</td>
</tr>
<tr>
<td><strong>E</strong>(5)</td>
<td>Access to water source</td>
<td>12.9%</td>
<td>12.0%</td>
<td>12.3%</td>
<td>★ 10.9%</td>
</tr>
<tr>
<td></td>
<td>Adequate sewage system</td>
<td>14.1%</td>
<td>14.5%</td>
<td>12.1%</td>
<td>★ 11.3%</td>
</tr>
<tr>
<td></td>
<td>Adequate floors</td>
<td>7.5%</td>
<td>6.3%</td>
<td>5.9%</td>
<td>5.6%</td>
</tr>
<tr>
<td></td>
<td>Adequate external walls</td>
<td>3.1%</td>
<td>3.2%</td>
<td>2.2%</td>
<td>2.1%</td>
</tr>
<tr>
<td></td>
<td>No critical overcrowding</td>
<td>15.7%</td>
<td>14.2%</td>
<td>13.1%</td>
<td>8.4%</td>
</tr>
</tbody>
</table>

*** Change 2011-2012 est. significat
An example of geographical targeting using MPI

Colombia’s Conditional Cash Transfer Program

“Más Familias en Acción”

2.7 million families
Different types of social programs depending on multidimensional poverty incidence
Are the M0 values different?
Standard Errors & Confidence Intervals

Source Alkire and Seth (2012)
OPHI Summer Schools

- USA 2014
  - 60+ people

- USA 2013
  - 60+ people

- UK 2011
  - 44 people
  - 33 countries

- JORDAN 2010
  - 36 people
  - 24 countries

- INDIA 2008
  - 37 people
  - 22 countries

- PERU 2009
  - 38 people
  - 21 countries

- CHILE 2010
  - 35 people
  - 9 countries

- INDONESIA 2012
  - ??
  - 41 countries
Thank you from whole the OPHI team