ASIA AND PACIFIC COMMISSION ON AGRICULTURAL STATISTICS

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Agenda Item 6.2
Monitoring SDG target 2.1 – Methodological development and new capacity development initiatives related to food insecurity measurement

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Food security

Target 2.1 (in the new SDG Agenda)
"*By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round.*"

The State of Food Insecurity 2001 defines:
"*Food security [is] a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life*

SDG Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture

2.1.1 Prevalence of undernourishment	FAO	Tier I
2.1.2 Prevalence of moderate or severe food insecurity in the population, based on the Food Insecurity Experience Scale (FIES)	FAO	Tier II
2.2.1 Prevalence of stunting (height for age <-2 standard deviation from the median of the World Health Organization (WHO) Child Growth Standards) among children under 5 years of age	UNICEF	Tier I
2.2.2 Prevalence of malnutrition (weight for height >+2 or <-2 standard deviation from the median of the WHO Child Growth Standards) among children under 5 years of age, by type (wasting and overweight)	UNICEF	Tier I
2.3.1 Volume of production per labour unit by classes of farming/pastoral/forestry enterprise size	FAO	Tier III
2.3.2 Average income of small-scale food producers, by sex and indigenous status	FAO	Tier III
2.4.1 Proportion of agricultural area under productive and sustainable agriculture	FAO	Tier III
2.5.1 Number of plant and animal genetic resources for food and agriculture secured in either medium or long-term conservation facilities	FAO	Tier II
2.5.2 Proportion of local breeds classified as being at risk, not-at-risk or at unknown level of risk of extinction	FAO	Tier II
2.a.1 The agriculture orientation index for government expenditures	FAO	Tier II
2.a.2 Total official flows (official development assistance plus other official flows) to the agriculture sector	OECD	Tier I
2.b.1 Agricultural export subsidies	WTO	Tier I
2.c.1 Indicator of food price anomalies	FAO	Tier II

SDG INDICATOR 2.1.1: PREVALENCE OF UNDERNOURISHMENT

Theory, definitions and justifications (1)

- Undernourishment is the condition of people who consume, on a regular basis, amounts of food that do not provide the dietary energy needed to be healthy and active.

- Ideally, direct assessments would be based on observations of food consumption, computation of the amount of dietary energy available from the consumed food, and comparison with normative dietary energy needs, to classify individuals in a representative sample of the population.

Theory, definitions and justifications (2)

- In practice, two orders of problems make the direct, so called "headcount" approach, unfeasible, a reason why an indirect, model-based approach is necessary

1. The assessment should be made in terms of **habitual dietary energy consumption**, to reflect the normal condition of individuals. Repeated observations would be needed to **control for short term variations** that have no implications in terms of nutrition adequacy, due to the ability of the human body to regulate the energy balance and which might be due to changes.

2. Also, **true individual energy requirements are unobservable.** We can predict what the energy requirements of a person of a certain age, sex, height, engaged in a given type of physical activity level is, on average, but we can never be sure that the particular person whose food consumption we have recorded is indeed an "average" person.

Theory, definitions and justifications (3)

- The combination of these two facts implies that:

a) We **need a model that applies to groups,** not to individuals. The actually observed individuals are just elements of a sample that represents the group for which the assessment is made. With the model we can assess the extent of adequacy or inadequacy in the group.

b) The assessment can **only be made in probabilistic terms,** that is we can estimate the prevalence of inadequacy in a population group, as a probability that, conditional on his or her own observed food consumption and physical, demographic and social characteristics, any randomly selected individual from the group would be "undernourished"

Theory, definitions and justifications (4)

- FAO has estimated the PoU since 1960, when the Indian statistician **P.V. Sukhatme** introduced what is known now as the "**FAO method**" to estimate undernourishment.

- FAO has continued to produce PoU estimates since, informing the global assessments presented **for the first time in 1974**, with the fourth World Food Survey, and then **again in 1985 and in 1996**, with the fifth and the sixth editions.

- **Since 1999**, the assessment become **annual** with the State of Food Insecurity (**SOFI**) publication
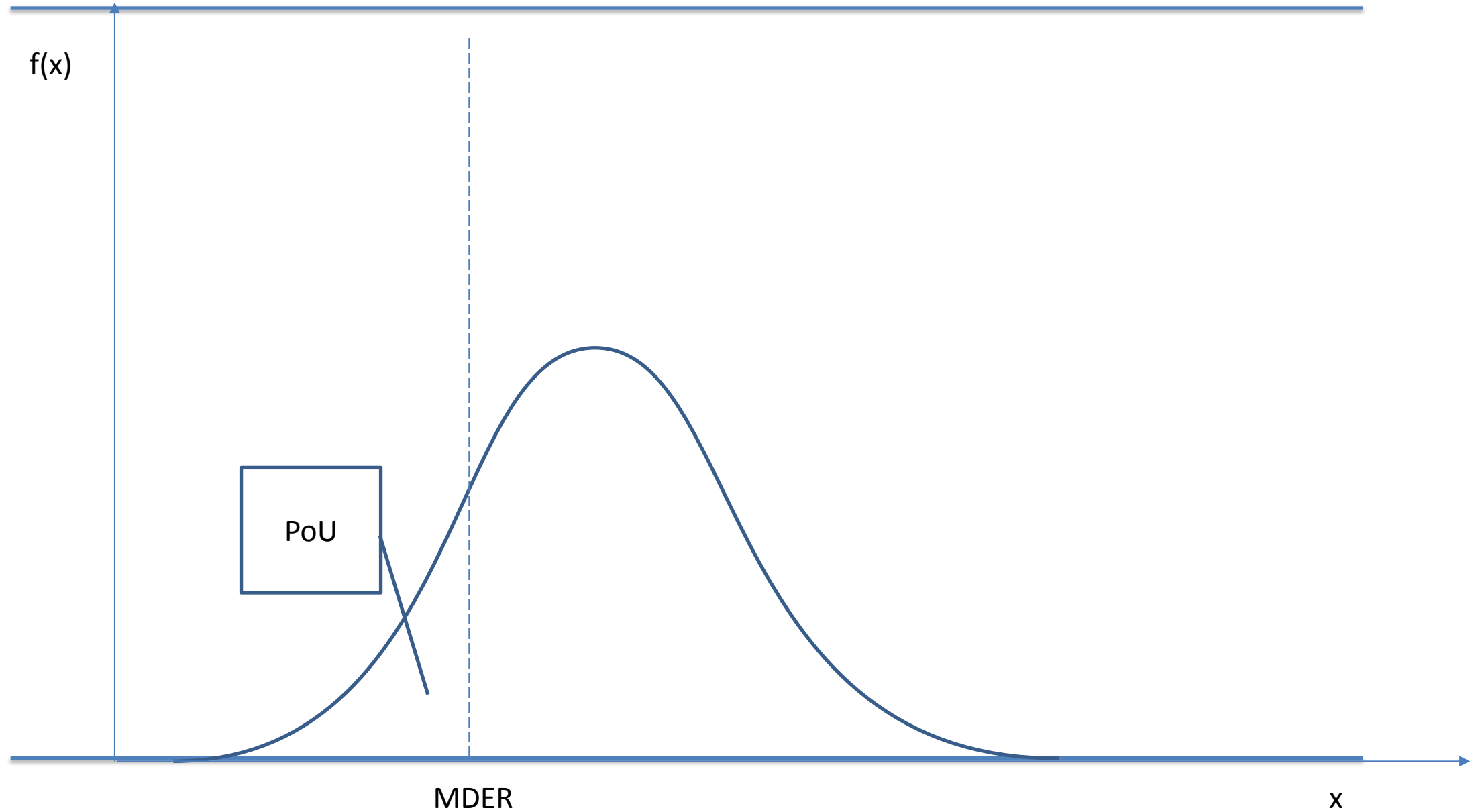
The FAO method

- Estimates the PoU as

$$PoU = \int_{x<MDER} f(x)d(x)$$

- It can be applied to any population for which there are sufficient data on the distribution of food consumption and on relevant characteristics of the population (sex, age, height and occupation)
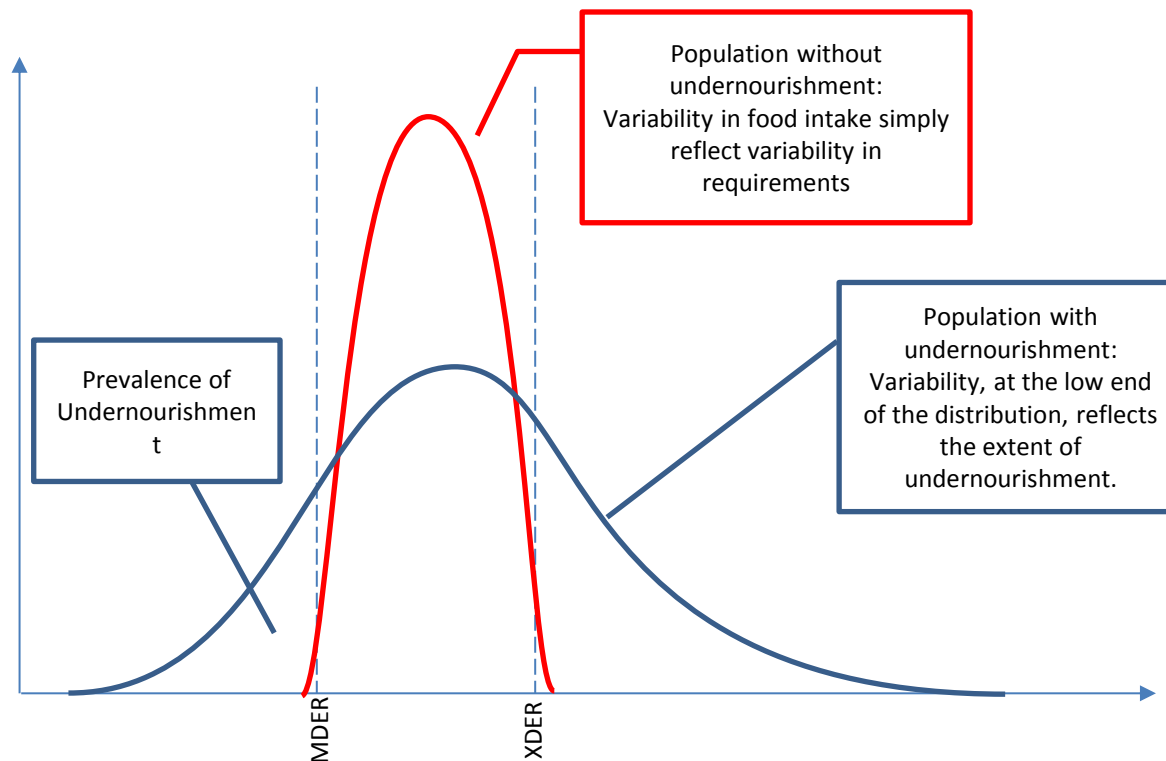
The FAO method

- The distribution *f(x)* is the probability density distribution of different levels of habitual daily dietary energy consumption (DEC) for the *representative individual in the population*

- The MDER thresholds reflect the lower bound of the range of dietary energy requirements that are compatible with a healthy and active life

  - Ranges of DER are defined for each sex and age class, taking into consideration different body masses (from 19.5 to 24.5) and different levels of physical activity (from PAL = 1.55 to PAL = 2.25)

  - The MDER is the weighted average of the lowest bound of these ranges, using the size of the population in each class as weights

Key to the FAO method: representing the population through the probability density function of habitual food consumption of the "average" individual

Population without undernourishment: Variability in food intake simply reflect variability in requirements

Population with undernourishment: Variability, at the low end of the distribution, reflects the extent of undernourishment.

Prevalence of Undernourishment
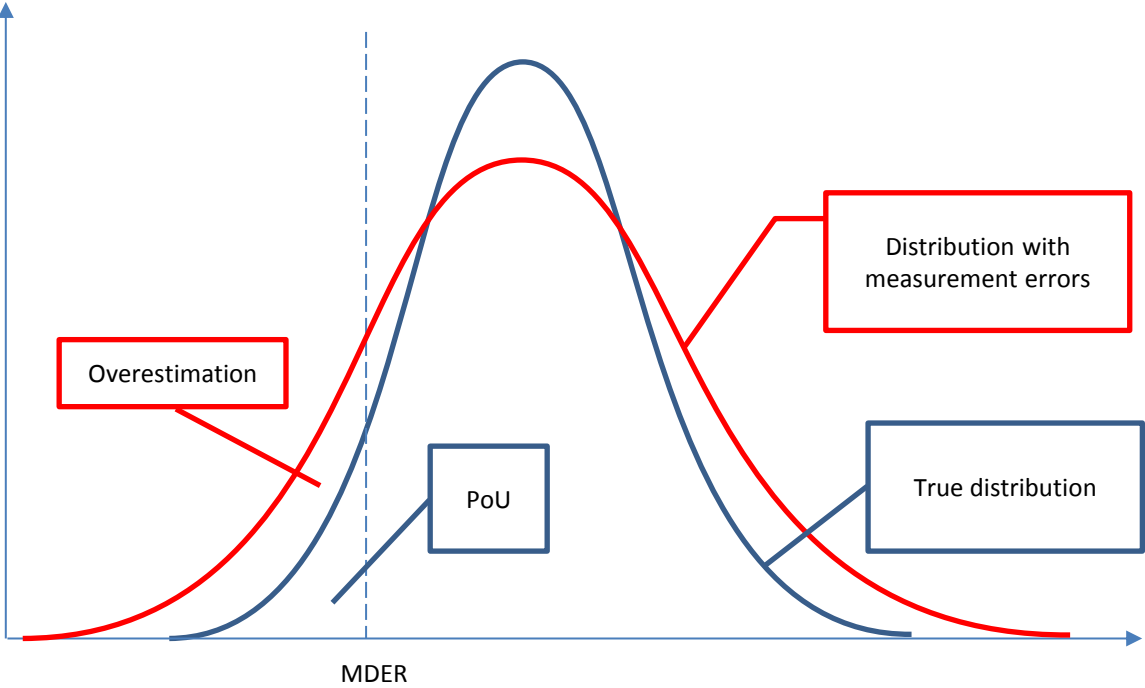
MDER

XDER

Data related problems

- To establish whether somebody is consuming an adequate amount of dietary energy, we need data on **habitual food consumption levels**.

- Food consumption data collected over short reference periods can be used as a proxy, but it will always contains significant **measurement error**.

Estimating the parameters

- Mean consumption
  - Can be estimated from household surveys
    - But survey data may fail to cover ALL food consumption sources
  - Can be estimated from Food Balance Sheets
    - Still the preferred option, but there are issues of coverage (i.e. non commercial production, accounting for losses etc.), precision (unreported trade, stocks).
    - Do not exist at subnational level
- CV of food consumption
  - Cannot be estimated simply as the empirical CV from household survey data, as household survey data only provide *average* consumption within the household, and are affected by *measurement errors*
  - Need a method to control for spurious variation (CV of food consumption between groups of income; CV of predicted consumption from regression analysis)

Failing to control for spurious variability will overestimate the Prevalence of Undernourishment

Implementation challenges

- To implement the PoU, at country level, to serve the needs of the SDGs, will require a significant, coordinated effort to make sure that:
  - Existing methods to process data and analyze the information on food consumption be carefully scrutinized, to avoid grossly misleading assessments
  - More frequent and better data on individual and/or household food consumption be available, collected with well-designed, harmonized questionnaires, through representative surveys at low geographic level, and possibly also by major socio-economic groups
  - The evidence produced by analyzing household food consumption be validated with other information, such as that FBS, and by experiential scales designed to measure the households' ability to access food, and triangulated with indicators of poverty and of the forms of malnutrition

SDG INDICATOR 2.1.2 PREVALENCE OF MODERATE OR SEVERE FOOD INSECURITY MEASURED WITH THE FIES

Theory, definitions and justification

- Many different indicators have been used during the last 30 years to provide information on <u>household food insecurity</u>, but none existed that combined the properties of **validity, reliability** and cross-country and over-time **comparability**
  - **Validity** is the property by which a measurement tool produces readings that are strictly proportional to the magnitude of the attribute it intends to measure
  - **Reliability** is the combination of precision (small measurement errors) and accuracy (measurement errors are in no determined direction)
  - **Comparability** requires the existence of a reference standard, against which measures obtained in different time and places can be calibrated

Theory, definitions and justification

- In the social sciences, proper measurement must address the problem that **attributes of interest are often conceptual, inherently unobservable constructs** (latent traits)
  - What are exactly " food insecurity", "poverty", "intelligence", "democratic participation"? …
- What is measured is **operationally defined by the adopted measure**
  - It becomes almost futile to try and compare measures obtained with different tools as they effectively refer pertain to different attributes (even though, at times, they are given the same name)

The experience-based food security scales

- In 2012, FAO established the **Voices of the Hungry** project to address this issue
  - With support from the UK and from Belgium (through the FAO multi partner support program – FMM), Gallup was contracted to pilot the **Food Insecurity Experience Scale** (FIES), an 8–item food insecurity module derived directly from the HFSSM and the ELCSA, in four countries in Africa, using the existing Gallup World Poll as a vehicle in 2013.
- The positive results from the 2013 application led us to bring the test to the global level in 2014, collecting FIES data in all countries (about 150) covered annually by the GWP.

The Food Insecurity Experience Scale

During the last 12 MONTHS, was there a time when:

1. *You were **worried you would run out of food** because of a lack of money or other resources?*

2. *You were **unable to eat healthy and nutritious food** because of a lack of money or other resources?*

3. *You **ate only a few kinds of foods** because of a lack of money or other resources?*

4. *You **had to skip a meal** because there was not enough money or other resources to get food?*

5. *You **ate less than you thought you should** because of a lack of money or other resources?*

6. *Your **household ran out of food** because of a lack of money or other resources?*

7. *You **were hungry but did not eat** because there was not enough money or other resources for food?*

8. *You **went without eating for a whole day** because of a lack of money or other resources?*

The Rasch model (G. Rasch, 1960)

$$Prob(X_{i,j} = 1) = \frac{\exp(a_i - b_j)}{1 + \exp(a_i - b_j)}$$

- It is the foundation of Item-Response Theory
- $X_{i,j} \in \{0,1\}$ is the "response" of the i-th respondent to the j-th "item".
  - The probability that a respondent whose position on a scale is a_i might respond to an item positioned at b_j on the same scale is a (logistic) function of the difference $(a_i - b_j)$
- The model provides the probabilistic basis for
  - Estimating the parameters associated with both items and respondents
  - Conducting statistical tests of the strength of association of the responses to the latent trait and of goodness of fit

Properties of the Rasch model

- If data supports the Rasch models assumptions ⋯
  - Infit statistics in the range 0.7 - 1.3
  - High Rasch reliability measures
  - No correlation among "residuals"
- ⋯ than the raw score is a **sufficient statistics** for the latent trait measure
  - Two respondents with the same raw score but different response patterns will be assigned the same measure (even though the absolute error around the measure may differ)
- Respondent parameters form an **interval scale** on the latent trait metrics
  - The metric has no natural origin. The position of the zero and the unit of measure are arbitrary.
  - To compare measures obtained in different applications, there is thus a need **to define a reference scale.**

Statistical definition of the FIES indicator?

$$FI_{mod+sev} = \sum_{i=0}^{8} P_{mod+sev}^{i} \times wN^{i}/N$$

$$P_{mod+sev}^{i} = 1 - \Phi(T_{m+s}; \mu = a_i; \sigma = \text{s.e.}(a_i))$$

where:

a_i = Rasch model respondent parameters for a respondent with raw−score RS = i

wN^i/N = weighted proportion of respondents in a representative sample of the population, with raw score RS = i

T_{m+s} = international «food insecurity» line

$\Phi(.)$ = Normal Distribution function

- a_i and s.e.(a_i) are estimated from FIES data using conditional maximum likelihood methods on the Rasch model;
- Before computation, the set of FIES data must pass the Rasch model validity and reliability tests
- a_i, s.e.(a_i) and $T_{mod+sev}$ are expressed on the same metric, following the calibration method developed by FAO Voices of the Hungry project

The Analytics: a global standard

- A global reference scale is identified by comparing the standardized estimated severity of the 8 FIES items in 147 countries and territories
- Each country's scale is then equated to the standard by equating the mean and the standard deviation of the set of common items (i.e., for which the difference in normalized severity is less than a set tolerance)
  - To identify common items after proper equating requires an iterative process
    - At the first iteration, all items are assumed common and severity parameters standardized to have mean zero and unit s.d. The median values of severity are taken to identify a provisional reference scale
    - Items whose severity differ from the reference by more than a set tolerance are treated as unique, and the measures re-standardized, based on the mean and s.d. of common items only. A new reference scale is formed
    - The process iterates until the set of common items no longer changes
  - For 95% of the countries we identify at least 5 of the 8 items as common to the global scale (even though the set of common items may differ by country)

The merits

- The validity and reliability of the measures can be formally assessed
  - Statistical tests on the data, to confirm they yield **proper measures** of a single underlying latent trait
  - Sampling **and non-sampling (!)** errors can be computed
- It is easy to implement
  - FAO provides FIES questionnaires in **200 different languages**
  - Flexibly adapted, it can be included in **virtually any population survey.**
  - It requires an average of **3 minutes of survey time** to apply
  - Can be **easily programmed in CAPI** applications

The merits

- It generates disaggregated information
  - When included in large scale representative surveys, results can be disaggregated at the level of any **population group** for which the survey is representative
- The information it produces can be used to guide policy and intervention
  - Can be **quickly** analyzed to generate **real-time results**
  - The food insecurity condition of household and individuals is one of the most effective **predictors of malnutrition**
  - In the US, the prevalence of food insecurity among households has been found to be particularly **sensitive to general macroeconomic conditions** (e.g., economic crises, unemployment rates)

EXPERIENCES WORKING WITH COUNTRIES ON SDG TARGET 2.1 MONITORING

Monitoring framework

- Countries are mainly responsible for gathering data
- **UN General Assembly has officially approved** the monitoring framework and the list of indicators, countries need to report **SDG indicators by official national data.**
- Custodian agencies provide support to the countries they need to inform their SDG monitoring framework
- FAO's fundamental global role is to develop methods and standards for food and agriculture statistics, and provide technical assistance
- FAO as custodian agency of both SDG Target 2.1 indicators, one of its roles is to promote the adoption of the FIES and PoU methodologies by national governmental institutions.

FAO's Assistance

- Building capacities of NSOs to collect needed data for monitoring SDG indicators and to conduct data analysis and produce SDG indicators related to food security;

- Strengthening the capacities of national policy makers to use the information to guide food security policy.

- Leveraging on the capacities of countries already using these indicators

Capacity Development Strategy (1)

- Production and dissemination of tools and training material
  - Development of software for processing FIES data to produce SDG 2.1.2
  - Development of ADePT-FSM software to analyze food consumption data collected in surveys and produce SDG 2.1.1
  - Development of FIES survey modules translated into 150 languages and dialects
  - E-learning courses are developed to build countries' capacities to produce SDG 2.1.1 and 2.1.2 http://www.fao.org/elearning/#/elc/en/course/SDG212
  - Development of user manuals and various video tutorials
  - Data dissemination portal with links to all existing available FIES datasets.

Capacity Development Strategy (2)

- Conduct regional and country-level workshops
- Technical assistance to improve survey instrument or to include the FIES
  - 34 (10 Asia and Pacific) countries colleting the FIES/EBFS Survey module in their national surveys and 12 countries decided to include in their upcoming surveys
  - Improvements achieved in methodologies for the collection
    - Development of guidelines to improve food consumption data
    - Jointly Pakistan and Indonesia, developed methodologies to estimate the missing calories consumed away from home.

Thank you for your listening

Question/Answer ?