The FAO method to estimate the Prevalence of Undernourishment

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Undernourishment

◦ <u>Conceptually</u> it is the condition of not being adequately nourished

◦ <u>Operationally</u>, it is the condition by which a household or an individual has access, on a regular basis, to an amount of food that does not cover their normal energy requirement for an active and healthy life

◦ <u>Different</u> from malnourishment (poorly or improperly nourished or suffering from malnutrition) or undernutrition (inadequate nutrition resulting from lack of food or failure of the body to absorb or assimilate nutrients properly.)

History of the global assessment of undernourishment – from food supply to food access

From 1947 through 1967 assessment was based on comparison of average food **supplies** to average food requirements

P.V. Sukhatme (1961) introduced a method to estimate the percentage of those, in a population, who are at risk of not having sufficient food

In 1974 a method to estimate the prevalence of **inadequate access to food** ("prevalence of undernourishment") was introduced

Definition

The Prevalence of undernourishment is the probability that selecting one individual at <u>random</u> from the population, that person is found to be consuming, on a <u>regular</u> basis, an amount of food that provides <u>less</u> than his or her own dietary energy <u>requirements</u>.

The fundamental elements of the PoU

PoU is not a ''**headcount**'' approach ....

... to do a headcounting would be data demanding and methodologically problematic

Undernourishment is inherently an **individual characteristic**

The fundamental elements of the PoU

Through normal socioeconomic data collection methods it is extremely difficult to measure food intake of individuals ;

Food requirements at the individual level cannot be measured ;

Both **food consumption and energy requirements can be highly variable** in their day-to-day values, and arguably in a highly correlated way

The key intuition behind Sukhatme model, is that part of the variability observed in food consumption has nothing to do with food insecurity, as it reflects the **normal variability** due to differences in food requirements;

The fundamental elements of the PoU

The crucial issue is to determine how wide is such variability.

FAO determines it in terms of dietary energy requirements associated with demographic and physical characteristics (age, sex, physical activity level)
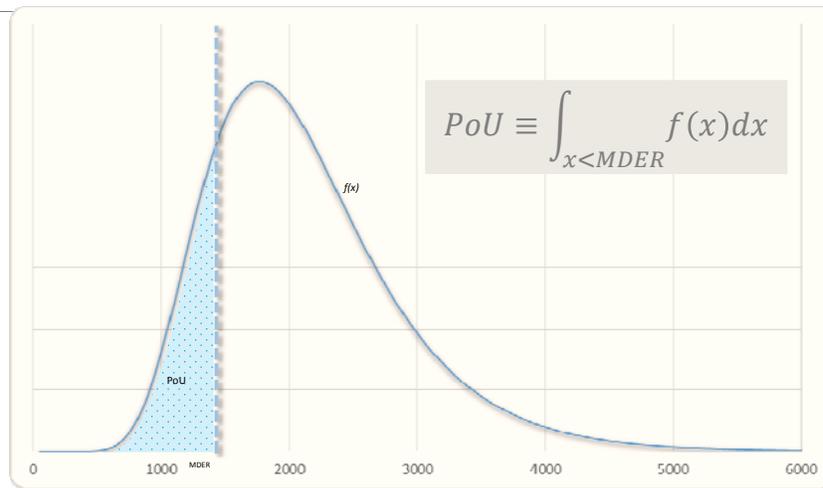
The FAO method

Estimate 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 fundamental elements of the PoU

$$PoU \equiv \int_{x<MDER} f(x)dx$$

The fundamental elements of the PoU

Sukhatme's approach is an ingenious way to reconcile information, at the population level, from various sources
◦ Population structure
◦ Aggregate food balances
◦ Household surveys

It is crucial to understand the operational assumptions
◦ Choice of the distribution
◦ Estimation of parameters

The fundamental elements of the PoU

Choice of the distribution

◦ It should represent the probability distribution associated with food (calorie) consumption of the *average, representative individual* in the population

  ◦ Could be indifferently expressed on a *per caput* or on a *per adult equivalent* basis (it is only a matter of scaling)

  ◦ Possibly positively, but not excessively skewed (there is a natural limit to how much calories a human body can consume)

The log normal model was adopted, in 1996, for analytic convenience and goodness of fit, based on existing food intake surveys

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The fundamental elements of the PoU

Determination of the parameters

Mean consumption estimated from Food Balance Sheets

◦ Still the preferred option

  ◦ Issues of coverage (i.e. non commercial production, accounting for losses etc.), precision (unreported trade, stocks).

The fundamental elements of the PoU

<u>Determination of the parameters</u>

Coefficient of Variation (CV) of food consumption is derived from food consumption data collected in Household Consumption and expenditure surveys,…

…. but 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**….and non systematic measurement errors **inflate the estimate of the variance….**

The fundamental elements of the PoU

<u>Determination of the parameters</u>

CV of food consumption
- …. And to correct for excess variability due to measurement error, FAO has developed a methodology to reduce the variability that exists in food consumption data, and the CV used to estimate PoU does not correspond to the empirical CV of the food consumption distribution but is indeed obtained as the sum of two CVs

$$CV_{tot} = \sqrt{CV_{inc}^2 + CV_{req}^2}$$

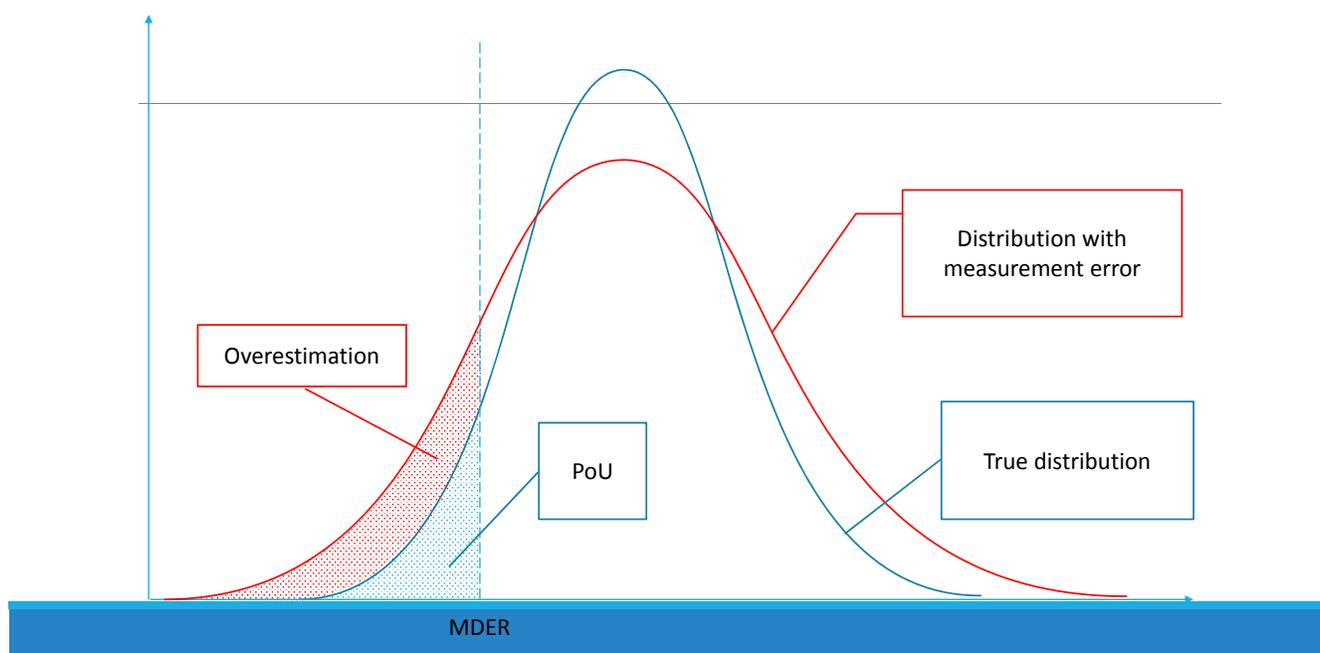# The fundamental elements of the PoU

Determination of the parameters

CV of food consumption

◦ …. And [to correct for excess variability] due to measurement error, FAO has developed [a methodology to reduce the] the variability that exists in food consumption data, an[d the CV used to estimate Po]U does not correspond to the empirical CV of the foo[d consumption distribution b]ut is indeed obtained as the sum of two CVs

Variability that exists between households and that is mainly due to differences in income

$$CV_{tot} = \sqrt{CV_{inc}^2 + CV_{req}^2}$$

The fundamental elements of the PoU

Determination of the parameters

CV of food consumption

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range of normal variability in requirements that exist in the population due to differences in physical activity level and body mass and which may be up to 20% of the average requirements

$$CV_{tot} = \sqrt{CV_{inc}^2 + CV_{req}^2}$$

Distribution with measurement error

Overestimation

PoU

True distribution

MDER

The fundamental elements of the PoU

Location of the threshold

The presence of three subgroups in the population need to be recognized,

- The threshold cannot be set at the <u>average</u> dietary energy requirement, as this will inevitably produce estimates close to 50%, irrespective of the actual extent of food inadequacy.

- By definition of "<u>under</u>nourishment", the average intake of the undernourished must be lower than the average intake of the adequately nourished and of those who are over consuming

Population without undernourishment

Population with undernourishment

PoU

MDER   ADER   XDER
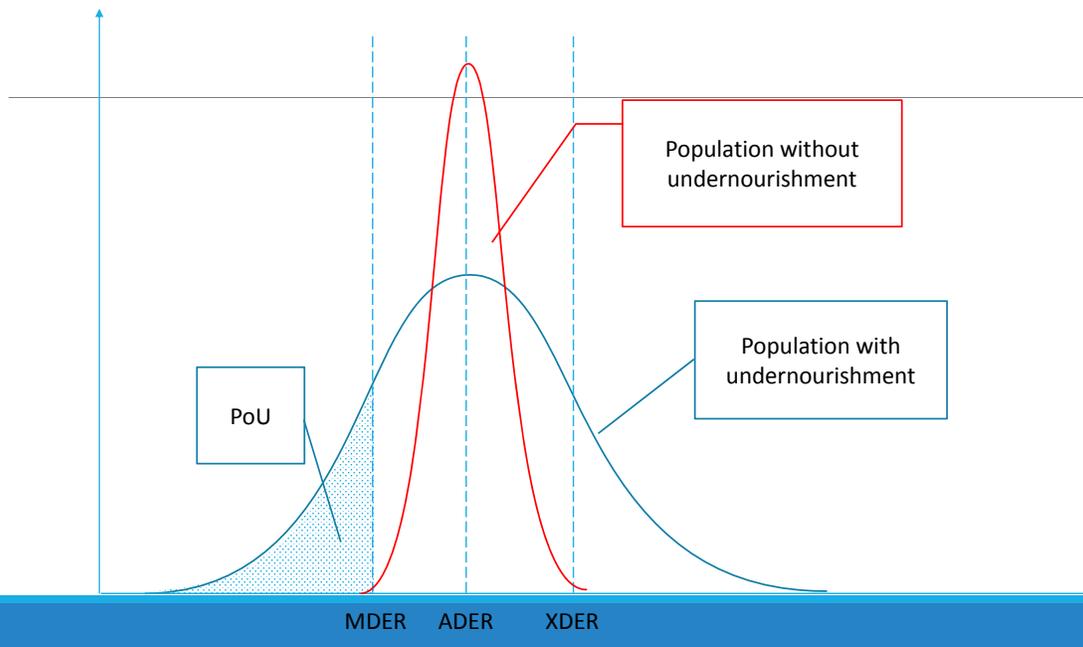
The fundamental elements of the PoU

Location of the threshold

Energy requirements are established on the basis of body mass and physical activity level

There are ranges of acceptable body masses values and physical activity level values that are perfectly compatible with normally active healthy life
- BMI's from 18.5 to 24.5 are perfectly healthy
- PAL levels from 1.55 to 2.25 are perfectly legitimate

Because of that, unless you know the actual body mass and the actual PAL of an individual you cannot establish a given level of daily dietary energy requirement, but only a range that goes from a **minimum** (corresponding to BMI = 18.5 and PAL = 1.55) to a **maximum** (BMI = 24.5, PAL 2.25)

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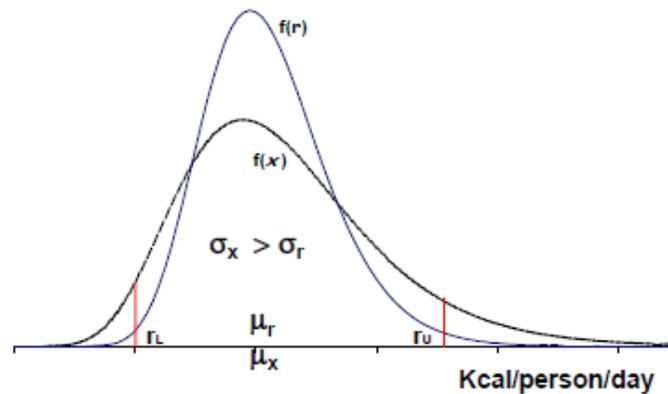
The fundamental elements of the PoU

Location of the threshold

The "optimal" choice of the threshold location depends on the cost associated with the probability of both under and over estimating

◦ FAO determines it based on the **minimum of the ranges of dietary energy requirement for a population engaged in normal physical activity,** assuming that the probability of being undernourished falls rapidly when intakes are above the threshold

Overcoming a persistent misconception

Misconception: "the prevalence of caloric inadequacy can be estimated by counting the proportion of individual/households reporting habitual consumption levels below the average recommended level of caloric consumption."

This **cannot** be. This is problematic for two distinct problems:
◦ Methodological
◦ Data related

The PoU method addresses both

The FAO method

Estimate, as best as possible, the distribution of habitual daily dietary energy consumption in the population from food consumption data (FBS, household surveys, nutrition surveys)
◦ Can be expressed either on a per-caput basis, or per-adult equivalent

Estimate the range of normal energy requirements in the population (DHS, anthropometry, time use surveys, etc.) to set the threshold

Evaluate the cumulative probability below the threshold

If you do not understand it, you are not the only one…

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When the United Nations Food and Agriculture Organization calculates national rates of undernourishment, they don't do what you might expect: take a large sample of people and determine how many aren't eating enough.


Food and Agriculture Organization of the United Nations

Conceptual problems

Undernourishment is an individual condition, that depends on the comparison of intake with requirements

Dietary energy requirement vary in the population, depending on sex, age, body mass and physical activity level

Contrary to other nutrients, dietary energy consumption and dietary energy requirements are not statistically independent:

◦ The level of dietary energy consumption, for the part of population that is not constrained in their access to food, reflects their requirement

◦ The normal variability of requirement in the population must be recognized to avoid overestimation
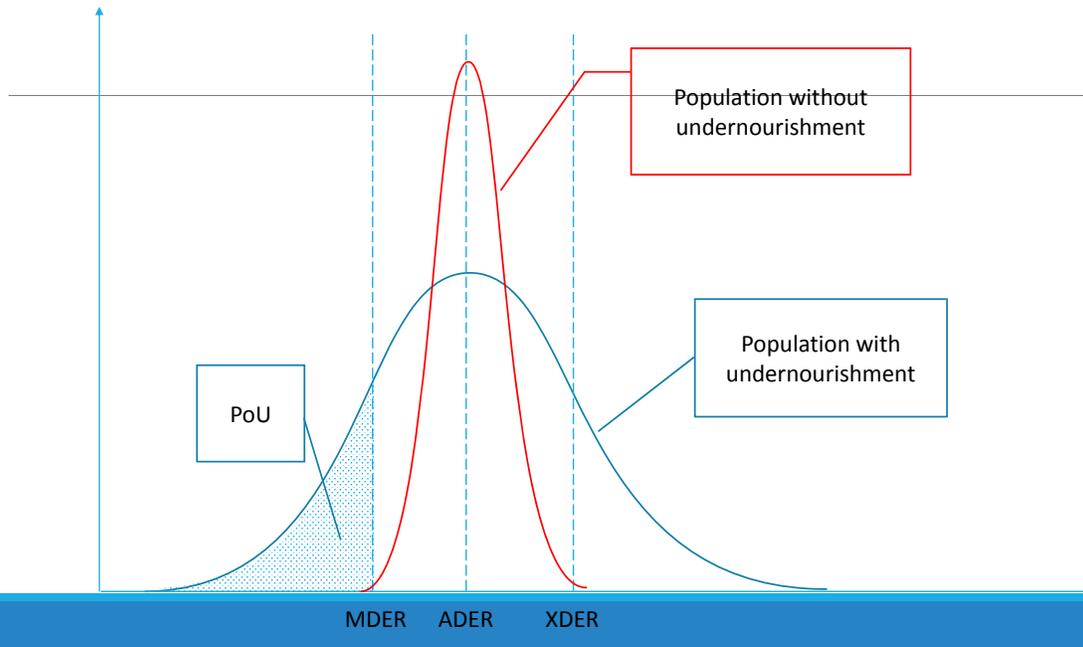
Data related problems

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**.
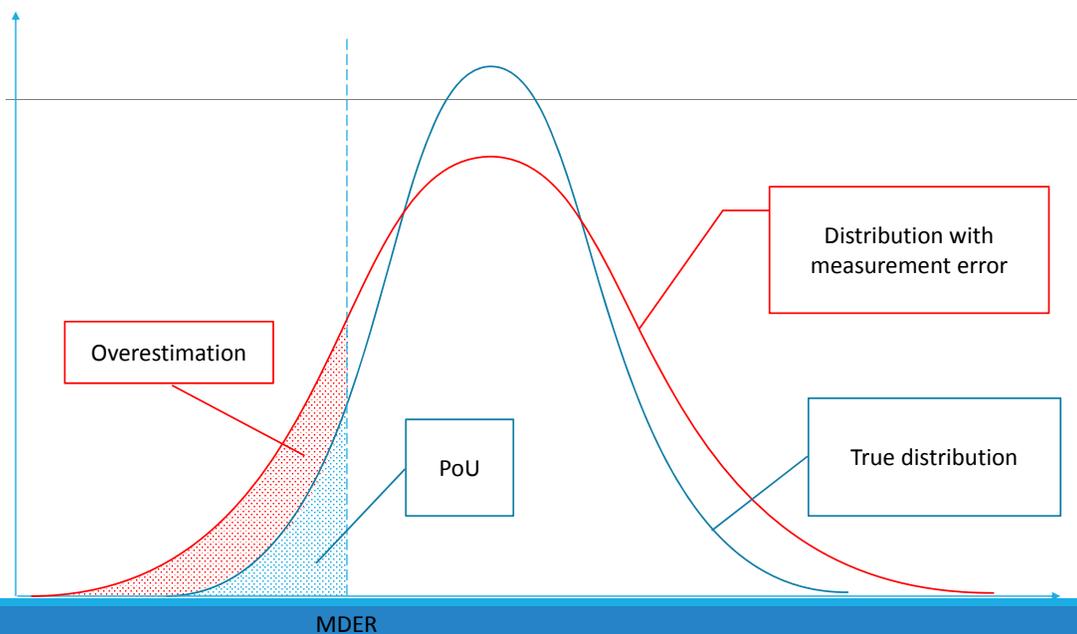
Data related problems

Even if it might not bias the estimate of the mean, non systematic measurement errors certainly **inflate the estimate of the variance**:

$$x_i = c_i + e_i, \; E(e) = 0, e \perp x$$

$$E(x) = E(c) + E(e) \Rightarrow E(x) = E(c)$$

$$Var(x) = Var(c) + Var(e)$$

$$CV(x) = \sqrt{CV(c)^2 + CV(e)^2} > CV(c)$$

Distribution with measurement error

Overestimation

PoU

True distribution

MDER

The FAO method – the way forward

The new 2030 Sustainable Development Agenda (Goal 2) calls for the ERADICATION of hunger, with a focus on "leaving no one behind".

→ FAO is now working on revising the methodology to estimate PoU at sub national level

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How FAO can assist countries in estimating the PoU in context of SDG monitoring?

- Assist countries in designing food consumption modules of household surveys to reduce measurement error in food data

- Provide capacity development to countries on
  ◦ Processing food data in order to derive the dietary energy consumption distribution from which to derive the parameters to estimate the PoU
  ◦ The methodology to estimate the minimum energy requirement
  ◦ The methodology to estimate the prevalence of undernourishment at sub national level
  ◦ The interpretation of results to inform policies

Difference between PoU and FIES

The concepts that inform both the FIES and the PoU are different and therefore the two indicators should not be confused.

●The FIES provides estimates of the proportion of the population facing difficulties in **accessing** food, at different levels of severity

●The PoU is an estimate of the **adequacy** of dietary energy intake in a population.

The number of people having experienced food insecurity in a given country is expected to be greater than the number of those who are estimated to be "undernourished": People may be in a situation of **food insecurity** yet still **meet their dietary energy needs** by consuming less expensive and energy dense foods, or cutting back on other basic needs.

Complementarities between PoU and FIES

●The PoU methodology, gives a **snapshot** of the magnitude of the food insecurity in the country and is useful for observing national trends.

● The FIES provides **actionable information** that policy makers can use to identify vulnerable population groups and guide policy interventions.

THANK YOU!