



LEARNING ABOUT
2 **1.2**
INDICATOR

SDG Indicator 2.1.2 – Using the Food Insecurity Experience Scale (FIES)

Lesson 4: Using FIES data to calculate food insecurity prevalence rates

Text-only version

The interactive version of this lesson is available free of charge at: www.fao.org/elearning



This lesson is available in Open Access under the Attribution-ShareAlike 3.0 IGO ([CC-BY-SA 3.0 IGO](http://creativecommons.org/licenses/by-sa/3.0/)) license. FAO holds copyright of the lesson content, 2018.



Food and Agriculture
Organization of the
United Nations



working for Zero Hunger

In this lesson

SDG Indicator 2.1.2 – Using the Food Insecurity Experience Scale (FIES)	1
Using FIES data to calculate food insecurity prevalence rates	3
Learning objectives	3
The FAO Excel template	3
Estimating the prevalence of food insecurity in the population	4
The two FIES-based indicators	5
General steps	6
The need for comparable estimates	6
Equating: calibrating to a common metric	7
The FIES global standard scale	7
Thresholds defining classes of food insecurity	8
Placement of thresholds	8
The Global Standard thresholds	9
Placement of the first and second thresholds	9
Equating step by step.....	10
Exploring the FIES Excel template: The equating worksheet.....	13
Determining common and unique items.....	14
Effect of equating decisions on prevalence rates.....	15
Adjusted thresholds	16
Probabilistic assignment	16
Uncertainty in classification.....	17
Relationship between raw score and probability of food insecurity.....	18
Discrete assignment: an alternative approach?	19
Calculating prevalence estimates	20
The Insert Input worksheet of the Excel template	21
Producing Indicator 2.1.2 using household data	22
Summary	23

Using FIES data to calculate food insecurity prevalence rates

This lesson explains the process of using data collected with the Food Insecurity Experience Scale (FIES) to calculate an estimate of the prevalence of food insecurity in the population.

It illustrates the process of "equating" (i.e. calibrating measures obtained from any specific application of experience-based food security questionnaires to the global FIES reference scale).

It also shows how to compute prevalence rates by assigning each respondent a probability of being food insecure at different levels of severity.

Learning objectives

At the end of this lesson, you will be able to:

- define food insecurity prevalence estimates and the two FIES-based indicators produced by FAO;
- explain why equating is necessary for valid comparison of food insecurity prevalence estimates across countries or subpopulations;
- describe how thresholds are set for defining classes of food insecurity severity, and how they are transferred from the global standard to country scale;
- demonstrate how the selection of common and unique items during the equating process is carried out, and how it affects the prevalence estimates;
- explain how respondents are assigned a probability of belonging to classes of food insecurity (probabilistic assignment);
- demonstrate how comparable prevalence estimates are calculated.

The FAO Excel template

In Lesson 3 “**Statistical validation of FIES data**”, you learned that respondent and item parameters can be calculated using the RM.weights software.

In this lesson you will learn how to **use this output**, along with information about the distribution of the sample population across raw scores, to **calculate estimates of the prevalence of food insecurity** that can be compared across countries (or across any application of the FIES).

FAO has developed an Excel Template to facilitate the calculation of comparable food insecurity prevalence estimates.

Instructions: The "1. INSERT INPUT" worksheet is where you will add the input necessary for the equating process. In the cells of this color, you will paste the corresponding information included in the RM.w function's output. Once this is done, you can go to worksheet "2. PERFORM EQUATING" to choose the common items and obtain the corresponding food insecurity prevalence rates. Details of the calculations are provided in the lower half of worksheet 1.

Item parameters and statistics for the 8 FIES items(Country 1)			Raw score parameters and errors (Country 1)			
Item	Severity *		Raw score	Severity ***	Error ****	W cases *****
WORRIED	-2.25		0	-4.27	1.52	8782.86
HEALTHY	-1.49		1	-2.81	1.15	973.23
FEWFOOD	-1.69		2	-1.75	0.95	558.50
SKIPPED	0.35		3	-0.92	0.90	572.03
ATELESS	-0.52		4	-0.12	0.90	427.86
RUNOUT	0.48		5	0.73	0.95	275.46
HUNGRY	2.05		6	1.71	1.04	230.41
WHLDAY	3.05		7	2.98	1.25	139.13
			8	4.00	1.52	316.97
Sum						12276.45

CALCULATIONS									
Item parameters of the 8 FIES items (FAO global scale 2014-2016)			Comparable thresholds	Moderate+Severe FI	Severe FI	Probability (mod+sev)	Probability (sev)	Prevalence rate (Mod)	Prevalence rate (Sev)
					-0.543				
					3.264				
Item	Before the Standardization	After the standardization	Equal severity	Raw score	Percentage of Individuals	Probability (mod+sev)	Probability (sev)		
WORRIED	-1.2230564	-2.1286	-2.25	0	71.5%	0	0	12.208%	2.376%
HEALTHY	-0.847121	-1.4743	3.26	1	7.9%	0.024882	0.000000		
FEWFOOD	-1.1056616	-1.9243		2	4.5%	0.100227	0.000000		
SKIPPED	0.3509848	0.6109		3	4.7%	0.337889	0.000001		
ATELESS	-0.3117999	-0.5426		4	3.5%	0.682742	0.000086		
RUNOUT	0.5065051	0.8815		5	2.2%	0.910726	0.003664		
				6	1.9%	0.984718	0.068293		

FIES items	Choose common items	Mean of common items (country)	Common Items Country	Common items Standard
WORRIED	x	2.75941E-05	-2.246312204	-1.2230564
HEALTHY	x	1.860563383	-1.485940939	-0.847121

When you download the template, and you will see that there is already an **example included** within the template, meaning that there are values present for the required input. You will use this to follow along with the lesson. Once you are ready to analyse your own FIES data, you will simply **replace the example values** with the relevant output from RM.weights.

Estimating the prevalence of food insecurity in the population

The focus of this course is on applying the FIES to **estimate the prevalence of food insecurity in a population at specified levels of severity**, which can be used for national or international monitoring

purposes, both over time and across population groups. The **estimated prevalence rates** are **reliable** even in countries with very low or very high prevalence rates of food insecurity, if:

- ➔ the **samples** used are **large enough** to ensure reliable estimates of the parameters
- ➔ the samples are **representative of the population** of interest
- ➔ the FIES data **pass the validation tests** discussed in Lesson 3



What exactly do we mean by "prevalence"?

We mean the **percentage** of individuals in the **total population** who are **affected by a given condition**. In the case of the **FIES**, this means **food insecurity at different levels** of severity. It is important to keep in mind that this percentage is **not simply** the **proportion** of food insecure individuals or households **in the sample** that has been surveyed. **Sampling weights must be applied** to account for unequal sampling, and to ensure that the prevalence rates reported reflect the proportion of food insecure individuals or households in the population.

The two FIES-based indicators

FAO produces **two FIES-based indicators** for global monitoring: $FI_{mod+sev}$ and FI_{sev} . The **first of these** has been selected as a **monitoring Indicator for SDG Goal 2, Target 2.1**. Both are expressed in terms of the prevalence of food insecurity in the population, and they **differ only** in the **level of severity** at which prevalence rates are assessed. These indicators are:

$FI_{mod+sev}$: The proportion of the population experiencing **moderate to severe** food insecurity (SDG Indicator 2.1.2)

FI_{sev} : The proportion of the population experiencing **severe** food insecurity



$FI_{mod+sev}$ is the **sum** of the proportions of the reference population classified as experiencing **moderate** food insecurity **plus** those experiencing **severe** food insecurity. Thus **FI_{sev}** is **included within** the **$FI_{mod+sev}$** Indicator.



The concept of the food security continuum is explained in more detail in Lesson 3 'Statistical validation of FIES data' of this course.

General steps

Estimating the prevalence of food insecurity in the population involves **two general steps**.

- ① **Define thresholds** along the scale (levels of severity) that will define classes of food security.
- ② **Calculate the percentage of individuals or households** in the population expected (or "likely") to be food insecure at severity levels **in excess of the threshold**.

The need for comparable estimates

Before we consider the two steps, let's consider the ultimate goal of the SDG Indicator - production of comparable rates of food insecurity.

To achieve comparability, prevalence rates must be calculated with reference to **common thresholds**. The **measures obtained** with the FIES and the **thresholds used for classification** must be expressed in a **common metric**.

Equating must be done every time we **compare measures** across two **different applications** of an experience-based food security questionnaire, such as when comparing results obtained in two different countries, using their respective national scales.

It should also be done when comparing the results obtained with applications of the **same scale** in two **different points in time**, or when using different scales for **different population groups** (for example, in households with and without children).

Equating is used for the following purposes:

- ✓ **testing** for possible differences in how the scale functions between different applications of the FIES;
- ✓ **producing national prevalence rates** that can be validly compared with those of other countries, which is an important feature for global monitoring purposes;
- ✓ permitting valid **comparisons** of FIES results **between subpopulations** (such as different ethnic or language groups) within a country.

Let's consider **why you can't compare** the results directly.

Equating: calibrating to a common metric

Application of the Rasch model on a single country dataset produces a scale that is, to some extent, arbitrary and **idiosyncratic** to that country. Before comparing measures obtained in two different countries or populations, it will be necessary to **calibrate the two scales on a common metric** by **equating the mean** and the **standard deviation** of the set of items that are common to the two scales.

Simply **comparing the numbers obtained** from the analysis of FIES data in two different countries would be **meaningless**, rather like comparing **temperatures measured in Fahrenheit and Celsius**

The FIES global standard scale

The global standard is a set of item severity values that has been created based on results from over 140 countries covered by the Gallup World Poll in 2014, 2015 and 2016.



WORRIED -1.22 During the last 12 months, was there a time when **you ate only a few kinds of foods** because of a lack of money or other resources?

FEWFOOD -1.11 During the last 12 months, was there a time when **you were worried you would not have enough food to eat** because of a lack of money or other resources?

HEALTHY -0.85 During the last 12 months, was there a time when you were **unable to eat healthy and nutritious food** because of a lack of money or other resources?

ATELESS -0.31 During the last 12 months, was there a time when you **ate less than you thought you should** because of a lack of money or other resources?

SKIPPED -0.35 During the last 12 months, was there a time when **you had to skip a meal** because there was not enough money or other resources to get food?

RUNOUT -0.51 During the last 12 months, was there a time when **your household ran out of food** because of a lack of money or other resources?

HUNGRY -0.75 During the last 12 months, was there a time when **you were hungry but did not eat because** there was not enough money or other resources for food?

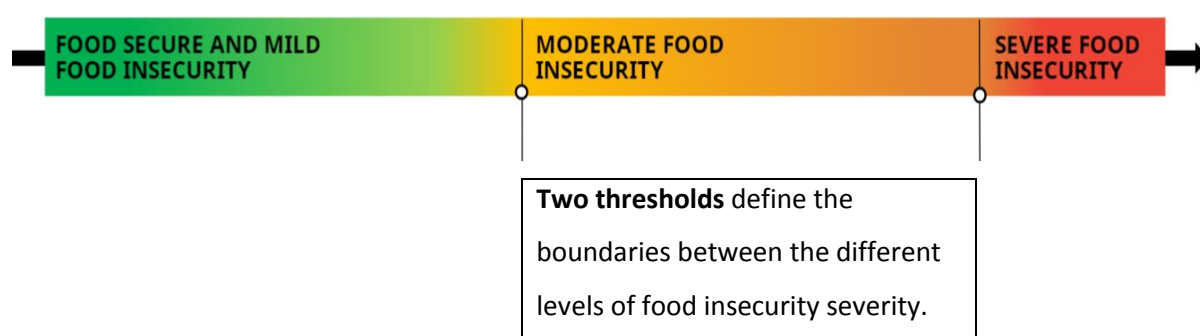
WHLDAY 1.88 During the last 12 months, was there a time when **you went without eating for a whole day** because of a lack of money or other resources?

The Gallup World Poll

In 2014, 2015 and 2016, the FIES was included in the Gallup World Poll (GWP) in nearly 150 countries. This allowed FAO to develop a **sound analytic methodology** and a **global standard** for producing estimates of food insecurity that are valid, reliable and comparable across contexts. The GWP database has been used to define **provisional baseline estimates** of the prevalence of moderate or severe food insecurity. These estimates will serve as a starting point for measuring progress towards the Sustainable Development Goals (SDGs).

Thresholds defining classes of food insecurity

Remember that the **underlying scale** of food insecurity severity is **defined on a continuum** that goes from being food secure to being severely food insecure. A threshold, or level of severity on the scale, is set to define a certain "class" of food insecurity. Respondents can then be categorized as belonging to that class if the severity of their food insecurity is beyond that threshold level.



Placement of thresholds

So, each time I apply the FIES, I can choose where to place the thresholds?

There are important reasons why you should carefully place thresholds along the scale of severity and maintain their consistency across applications of the FIES. Consistent thresholds are essential:

➡ To monitor food insecurity prevalence over time, the **definition of severity categories** must **remain the same**. Otherwise, you cannot know **whether a change in prevalence is meaningful** or simply a consequence of changing thresholds.

➡ For communication purposes, consistent thresholds give **generic labels**, such as "moderate" or "severe" a **common meaning**.

➡ If you choose the specific thresholds on the **global standard scale**, you will be able to produce **internationally comparable results**. This will be explained further in the next sections.

Remember that the ultimate goal in the context of the SDGs is the production of **comparable rates** of food insecurity that can be used for global monitoring.

The Global Standard thresholds

In the case of the FIES, we can use the **severity of specific items on the global standard scale** as our thresholds: one to divide food secure/mild food insecurity from moderate food insecurity, and the other to divide moderate from severe.

In the image of the global FIES standard scale above, we can see that there are **two distinct clusters of items**, WORRIED, FEWFOODS and HEALTHY, and then SKIPPED, RUNOUT and HUNGRY.

ATELESS and WHLDAY are further from the other items. This means that they are sufficiently far from others to represent a **clearly detectable difference in food insecurity severity**.

Placement of the first and second thresholds

For this reason, ATELESS and WHLDAY have been selected to set the two thresholds:



The **first threshold** is set at the **severity level** of the FIES item **ATELESS** (that is, at the condition of eating "less than you should"), and separates the class of "food secure or mildly food insecure" from the class of "moderately food insecure".

The **second threshold** is set at the **severity level** of the FIES item **WHLDAY** ("gone for a whole day without eating") and separates the class of "moderately food insecure" from that of the "severely food insecure".

Equating step by step

① **Equating** the mean and the standard deviation of the 8 item parameters estimated on the national scale to those of the reference global scale.

② **Comparing** the adjusted item parameters of the two scales.

If the parameters for an item differ too much, it is considered to represent a different condition in that country than in a typical one, and is therefore "unique".

③ **Repeating** the **linear adjustment** described in Step 1, this time equating the mean and the standard deviation of the common (non-unique) items, and compare the newly adjusted parameters. Repeat these steps again if the parameters for any other item differ too much between the two scales. For **equating** to be considered **acceptable**, **no more than 3 items** should be considered **unique**, and at least five items must be considered "common".

If this is the case, the two scales can be "anchored" to each other via the common items, whose relative order and spread of severity is similar enough to provide reasonable confidence that they are, in fact, equivalent.

④ The **global standard thresholds** are **adjusted** to the metric of the country scale by **applying the linear function** that was developed in the **equating process** to the global standard thresholds. The thresholds defined on the global reference scale can thus be **adjusted to the metric of the country scale**, to ensure comparability of the classification at international level.

⑤ The adjusted thresholds are used to **calculate comparable prevalence rates**.

An example of equating

Let's look at an example of the linear transformation described in Step 1 of the equating process. In this case, the global standard item parameters are adjusted to the country metric. In other words,

column 2 is transformed into column 3. Note that the equating is being done using 7 of the 8 FIES items, as one item (HUNGRY) was determined to be "unique".

Item	Item severities - Country	Item severities - Global standard	Global standard item severities on country metric
WORRIED	-2.24631	-1.22306	-2.10620
HEALTHY	-1.48594	-0.84712	-1.49492
FEWFOOD	-1.68542	-1.10566	-1.91531
SKIPPED	0.35460	0.35098	0.45322
ATELESS	-0.51598	-0.31180	-0.62448 (adjusted threshold)
RUNOUT	0.47733	0.50651	0.70609
WHLDAY	3.05227	1.87554	2.93 216 (adjusted threshold)
Mean	-0.2928	-0.1078	-0.2928
SD	1.7996	1.1067	1.7996

There are **seven items** were found to be common following equating (all except HUNGRY).

Here we see the **item severities on the country scale.**

Here we see the **item severities on the global scale.**

Column 3 shows the item severities of the **global standard expressed in terms of the country's scale (Y)**

In the column 3 this is done by the adjustment (**linear transformation**) described earlier, where the mean and standard deviation of the global standard are transformed to equal those of the country scale. This uses the formula:

$$Y = -0.12 + 1.63X$$

where -0.12 and 1.63 are derived from:

$$\text{COUNTRY MEAN} - \left(\frac{\text{GLOBAL STANDARD DEVIATION}}{\text{GLOBAL MEAN}} \times \frac{\text{STANDARD DEVIATION}}{\text{GLOBAL STANDARD DEVIATION}} \right)$$

$$-0.2928 - (-0.1078 \times (1.7996/1.1067)) = -0.2928 - (-0.1078 \times (1.63)) = -0.2928 + 0.17529 = -0.12$$



While the RM.weights package produces a mean of all item severities of 0 by default, here we are displaying the mean and standard deviation of **common items**, and since the item HUNGRY was determined to be "unique" it was omitted from this calculation.

Exploring the FIES Excel template: The equating worksheet

Now we will consider one of the two worksheets provided in the Excel template, the one called "Perform equating".

The eight FIES items. Select which items are determined to be "common". Absolute differences between the item severities of the two scales.



Instructions: in the worksheet "2. PERFORM EQUATING", you will choose the common items. In cells of this color, type an "x" if you determine the item to be common, and leave the cell empty if you determine it to be unique. Cells B17 and C17 will show the resulting prevalence rates of food insecurity at moderate and severe levels.

FIES items	Choose common items	Absolute difference between country and standard item severities (after calibration)
WORRIED	x	0.12
HEALTHY	x	0.01
FEWFOOD	x	0.24
SKIPPED	x	0.26
ATELESS	x	0.03
RUNOUT	x	0.40
HUNGRY	x	0.74
WHLDAY	x	0.21

Correlation between common items: 98.17%

Prevalence rate (Mod+Sev)	Prevalence rate (Sev)
12.208%	2.376%



Correlation between common items



Prevalence of food insecurity at two levels of severities: **the final results.**



Plot of adjusted item severities of the two scales.

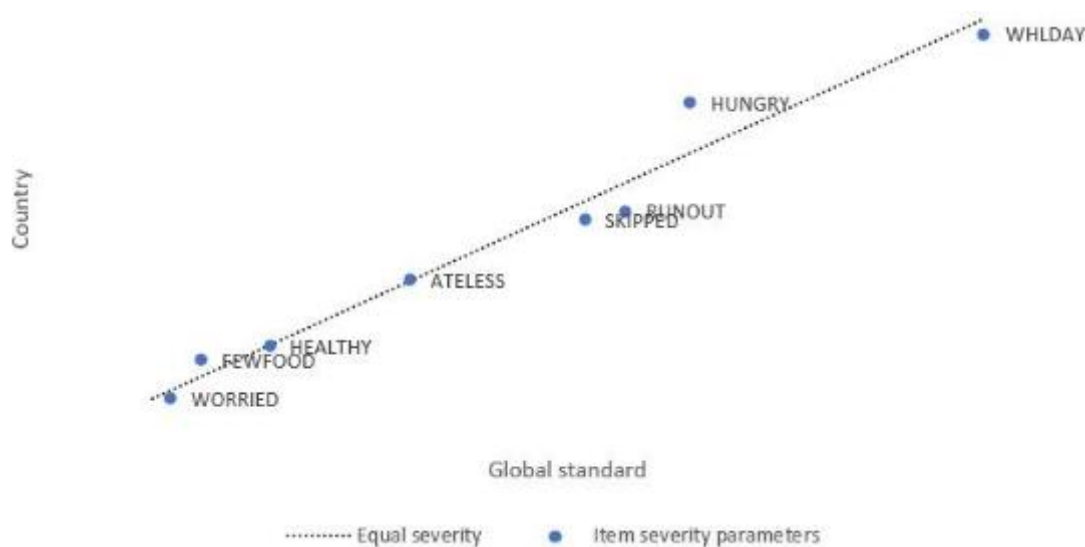
Determining common and unique items

The important first step in equating is to **determine which items** are **common between two scales**. Refer to the example provided in the **Perform equating** worksheet. The two sets of item parameters can only be compared once **one of the two scales' item parameters** (the mean and standard deviation) have been **standardized to those of the other**.

By doing this you can then **identify unique items** whose **parameters differ too much** between the two scales. The equating procedure can then be repeated, omitting the unique items. There are three pieces of information you can use to identify unique items:

① By **examining a plot** of the two scale's item parameters

By examining this graphical representation of the item parameters visually, **you can see that the item HUNGRY is discrepant** (far from the diagonal line), and so you may choose to omit it and repeat the equating.



② By looking at the **correlation** between the common items' adjusted item parameters.

- ③ By considering the absolute difference between the two scales' item parameters for each item.

The absolute difference between the two scales' item parameters for each item is generally expressed in the metric of the FIES global standard. In the example, you can identify a discrepant item, HUNGRY (with the highest absolute difference of 0.74), which suggests it could be dropped and the equating repeated. You may also examine the correlation between item parameters of the two scales. In the example, it is **98.17%**.

WORRIED	0.12
HEALTHY	0.01
FEWFOOD	0.24
SKIPPED	0.26
ATELESS	0.03
RUNOUT	0.40
HUNGRY	0.74
WHLDAY	0.21


Omitting unique items

Let's see what happens if we omit HUNGRY and equate the two scales once again. You can try this in the FIES Excel Template yourself. In general, the common items (those other than HUNGRY) moved closer to the diagonal line and the correlation between item parameters increased.

Effect of equating decisions on prevalence rates

🗨️ *“So Denis, I'm a little unsure about how the selection of common and unique items will affect the estimates we make for the Indicator. Can you explain?” - Grace*

*“Yes of course. Notice how by choosing a different set of common items, the estimated prevalence of food insecurity changes. The changes we see are due to the impact of your choice on the position of the internationally comparable thresholds on the national scale. We choose which items to treat as "common" either based on **a tolerance level**, where we define as "unique" any items with absolute differences in severity beyond a certain threshold. We can also consider the **correlation between common items** of the plot of item severities to inform our decision. These choices may involve a **level of informed judgement** or "art", but they are nevertheless **guided by principle**. As long as we **clearly***

report the factors that went into our choice of common and unique items, we provide a solid justification for our results.”  - Denis



It is important to **seriously consider** the **impact** of your decision regarding the definition of common and unique items. While it is **always important** to **thoroughly describe the criteria** used to inform your actions, this is **especially crucial** if alternative choices result in large differences in estimated prevalence rates.

Adjusted thresholds

Let's return to the table showing the linear transformation. Remember that it was done using the seven items determined to be common (all except HUNGRY). With the global standard item severities now adjusted to the country metric, we see our two standard thresholds are at the adjusted severity level of ATELESS (-0.6245) and WHLDAY (2.9322). If you were to have used all eight items for equating, the resulting adjusted thresholds would be different. Go ahead and try this by using the FIES Excel Template, referring to the tab, **Insert Input**, where you will see the thresholds change based on your selection of common items.

Item	Item severities - Country	Item severities - Global standard	Global standard item severities on country metric
WORRIED	-2.24631	-1.22306	-2.10620
HEALTHY	-1.48594	-0.84712	-1.49492
FEWFOOD	-1.68542	-1.10566	-1.91531
SKIPPED	0.35460	0.35098	0.45322
ATELESS	-0.51598	-0.31180	-0.62448 (adjusted threshold)
RUNOUT	0.47733	0.50651	0.70609
WHLDAY	3.05227	1.87554	2.93216 (adjusted threshold)
Mean	-0.2928	-0.1078	-0.2928
SD	1.7996	1.1067	1.7996

ATELESS defines the boundary between food security and moderate food insecurity.

WHLDAY defines the boundary between moderate and severe food insecurity.

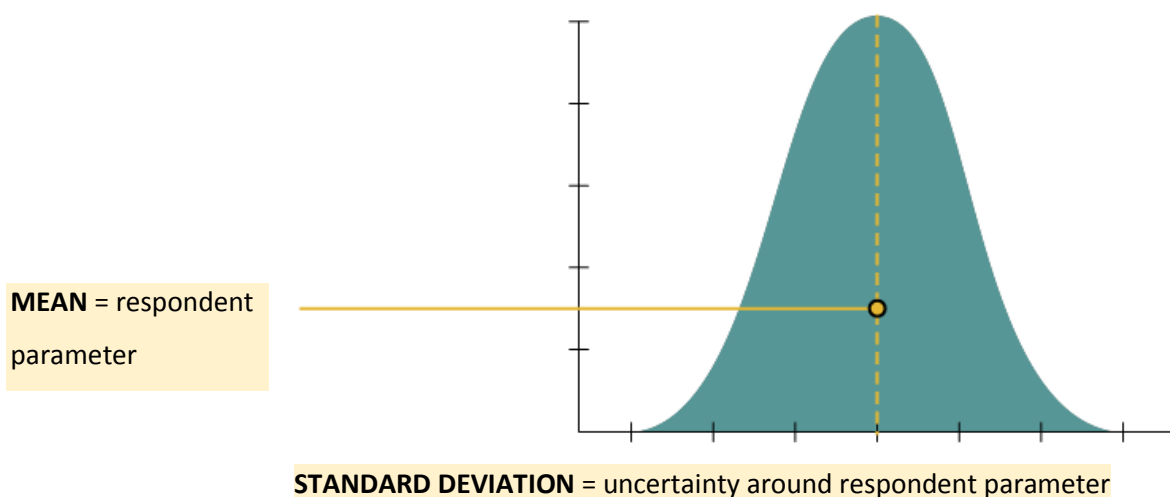
Next, we will see how the **placement of the thresholds** affects the calculated estimates of the prevalence of food insecurity at the two levels of severity.

Probabilistic assignment

With the **classes of food insecurity defined** by the adjusted thresholds, prevalence rates can now be calculated. This begins with the **probabilistic assignment of respondents** to food insecurity classes,

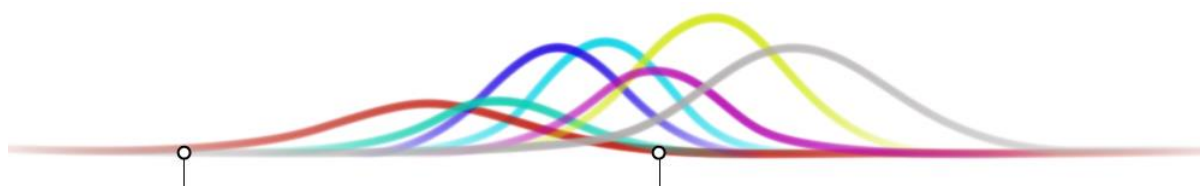
which means assigning **each respondent** a **probability of falling into a certain class**, i.e. that their true severity level is above or below the threshold, given their **raw score**.

In the image below we see an illustration of the **distribution of true food insecurity** around each raw score. Each respondent parameter and the associated uncertainty around it are treated as the **mean** and the **standard deviation**, respectively, of the (normal) distribution of the **true severity level** within the population represented by the group of respondents who have reported that raw score.



Uncertainty in classification

Here we see the **normal curves for each raw score**. The probability of a respondent's true severity of food insecurity being beyond a given threshold is calculated using the **normal probability distribution**.



The relatively **wide distribution of severity around raw score 1** means that there would be a **large amount of uncertainty** in classifying someone with this raw score as either food secure or mildly food insecure, as their true severity may very well be higher or lower.

This is the reason why in the continuum of food insecurity, **no threshold** is placed between food **secure** and **mildly food insecure**, which are grouped together.

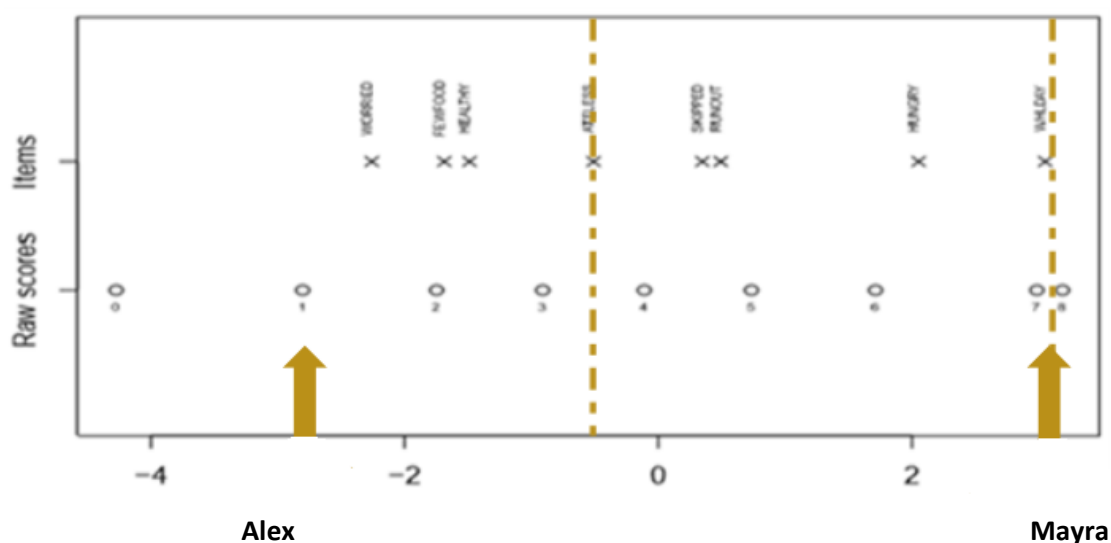


Relationship between raw score and probability of food insecurity

The table below is an example showing the probability of being beyond the ATELESS thresholds (that is, of being moderately or severely food insecure) at each raw score. The probabilities in this table are an example only, and will be different for each application of the FIES. You can see that the **probability increases with higher raw scores** - this means that as a person answers more questions affirmatively, they have a higher probability of being moderately or severely food insecure.

Raw Score	Probability of being beyond the “moderate” threshold
0	0
1	0.01
2	0.04
3	0.17
4	0.47
5	0.79
6	0.95
7	0.99
8	1

Consider two individuals Alex and Mayra, positioned along the scale at the level of their raw score.



Alex has a **raw score of 1**. The **probability** of his being even moderately food insecure is **0.01 (very low)**. It is extremely unlikely that someone who is moderately or severely food insecure would answer only one FIES question affirmatively.

Mayra has a **raw score of 7**. The **probability** of her being moderately or severely food insecure is **much higher, 0.99**.

Discrete assignment: an alternative approach?

It is **possible** to classify respondents based solely on their **raw score**, an approach known as **discrete assignment**. As it is both **easier to implement** and **explain** to different audiences, many countries with experience-based food security scales have used this approach. However the **FIES methodology** for calculating the SDG indicators as described in this lesson is **highly recommended**, resulting in **more accurate** prevalence rates that are **comparable** across countries. There are **two key reasons** why the discrete assignment approach should be avoided:

🔗 **Risk of inconsistent classification** - In multiple applications in **different periods** or over **different population groups**, a given raw score might actually correspond to different levels of severity, with a risk of inconsistent classifications. **The risk is lower** when there is **evidence that the scale works well** in a given linguistic and cultural context. For example, when the same scale has been used on the same population for several years and analysts have verified the stability of the severity levels associated with different raw scores. **The risk is higher** when the comparison is made between classifications obtained:

- in different countries;
- on populations that differ linguistically or culturally;
- when the stability of the scale might have been conditioned by adaptations of the scale.

🔗 **Loss of comparability of results**

The risk of inconsistency also means that each country ends up using possibly **different thresholds to define food security classes** that are therefore **not internationally comparable**, even if they are often labelled in the same way (e.g. "severe food insecurity") in different countries.

To avoid these risks, the **process described in this lesson** of equating all measures onto a common reference scale, and using **probabilistic assignment to obtain prevalence rates** has been developed, and although it is a slightly more complicated procedure, it is **highly preferred**.



How does discrete assignment work?

All cases with the same raw score are simply counted to determine the proportion of cases that fall into a particular food security class. For example, all respondents with raw score 4 or higher may be classified as "moderately or severely food insecure", while all those with raw scores 7 or 8 may be classified as "severely food insecure". The estimated prevalence of moderate and severe food insecurity is equal to the ratio between the weighted number of cases thus classified and the total weighted number of cases.

Calculating prevalence estimates

The final step is to calculate the overall prevalence of food security in the population.

This is done using the **weighted proportion** of cases in the population **with each raw score** to generate a **weighted sum** of the **raw score-specific probabilities**.

Let's take another look at the FIES Excel Template, on the first worksheet called **Insert Input** to better understand exactly how **prevalence rates are calculated**. The template takes output from RM.weights to calculate the proportion of individuals or households with food insecurity more severe than each of the two adjusted thresholds. In other words, **it reports the prevalence rates** for FImod+sev and FIssev.

The Insert Input worksheet of the Excel template

The image below explains the various sections of the Insert Input worksheet from the FIES Excel Template.

Instructions: The "1. INSERT INPUT" worksheet is where you will add the input necessary for the equating process. In the cells of this color, you will paste the corresponding information included in the RM.w function's output. Once this is done, you can go to worksheet "2. PERFORM EQUATING" to choose the common items and obtain the corresponding food insecurity prevalence rates. Details of the calculations are provided in the lower half of worksheet 1.

Item parameters and statistics for the 8 FIES items(Country 1)			Raw score parameters and errors (Country 1)			
				*** CELLS B20-B28 B10-B17 in RM.w output	****CELLS C20- C2 B10-B17 in RM.w output	***** CELLS F20- F28 B10-B17 in RM.w output
	* CELLS B10-B17 in RM.w output		Raw score	Severity ***	Error ****	W cases *****
Item	Severity *					
WORRIED	-2.25		0	-4.27	1.52	8782.86
HEALTHY	-1.49		1	-2.81	1.15	973.23
FEWFOOD	-1.69		2	-1.75	0.95	558.50
SKIPPED	0.35		3	-0.92	0.90	572.03
ATELESS	-0.52		4	-0.12	0.90	427.86
RUNOUT	0.48		5	0.73	0.95	275.46
HUNGRY	2.05		6	1.71	1.04	230.41
WHLDAY	3.05		7	2.98	1.25	139.13
			8	4.00	1.52	316.97
				Sum		12276.45

① Severity of FIES items on country scale (from RM.w output).

② Respondent parameters, error, and weighted cases at each raw score. (From RM.w output). If you use household weights, the final result will be a prevalence of **households**. If weights are at **individual** level, it will be the prevalence of individuals in the total population.

③ FIES global standard item parameters **before and after** standardization.

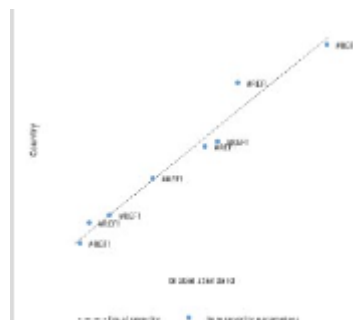
⑤ Thresholds of Moderate and Severe and Severe food insecurity.

⑥ The **prevalence rate** at each level of severity, **expressed as percentages**.

CALCULATIONS									
Item parameters of the 8 FIES items (FAO global scale 2014-2016)				3.	Comparable thresholds		5.	6.	
	Before the Standardization	After the standardization	Equal severity		Moderate+Severe FI	-0.543			
					Severe FI	3.264			
Item				Raw score	Percentage of individuals	Probability (mod+sev)	Probability (sev)	Prevalence rate (Mod)	Prevalence rate (Sev)
WORRIED	-1.2230564	-2.1286	-2.25	0	71.5%	0	0	12.208%	2.376%
HEALTHY	-0.847121	-1.4743	3.26	1	7.9%	0.024882	0.000000		
FEWFOOD	-1.1056616	-1.9243		2	4.5%	0.100227	0.000000		
SKIPPED	0.3509848	0.6109		3	4.7%	0.337889	0.000001		
ATELESS	-0.3117999	-0.5426		4	3.5%	0.682742	0.000086		
RUNOUT	0.5065051	0.8815		5	2.2%	0.910726	0.003664		
HUNGRY	0.7546138	1.3134		6	1.9%	0.984718	0.068293		
WHLDAY	1.8755353	3.2642		7	1.1%	0.997586	0.410954		
				8	2.6%	0.998628	0.687016		

④ Percentage of individuals with each raw score, and their probabilities of being food insecure at two levels of severity. FIES global standard item parameters **before and after** standardization.

FIES items	Choose common items Type "x" if the item is common and leave the cell empty if it is unique			
		Mean of common items (country)	2.75941E-05	Common Items Country
		Mean of common items (standard)	1.25E-08	-2.246312204
WORRIED	x	SD of common items (country)	1.860563383	-1.485940939
HEALTHY	x	SD of common items (standard)	1.069044974	-1.68541628
FEWFOOD	x			-1.1056616
SKIPPED	x			0.354602771
ATELESS	x			0.3509848
RUNOUT	x			-0.515978753
HUNGRY	x			-0.3117999
WHLDAY	x			0.477331719
				0.5065051
				2.049661216
				0.7546138
				3.052273221
				1.8755353



⑦ Choose common items by typing x for common item and leave empty if item is unique.

⑧ Mean and Standard deviation of common items for country and global standard scales.

⑨ Common items on country scale and global standard.

Producing Indicator 2.1.2 using household data

When the **individual version** of the FIES survey module has been applied and the cases weighted by individual weights, the results produced by the FIES Excel Template are a **prevalence of food insecure individuals**. As the individual questionnaire will always be applied to adults, the reference population for this prevalence is the adult population, and not the total (all ages) national population. See “key assumptions” below for more details.

However, when the **household version** of the FIES survey module has been applied and cases weighted by household weights, the results are the prevalence of food insecure households. In this case, some **additional calculations are necessary** to arrive at the prevalence estimate required for reporting SDG 2.1.2.

If you have household referenced data, you must:

- Estimate the item parameters using the original, household referenced data.
- Produce the **distribution of individuals** across raw scores by multiplying the household sampling weights by the household size.



These procedures **can be carried out within** the **RM.weights** application, but users with household level data must remember to carry out this additional calculation, to ensure that their resulting prevalence **rates refer to individuals** in the national population.



Key assumptions

Irrespective of whether one uses the individual or the household referenced questionnaire, SDG 2.1.2 will **always** be computed by assuming that all individuals living in the same household will share the same probability of being food insecure.

The only difference is that with the individual framed version, we make the further assumption that a household is considered food insecure even if only one adult in the household is found to be food insecure.

The SDG **Indicator** refers to **people living in food insecure households**.

Children are considered food insecure if they live in a household with a food insecure adult.

Therefore, information on the number of children living in each household is required to calculate a prevalence of food insecurity that refers to the total national population.

Summary

This lesson has explained the process of using the FIES data collected in order to calculate a comparable estimate of the prevalence of food insecurity in a population, or the percentage of individuals in the total population who are affected by a given condition.

It has covered:

- the two FIES indicators, $FI_{mod+sev}$ and FI_{sev} and the food insecurity prevalence rates that these indicators communicate;
- the two steps of the process: selecting the thresholds and calculating the percentage of individuals or households in the population with severity in excess of the threshold;
- the FIES global standard scale and the importance of using the equating process to calibrate a country scale to this global metric;
- the use of ATELESS and WHLDAY as the thresholds between mildly and moderately food insecure, and between moderately and severely food insecure, respectively;
- the selection of common and unique items during the equating process.
- the advantages of using probabilistic rather than discrete assignment, and how prevalence rates are calculated.

In Lesson 5 “*Using the FIES to make a difference: presentation and communication of results*” you will learn how to use the prevalence estimates that are calculated in order to report on SDG Indicator 2.1.2 and communicate with stakeholders about the status of food insecurity.