Simple Poverty Scorecard® Poverty-Assessment Tool Uganda

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This document is at `SimplePovertyScorecard.com`.

Abstract

The Simple Poverty Scorecard®-brand poverty-assessment tool uses ten low-cost indicators from Uganda's 2009/10 National Household Survey to estimate the likelihood that a household has expenditure below a given poverty line. Field workers can collect responses in about ten minutes. The scorecard's accuracy is reported for a range of poverty lines. The scorecard is a practical way for pro-poor programs in Uganda to measure poverty rates, to track changes in poverty rates over time, and to segment clients for targeted services.

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Simple Poverty Scorecard® Poverty-Assessment Tool

			Name	Identifier
Interview ID:				
Interview date:		Participant:		
Country:	UGA	Field agent:		
Scorecard:	001	Service point:		
Sampling wgt.:		Number of household members:		

Indicator	Value	Points	Score
1. How many members does the household have?	A. Six or more	0	
	B. Four or five	6	
	C. Three	9	
	D. Two	14	
	E. One	27	
2. Do all children ages 6 to 18 currently attend school (government, private, NGO/religious, or boarding)?	A. Not all attend	0	
	B. All attend government schools	2	
	C. No children ages 6 to 18	4	
	D. All attend, and one or more attend a private, NGO/religious, or boarding school	5	
3. What is the highest grade that the female head/spouse completed?	A. No female head/spouse	0	
	B. P.5 or less, or none	2	
	C. P.6	6	
	D. P.7 to S.6	8	
	E. Higher than S.6	19	
4. What is the **major** construction material of the roof?	A. Thatch, straw, or other	0	
	B. Iron sheets, or tiles	5	
5. What is the **major** construction material of the external wall?	A. Un-burnt bricks, mud and poles, thatch/straw. timber, stone, burnt bricks with mud, other	0	
	B. Burnt bricks with cement, or cement blocks	2	
6. What is the **main** source of lighting in your dwelling?	A. Firewood	0	
	B. *Tadooba*, or other	11	
	C. Paraffin lantern, or electricity (grid, generator, solar)	17	
7. What is the type of toilet that is mainly **used** in your household?	A. Bush (none)	0	
	B. Covered pit latrine (private or shared), VIP latrine (private or shared), uncovered pit latrine, flush toilet (private or shared), or other	4	
8. Does any member of your household own electronic equipment (e.g., TV, radio, cassette, etc.) at present?	A. No	0	
	B. Yes	7	
9. Does every member of the household have at least two sets of clothes?	A. No	0	
	B. Yes	5	
10. Does every member of the household have at least one pair of shoes?	A. No	0	
	B. Yes	9	

Score:

Back-page Worksheet:
Household Members and School Atttendance

Complete using the definition of *household member* below and in "Guidelines for the Interpretation of Scorecard Indicators". Then record household size and responses for scorecard questions 1 and 2.

Name of household member	How old is [name]? (in completed years)	Does [name] currently attend school? (ask only for ages 6 to 18)	Who manages the school [name] attends? (ask only for ages 6 to 18)		
			Does not attend	Govt.	Private, NGO/religious, or boarding
1.		Not 6 to 18 No Yes			
2.		Not 6 to 18 No Yes			
3.		Not 6 to 18 No Yes			
4.		Not 6 to 18 No Yes			
5.		Not 6 to 18 No Yes			
6.		Not 6 to 18 No Yes			
7.		Not 6 to 18 No Yes			
8.		Not 6 to 18 No Yes			
9.		Not 6 to 18 No Yes			
10.		Not 6 to 18 No Yes			

Use an additional sheet if there are more than 12 household members.

- Record the total number of household members under "household size" at the top of the scorecard
- Mark scorecard Question 1 based on the total number of household members
- Mark scorecard Question 2 based on school attendance by household members ages 6 to 18

A *household* is a person or people, related or unrelated, who live together, who acknowledge a head of household, and who ate their meals together for at least 6 of the last 12 months. Infants, newlyweds, and others present for less than six months are household members if they expect to remain. So are students and seasonal workers who have not been living in another household. Servants and farm workers are members if they live and eat there. People who live in the same dwelling, but who do not share food expenses or eat meals together, are not members. Visitors are not members. Polygamous marriages are separate households if each wife and her children live and eat separately.

Currently attending school refers to primary, secondary, vocational/technical, or professional school. Students are counted as currently attending if they are not attending because they are on holiday, on vacation, studying for exams, or if school is temporarily closed. *Government, private, NGO/religious, or boarding* refers to who manages the school. "Day and boarding" counts as "Boarding". Please consult the "Guidelines for the Interpretation of Scorecard Indicators".

Look-up table for converting scores to poverty likelihoods

	Poverty likelihood (%)							
		National			USAID	Intl. 2005 PPP		Sulaiman
Score	Food	100%	150%	200%	'Extreme'	$1.25	$2.50	$1.25/day
0–4	87.6	94.2	100.0	100.0	78.9	100.0	100.0	97.1
5–9	82.0	90.5	100.0	100.0	70.9	92.1	100.0	89.5
10–14	62.7	87.4	100.0	100.0	47.7	100.0	100.0	78.9
15–19	51.6	74.0	97.9	98.8	45.3	92.3	98.8	58.4
20–24	35.5	65.1	86.1	95.8	31.9	82.6	100.0	55.3
25–29	25.0	47.9	73.7	90.2	24.9	67.0	95.5	38.1
30–34	11.3	38.1	69.9	85.7	13.7	61.8	94.8	29.2
35–39	12.0	27.3	64.8	85.2	13.4	55.3	93.0	16.7
40–44	4.3	15.1	47.2	73.0	4.2	38.0	86.5	13.3
45–49	4.0	10.7	41.1	66.8	3.9	31.3	83.7	6.3
50–54	1.8	6.7	34.6	57.1	0.5	24.6	78.1	5.4
55–59	0.7	2.9	18.3	41.6	0.9	11.3	61.5	3.1
60–64	0.2	0.8	17.5	33.5	0.0	6.2	47.4	0.0
65–69	0.0	0.5	6.2	18.8	0.0	2.5	32.1	0.0
70–74	0.0	0.7	6.0	13.5	0.0	2.8	14.3	0.0
75–79	0.0	0.0	1.8	2.9	0.0	0.0	9.3	0.0
80–84	0.0	0.0	0.0	3.9	0.0	0.0	5.7	0.0
85–89	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
90–94	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
95–100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Simple Poverty Scorecard® Poverty-Assessment Tool Uganda

1. Introduction

Pro-poor programs in Uganda can use the low-cost Simple Poverty Scorecard poverty-assessment tool to estimate the likelihood that a household has expenditure below a given poverty line, to monitor groups' poverty rates at a point in time, to track changes in groups' poverty rates between two points in time, and to target services to households.

The direct approach to poverty measurement via surveys asks households about a long list of expenditure items and so is difficult and costly. As a case in point, the socio-economic module of Uganda's 2009/10 National Household Survey (UNHS) runs 22 pages, lasts 60–90 minutes, and asks about more than 175 expenditure items. One such expenditure item is: "In the last seven days, how much purchased *matooke* did the household consume? What units is that in? How much did that *matooke* cost? How much home-produced *matooke* did the household consume? How much would that *matooke* cost, if purchased? How much *matooke* did the household consume that was received as an in-kind payment or as a gift? How much would that *motooke* cost, if purchased? Now then, in the last seven days, how much purchased fresh cassava did the household consume? . . ."

In contrast, the indirect approach via the scorecard is simple, quick, and inexpensive. It uses ten verifiable indicators (such as "What is the major construction material of the roof?" and "Does every member of the household have at least one pair of shoes?") to get a score that is highly correlated with poverty status as measured by the exhaustive survey.

The scorecard here differs from "proxy-means tests" (Coady, Grosh, and Hoddinott, 2002) in that it is tailored to the capabilities and purposes not of national governments but rather of local, pro-poor organizations. The feasible poverty-measurement options for these local organizations are typically subjective and relative (such as participatory wealth ranking by skilled field agents) or blunt (such as rules based on land-ownership or housing quality). Measurements from these approaches may not be comparable across organizations, they may be costly, and their accuracy is unknown.

Local, pro-poor organizations can use the scorecard to measure the share of their participants who are below a given poverty line, such as the Millennium Development Goals' $1.25/day line at 2005 purchase-power parity. USAID microenterprise partners can use the scorecard to report how many of their participants are among the poorest half of people below the national poverty line. Local organizations can also use the tool to measure movement across a poverty line. For all these purposes, the scorecard provides an expenditure-based, objective tool with known accuracy. While expenditure

surveys are costly even for governments, some small, local organizations may be able to implement an inexpensive scorecard that can serve for monitoring and targeting.

The statistical approach here aims to be understood by non-specialists. After all, if managers are to adopt the scorecard on their own and apply it to inform their decisions, they must first trust that it works. Transparency and simplicity build trust. Getting "buy-in" matters; proxy-means tests and regressions on the "determinants of poverty" have been around for decades, but they are rarely used to inform decisions, not because they do not work, but because they are presented (when they are presented at all) as tables of regression coefficients incomprehensible to non-specialists (with cryptic indicator names such as "`LGHHSZ_2`", negative values, and many decimal places). Thanks to the predictive-modeling phenomenon known as the "flat maximum", simple scorecards are often about as accurate as complex ones.

The technical approach here is also innovative in how it associates scores with poverty likelihoods, in the extent of its accuracy tests, and in how it derives formulas for standard errors. Although these techniques are simple and commonplace in statistical practice and in for-profit credit-risk scoring, they have rarely or never been applied to scorecards.

The scorecard is based on the 2009/10 UNHS conducted by Uganda's Bureau of Statistics (UBOS). Indicators are selected to be:

- Inexpensive to collect, easy to answer quickly, and simple to verify
- Strongly correlated with poverty
- Liable to change over time as poverty status changes

All points in the scorecard are non-negative integers, and total scores range from 0 (most likely below a poverty line) to 100 (least likely below a poverty line). Non-specialists can collect data and tally scores on paper in the field in five to ten minutes.

The scorecard can estimate three basic quantities. First, it can estimate a particular household's "poverty likelihood", that is, the probability that the household has per-capita or per-adult-equivalent expenditure below a given poverty line.

Second, the scorecard can be used to estimate the poverty rate of a group of households at a point in time. This estimate is the average of the poverty likelihoods among the households in the group.

Third, the scorecard can be used to estimate changes in the poverty rate for a group of households (or for two independent samples of households that are representative of the same population) between two points in time. This estimate is the change in the average poverty likelihood of the group(s) over time.

Some pro-poor organizations in Uganda are already using a poverty-assessment tool (Sulaiman, 2009) based on the 2005/6 UNHS. To allow these organizations to measure change between a measurement with Sulaiman's scorecard and a later measurement with the new scorecard here, this paper calibrates scores from the new scorecard to poverty likelihoods for Sulaiman's poverty line and his definition of expenditure. Under the maintained assumptions of the scorecard, the difference between

a group's estimated poverty rates for Sulaiman's poverty line and his definition of expenditure is still an unbiased measure of change.[1]

The scorecard can also be used for targeting. To help managers choose an appropriate targeting cut-off for their purposes, this paper reports several measures of targeting accuracy for a range of possible cut-offs.

This paper presents a single scorecard whose indicators and points are derived from household expenditure data and Uganda's national poverty line. Scores from this one scorecard are calibrated to poverty likelihoods for eight poverty lines.

The scorecard is constructed and calibrated using half the households in the 2009/10 UNHS, and its accuracy is validated on the other half.

While all three scoring estimators are *unbiased* (that is, they match the true value on average in repeated samples when applied to the same population from which the scorecard was built), they are—like all predictive models—biased to some extent when applied to a different population.[2]

Thus, while the indirect scoring approach is less costly than the direct survey approach, it is also biased. There is bias because scoring must assume that the future relationships between indicators and poverty will be the same as in the data used to

[1] Measures of precision are not presented, as they depend on the unknown covariance of the two estimators and on the unknown standard error of Sulaiman's estimator.
[2] Important cases include nationally representative samples at a different point in time or non-nationally representative sub-groups (Tarozzi and Deaton, 2009).

build the scorecard. Of course, this assumption—ubiquitous and inevitable in predictive modeling—holds only partly.

When applied to the validation sample with bootstraps of $n = 16{,}384$, the difference between scorecard estimates of groups' poverty rates and the true rates at a point in time is +0.5 percentage points for the national line. The average absolute difference across all eight lines is 0.6 percentage points. These differences are due to sampling variation and not bias; the average of each difference would be zero if the whole 2009/10 UNHS were to be repeatedly redrawn and divided into sub-samples before repeating the entire process of building, calibrating, and validating scorecards.

The 90-percent confidence intervals for these estimates are ±0.6 percentage points or less. For $n = 1{,}024$, these intervals are ±2.4 percentage points or less.

Section 2 below describes data and poverty lines. Sections 3 and 4 describe scorecard construction and offer guidelines for use in practice. Sections 5 and 6 detail the estimation of households' poverty likelihoods and of groups' poverty rates at a point in time. Section 7 discusses estimating changes in poverty rates over time, and Section 8 covers targeting. Section 9 places the new scorecard here in the context of existing poverty-measurement tools for Uganda, including Sulaiman (2009). Section 10 is a summary.

2. Data and poverty lines

This section discusses the data used to construct and test the scorecard. It also presents the poverty lines to which scores are calibrated.

2.1 Data

The scorecard is based on data from the 6,775 households in Uganda's nationally representative UNHS done from May 2009 to April 2010.

For the purposes of the scorecard, the households in the 2009/10 UNHS are randomly divided into two sub-samples (Figure 1):

- *Construction* and *calibration* for selecting indicators and points and for associating scores with poverty likelihoods
- *Validation* for measuring accuracy on data not used in construction or calibration

2.2 Poverty rates and poverty lines

2.2.1 Rates

As a general definition, the *poverty rate* is the share of people in a group who live in households whose total household expenditure (divided by the number of adult equivalents or household members) is below a given poverty line.

Beyond this general definition, there two special cases, *household-level poverty rates* and *person-level poverty rates*. With household-level rates, each household is counted as if it had only one person, regardless of true household size, so all households

are counted equally. With person-level rates (the "head-count index"), each household is weighted by the number of people in it, so larger households count more.

For example, consider a group of two households, the first with one member and the second with two members. Suppose further that the first household has per-adult-equivalent expenditure or per-capita expenditure above a poverty line (it is "non-poor") and that the second household has per-adult-equivalent expenditure or per-capita expenditure below a poverty line (it is "poor"). The household-level rate counts both households as if they had only one person and so gives a poverty rate of $1 \div (1 + 1) =$ 50 percent. In contrast, the person-level rate weighs each household by the number of people in it and so gives a poverty rate of $2 \div (1 + 2) = 67$ percent.

Whether the household-level rate or the person-level rate is relevant depends on the situation. If an organization's "participants" include all the people in a household, then the person-level rate is relevant. Governments, for example, are concerned with the well-being of people, regardless of how people are arranged in households, so governments typically report person-level poverty rates.

If an organization has only one "participant" per household, however, then the household-level rate may be relevant. For example, if a microlender has only one borrower in a household, then it might prefer to report household-level poverty rates.

Figure 1 reports poverty lines and poverty rates for Uganda at both the household-level and the person-level. Figure 2 reports the same information for the eight

geographic regions for which UBOS defines poverty lines. The national figures are weighted averages of the regional figures.

The scorecard is constructed using the 2009/10 UNHS and household-level lines. Scores are calibrated to household-level poverty likelihoods, and accuracy is measured for household-level rates. This assumes that the household level is relevant for most pro-poor organizations.

Person-level poverty rates can be estimated by taking a household-size-weighted average of the household-level poverty likelihoods. It is possible to construct, calibrate, and validate a scorecard based on person-level weights, but it is not done here.

2.2.2 Poverty lines

The data from the UBOS used in this paper include two national poverty lines, a food line and a food-plus-non-food line (the "national line"). Appleton *et al.* (1999) derive the original food line as the cost of 3,025 Calories from the food basket consumed by the poorest half of adult equivalents in Uganda's 1993/4 First Monitoring Survey. The food line is updated over time using the change in the average national Consumer Price Index (CPI) for the months when the 1993/4 survey and the 2009/10 UNHS were in the field (UBOS, 2010). The food line is UGX1,011 per adult equivalent per day for all regions. The UGX are in average constant units during the May 2009 to April 2010 period when the UNHS was in the field.[3] This gives a food-poverty rate for Uganda

[3] Adult equivalents adjust for how nutritional requirements vary by age and sex. Uganda uses the scale in World Health Organization (1985).

overall of 9.0 percent at the household level and 11.8 percent at the person level (Figure 1).

Following Ravallion and Bidani (1994), Uganda's national line is defined as the food line plus the non-food expenditure observed for households whose total expenditure is at the food line (Ssewanyana and Okidi, 2007). Food prices from the 2009/10 UNHS are used to adjust for differences in cost-of-living across Uganda's eight poverty-line regions (UBOS, 2010). The average national line for Uganda is UGX1,387 per adult equivalent per day, giving a household-level poverty rate of 19.3 percent and a person-level poverty rate of 24.5 percent (Figure 1).

Because local pro-poor organizations may want to use different or various poverty lines, this paper calibrates scores from its single scorecard to poverty likelihoods for eight lines:

- Food
- 100% of national
- 150% of national
- 200% of national
- USAID "extreme"
- $1.25/day 2005 PPP
- $2.50/day 2005 PPP
- Sulaiman $1.25/day 2005 PPP

150% of the national line is found as the national line multiplied by 1.5, and 200% of the national line is the national line multiplied by 2.

The USAID "extreme" line is defined as the median expenditure of people (not households nor adult equivalents) below the national line (U.S. Congress, 2004).

Uganda's regional $1.25/day 2005 PPP poverty lines are derived from:

- 2005 PPP exchange rate for "individual consumption expenditure by households" (World Bank, 2008): UGX744.62 per $1.00
- Average monthly CPI in 2005 for Uganda: 96.9
- Average CPI for May 2009 to April 2010: 143.0
- Eight regional national poverty lines (L_i, $i = 1, 2, \ldots 8$) from Figure 2
- Person-weighted average of the eight L_i: UGX1,387

Given this, the $1.25/day 2005 PPP line for region r in average UGX for the period from May 2009 to April 2010 is (Sillers, 2006):

$$\left(\text{2005 PPP exchange rate}\right) \cdot \$1.25 \cdot \left(\frac{\text{CPI}_{\text{Ave. 2009/10}}}{\text{CPI}_{\text{Ave. 2005}}}\right) \cdot \left(\frac{L_r}{\sum_{i=1}^{8} \frac{L_i}{8}}\right).$$

For the example of the Central Urban region, the national line is UGX1,527 per adult equivalent per day (Figure 2), so the $1.25/day 2005 PPP line is:

$$744.62 \cdot \$1.25 \cdot \left(\frac{143.0}{96.9}\right) \cdot \left(\frac{1{,}527}{1{,}387}\right) = 1{,}512.$$

The average $1.25/day line across all eight regions in Uganda is UGX1,374 per person per day. The resulting household-level poverty rate is 34.5 percent, and the person-level rate is 42.7 percent.

The $2.50/day 2005 PPP line is twice the $1.25/day line.

2.2.3 Sulaiman's $1.25/day 2005 PPP poverty line

Some organizations in Uganda are already using a poverty-assessment tool based on the 2005/6 UNHS by Sulaiman (2009). To allow these organizations to estimate changes in poverty rates with a baseline done with Sulaiman's scorecard and a follow-

up done with the new scorecard here, scores from the new scorecard are calibrated to poverty status using the same definition of expenditure and same poverty line (in constant terms) as in Sulaiman. Estimates of change that combine point-in-time estimates from the two scorecards are unbiased, although their precision is unknown.

Because the UBOS did not provide data on the official definition of expenditure nor on the official poverty lines for the 2005/6 UNHS, Sulaiman had to define expenditure and a poverty line on his own. The resulting definition of poverty status differs in some respects from those used for the other seven lines here.

For expenditure, Sulaiman excludes from the analysis all households with no responses for certain sections in the questionnaire on non-food expenditure. This is a reasonable decision, but it appears that the UBOS sets expenditure in these cases to zero.

For his single poverty line, Sulaiman uses $1.25/day 2005 PPP. Unlike this paper or Sillers (2006), he does not adjust for changes in average prices between January to December 2005 (the period for which the PPP factor is defined) and average prices while the 2005/6 UNHS was in the field (May 2005 to April 2006). Nor does he adjust (again, because of lack of information from the UBOS) for regional differences in cost-of-living.

Sulaiman uses the 2005 PPP factor for "Gross Domestic Product" of UGX619.64 per $1.00, whereas the World Bank's (undocumented) practice is to use the PPP factor for "Individual Consumption Expenditure" (UGX744.62).

The World Bank (and this paper) defines its $1.25/day 2005 PPP poverty lines in per-capita terms, but Sulaiman's line is in per-adult-equivalent terms. Also, because the UBOS did not provide data on adult equivalents for the 2005/6 UNHS, Sulaiman uses his own formula to determine the number of adult equivalents, but it does not match that of WHO (1985) nor Appleton *et al.* (1999), the sources that the UBOS says that it uses.

The result is that the Sulaiman $1.25/day 2005 PPP line is 1.25 x 619.64 = UGX774.55 per adult equivalent in 2005/6 units. UBOS (2010) reports that the change in the overall Uganda CPI from 2005/6 to 2009/10 is 43 percent, so the Sulaiman $1.25/day line in 2009/10 in constant units is 774.55 x 1.43 = UGX1,108.

For construction and calibration, Sulaiman uses equal weights, not household or person weights. This means that the population for which his scorecard produces unbiased results is unknown.

The discussion above explains why the Sulaiman $1.25/day line differs from the $1.25/day line derived here. It is also why poverty likelihoods (and estimated poverty rates) based on Sulaiman's definition of poverty status are not comparable with poverty likelihoods (and estimates of poverty rates) for the other lines here. All this suggests that organizations who switch from Sulaiman's scorecard to the new one here should also record scores and poverty likelihoods for the other seven poverty statuses so that in the future they can measure change by these definitions.

In the meantime, scores from the new scorecard based on the 2009/10 UNHS can be converted to poverty likelihoods for the Sulaiman $1.25/day line to measure change vis-à-vis earlier measurements based on Sulaiman's scorecard derived from the 2005/6 UNHS.

The unweighted poverty rate for this line is 35.2 percent in the 2005/6 UNHS and 22.7 percent in the 2009/10 UNHS. This is a four-year decrease of 12.5 percentage points, or a one-third reduction in poverty. For perspective, the person-weighted poverty rate for the national line fell by 6.6 percentage points (from 31.1 to 24.5 percent). The reduction in poverty implied by the Sulaiman definitions is twice as large as the reduction using the national poverty line; if correct, this reduction would be one of the fastest and largest in history. It is not clear how much of the reduction is real and how much is due to the definitional differences noted above. Users should note this in any analysis of change over time that uses this definition of poverty status.

3. Scorecard construction

For Uganda, about 70 potential indicators are initially prepared in the areas of:[4]

- Family composition (such as number of members)
- Education (such as school attendance by children)
- Housing (such as type of roof)
- Ownership of durable goods (such as shoes)

Figure 3 lists the potential indicators, ordered by the entropy-based "uncertainty coefficient" that measures how well a given indicator predicts poverty on its own (Goodman and Kruskal, 1979).

The scorecard also aims to measure *changes* in poverty through time. This means that, when selecting indicators and holding other considerations constant, preference is given to more sensitive indicators. For example, having shoes is probably more likely to change in response to changes in poverty than is the age of the male head/spouse.

The scorecard itself is built using the national poverty line and Logit regression on the construction/calibration sub-sample. Indicator selection uses both judgment and statistics. The first step is to use Logit to build one scorecard for each candidate indicator. Each scorecard's accuracy is taken as "c", a measure of ability to rank by poverty status (SAS Institute Inc., 2004).

One of these one-indicator scorecards is then selected based on several factors (Schreiner *et al.*, 2004; Zeller, 2004). These include improvement in accuracy, likelihood of acceptance by users (determined by simplicity, cost of collection, and "face validity"

[4] The UBOS did not provide data from survey modules for employment and agriculture.

in terms of experience, theory, and common sense), sensitivity to changes in poverty status, variety among indicators, and verifiability.

A series of two-indicator scorecards are then built, each based on the one-indicator scorecard selected from the first step, with a second candidate indicator added. The best two-indicator scorecard is then selected, again based on "c" and judgment. These steps are repeated until the scorecard has 10 indicators.

The final step is to transform the Logit coefficients into non-negative integers such that total scores range from 0 (most likely below a poverty line) to 100 (least likely below a poverty line).

This algorithm is the Logit analogue to the common R^2-based stepwise least-squares regression. It differs from naïve stepwise in that the criteria for selecting indicators include not only statistical accuracy but also judgment and non-statistical factors. The use of non-statistical criteria can improve robustness through time and helps ensure that indicators are simple and make sense to users.

The single scorecard here applies to all of Uganda. Evidence from India and Mexico (Schreiner, 2006a and 2005a), Sri Lanka (Narayan and Yoshida, 2005), and Jamaica (Grosh and Baker, 1995) suggests that segmenting scorecards by urban/rural does not improve targeting accuracy much, although it may improve the accuracy of estimates of poverty rates for sub-groups (Tarozzi and Deaton, 2009).

4. Practical guidelines for scorecard use

The main challenge of scorecard design is not to maximize statistical accuracy but rather to improve the chances that the scorecard is actually adopted and used in practice (Schreiner, 2005b). When scoring projects fail, the reason is not usually statistical inaccuracy but rather the failure of an organization to decide to do what is needed to integrate scoring in its processes and to learn to use it properly (Schreiner, 2002). After all, most reasonable scorecards predict about the same, thanks to the empirical phenomenon known as the "flat maximum" (Falkenstein, 2008; Hand, 2006; Baesens *et al.*, 2003; Lovie and Lovie, 1986; Kolesar and Showers, 1985; Stillwell, Barron, and Edwards, 1983; Dawes, 1979; Wainer, 1976; Myers and Forgy, 1963). The bottleneck is less technical and more human, not statistics but organizational-change management. Accuracy is easier to achieve than adoption.

The scorecard here is designed to encourage understanding and trust so that users will adopt it and use it properly. Of course, accuracy matters, but it is balanced against simplicity, ease-of-use, and "face validity". Programs are more likely to collect data, compute scores, and pay attention to the results if, in their view, scoring does not make much additional work and if the whole process generally seems to make sense.

To this end, the scorecard here fits on one page. The construction process, indicators, and points are simple and transparent. Additional work is minimized; non-specialists can compute scores by hand in the field because the scorecard has:

- Only 10 indicators
- Only categorical indicators
- Simple weights (non-negative integers, no arithmetic beyond addition)

A field agent using the paper scorecard would:

- Record participant identifiers and household size
- Read each question from the scorecard
- Circle the response and its point value
- Write the point value in the far-right column
- Add up the points to get the total score
- Implement targeting policy (if any)
- Deliver the paper scorecard to a central office for filing or data entry and analysis

4.1 Data quality

Of course, field agents must be trained. Quality outputs depend on quality inputs. If organizations or field agents gather their own data and believe that they have an incentive to exaggerate poverty rates (for example, if funders reward them for higher poverty rates), then it is wise to do on-going quality control via data review and audits (Matul and Kline, 2003).[5] IRIS Center (2007a) and Toohig (2008) are useful nuts-and-

[5] If an organization does not want field agents to know the points associated with indicators, then they can use the version of the scorecard without points and apply the points later in a spreadsheet or database at the central office. Schreiner (2011a) argues that experience in Colombia (Camacho and Conover, 2011) suggests that hiding points does little to deter cheating and that cheating by an organization's central office is more likely and more damaging than cheating by field agents and respondents.

bolts guides for budgeting, training field agents and supervisors, managing logistics, sampling, interviewing, piloting, recording data, and controlling quality.

In particular, while collecting scorecard indicators is relatively easier than alternatives, it is still absolutely difficult. Training and explicit definitions of terms and concepts in the scorecard is essential (see Appendix). For the example of Nigeria, Onwujekwe, Hanson, and Fox-Rushby (2006) found distressingly low inter-rater and test/retest correlations for indicators as seemingly simple and obvious as whether the household owns a car. At the same time, Grosh and Baker (1995) find that gross underreporting of assets does not affect targeting. For the first stage of targeting in a Mexican social program, Martinelli and Parker (2007) find that "underreporting [of asset ownership] is widespread but not overwhelming, except for a few goods . . . [and] overreporting is common for a few goods, which implies that self-reporting may lead to the exclusion of deserving households" (pp. 24–25). Still, as is done in Mexico in the second stage of its targeting process, most false self-reports can be corrected by field agents who verify responses with a home visit, and this is suggested for Uganda.

4.2 Sample design

In terms of sampling design, an organization must make choices about:

- Who will do the scoring
- How scores will be recorded
- What participants will be scored
- How many participants will be scored
- How frequently participants will be scored
- Whether scoring will be applied at more than one point in time
- Whether the same participants will be scored at more than one point in time

In general, the sampling design should follow from the organization's goals for the exercise and from the business questions that the analysis seeks to inform.

The non-specialists who apply the scorecard with participants in the field can be:

- Employees of the organization
- Third-party contractors

Responses, scores, and poverty likelihoods can be recorded:

- On paper at the respondent's homestead and then filed at an office
- On paper at the home and then keyed into a database or spreadsheet at an office
- On portable electronic devices at the home and downloaded to a database

Given a group of interest for a given question, the subjects to be scored can be:

- All participants
- A representative sample of all participants
- All participants in a representative sample of branches
- A representative sample of all participants in a representative sample of branches

If not determined by other factors, the number of participants to be scored can be derived from sample-size formulas (presented later) for a desired level of confidence and a desired confidence interval.

Frequency of application can be:

- At in-take of new clients only (precluding measuring change in poverty rates)
- As a once-off project for current participants (precluding measuring change)
- Once a year (or at some other fixed time interval, allowing measuring change)
- Each time a field agent visits a participant at home (allowing measuring change)

When the scorecard is applied more than once in order to measure change in poverty rates, it can be applied:

- With a different set of participants
- With the same set of participants

An example set of choices is illustrated by BRAC and ASA, two microlenders in Bangladesh. Each has more than 7 million participants, and each is using a scorecard similar to the one here (Chen and Schreiner, 2009b). Their design is that loan officers in a random sample of branches score all their participants each time they visit a homestead (about once a year) as part of their standard due diligence prior to loan disbursement. Responses are recorded on paper in the field before being sent to a central office to be entered into a database. ASA's and BRAC's sampling plans cover more than 50,000 participants (far more than most pro-poor organizations would need).

5. Estimates of household poverty likelihoods

The sum of scorecard points for a household is called the *score*. For Uganda, scores range from 0 (most likely below a poverty line) to 100 (least likely below a poverty line). While higher scores indicate less likelihood of being below a line, the scores themselves have only relative units. For example, doubling the score increases the likelihood of being above a given poverty line, but it does not double the likelihood.

To get absolute units, scores are converted to *poverty likelihoods*, that is, probabilities of being below a poverty line. This is done via simple look-up tables. For the example of the national line, scores of 30–34 have a poverty likelihood of 38.1 percent, and scores of 35–39 have a poverty likelihood of 27.3 percent (Figure 4).

The poverty likelihood associated with a score varies by poverty line. For example, scores of 30–34 are associated with a poverty likelihood of 38.1 percent for the national line but 61.8 percent for the $1.25/day 2005 PPP line.[6]

5.1 Calibrating scores with poverty likelihoods

A given score is associated ("calibrated") with a poverty likelihood by defining the poverty likelihood as the share of households in the calibration sub-sample who have the score and who are below a given poverty line.

[6] From Figure 4 on, many figures have eight versions, one for each of eight poverty lines. To keep them straight, they are grouped by poverty line. Single tables that pertain to all poverty lines are placed with the first group of tables for the national line.

For the example of the national line (Figure 5), there are 8,444 (normalized) households in the calibration sub-sample with a score of 30–34, of whom 3,217 (normalized) are below the poverty line. The estimated poverty likelihood associated with a score of 30–34 is then 38.1 percent, because 3,217 ÷ 8,444 = 38.1 percent.

To illustrate with the national line and a score of 35–39, there are 10,135 (normalized) households in the construction/calibration sample, of whom 2,763 (normalized) are below the line (Figure 5). Thus, the poverty likelihood for this score is 2,763 ÷ 10,135 = 27.3 percent.

This method is used to calibrate scores with estimated poverty likelihoods for all eight poverty lines.

Figure 6a shows, for all scores, the likelihood that expenditure falls in a range demarcated by two adjacent national poverty lines.[7] For example, the daily per-adult-equivalent expenditure of someone with a score of 30–34 falls in the following ranges with probability:

- 11.3 percent below the food line
- 26.8 percent between the food line and 100% of the national line
- 31.8 percent between 100% of the national line and 150% of the national line
- 15.8 percent between 150% of the national line and 200% of the national line
- 14.3 percent above 200% of the national line

[7] Figure 6a is for the food line, the national line, and the multiples of the national line compared with per-adult-equivalent expenditure. Figure 6b is for the USAID "extreme" line and the international 2005 PPP lines compared with per-capita expenditure. The Sulaiman (2009) $1.25/day line is omitted from both figures 6a and 6b because it is not comparable with any of the other seven poverty lines.

Figure 6b is for the international 2005 PPP lines and the USAID "extreme" line. For example, the daily per-capita expenditure of someone with a score of 30–34 falls in the following ranges with probability:

- 13.7 percent below the USAID "extreme" line
- 48.0 percent between the USAID "extreme" line and $1.25/day 2005 PPP
- 33.0 percent between $1.25/day and $2.50/day 2005 PPP
- 5.2 percent above $2.50/day 2005 PPP

Even though the scorecard is constructed partly based on judgment, the calibration process produces poverty likelihoods that are objective, that is, derived from survey data on expenditure and quantitative poverty lines. The poverty likelihoods would be objective even if indicators and/or points were selected without any data at all. In fact, objective scorecards of proven accuracy are often constructed using only expert judgment (Fuller, 2006; Caire, 2004; Schreiner *et al.*, 2004). Of course, the scorecard here is constructed with both data and judgment. The fact that this paper acknowledges that some choices in scorecard construction—as in any statistical analysis—are informed by judgment in no way impugns the objectivity of the poverty likelihoods, as this depends on using data in score calibration, not on using data (and nothing else) in scorecard construction.

Although the points in the Uganda scorecard are transformed coefficients from a Logit regression, scores are not converted to poverty likelihoods via the Logit formula of $2.718281828^{\text{score}} \times (1 + 2.718281828^{\text{score}})^{-1}$. This is because the Logit formula is esoteric and difficult to compute by hand. Non-specialists find it more intuitive to define the poverty likelihood as the share of households with a given score in the calibration sample who

are below a poverty line. In the field, going from scores to poverty likelihoods in this way requires no arithmetic at all, just a look-up table. This calibration can also improve accuracy, especially with large samples.

5.2 Accuracy of estimates of households' poverty likelihoods

As long as the relationships between indicators and poverty do not change, and as long as the scorecard is applied to households that are representative of the same population as that from which the scorecard was constructed, then this calibration process produces unbiased estimates of poverty likelihoods. *Unbiased* means that in repeated samples from the same population, the average estimate matches the true value. The scorecard also produces unbiased estimates of poverty rates at a point in time, as well as unbiased estimates of changes in poverty rates between two points in time.[8]

Of course, the relationship between indicators and poverty does change to some unknown extent with time and also across sub-groups in Uganda's population. Thus, the scorecard will generally be biased when applied after April 2010 (when fieldwork for the 2009/10 UNHS ended) or when applied with non-nationally representative sub-groups.

[8] This follows because these estimates of groups' poverty rates are linear functions of the unbiased estimates of households' poverty likelihoods.

How accurate are estimates of households' poverty likelihoods? To measure, the scorecard is applied to 1,000 bootstrap samples of size $n = 16{,}384$ from the validation sub-sample. Bootstrapping entails (Efron and Tibshirani, 1993):

- Score each household in the validation sample
- Draw a new bootstrap sample *with replacement* from the validation sample
- For each score, compute the true poverty likelihood in the bootstrap sample, that is, the share of households with the score and expenditure below a poverty line
- For each score, record the difference between the estimated poverty likelihood (Figure 4) and the true poverty likelihood in the bootstrap sample
- Repeat the previous three steps 1,000 times
- For each score, report the average difference between estimated and true poverty likelihoods across the 1,000 bootstrap samples
- For each score, report the two-sided interval containing the central 900, 950, or 990 differences between estimated and true poverty likelihoods

For each score range and for $n = 16{,}384$, Figure 7 shows the average difference between estimated and true poverty likelihoods. It also shows confidence intervals for the differences.

For the national line, the average poverty likelihood across bootstrap samples for scores of 30–34 in the validation sample is too high by 2.7 percentage points. For scores of 35–39, the estimate is too high by 1.2 percentage points.[9]

The 90-percent confidence interval for the differences for scores of 30–34 is ±2.4 percentage points (Figure 7). This means that in 900 of 1,000 bootstraps, the difference between the estimate and the true value is between +0.3 and +5.1 percentage points

[9] These differences are not zero, in spite of the estimator's unbiasedness, because the scorecard comes from a single sample. The average difference by score would be zero if samples were repeatedly drawn from the population and split into sub-samples before repeating the entire process of scorecard construction/calibration and validation.

(because +2.7 – 2.4 = +0.3, and +2.7 + 2.4 = +5.1). In 950 of 1,000 bootstraps (95 percent), the difference is +2.7 ±2.9 percentage points, and in 990 of 1,000 bootstraps (99 percent), the difference is +2.7 ±3.7 percentage points.

For many scores, Figure 7 shows differences—some of them large—between estimated poverty likelihoods and true values. This is because the validation sub-sample is a single sample that—thanks to sampling variation—differs in distribution from the construction/calibration sub-samples and from Uganda's population.

For targeting, what matters is less the difference in all score ranges and more the difference in score ranges just above and below the targeting cut-off. This mitigates the effects of bias and sampling variation on targeting (Friedman, 1997). Section 8 below looks at targeting accuracy in detail.

In addition, if estimates of groups' poverty rates are to be usefully accurate, then errors for individual households must largely cancel out. This is generally the case, as discussed in the next section.

Another possible source of differences between estimates and true values is overfitting. By construction, the scorecard here is unbiased, but it may still be overfit when applied after the end of the UNHS fieldwork in April 2010. That is, it may fit the 2009/10 UNHS construction data so closely that it captures not only some timeless patterns but also some random patterns that, due to sampling variation, show up only in the construction/calibration data. Or the scorecard may be overfit in the sense that

its bias is highly sensitive to changes over time in the relationship between indicators and poverty or when applied to non-nationally representative sub-groups.

Overfitting can be mitigated by simplifying the scorecard and by not relying only on data but rather also considering experience, judgment, and theory. Of course, the scorecard here does this. Combining scorecards can also help, at the cost of complexity.

Most errors in the estimates of individual households' poverty likelihoods, however, cancel out in the estimates of groups' poverty rates (see later sections). Furthermore, at least some of the differences arise from non-scorecard sources such as sampling variation that can be addressed only by improving data quantity and quality (which is beyond the scope of the scorecard) or by reducing overfitting (which likely has limited returns, given the scorecard's parsimony).

6. Estimates of a group's poverty rate at a point in time

A group's estimated poverty rate at a point in time is the average of the estimated poverty likelihoods of the individual households in the group.

To illustrate, suppose a program samples three households on Jan. 1, 2011 and that they have scores of 20, 30, and 40, corresponding to poverty likelihoods of 65.1, 38.1, and 15.1 percent (national line, Figure 4). The group's estimated poverty rate is the households' average poverty likelihood of (65.1 + 38.1 + 15.1) ÷ 3 = 39.4 percent.[10]

6.1 Accuracy of estimated poverty rates at a point in time

For the Uganda scorecard applied to the validation sample with n = 16,384, the difference between the estimated poverty rate at a point in time and the true rate for the national line is +0.5 percentage points (Figure 9, summarizing Figure 8 for all poverty lines). Across all eight lines, all but two of the absolute differences are 0.5 percentage points or less, and the average absolute difference is 0.6 percentage points. Part of these differences is due to sampling variation in the division of the 2009/10 UNHS into two sub-samples.

In terms of precision, the 90-percent confidence interval for a group's estimated poverty rate at a point in time with n = 16,384 is ±0.6 percentage points or less (Figure

[10] The group's poverty rate is *not* the poverty likelihood associated with the average score. Here, the poverty likelihood associated with the average score of 30 is 38.1 percent, which differs from the average of the three poverty likelihoods associated with each of the three scores (39.4 percent).

9). This means that in 900 of 1,000 bootstraps of this size, the difference between the estimate and the true value is within 0.6 percentage points of the average difference. In the specific case of the national line and the validation sample, 90 percent of all samples of $n = 16{,}384$ produce estimates that differ from the true value in the range of +0.5 – 0.5 = 0.0 to +0.5 + 0.5 = +1.0 percentage points. This is because +0.5 is the average difference, and ±0.5 is its 90-percent confidence interval. The average difference is +0.5 because the average scorecard estimate is too high by 0.5 percentage points; the average estimated poverty rate for the validation sample is 19.9 percent, but the true value is 19.4 percent (Figure 1).

6.2 Formula for standard errors for estimates of poverty rates

How precise are the point-in-time estimates? Because they are averages of binary (0/1, or poor/non-poor) variables, the estimates (in "large" samples) have a Normal distribution and can be characterized by their average difference vis-à-vis true values, together with the standard error of the average difference.

To derive a formula for the standard errors of estimated poverty rates at a point in time from indirect measurement via poverty-assessment tools (Schreiner, 2008a), note that the textbook formula (Cochran, 1977) that relates confidence intervals with standard errors in the case of direct measurement of a proportion is $c = +/- z \cdot \sigma$, where:

c is a confidence interval as a proportion (*e.g.*, 0.02 for ±2 percentage points),

z is from the Normal distribution and is $\begin{cases} 1.64 \text{ for confidence levels of 90 percent} \\ 1.96 \text{ for confidence levels of 95 percent} \\ 2.58 \text{ for confidence levels of 99 percent} \end{cases}$,

σ is the standard error of the estimated poverty rate, that is, $\sqrt{\frac{p \cdot (1-p)}{n}}$,

p is the proportion of households below the poverty line in the sample, and

n is the sample size.

For example, this implies that for a sample n of 16,384 with 90-percent confidence ($z = 1.64$) and a poverty rate p of 19.3 percent (the poverty rate in the construction and calibration samples in Figure 1 for the national line), the confidence interval c is $+/- z \cdot \sqrt{\frac{p \cdot (1-p)}{n}} = +/- 1.64 \cdot \sqrt{\frac{0.193 \cdot (1-0.193)}{16{,}384}} = \pm 0.506$ percentage points.

Scorecards, however, do not measure poverty directly, so this formula is not immediately applicable. To derive a formula for the Uganda scorecard, consider Figure 8, which reports empirical confidence intervals c for the differences for the scorecard

applied to 1,000 bootstrap samples of various sizes from the validation sample. For $n =$ 16,384 and the national line, the 90-percent confidence interval is 0.455 percentage points.[11]

Thus, the 90-percent confidence interval with $n = 16{,}384$ is ± 0.455 percentage points for the Uganda scorecard and ± 0.506 percentage points for direct measurement. The ratio of the two intervals is $0.455 \div 0.506 = 0.90$.

Now consider the same case, but with $n = 8{,}192$. The confidence interval under direct measurement is $+/-1.64 \cdot \sqrt{\frac{0.193 \cdot (1-0.193)}{8{,}192}} = \pm 0.715$ percentage points. The empirical confidence interval with the Uganda scorecard (Figure 8) is 0.645 percentage points. Thus for $n = 8{,}192$, the ratio of the two intervals is $0.645 \div 0.715 = 0.90$.

This ratio of 0.90 is the same for $n = 8{,}192$ as for $n = 16{,}384$. Across all sample sizes of 256 or more in Figure 8, the average ratio turns out to be 0.90, implying that confidence intervals for indirect estimates of poverty rates via the Uganda scorecard and the national poverty line are 10-percent narrower than for direct estimates via the 2009/10 UNHS. This 0.90 appears in Figure 9 as the "α factor" because if $\alpha = 0.90$, then the formula relating confidence intervals c and standard errors σ for the Uganda scorecard is $c = +/- z \cdot \alpha \cdot \sigma$. That is, formula for the standard error σ for point-in-time estimates of poverty rates via scoring is $\alpha \cdot \sqrt{\frac{p \cdot (1-p)}{n}}$.

[11] Due to rounding, Figure 8 displays 0.5, not 0.455.

In general, α can be more or less than 1.00. When α is less than 1.00, it means that the scorecard is more precise than direct measurement. This occurs for five of eight poverty lines in Figure 9.

The formula relating confidence intervals with standard errors for the scorecard can be rearranged to give a formula for determining sample size before measurement.[12] If $\hat{p}$ is the expected poverty rate before measurement, then the formula for sample size n based on the desired confidence level that corresponds to z and the desired confidence interval $\pm c$ is $n = \left(\frac{\alpha \cdot z}{c}\right)^2 \cdot \hat{p} \cdot (1 - \hat{p})$.

To illustrate how to use this, suppose $c = 0.03810$ and $z = 1.64$ (90-percent confidence). Then the formula gives $n = \left(\frac{0.90 \cdot 1.64}{0.03810}\right)^2 \cdot 0.193 \cdot (1 - 0.193) = 234$, not too far from the sample size of 256 observed for these parameters in Figure 8 for the national line.

Of course, the α factors in Figure 9 are specific to Uganda, its poverty lines, its poverty rates, and this scorecard. The derivation of the formulas, however, is valid for any poverty-assessment tool following the approach in this paper.

[12] IRIS Center (2007a and 2007b) says that a sample size of $n = 300$ is sufficient for USAID reporting. If a poverty-assessment tool is as precise as direct measurement, if the expected (before measurement) poverty rate is 50 percent, and if the confidence level is 90 percent, then $n = 300$ implies a confidence interval of +/–2.2 percentage points. In fact, USAID has not specified confidence levels or intervals. Furthermore, the expected poverty rate may not be 50 percent, and the poverty-assessment tool could be more or less precise than direct measurement.

In practice after the end of fieldwork for the UNHS in April 2010, an organization would select a poverty line (say, the national line), select a desired confidence level (say, 90 percent, or $z = 1.64$), select a desired confidence interval (say, ± 2.0 percentage points, or $c = 0.02$), make an assumption about $\hat{p}$ (perhaps based on a previous measurement such as the 19.3 percent national average in the 2009/10 UNHS in Figure 1), look up α (here, 0.90), assume that the scorecard will still work in the future and/or for non-nationally representative sub-groups,[13] and then compute the required sample size. In this illustration, $n = \left(\frac{0.90 \cdot 1.64}{0.02}\right)^2 \cdot 0.193 \cdot (1 - 0.193) = 849$.

[13] This paper reports accuracy for the scorecard applied to the validation sample, but it cannot test accuracy for later years or for other groups. Performance after April 2010 will resemble that in the 2009/10 UNHS with deterioration to the extent that the relationships between indicators and poverty status change over time.

7. Estimates of changes in group poverty rates over time

The change in a group's poverty rate between two points in time is estimated as the change in the average poverty likelihood of the households in the group.

With data only from the 2009/10 UNHS, this paper cannot test estimates of change over time for Uganda, and it can only suggest approximate formulas for standard errors. Nevertheless, the relevant concepts are presented here because, in practice, pro-poor organizations can apply the scorecard to collect their own data and to measure change through time.

7.1 Warning: Change is not impact

Scoring can estimate change. Of course, poverty could get better or worse, and scoring does not indicate what caused change. This point is often forgotten or confused, so it bears repeating: the scorecard simply estimates change, and it does not, in and of itself, indicate the reason for the change. In particular, estimating the impact of program participation requires knowing what would have happened to participants if they had not been participants. Knowing this requires either strong assumptions or a control group that resembles participants in all ways except participation. To belabor the point, the scorecard can help estimate program impact only if there is some way to know what would have happened in the absence of the program. And that information must come from somewhere beyond the scorecard.

7.2 Calculating estimated changes in poverty rates over time

Consider the illustration begun in the previous section. On Jan. 1, 2011, a program samples three households who score 20, 30, and 40 and so have poverty likelihoods of 65.1, 38.1, and 15.1 percent (national line, Figure 4). The group's baseline estimated poverty rate is the households' average poverty likelihood of (65.1 + 38.1 + 15.1) ÷ 3 = 39.4 percent.

After baseline, two sampling approaches are possible for the follow-up round:

- Score a new, independent sample, measuring change by cohort across samples
- Score the same sample at follow-up as at baseline

By way of illustration, suppose that a year later on Jan. 1, 2012, the program samples three additional households who are in the same cohort as the three households originally sampled (or suppose that the program scores the same three original households a second time) and finds that their scores are 25, 35, and 45 (poverty likelihoods of 47.9, 27.3, and 10.7 percent, national line, Figure 4). Their average poverty likelihood at follow-up is now (47.9 + 27.3 + 10.7) ÷ 3 = 28.6 percent, an improvement of 39.4 – 28.6 = 10.8 percentage points.[14]

This suggests that about one in nine participants in this hypothetical example crossed the poverty line in 2011.[15] Among those who started below the line, about one in four (10.8 ÷ 39.4 = 27.4 percent) on net ended up above the line.[16]

[14] Of course, such a large reduction in poverty in one year would be miraculous, but this is just an example to show how the scorecard can be used to estimate change.
[15] This is a net figure; some people start above the line and end below it, and vice versa.

7.3 Accuracy for estimated change in two independent samples

With only the 2009/10 UNHS, it is not possible to measure the accuracy of scorecard estimates of changes in groups' poverty rates over time. In practice, of course, local pro-poor organizations can still apply the Uganda scorecard to estimate change. The rest of this section suggests approximate formulas for standard errors and sample sizes that may be used until there is additional data.

For two equal-sized independent samples, the same logic as above can be used to derive a formula relating the confidence interval c with the standard error σ of a scorecard's estimate of the change in poverty rates over time:

$$c = +/- z \cdot \sigma = +/- z \cdot \alpha \cdot \sqrt{\frac{2 \cdot p \cdot (1-p)}{n}} \, .$$

z, c, and p are defined as above, n is the sample size at both baseline and follow-up,[17] and α is the average (across a range of bootstrapped sample sizes) of the ratio of the observed confidence interval from a scorecard and the theoretical confidence interval under direct measurement.

[16] The scorecard does not reveal the reasons for this change.

[17] This means that, for a given precision and with direct measurement, estimating the change in a poverty rate between two points in time requires four times as many measurements (not twice as many) as does estimating a poverty rate at a point in time.

As before, the formula for confidence intervals can be rearranged to give a formula for sample sizes before indirect measurement via a scorecard, where $\hat{p}$ is based on previous measurements and is assumed equal at baseline and follow-up:

$$n = 2 \cdot \left(\frac{\alpha \cdot z}{c} \right)^2 \cdot \hat{p} \cdot (1 - \hat{p}) .$$

For countries for which this α has been measured (Schreiner, 2010, 2009a, 2009b, 2009c, 2009d, 2009e, and 2008b; Schreiner and Woller, 2010a and 2010b; and Chen and Schreiner, 2009a and 2009b), the simple average of α across poverty lines and years for a given country and then across countries is 1.19. This is as reasonable a figure as any to use for Uganda.

To illustrate the use of the formula above to determine sample size for estimating changes in poverty rates across two independent samples, suppose the desired confidence level is 90 percent ($z = 1.64$), the desired confidence interval is 2 percentage points ($c = 0.02$), the poverty line is the national line, $\alpha = 1.19$, and $\hat{p} = 0.193$ (from Figure 1). Then the baseline sample size is $n = 2 \cdot \left(\frac{1.19 \cdot 1.64}{0.02} \right)^2 \cdot 0.193 \cdot (1 - 0.193) =$ 2,967, and the follow-up sample size is also 2,967.

7.4 Accuracy for estimated change for one sample, scored twice

Analogous to previous derivations, the general formula relating the confidence interval c to the standard error σ when using a scorecard to estimate change for a single group of households, all of whom are scored at two points in time, is:[18]

$$c = +/- z \cdot \sigma = +/- z \cdot \alpha \cdot \sqrt{\frac{p_{12} \cdot (1 - p_{12}) + p_{21} \cdot (1 - p_{21}) + 2 \cdot p_{12} \cdot p_{21}}{n}},$$

where z, c, and α are defined as usual, p_{12} is the share of all sampled households that move from below the poverty line to above it, and p_{21} is the share of all sampled households that move from above the line to below it.

The formula for standard errors can be rearranged to give a formula for sample size before measurement. This requires an estimate (based on information available before measurement) of the expected shares of all households who cross the poverty line $\hat{p}_{12}$ and $\hat{p}_{21}$. Before measurement, it is reasonable to assume that the net change in the poverty rate will be zero, which implies $\hat{p}_{12} = \hat{p}_{21} = \hat{p}_*$, giving:

$$n = 2 \cdot \left(\frac{\alpha \cdot z}{c} \right)^2 \cdot \hat{p}_* .$$

[18] McNemar (1947) and Johnson (2007). John Pezzullo helped find this formula.

Because $\hat{p}_*$ can range from 0–0.5, more information is needed to apply this formula. In Peru (Schreiner, 2009a), the observed relationship between $\hat{p}_*$, the number of years y between baseline and follow-up, and $p_{\text{baseline}} \cdot (1 - p_{\text{baseline}})$ is close to:

$$\hat{p}_* = -0.02 + 0.016 \cdot y + 0.47 \cdot [p_{\text{baseline}} \cdot (1 - p_{\text{baseline}})] .$$

Given this, a sample-size formula for a group of households to whom the Uganda scorecard is applied twice (once after April 2010 and then again later) is

$$n = 2 \cdot \left(\frac{\alpha \cdot z}{c} \right)^2 \cdot \{-0.02 + 0.016 \cdot y + 0.47 \cdot [p_{\text{baseline}} \cdot (1 - p_{\text{baseline}})]\}.$$

Peru is the only other country with an estimate of α (Schreiner 2009a). There, the average α across years and poverty lines is about 1.30.

To illustrate the use of this formula, suppose the desired confidence level is 90 percent ($z = 1.64$), the desired confidence interval is 2.0 percentage points ($c = 0.02$), the poverty line is the national line, and the sample will first be scored in 2011 and then again in 2014 ($y = 3$). The before-baseline poverty rate is 19.3 percent ($p_{2009/10} = 0.193$, Figure 1), and suppose $\alpha = 1.30$. Then the baseline sample size is

$n = 2 \cdot \left(\frac{1.30 \cdot 1.64}{0.02} \right)^2 \cdot \{-0.02 + 0.016 \cdot 3 + 0.47 \cdot [0.193 \cdot (1 - 0.193)]\} = 2{,}301$. The same group of 2,301 households is scored at follow-up as well.

8. Targeting

When a program uses the scorecard for targeting, households with scores at or below a cut-off are labeled *targeted* and treated—for program purposes—as if they are below a given poverty line. Households with scores above a cut-off are labeled *non-targeted* and treated—for program purposes—as if they are above a given poverty line.

There is a distinction between *targeting status* (scoring at or below a targeting cut-off) and *poverty status* (having expenditure below a poverty line). Poverty status is a fact that depends on whether expenditure is below a poverty line as directly measured by a survey. In contrast, targeting status is a program's policy choice that depends on a cut-off and on an indirect estimate from a scorecard.

Targeting is successful when households truly below a poverty line are targeted (*inclusion*) and when households truly above a poverty line are not targeted (*exclusion*). Of course, no scorecard is perfect, and targeting is unsuccessful when households truly below a poverty line are not targeted (*undercoverage*) or when households truly above a poverty line are targeted (*leakage*). Figure 10 depicts these four possible targeting outcomes. Targeting accuracy varies with the cut-off score; a higher cut-off has better inclusion (but greater leakage), while a lower cut-off has better exclusion (but higher undercoverage).

Programs should balance these trade-offs when setting a cut-off. A formal way to do this is to assign net benefits—based on a program's values and mission—to each of

the four possible targeting outcomes and then to choose the cut-off that maximizes total net benefits (Adams and Hand, 2000; Hoadley and Oliver, 1998).

Figure 11 shows the distribution of households in Uganda by targeting outcome. For an example cut-off of 30–34, outcomes for the national line in the validation sample are:

- Inclusion: 11.8 percent are below the line and correctly targeted
- Undercoverage: 7.6 percent are below the line and mistakenly not targeted
- Leakage: 12.3 percent are above the line and mistakenly targeted
- Exclusion: 68.3 percent are above the line and correctly not targeted

Increasing the cut-off to 35–39 improves inclusion and undercoverage but worsens leakage and exclusion:

- Inclusion: 14.5 percent are below the line and correctly targeted
- Undercoverage: 4.9 percent are below the line and mistakenly not targeted
- Leakage: 19.8 percent are above the line and mistakenly targeted
- Exclusion: 60.9 percent are above the line and correctly not targeted

Which cut-off is preferred depends on total net benefit. If each targeting outcome has a per-household benefit or cost, then total net benefit for a given cut-off is:

(Benefit per household correctly included x Households correctly included) –
(Cost per household mistakenly not covered x Households mistakenly not covered) –
(Cost per household mistakenly leaked x Households mistakenly leaked) +
(Benefit per household correctly excluded x Households correctly excluded).

To set an optimal cut-off, a program would:

- Assign benefits and costs to possible outcomes, based on its values and mission
- Tally total net benefits for each cut-off using Figure 11 for a given poverty line
- Select the cut-off with the highest total net benefit

The most difficult step is assigning benefits and costs to targeting outcomes. A program that uses targeting—with or without scoring—should thoughtfully consider

how it values successful inclusion or exclusion versus errors of undercoverage or leakage. It is healthy to go through a process of thinking explicitly and intentionally about how possible targeting outcomes are valued.

A common choice of benefits and costs is "Total Accuracy" (IRIS Center, 2005; Grootaert and Braithwaite, 1998). With "Total Accuracy", total net benefit is the number of households correctly included or correctly excluded:

Total Accuracy =	1	x	Households correctly included	–
	0	x	Households mistakenly undercovered	–
	0	x	Households mistakenly leaked	+
	1	x	Households correctly excluded.	

Figure 11 shows "Total Accuracy" for all cut-offs for the Uganda scorecard. For the national line in the validation sample, total net benefit is greatest (83.6) for a cut-off of 24 or less, with about five in six households in Uganda correctly classified.

"Total Accuracy" weighs successful inclusion of households below the line the same as successful exclusion of households above the line. If a program valued inclusion more (say, twice as much) than exclusion, it could reflect this by setting the benefit for inclusion to 2 and the benefit for exclusion to 1. Then the chosen cut-off would maximize (2 x Households correctly included) + (1 x Households correctly excluded).[19]

As an alternative to assigning benefits and costs to targeting outcomes and then choosing a cut-off to maximize total net benefit, a program could set a cut-off to achieve a desired poverty rate among targeted households. The third column of Figure

[19] Figure 11 also reports "BPAC", a measure discussed in the next section.

12 ("% targeted who are poor") shows, for the Uganda scorecard applied to the validation sample, the expected poverty rate among households who score at or below a given cut-off. For the example of the national line, targeting households who score 34 or less would target 24.1 percent of all households (second column), and that targeted group would have a poverty rate of 48.8 percent (third column).

Figure 12 also reports two other measures of targeting accuracy. The first is a version of coverage ("% of poor who are targeted"). For the example of the national line in the validation sample and a cut-off of 34 or less, 60.7 percent of all poor households are covered.

The final targeting measure in Figure 12 is the number of successfully targeted poor households for each non-poor household mistakenly targeted (right-most column). For the national line in the validation sample and a cut-off of 34 or less, covering 1 poor household means leaking to 1 non-poor household.

9. Context of poverty-assessment tools for Uganda

This section discusses eleven existing poverty-assessment tools for Uganda in terms of their goals, methods, poverty definitions, data, indicators, cost, accuracy, and precision. The main advantages of the new scorecard here are its use of the latest nationally representative data, its focus on feasibility for local, pro-poor organizations, its testing of accuracy and precision, and its reporting of formulas for standard errors.

9.1 Asset indices

This sub-section reviews asset indices derived using Principal Components Analysis with simple, low-cost indicators for Uganda. PCA asset indices are like the scorecard here except that, because they do not consider expenditure, they are based on a different conception of poverty, their accuracy vis-à-vis expenditure-based poverty is unknown, and they can only be assumed to be a proxy for long-term wealth/economic status.[20] Well-known examples of the PCA asset-index approach include Ferguson *et al.* (2003), Sahn and Stifel (2003), and Filmer and Pritchett (2001).

[20] Still, because the indicators are similar and because the "flat maximum" is important, carefully built PCA indices and expenditure-based poverty-assessment tools may pick up the same underlying construct (perhaps "permanent income", see Bollen, Glanville, and Stecklov, 2007). Tests of how well rankings by PCA indices correspond with rankings by expenditure-based poverty-assessment tools include Howe *et al.* (2009), Filmer and Scott (2008), Lindelow (2006), Sahn and Stifel (2003), Wagstaff and Watanabe (2003), and Montgomery *et al.* (2000).

PCA indices were developed for use in the health-care field to:

- Segment households by quintiles to see how health, population, and nutrition vary with socio-economic status
- Monitor (via exit surveys) how well local health-service posts reach the poor
- Measure coverage of health services via local, small-scale surveys

The first goal is akin to targeting, and the last two goals resemble the monitoring goals here, so the uses of asset indices are similar to the uses of the scorecard here.

PCA asset indices share many of the strengths of the scorecard approach here in that they can be used for targeting and in that they are flexible, low-cost, and adaptable to diverse contexts. Because asset indices do not require price adjustments over time or between countries—and they do no require expenditure data at all—they are more adaptable in these dimensions than is the scorecard here.

PCA asset indices are not linked to an absolute, expenditure-based poverty line. Thus, while an asset index can rank households, it cannot—unlike the scorecard—estimate expenditure-based poverty status. In fact, asset indices *define* poverty in terms of their particular indicators and points. Thus, the indices can be seen not as proxies standing in for expenditure but rather as direct measures of a non-expenditure-based definition of poverty. There is nothing wrong—and a lot right—about defining poverty in this way, but it is not as common or as well-understood as an expenditure-based definition.[21]

[21] Arguments for the asset-based view of poverty include Carter and Barrett (2006), Schreiner and Sherraden (2006), and Sherraden (1991). In practice, the two distinct views are tightly linked, as expenditure/consumption are flows of resources received/consumed from the use of stocks of assets. Both views are low-dimensional

None of the asset indices below report accuracy, nor do they discuss standard errors of the relative ranks that they produce. Indeed, because the indices define poverty in terms of the index, they are—by definition—completely accurate.

9.1.1 Gwatkin *et al.*

Gwatkin *et al.* (2007) apply to Uganda an approach used in 56 countries with Demographic and Health Surveys (Rutstein and Johnson, 2004). They construct a PCA asset index using 20 simple, low-cost indicators available for the 7,855 households in Uganda's 2000/1 DHS:

- Characteristics of the residence:
  - Type of wall
  - Type of floor
  - Type of roof
  - Source of drinking water
  - Type of toilet arrangement
  - Fuel for cooking
  - Electrical connection
  - Means of lighting
- Ownership of consumer durables:
  - Cupboard
  - Lantern
  - Radio
  - Television
  - Refrigerator
  - Telephone
  - Bicycle
  - Motorcycle
  - Car or truck
  - Boat or canoe
- Agriculture:
  - Whether any household members work their own or family's agricultural land
  - Donkey

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simplifications—due to practical limits on definitions and measurement—of a higher-dimensional and more complete conception of the production of human well-being.

The Gwatkin *et al.* index is more difficult and costly than the scorecard here because it cannot be computed by hand in the field, as it has 20 indicators and 140 point values (half of them negative, and all with five decimal places).

9.1.2 Sahn and Stifel

Sahn and Stifel (2000) use factor analysis (a close relative of PCA that gives similar results) to construct an asset index meant to measure poverty in terms of long-term wealth. Their aim is to inform governments and donors about the broad progress of poverty-reduction efforts in Africa, not to provide a tool to help local, pro-poor organizations to manage their poverty-alleviation efforts.

Sahn and Stifel construct their index by pooling Uganda's 1988 and 1995 DHS. After defining poverty status according to lines set at the 25^{th} and 40^{th} percentiles of the asset index, they compare the distribution of the index and poverty rates over time (within Uganda) and across countries (Uganda and 10 other sub-Saharan countries).

For the cross-country analysis, Sahn and Stifel construct a single cross-country index from pooled DHS data for the 11 countries (plus five others for which only a single DHS round is available). This is possible because the DHS in all rounds and countries uses a common set of simple, inexpensive, and verifiable indicators.

Sahn and Stifel's nine indicators are similar to those in the scorecard here:

- Education of the head
- Characteristics of the residence:
  - Type of floor
  - Source of drinking water
  - Type of toilet arrangement
- Ownership of consumer durables:
  - Radio
  - Television
  - Refrigerator
  - Bicycle
  - Motorized transport

9.1.3 Filmer and Scott

Filmer and Scott (2008) test (on 11 countries, including Uganda) how well different types of asset indices produce ranks that correlate with ranks from:

- Other asset indices
- Expenditure as directly measured by a survey
- Expenditure as predicted by a regression

They find that different approaches to constructing asset indices generally lead to similar rankings vis-à-vis the benchmarks of directly measured expenditure and regression-predicted expenditure. This result is strongest for countries where regression works well for predicting expenditure and for less-poor countries where most expenditure is not for food.

For Uganda, Filmer and Scott use data on the 10,696 households in the 2000/1 UNHS, selecting 13 simple, low-cost, and verifiable indicators:

- Characteristics of the residence:
  - Tenancy status
  - Type of floor
  - Type of roof
  - Type of toilet arrangement
  - Source of lighting
  - Rooms per person
- Ownership of consumer durables:
  - Furnishings
  - Electronic appliances
  - Jewelry and watches
  - Bicycles
  - Other transportation assets
  - Houses
  - Other buildings

As Filmer and Scott's goal is to establish general properties of approaches to constructing asset indices (rather than to provide asset indices that local, pro-poor organizations can use), they do not report their tool's points or standard errors.

9.1.4 Zeller *et al.*

Zeller *et al.* (2006a) construct PCA asset indices for Uganda, Bangladesh, Peru, and Kazakhstan in order to:

- Predict households' poverty status and to monitor the poverty rates of groups of households with easily measured indicators
- Compare in-sample to out-of-sample predictive power[22]
- Report confidence intervals (equivalent to reporting standard errors)
- Compare the accuracy of a PCA index with that of poverty-assessment tools that directly estimate expenditure or expenditure-based poverty likelihoods (see next sub-sections)

These last three goals may be of interest because some of the authors of Zeller *et al.* designed a PCA asset index (the "CGAP PAT", Zeller *et al.*, 2006b, and Henry *et al.*, 2003) that—before the advent of the scorecard approach in this paper—was the most widely used poverty-assessment tool in microfinance. Also, it has been noted that another poverty tool by some of the authors of Zeller *et al.* (the USAID/IRIS PAT, see next sub-section) does not report out-of-sample accuracy nor standard errors.

Zeller *et al.* use their own nationally representative survey of 800 households in Uganda from August to October 2004 (Zeller and Alcaraz V., 2005a).[23] The poverty line is $1.08/day 1993 PPP, giving a household-level poverty rate in their data of 31.4

[22] An *in-sample* test uses the same data to construct a tool as well as to test its accuracy. An *out-of-sample* test divides data in two parts, one for tool construction and another for accuracy testing. In practice, poverty-assessment tools are used out-of-sample, so out-of-sample tests are more relevant; in-sample tests tend to overstate accuracy relative to out-of-sample standards. Thus, out-of-sample tests are preferred.

[23] The 2002/3 UNHS is not used—despite its much larger sample, its almost-universal use in poverty research for Uganda, and the low cost of accessing the data—because Zeller *et al.* want to test some potential indicators that the UNHS does not collect. Nevertheless, all ten indicators that end up in their PCA index are also in the UNHS.

percent. Two-thirds of the data is used for construction, and one-third is set aside for out-of-sample validation.

Zeller *et al.* construct five types of poverty-assessment tools:

- Least-squares regression to estimate the logarithm of per-capita (not per-adult-equivalent) expenditure for comparison with an expenditure-based poverty line
- Quantile regression (Koenker and Hallock, 2001) to estimate the 46th percentile of per-capita expenditure for comparison with a poverty line
- Probit regression to estimate the likelihood that expenditure is below a poverty line
- Least-squares regression to estimate the likelihood of being below a poverty line
- PCA to find "the linear combination of the original indicators that accounts for the maximum of the total variance in the original indicators" (Zeller *et al.*, p. 6)

The four non-PCA tools are the same ones constructed by some of the same authors in Zeller *et al.* for the USAID/IRIS PAT (see next sub-section).

The ten indicators in the PCA asset index are:

- Characteristics of the residence:
  - Type of floor
  - Type of roof
  - Source of drinking water
  - Type of toilet arrangement
  - Source of lighting
  - Type of cooking fuel
- Ownership of consumer durables:
  - Black-and-white television
  - Mobile telephone
  - Savings account
  - Logarithm of the value of jewelry

These indicators are quick and simple to collect, except the value of jewelry, which households are unlikely to estimate well, even if they do reveal its ownership.

To compare accuracy for the asset index versus the other four approaches requires a benchmark that defines whether a given household is poor. A common

definition is whether a household has expenditure below a poverty line.[24] Zeller *et al.*, however, use two definitions of poverty. For the PCA asset index, their benchmark is whether a household's asset-index value is below the average asset-index value of the 20 households centered on the 31.4th percentile of their construction sample. For the other four approaches, Zeller *et al.*'s benchmark is whether expenditure from their survey is below the $1.08/day 1993 PPP poverty line.

Defining two benchmarks is a fundamental mistake; it invalidates the accuracy comparisons in Zeller *et al.* It is not meaningful to compare how an asset index predicts one definition of poverty (being below a given percentile in the ranking of households by the PCA index itself) versus how a scorecard predicts another definition (having expenditure from a survey below a poverty line). Even though both definitions give poverty rates of 34.1 percent, the specific households defined as poor differ.

Thus, even if an asset index predicted poverty rates as accurately as an expenditure-based tool, or even if an asset index targets poor households (by its definition) as accurately as an expenditure-based tool (with a different definition), it says nothing about the two tools' relative power for a single, common definition of poverty. Unawares, Zeller *et al.* compare apples to oranges and thus fail to provide useful information about the central questions in their paper.[25]

[24] Schreiner (2011b) uses this benchmark to compare the accuracy of a PCA index versus scorecards like the one here for Bangladesh, Ethiopia, and Malawi.
[25] Schreiner (2011b) provides a more meaningful comparison.

In addition, defining a poverty line for an asset index based on the index's own ranks leads—when overfitting and sampling variation are not dominant factors—to overstated accuracy when extrapolated to any other definition of poverty.

Nevertheless, Zeller *et al.* (pp. 20–21) conclude that "our results demonstrate that these [asset] indices can be calibrated to predict absolute poverty status with relatively high accuracy." Even if their comparisons could be taken at face value, it is not clear by what standard accuracy is "relatively high". In out-of-sample tests, Uganda's PCA index has the lowest targeting accuracy and the most-biased estimated poverty rates. For Bangladesh, "PCA is one of the most inferior methods" (Zeller *et al.*, p. 15), being next-to-last in terms of poverty-rate bias and third in terms of targeting. For Peru, the asset index does better, coming in second of five for both estimated poverty rates and for targeting. Finally, the Kazakhstan asset index has the worst bias and the second-best targeting accuracy.[26]

[26] Apart from the issues already discussed, results for Kazakhstan are to be taken with a grain of salt, as only 37 of the 800 households in the data are poor (Zeller and Alcaraz V., 2005b). Given that the validation sample is expected to have about 13 poor households, sampling variation and overfitting lead to imprecise estimates of out-of-sample accuracy and large in-sample/out-of-sample differences (Zeller *et al.*, p. 15).

9.2 Direct-expenditure poverty-assessment tools

As just discussed, an alternative to PCA asset indices are poverty-assessment tools that estimate expenditure-based poverty status directly as the:

- Level of expenditure (which is compared to a poverty line to get poverty status)
- Likelihood of having expenditure below a poverty line

This sub-section presents direct-expenditure tools for Uganda, and the next sub-section presents poverty-likelihood tools (like the new scorecard in this paper).

Tools that estimate expenditure directly are constructed from stepwise regressions that relate indicators to the logarithm of expenditure. When the tool is applied to a given household, estimated expenditure is the tool's index value (raised to the power of 2.718281828). The household is "poor" if this estimate is below a given poverty line.

The direct-expenditure approach has two weaknesses. First, its estimates of poverty rates are biased.[27] Second, it ignores that estimated expenditure has a sampling distribution. This means that even though the point estimate of expenditure is on one side of a poverty line, true expenditure may be on the other side. For example, if a household's estimated expenditure is UGX1,000 and the poverty line is UGX1,011, this approach labels the household as 100-percent poor, even though the likelihood that true expenditure is above the line may be, say 47 percent. It is better to say that there is a 53-percent likelihood of being poor and a 47-percent likelihood of being non-poor.[28]

[27] See Hentschel *et al.* (2000), and Bedi, Coudouel, and Simler (2007). Bias comes from changing the continuous estimate of expenditure into a discrete poor/non-poor label.
[28] The poverty-likelihood approach in the next sub-section does exactly this.

The documents for the tools below seem unaware of these issues. In practice, however, direct-expenditure poverty-assessment tools are about as accurate as poverty-likelihood tools, so these issues are not reasons to favor one approach or the other.

9.2.1 IRIS Center

USAID commissioned IRIS Center (2011; see also Zeller and Alcaraz V., 2005a) to build a "Poverty Assessment Tool" (PAT) so that USAID's microenterprise partners in Uganda could report on their participants' poverty rates. In general, the USAID/IRIS PAT for Uganda is like the scorecard here, except that it follows the direct-expenditure approach, it uses an older and smaller data set, it uses more indicators, and it does not report standard errors.

IRIS uses the same data as Zeller *et al.* (2006a). The PAT supports five poverty lines in 2005 PPP:[29]

- $0.75/day
- $1.00/day
- $1.25/day
- $2.00/day
- $2.50/day

[29] $1.25/day 2005 PPP is 888UGX per person per day as of September 2004, see `http://www.povertytools.org/countries/Uganda/Uganda.html`, retrieved 18 September 2011.

IRIS tests the four direct-expenditure methods discussed in Zeller *et al.* (2006a) in both one-stage and two-stage versions (IRIS, 2005; Zeller and Alcaraz V., 2005a), settling on a quantile regression that estimates not poverty likelihoods but rather the 54^{th} percentile of the logarithm of per-capita household expenditure. Its 16 indicators (IRIS, 2010) differ from those in Zeller *et al.* (2006a):

- Demographics:
  - — Household size (and its square)
  - — Age of the head (and its square)
  - — Marital status of the head
- Education:
  - — Educational attainment of the head
  - — Share of household members who have not completed first grade
- Health: Whether any household member had a serious chronic illness or a major disability in the last three years
- Characteristics of the residence:
  - — Type of roof
  - — Source of lighting
  - — Type of fuel for cooking
- Ownership of consumer durables:
  - — Number of leather shoes owned by the household head
  - — Number of metal cooking pots (including sauce pans)
  - — Spray pumps
  - — Number of *Panga*
  - — Number of chickens and ducks
- Location:
  - — Region
  - — Urban/rural

All these indicators—except the one related to historical illness and disability—are quick and simple to collect.

The purpose of the IRIS PAT is to estimate poverty rates for USAID. Its bias is –0.1 percentage points (IRIS, 2010), Total Accuracy is 77.3 percent, and its "Balanced Poverty Accuracy Criterion" is 75.5. BPAC is a measure invented by IRIS (2005) that USAID has adopted as its criterion for certifying its tools. It considers accuracy in

terms of the estimated poverty rate (the purpose of the PAT) and in terms of inclusion (a targeting purpose that IRIS disavows). The formula is:

BPAC = (Inclusion – |Undercoverage – Leakage|) x [100 ÷ (Inclusion+Undercoverage)].

Because the data used by IRIS and in this paper differ in age and in sample size, accuracy comparisons with the new scorecard are not done here.

IRIS states that the PAT should not be used for targeting,[30] and IRIS doubts that the PAT can be useful for measuring changes in poverty rates, noting that "it is unclear that the tools will be able to identify real changes in poverty over time due to their inherent measurement errors. Unless the changes in the poverty rate are exceptionally large and the tools exceptionally accurate, the changes identified are likely to be contained within the margin of error."[31] In contrast, this paper supports these uses, reporting various aspects of targeting accuracy and margins of error for measures of change over time so that users can decide for themselves whether accuracy is adequate for their purposes.

9.2.2 Kraybill and Bashaasha

Kraybill and Bashaasha (2006) seek to test whether the poverty rate would be reduced more by targeting households or by targeting geographic areas (Local Council 1 level). To do this, they use data on 9,664 households in the 2002/3 UNHS to construct a direct-expenditure poverty-assessment tool with person-weighted least-squares

[30] `http://www.povertytools.org/faq/faq.html#11`, retrieved 19 February 2009.
[31] `http://www.povertytools.org/faq/faq.html#12`, retrieved 19 February 2009.

regression. They compute expenditure per adult equivalent themselves,[32] adjusting the poverty line to make their poverty rate match the published 37.7 percent. They construct tools at the national level and for urban/rural. The 22 indicators in the national tool are:

- Demographics:
  - Sex of the head
  - Age of the head
  - Number of household members:
    - 9-years-old or younger
    - Ages 10 to 17
    - Ages 18 to 59
    - 60-years-old or older
- Education:
  - Number of adult females who completed:
    - Primary school
    - Senior secondary school
    - University degree
  - Number of adult males who completed:
    - Primary school
    - Senior secondary school
    - University degree
- Employment:
  - Number of adults with formal employment
  - Presence of a non-crop enterprise
- Agricultural assets:
  - Per-capita acres of land cultivated
  - Per-capita value of livestock
- Characteristics of the community:
  - Availability of electricity
  - Average distance to nearest schools, health posts, and government offices
  - Presence of two outlets selling agricultural inputs within five kilometers
  - Presence of a paid phone booth within two kilometers
  - Presence of a feeder/rural access/all-weather road within one km
  - Presence of a formal lender who does not require collateral within 10 km

[32] Although aggregate household expenditure is the central item derived from the UNHS, the UBOS apparently did not provide it with the rest of the data.

Absent are indicators for the ownership of consumer durables (they were not collected in the 2002/3 UNHS) and for characteristics of the residence. Usually, these two classes provide several indicators, so their absence weakens this tool.

Assuming that all the relationships between indicators and poverty in their tool are causal, Kraybill and Bashaasha simulate the changes in poverty rates when targeting the poorest 10 percent of Local Council 1 jurisdictions versus targeting households with the same number of people as in the geographically targeted jurisdictions. They consider six hypothetical policies that would somehow:

- Reduce by one the number of children 9-years-old or younger
- If there are adult females, increase by one the number who complete primary school
- If there are adult males, increase by one the number who complete primary school
- If there are adult males, increase by one the number with an A-level certificate
- Increase by one the number people in formal employment
- If a household does not have a non-crop enterprise, create one

It turns out that poverty rates decrease more with geographic targeting than with household targeting. How can this be? As Kraybill and Bashaasha explain, many of the poorest households are so poor that even large increases in expenditure are often too little to push them over the poverty line. In contrast, the poorest communities have more poor people who are closer to the poverty line and who can thus leave poverty with a given push. They also point out that if the goal is to reduce not the poverty rate but rather the *poverty gap* (that is, the average distance between poor people and the poverty line), then household targeting would be better.

Kraybill and Bashaara differ from the scorecard here in that they use older data, they act as if they are building an explanatory model rather than a predictive one,[33] they do not report standard errors for their simulated changes in poverty rates, and their tool is larger and more complex. They seek the best way to target a program that is assumed to achieve a given outcome effectively. In contrast, the scorecard here seeks to help managers to improve the outcomes of their programs by sticking to its mission to serve the poor. After all, policymakers already know that poverty would be reduced by smaller families, greater access to education, and more formal jobs and off-farm jobs. A more important and difficult question is not how to target an effective program but rather how motivate the design, financing, and appropriate implementation of effective programs.

9.2.3 McKay

McKay (2001) reports on a direct-expenditure poverty-assessment tool constructed using the 1999/2000 UNHS. The goal is to test the tool as a way for the UBOS to update estimates of poverty rates using non-expenditure indicators from "light" monitoring surveys in-between UNHS expenditure surveys. Nine tools (one national, and eight for urban/rural in four regions) are tested out-of-sample on data from Uganda's 1997 Monitoring Survey.

[33] For example, they try to avoid indicators that are highly correlated with other indicators, and they report hypotheses for regression coefficients.

The national tool has 15 indicators:

- Demographics:
  - Number of children 14-years-old or younger
  - Ratio of all household members to economically active members
- Characteristics of the residence:
  - Type of floor
  - Source of drinking water
  - Source of lighting
  - People per room
- Ownership of consumer durables:
  - Asset index value (McKay does not provide additional detail on what this is)
  - Whether each household member has:
    - Two sets of clothes
    - A blanket
- Expenditure on specific items (in an undefined period):
  - Whether fresh milk was purchased
  - Level of expenditure on:
    - Sugar
    - Soap
    - Transport
- Characteristics of the community:
  - Region
  - Whether it is affected by cattle rustling

McKay's tool is more complex than the new one here. Two indicators are ratios, the asset-index value probably has several components, and the four expenditure indicators deal with non-verifiable past events that may be gamed or forgotten.

McKay judges targeting power by the quintile correspondence of ranks based on true expenditure versus tool estimates of expenditure. He calls performance "disappointing" because "for any poverty cut-off, non-negligible minorities of households will be predicted as being non-poor when they are in fact poor" (p. 5).

McKay also says that poverty-assessment tools should not be used to estimate poverty rates because it "predicts less variation in the consumption-based standard-of-living measure than there actually is" (p. 5). This is true, but it matters only for higher-

order measures (such as the poverty gap) that depend on distance from a poverty line. It does not matter for estimates of poverty rates, which depend only on being below a line.

After McKay finds that his tool is lacking for targeting and for estimating poverty rates,[34] he questions the usefulness of poverty-assessment tools in general, noting that reported accuracy for other countries are not better than in his test for Uganda.

As an alternative to poverty-assessment tools, McKay recommends:

- Monitoring poverty rates using full expenditure surveys
- Tracking changes in individual indicators of poverty
- Using tools only to estimate the level of average expenditure

Fortunately, poverty-assessment tools may still be useful for targeting even with "non-negligible" errors, and McKay's Uganda tool may be unusually biased (or data quality may have changed from the 1997 Monitoring Survey and the 1999/2000 UNHS, see Figure 3 in Mathiassen, 2011). Rather than pretending to know the level of targeting accuracy that would be required in all cases, this paper here gives potential users the information that they need to judge for themselves. In the same vein, it reports the bias and precision of estimated poverty rates. Ten years after McKay, several authors have found that poverty-assessment tools can usefully track changes in

[34] McKay does not report figures for bias nor precision.

poverty rates (Christiaensen *et al*, 2008; Stifel and Christiaensen, 2007; and for Uganda, Mathiassen, 2011; Louto, 2007; and Hoogeveen, Emwanu, and Okwi, 2003).[35]

9.2.4 Louto

Louto (2007) builds a direct-expenditure poverty-assessment tool with the 1999/2000 UNHS to predict poverty in the 2002/3 UNHS.[36] The goal is to check whether the unexpected increase in poverty rates between those two surveys might be spurious. The increase in poverty is suspicious because Uganda saw improvements in this period in:

- Ownership of assets by households
- Food's share of total expenditure
- Most macroeconomic indicators

If a tool's estimate contradicts the survey's direct measures, then it is more likely that the direct measures are off. This is because "indicators such as the presence or absence of a radio in the home are arguably easier to measure accurately than is a consumption-expenditure figure that is aggregated over many individual consumption components and adjusted for spatial and temporal price differences" (Louto, p. 15).

Louto's data from the UBOS did not include official poverty lines or expenditure measures,[37] so she computes them herself (following Appleton *et al.*, 1999) and then constructs urban and rural tools for each region. Unlike McKay, Luoto finds support for

[35] The previous section also cites nine papers by Schreiner and co-authors that find that scoring estimates of changes in poverty rates have bias less than one or two percentage points and 90-percent confidence intervals of about +/–0.7 percentage points.
[36] McKay also uses the 1999/2000 UNHS, predicting backward rather than forward.
[37] As for Kraybill and Bashaara and for Sulaiman (below), UBOS' omission of expenditure is ironic, as it is the most-important item derived from the UNHS.

the assumption—unavoidable when using a poverty-assessment tool to track change—that the relationships between indicators and poverty is constant over time.

Luoto's tool for all of Uganda has 19 indicators:

- Demographics:
  - — Household size (and its square)
  - — Share of household members who are female
  - — Whether the spouse is in the home
- Education:
  - — Whether all children ages 6 to 12 attend school
  - — Educational attainment of the head (and its square)
  - — Average educational attainment of adult females
- Employment: Whether the household runs a non-crop enterprise
- Characteristics of the residence:
  - — Type of residence
  - — Type of cooking fuel
  - — Type of lighting
- Ownership of consumer durables:
  - — Radio
  - — Bicycle
  - — Whether each household member owns two sets of clothes
- Welfare indicators
  - — What did the household do the last time that they ran out of salt
  - — Whether each household member ate meat or fish in the past seven days
  - — Number of illnesses suffered by household members in the past 30 days
  - — Number of adult working days lost to illness in the past 30 days
- Location:
  - — Region
  - — Urban/rural

Given Louto's purpose, it is not surprising that this tool—even though points are reported—would be difficult to implement, as it uses squares, ratios, and four indicators about unverifiable events in the past.

Whereas the poverty rate derived directly from the 2002/3 UNHS is 37.7 percent, Louto's tool's estimate is about nine percentage points lower (28.8 percent with a 90-

percent confidence interval of ±1.3 percentage points).[38] This suggests that poverty fell from 1999/2000 to 2002/3, consistent with non-expenditure evidence. Luoto argues that extreme prices imputed to home-grown, home-consumed *matooke* (plantain) are the most likely cause of the unexpected increase in poverty in the UNHS expenditure data.

9.2.5 Okwi, Emwanu, Hoogeveen, and Kristjansen

Okwi, Emwanu, and Hoogeveen (2003), and Emwanu, Okwi, Hoogeveen, and Kristjansen (2003, hereafter, OEHK) use Uganda's 1992/3 Integrated Household Survey (IHS) to build eight poverty-assessment tools (urban and rural in each of four regions) that are then applied to data from Uganda's January 1991 Population and Housing Census to estimate poverty rates at the level of Uganda's regions, counties, and sub-counties. This is the "poverty mapping" approach of Elbers, Lanjouw, and Lanjouw (2003) and Hentschel *et al.* (2000). The purpose of OEHK's poverty map is to show where the poor are so as to inform pro-poor growth policy and to facilitate the geographic targeting of poverty programs.

To construct their direct-expenditure tool, OEHK use stepwise regression to predict the logarithm of per-capita expenditure using data from the 1992/3 IHS and indicators found in both in the IHS and the Census. They apply the tools to households in the Census to estimate poverty rates at various levels of disaggregation. At these levels, the poverty-mapping estimates are more precise than direct estimates based on

[38] The standard error under direct measurement of change from two cross-sections is $\sqrt{2 \cdot 0.377 \cdot (1 - 0.377)} = 0.685$, so Luoto's implied sample-size factor alpha is $(1.3/1.64)/0.685 = 1.16$, about the same as the average alpha of 1.19 from nine countries in the previous section using a poverty-likelihood tool to track change.

the HIS,[39] and they can be reported as poverty maps that quickly show—in a way that is clear for non-specialists—how poverty rates vary by location.

Poverty mapping in OEHK (and poverty mapping in general) is similar to the scorecard in this paper in that they both:

- Build poverty-assessment tools with nationally representative survey data and then apply them to other data on sub-groups that may not be nationally representative
- Use simple, verifiable indicators that are quick and inexpensive to collect
- Provide unbiased estimates when their assumptions hold
- Are used to estimate poverty rates for groups
- Seek to be useful in practice and so aim to be understood by non-specialists

Strengths of poverty mapping include that it:

- Has formally established theoretical properties
- Can be applied straightforwardly to measures of well-being (such as the poverty gap) beyond poverty rates
- Requires less data for tool construction and calibration
- Often includes community-level indicators
- Uses only indicators that appear in a census
- Reports standard errors (and complex formula for standard errors)

Strengths of the scorecard include that it:

- Is simpler in terms of both construction and application
- Tests accuracy empirically
- Associates poverty likelihoods with scores non-parametrically
- Uses judgment and theory in scorecard construction to reduce overfitting
- Estimates poverty likelihoods for individual households
- Reports straightforward formulas for standard errors

The basic difference between the two approaches is that poverty mapping seeks to help governments design and target pro-poor policies, while the scorecard seeks to

[39] OEHK report standard errors but not sample sizes, so their α cannot be compared with that of the new scorecard here. They do not report bias (not having a benchmark against which to measure it).

help local pro-poor organizations to manage their social performance.[40] On a technical level, OEHK in Uganda (and other poverty mappers) use the direct-expenditure approach, whereas the new scorecard here uses the poverty-likelihood approach.

The 24 indicators in OEHK's tool for Uganda's Central Rural region are:

- Demographics:
  - Household size expressed as:
    - Logarithm of number of people
    - Logarithm of the number of adult equivalents
    - Whether household size is six
  - Number of household members who are males and aged:
    - 15 to 29
    - 30 or older
    - 50 or older
  - Number of household members who are females and aged:
    - 6 to 14
    - 60 or older
  - Proportion of females who are 52-years-old or younger
  - Age of head
- Education:
  - Number of males with education of:
    - One to four years
    - Primary
    - "O" level or higher
  - Proportion of males with secondary education
- Characteristics of the residence:
  - Type of wall
  - Whether the kitchen is shared with another household
  - Type of cooking fuel
  - Type of lighting

[40] Another apparent difference is that the developers of the poverty-mapping approach (Demombynes *et al.*, 2004; Elbers, Lanjouw, and Lanjouw, 2003) say that it is too inaccurate to be used for targeting individual households, while Schreiner (2008c) supports such targeting as a legitimate, potentially useful application of the scorecard. Recently, the developers of poverty mapping seem to have taken a small step away from their original position (Elbers *et al.*, 2007).

- Identity:
  - District
  - Tribal affiliation
- Other indicators reported by OEHK that they do not define:
  - `mnyredad`
  - `mnyredad2`
  - `xnm30min`
  - `maxyredu`

The poverty-map tool can use only indicators that are in both the expenditure survey and the census, so most indicators relate to demographics, education, and housing, without indicators for employment or ownership of assets.

The OEHK tools may be *overfit*, that is, too closely tailored to the construction sample and any random patterns that happen to be in it. Overfitting leads to decreased accuracy in other samples. Clues to overfitting in OEHK include:

- Stepwise regression
- Many combinations of indicators (not listed above), such as the presence of a shared kitchen combined with the proportion of males with secondary education, and `maxyrede` combined with `xnm30min`
- Apportionment of the 20,000 households in the IHS among eight tools
- Similar indicators (such as the logarithm of the number of household members and the logarithm of the number of adult equivalents)
- Indicators without clear logic (such as whether household size is six)

9.3 Poverty-likelihood poverty-assessment tools

Rather than directly estimating expenditure and then making an all-or-nothing comparison with a poverty line, poverty-likelihood tool—such as the new one here—estimate the probability that a household has expenditure below a poverty line.

The poverty-likelihood approach has the advantages of giving unbiased estimates of poverty rates and of recognizing that its estimates have a sampling distribution. Its accuracy is close to that of direct-expenditure tools, so the choice between them should be based on other dimensions. The main disadvantage of the poverty-likelihood approach is that non-specialists often have difficulty thinking in terms of probabilities.

9.3.1 Mathiassen

Like McKay, Mathiassen (2011) seeks to measure the accuracy of Ugandan poverty-assessment tools when applied to data collected at a different time than the data in the construction sample. She uses seven Ugandan expenditure surveys, all with the same definition of expenditure and a constant poverty line:

- 1993/4 Monitoring Survey
- 1994/5 Monitoring Survey
- 1995/6 Monitoring Survey
- 1997 Monitoring Survey
- 1999/2000 UNHS
- 2002/3 UNHS
- 2005/6 UNHS

For each of the seven expenditure surveys and by urban/rural, Mathiassen constructs six poverty tools, each with indicators matched to one of the other six surveys.[41] The tools are then applied to the other surveys backwards and forwards in time, comparing estimated poverty rates from her tools versus the survey. As in Luoto, tracking change requires assuming that the relationships between indicators and poverty does not change much over time. Mathiassen finds support for this assumption in that all the tools predict trends that resemble the actual trends.

[41] For example, ownership of assets was not recorded until the 2005/6 UNHS.

Mathiassen's tools are constructed in two steps. The first uses stepwise regression to relate indicators to the logarithm of per-adult-equivalent expenditure, just as in the direct-expenditure tools discussed above. The second step estimates a poverty likelihood by applying a Probit transformation to the difference between the poverty line and the direct estimate of expenditure. The average of poverty likelihoods for households in a given group is an estimate of their poverty rate. The Probit transform is non-linear in the tool's points, so this estimator is biased, but Mathiassen (2007) shows how to remove the bias and also gives a formula for standard errors.

In the example of the 2002/3 tool used to estimate urban poverty rates in 2005/6, the 31 indicators are:

- Demographics:
  - Number of household members (and its square)
  - Number of household members 14-years-old or younger
  - Ratio of number of households members ages 15 to 59 to those of other ages
  - Age of head
- Education:
  - Education attained by the head
  - Highest education attained among all household members (and its square)
- Employment: Whether the main source of income is wage work
- Characteristics of the residence:
  - Type of wall
  - Type of floor
  - Type of toilet arrangement
  - Type of cooking fuel
  - Source of lighting
- Ownership of clothes by each household member:
  - Two sets of clothes
  - One pair of shoes

- Foods eaten in the past week:
  - Fruit
  - Eggs
  - Rice
  - Bread
  - Fresh milk
  - Meat
  - Fish
  - Restaurant food
- Expenditures made in the past month:
  - Bathing soap
  - Toothpaste
  - Cosmetics
  - Shoes
  - Newspapers
  - Transport
  - Furniture
  - Electricity
- Food security: Average number of meals per day in the past seven days

The indicators relating to food and to expenditures in the past are not verifiable and may be difficult to collect.

Mathiassen finds that the trend in estimated poverty rates tends to follow the general decline in poverty in Uganda from 1993/4 to 2005/6, except for predicting an increase in 1997 for rural areas (when the survey showed a decrease) and for predicting a decrease in 2002/3 for rural areas (when the survey showed an increase). This second result fits with Luoto's speculation that something went awry in the 2002/3 UNHS.

Mathiassen reports bias and standard errors for the estimated differences between estimated and true poverty rates. The tool estimates are more precise than direct measurement.

Mathiassen concludes that "in most cases, this simple modeling approach produces predictions at rural, urban and sub-regional levels that are in line with the

official poverty figures. However, there are also many cases where the predictions differ significantly from the official poverty figures" (p. 26). As would be expected, accuracy decreases as predictions stretch further out in time and as true poverty changes more.

9.3.2 Sulaiman

Following Schreiner (2006b), Sulaiman (2009) constructs a poverty-likelihood poverty-assessment tool to help BRAC/Uganda[42] target clients and monitor poverty rates. Sulaiman uses data from the 2005/6 UNHS, but otherwise the new scorecard here is like his tool. The definition of poverty status has been discussed in Section 2 above. To reduce switching costs for BRAC/Uganda and other current users of Sulaiman's tool, indicators in the new scorecard are selected with an eye toward matching the 10 in Sulaiman:

- Demographics: Number of household members 10-years-old or younger
- Education: Educational attainment of the head
- Characteristics of the residence:
  - Type of wall
  - Type of roof
  - Type of cooking fuel
- Ownership of consumer durables:
  - Electronic equipment (e.g., TV, radio, cassette, etc.)
  - Bed net
  - Jewelry or watch
  - Whether each household member has at least:
    - Two sets of clothes
    - One pair of shoes

[42] BRAC/Bangladesh (one of the world's largest microlenders) founded BRAC/Uganda.

Both Sulaiman and the new scorecard here use the same Logit construction process, both scale points so that the total of points range from 0 to 100, both calibrate scores to poverty likelihoods as in Figure 5, both report targeting accuracy for a range of cut-offs, and both use out-of-sample tests to report bias.[43]

Beyond the definition of poverty status discussed earlier, the new tool here also differs from Sulaiman in that its indicators ask about the:

- Number of all household members (not just those 10-years-old or younger)
- Education of the female head (not simply the head, whether male or female)
- School attendance by children ages 6 to 18 (rather than bed net, which is barely related with poverty after controlling for other indicators in the updated scorecard)
- Source of lighting (rather than cooking fuel, which is barely related with poverty after controlling for other indicators in the updated scorecard)
- Type of toilet arrangement (rather than jewelry or watch, because these assets are non-intuitively linked with greater poverty likelihood in the updated scorecard and because Sulaiman reports that the jewelry question was difficult for enumerators and respondents to ask and to answer)

[43] For Sulaiman's line, bias is +0.4 percentage points. Standard errors are not reported.

10. Conclusion

The Simple Poverty Scorecard® tool is a low-cost way for pro-poor programs in Uganda to estimate the likelihood that a household has expenditure below a given poverty line, to estimate the poverty rate of a group of households at a point in time, and to estimate changes in the poverty rate of a group of households between two points in time. The scorecard can also be used for targeting.

The scorecard is inexpensive to use and can be understood by non-specialists. It is designed to be practical for local pro-poor organizations who want to improve how they manage their social performance.

The scorecard is built with a sub-sample of data from the 2009/10 UNHS, tested with a different sub-sample, and calibrated to eight poverty lines.

Accuracy and precision are reported for estimates of households' poverty likelihoods, groups' poverty rates at a point in time, and changes in groups' poverty rates over time. Support is provided for legacy users of Sulaiman's poverty-assessment tool based on the 2005/6 UNHS. Of course, the scorecard's estimates of change are not the same as estimates of program impact. Targeting accuracy is also reported.

When the scorecard is applied to the validation sample with $n = 16{,}384$, the absolute difference between estimates versus true poverty rates for groups of households at a point in time is usually 0.6 percentage points or less and averages—across the eight poverty lines—about 0.6 percentage points. For $n = 16{,}384$ and 90-percent confidence, the precision of these differences is ± 0.6 percentage points or better.

For targeting, programs can use the results reported here to select a cut-off that fits their values and mission.

Although the statistical technique is innovative, and although technical accuracy is important, the design of the scorecard here focuses on transparency and ease-of-use. After all, a perfectly accurate scorecard is worthless if programs feel so daunted by its complexity or its cost that they do not even try to use it. For this reason, the scorecard is kept simple, using ten indicators that are inexpensive to collect and that are straightforward to verify. Points are all zeros or positive integers, and scores range from 0 to 100. Scores are related to poverty likelihoods via simple look-up tables, and targeting cut-offs are likewise simple to apply. The design attempts to facilitate adoption by helping managers understand and trust scoring and by allowing non-specialists to generate scores quickly in the field.

In sum, the scorecard is a practical, objective way for pro-poor programs in Uganda to estimate poverty rates, track changes in poverty rates over time, and target services. The same approach can be applied to any country with similar data.

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Appendix:
Guidelines for the Interpretation of Scorecard Indicators

The following is taken from:

Uganda Bureau of Statistics. (2009) *Uganda National Household Survey 2009/10: Manual of Instructions*, Kampala. (the *Manual*).

1. How many members does the household have?

According to p. 8 of the *Manual*, "By definition, a *household* consists of a person or group of persons, related or unrelated, who live together in the same dwelling unit, who acknowledge one adult male or female as the head of household, who share the same living arrangements, and are considered as one unit. In some cases, one may find a group of people living together in the same house, but each person has separate eating arrangements; they should be counted as separate one-person households. Collective living arrangements such as hostels, army camps, boarding schools, or prisons are not considered as households in this survey."

According to pp. 11–13 of the *Manual*, "A *household* is defined as a group of people who have been living and eating their meals together for at least 6 of the 12 months preceding the interview. Therefore, the *member of the household* is defined on the basis of the usual place of residence. There are some exceptions to this rule as described below:

- The following categories of people are considered as household members even though they have lived [together] for less than 6 months in the past 12 months:
  - — Infants who are less than 6 months old
  - — Newlyweds who have been living together for less than 6 months
  - — Students and seasonal workers who have not been living in or as part of another household
  - — Other persons living together for less than 6 months but who are expected to live in the household permanently (or for a longer duration)

- Servants, farm workers and other such individuals who live and take meals with the household are to be identified as household members even though they may not have blood relationship with the household head
- People who have lived in the household for more than 6 months of the past 12 months but who have permanently left the household (*e.g.*, divorced or dead) are not considered as members of the household. However, they should be listed in the household roster

People who live in the same dwelling, but who do not share food expenses or eat meals together, are not members of the same household. For example, if a man has two or more wives who (with their children) live and eat together, then they form one household. Alternatively, if each wife and her children live and eat separately, then this family will form more than one household. Similarly, if two brothers, each having his own family, live in the same house, but maintain separate food budgets, they would constitute two separate households. The following are examples of a household:

- A household consisting of a man and his wife/wives and children, father/mother, nephew and other relatives or non relatives
- A household consisting of a single person
- A household consisting of a couple or several couples with or without their children"

"*Usual members* are defined as those persons who have been living in the household for 6 months or more during the last 12 months. However, members who have come to stay in the household permanently are to be included as usual members, even though they have lived in this household for less than 6 months. Furthermore, children born to usual members on any date during the last 12 months will be taken as usual members."

Usual members are counted as household members.

"*Regular members* refer to those persons who would have been usual members of this household, but have been away for more than six months during the last 12 months, for education purposes, search of employment, business transactions etc. and living in boarding schools, lodging houses or hostels etc."

Regular members are counted as household members.

"There may be guests or visitors present in the household on the date of the interview. Note that relatives to the head who happen to be visitors on the date of survey will be recorded as visitors."

Visitors are not counted as household members.

"[Overseas persons are those] considereded as members of the household but who have lived outside the household for 6 months or more during the last 12 months and are abroad or overseas for reasons of schooling and other reasons."

Overseas persons are not counted as household members for the purposes of the scorecard.

"[Departed people are those] who were household members during the last 12 months but left the household permanently or died."

Departed people are not counted as household members.

2. Do all children ages 6 to 18 currently attend school (government, private, NGO/religious, or boarding)?

According to p. 14 of the *Manual*, age is to be counted in completed years as of a person's most recent birthday.

According to pp. 16 of the *Manual*, "For the purpose of this survey, formal schooling includes schooling at primary or secondary school, vocational/technical or professional training. . . . *Currently attending school* applies to . . . any formal school. Students out of school on holidays, vacation or because of the temporary closure of the school or institution [are counted as currently attending]. Similarly, respondents who are temporarily absent from school/institution due to illness or other unavoidable circumstances but who will be going back [are counted as currently attending]. Students who are [not] attending school as such, but who are preparing to take examinations privately [are counted as currently attending]."

According to p. 17 of the *Manual*, "government, private, NGO/religious, or boarding" refers to who manages the school, and care should be taken to distinguish between government and religious institutions.

For the purpose of the scorecard, "Day and boarding" counts as "Boarding".

3. What is the highest grade that the female head/spouse completed?

According to p. 12 of the *Manual*, "In most cases, the *head of the household* is the one who manages the income earned and expenses incurred by the household, and who is the most knowledgeable about other members of the household. He/she will be the person named when you ask the question 'Who is the head of this household?' ([The person who is] recognised by other household members as the head.)"

The purposes of the scorecard, the *female head/spouse* is defined as:

- The household head, if the head is a woman
- The spouse of the household head, if the head is a man
- Non existent, if neither of the previous two criteria are met

According to p. 17 of the *Manual*, "*Completing a level* means having passed the formal examinations at the end of the academic year—the last full grade completed. For instance, for a person who dropped out in S.4 without completing the end of year examinations, then the highest grade completed will be S.3 since he/she did not completed S.4."

4. What is the major construction material of the roof?

According to p. 22 of the *Manual*, this question refers to "the physical characteristics of the dwelling: record the main construction material of the roof . . . of the main dwelling unit. If it is composed of more than one material, code the predominant material in the main structure."

5. What is the major construction material of the external wall?

According to p. 22 of the *Manual*, this question refers to "the physical characteristics of the dwelling: record the main construction material of the wall . . . of the main dwelling unit. If it is composed of more than one material, code the predominant material in the main structure."

6. What is the main source of lighting in your dwelling?

According to p. 22 of the *Manual*, the enumerator should "ask about the main source of lighting in the dwelling."

7. What is the type of toilet that is mainly **used** in your household?

According to p. 22 of the *Manual*, the question refers to "The type of toilet *used* by the household. Note that it refers to *use* rather than *ownership*."

8. Does any member of your household own electronic equipment (e.g., TV, radio, cassette, etc.) at present?

The *Manual* does not provide any additional information about this question.

9. Does every member of the household have at least two sets of clothes?

According to p. 28 of the *Manual*, this question "considers clothes in good or average condition only. Tatters should be excluded. There is need to establish whether every household member has two sets of clothes. School uniforms should be excluded."

10. Does every member of the household have at least one pair of shoes?

According to p. 29 of the *Manual*, this question aims to "find out whether every member of the household has a pair of shoes in good condition. Slippers, 'tire' shoes (*lugabire*), and gumboots are not considered as shoes."

Figure 1: Sample sizes and poverty rates by sub-sample and by poverty line at both the household level and the person level

Sub-sample	# households	% with expenditure below a poverty line							
		National				USAID	Intl. 2005 PPP		Sulaiman
		Food	100%	150%	200%	'Extreme'	$1.25	$2.50	$1.25/day
Poverty line (UGX/person/day)	6,775	1,011	1,387	2,081	2,775	781	1,374	2,747	1,108
All-Uganda poverty rates (%)									
Household level	6,775	9.0	19.3	42.2	59.1	9.0	34.5	70.8	22.7
Person level	6,775	11.8	24.5	50.3	67.5	12.0	42.7	79.9	
Construction and calibration: Selecting indicators and points, and associating scores with likelihoods									
Household level	3,300	9.0	19.3	42.1	59.5	8.8	34.7	70.9	23.2
Person level	3,300	11.9	24.4	50.0	67.7	11.7	43.1	80.1	
Validation: Measuring accuracy									
Household level	3,475	9.0	19.4	42.4	58.8	9.2	34.3	70.7	22.2
Person level	3,475	11.7	24.5	50.6	67.2	12.2	42.3	79.7	

Source: 2009/10 National Household Survey

All monetary units are Uganda shillings (UGX) in average constant terms over May 2009 to April 2010.

The food poverty line and the national poverty lines are in UGX per adult equivalent per day.

The USAID "extreme" poverty line and the international 2005 PPP poverty lines are in UGX per person per day.

See appendix for the definition of Sulaiman's (2009) $1.25/day 2005 PPP line. All poverty rates here for this line are unweighted.

Figure 2: Poverty lines and poverty rates at the household and person level by region

	Poverty line (UGX/person/day) and poverty rate (%)							
	National				USAID	Intl. 2005 PPP		Sulaiman
Region	Food	100%	150%	200%	'Extreme'	$1.25	$2.50	$1.25/day
All Uganda								
Poverty line	1,011	1,387	2,081	2,775	781	1,374	2,747	1,108
Household-level poverty rate	9.0	19.3	42.2	59.1	9.0	34.5	70.8	22.7
Person-level poverty rate	11.8	24.5	50.3	67.5	12.0	42.7	79.9	
Central Urban								
Poverty line	1,011	1,527	2,291	3,054	906	1,512	3,024	1,108
Household-level poverty rate	0.8	3.8	9.2	19.2	0.9	6.6	31.1	1.1
Person-level poverty rate	0.9	5.4	13.4	24.9	1.1	9.9	43.2	
Central Rural								
Poverty line	1,011	1,407	2,110	2,813	808	1,393	2,785	1,108
Household-level poverty rate	3.2	10.8	32.3	47.9	4.7	23.9	60.9	10.6
Person-level poverty rate	4.4	13.5	38.5	56.2	6.7	29.8	70.8	
Eastern Urban								
Poverty line	1,011	1,460	2,189	2,919	916	1,445	2,890	1,108
Household-level poverty rate	2.7	12.7	26.4	47.4	4.9	21.4	64.7	6.9
Person-level poverty rate	3.9	18.7	36.2	58.1	7.4	30.9	75.9	
Eastern Rural								
Poverty line	1,011	1,362	2,044	2,725	774	1,349	2,698	1,108
Household-level poverty rate	8.7	20.5	48.3	69.4	9.9	40.1	82.0	21.5
Person-level poverty rate	10.6	24.7	54.5	75.6	12.2	47.1	88.3	
Northern Urban								
Poverty line	1,011	1,438	2,157	2,876	789	1,424	2,848	1,108
Household-level poverty rate	5.7	15.1	31.4	46.5	6.9	26.4	61.0	19.3
Person-level poverty rate	7.6	19.7	42.2	55.6	9.6	36.3	71.9	
Northern Rural								
Poverty line	1,011	1,376	2,064	2,752	683	1,363	2,726	1,108
Household-level poverty rate	24.6	42.1	68.2	81.6	19.9	60.4	89.2	45.7
Person-level poverty rate	29.7	49.0	75.8	87.4	24.4	69.1	93.8	
Western Urban								
Poverty line	1,011	1,427	2,140	2,853	762	1,412	2,825	1,108
Household-level poverty rate	1.0	2.0	25.7	33.8	1.0	15.9	45.3	
Person-level poverty rate	1.8	4.2	32.4	39.5	1.8	21.2	52.1	7.54
Western Rural								
Poverty line	1,011	1,340	2,010	2,679	781	1,326	2,653	1,108
Household-level poverty rate	9.0	19.8	47.3	68.0	9.6	37.6	79.5	20.0
Person-level poverty rate	10.9	23.1	52.2	71.6	11.6	42.8	83.7	

Source: 2009/10 National Household Survey

All monetary units are Uganda shillings (UGX) in average constant terms over May 2009 to April 2010.

The food poverty line and the national poverty lines are in UGX per adult equivalent per day.

The USAID "extreme" poverty line and the intl. 2005 PPP lines are iu UGX per person per day.

See appendix for Sulaiman (2009) $1.25/day 2005 PPP line. All poverty rates here for this line are unweighted.

Figure 3: Poverty indicators by uncertainty coefficient

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
1585	Does every member of the household have at least one pair of shoes? (No; Yes)
1136	What is the main source of lighting in your dwelling? (Firewood; *Tadooba*, or other; Paraffin lantern, or electricity (grid, generator, solar))
1045	What type of dwelling is it? (Hut, uniport, or other; Independent house; Tenement (*muzigo*), independent flat/apartment, sharing house/flat/apartment, boys quarters, or garage)
1022	Does every child in this household (all those under 18-years-old) have a blanket? (No; Yes; No one under 18-years-old)
1007	What is the highest grade that the female head/spouse completed? (No female head/spouse; P.5 or less, or none; P.6; P.7 to S.6; Higher than S.6)
937	Do all children ages 6 to 16 currently attend school (government, private, NGO/religious, or boarding)? (Not all attend; All attend government schools; No children ages 6 to 16; All attend, and one or more attend a private, NGO/religious, or boarding school)
929	What is the major material of the floor? (Earth and cow dung, or other; Earth, or mosaic or tiles; Cement)
907	Do all children ages 6 to 15 currently attend school (government, private, NGO/religious, or boarding)? (Not all attend; All attend government schools; No children ages 6 to 15; All attend, and one or more attend a private, NGO/religious, or boarding school)
887	Do all children ages 6 to 14 currently attend school (government, private, NGO/religious, or boarding)? (Not all attend; All attend government schools; No children ages 6 to 14; All attend, and one or more attend a private, NGO/religious, or boarding school)
867	Do all children ages 6 to 17 currently attend school (government, private, NGO/religious, or boarding)? (Not all attend; All attend government schools; No children ages 6 to 17; All attend, and one or more attend a private, NGO/religious, or boarding school)

Figure 3 (cont.): Poverty indicators by uncertainty coefficient

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
843	Does any member of your household own mobile phone at present? (No; Yes)
843	Do all children ages 6 to 13 currently attend school (government, private, NGO/religious, or boarding)? (Not all attend; All attend government schools; No children ages 6 to 13; All attend, and one or more attend a private, NGO/religious, or boarding school)
823	How many household members are 18-years-old or younger? (Five or more; Four; Three; Two; One; None)
786	Do all children ages 6 to 12 currently attend school (government, private, NGO/religious, or boarding)? (Not all attend; All attend government schools; No children ages 6 to 12; All attend, and one or more attend a private, NGO/religious, or boarding school)
783	How many household members are 17-years-old or younger? (Four or more; Three; Two; One; None)
780	How many household members are 16-years-old or younger? (Four or more; Three; Two; One; None)
762	Do all children ages 6 to 18 currently attend school (government, private, NGO/religious, or boarding)? (Not all attend; All attend government schools; No children ages 6 to 18; All attend, and one or more attend a private, NGO/religious, or boarding school)
761	How many members does the household have? (Six or more; Four or five; Three; Two; One)
736	How many household members are 15-years-old or younger? (Four or more; Three; Two; One; None)
720	What is the major construction material of the external wall? (Un-burnt bricks, mud and poles, thatch/straw. timber, stone, burnt bricks with mud, other; Burnt bricks with cement, or cement blocks)
717	What is the major construction material of the roof? (Thatch, straw, or other; Iron sheets, or tiles)
708	Do all children ages 6 to 16 currently attend school? (No; Yes; No one ages 6 to 16)
705	What is the average number of meals taken by household members per day in the last 7 days? (One; Two; Three; Four or more)

Figure 3 (cont.): Poverty indicators by uncertainty coefficient

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
700	Do all children ages 6 to 11 currently attend school (government, private, NGO/religious, or boarding)? (Not all attend; All attend government schools; No children ages 6 to 11; All attend, and one or more attend a private, NGO/religious, or boarding school)
693	How many household members are 14-years-old or younger? (Four or more; Three; Two; One; None)
689	What type of cooking technology do you use in your household? (Traditional 3-stone open fire; Improved firewood stove; Improved charcoal stove; Traditional stove (*sigiri*), gas stove/cooker, paraffin stove, electric plate/cooker, or other)
685	Do all children ages 6 to 15 currently attend school? (No; Yes; No one ages 6 to 15)
677	Do all children ages 6 to 14 currently attend school? (No; Yes; No one ages 6 to 14)
667	Do all children ages 6 to 13 currently attend school? (No; Yes; No one ages 6 to 13)
660	Can the female head/spouse read and write with understanding in any language? (Unable to read and write; uses Braille, or able to read only; Able to read and write; No female head/spouse)
642	How many household members are 13-years-old or younger? (Four or more; Three; Two; One; None)
641	Do all children ages 6 to 17 currently attend school? (No; Yes; No one ages 6 to 17)
628	What is the household's tenure status? (Owned, or other; Rented (subsidized), supplied free by employer, or supplied free or rent paid by relative or other person; rented (normal))
620	What did you do when you last ran out of salt? (Did without; Borrowed from neighbors; Bought; Does not cook at all, or not applicable)
610	How many household members are 12-years-old or younger? (Three or more; Two; One; None)
607	Do all children ages 6 to 12 currently attend school? (No; Yes; No one ages 6 to 12)
593	What type of fuel do you use most often for cooking? (Firewood, or other; Charcoal, paraffin/kerosene, gas, electricity-grid, electricity-generator, or electricity-solar)

Figure 3 (cont.): Poverty indicators by uncertainty coefficient

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
582	What is the major source of water for drinking for your household? (Bore-hole; River, stream, lake, pond; Protected well/spring; Gravity flow scheme, rain water, or other; Private connection to pipeline, public taps, or vender/tanker truck)
572	Do all children ages 6 to 18 currently attend school? (No; Yes; No one ages 6 to 18)
547	Does any member of your household own electronic equipment (e.g., TV, radio, cassette, etc.) at present? (No; Yes)
546	What is the highest grade that the male head/spouse completed? (None, or P.2 or less, or none; P.3 to P.5; No male head/spouse; P.6 to J.3; S.1 to S.6; More than S.6)
543	Do all children ages 6 to 11 currently attend school? (No; Yes; No one ages 6 to 11)
539	How many household members are 11-years-old or younger? (Three or more; Two; One; None)
506	Does every member of the household have at least two sets of clothes? (No; Yes)
370	What is the type of toilet that is mainly used in your household? (Bush (none); B. Covered pit latrine (private or shared), VIP latrine (private or shared), uncovered pit latrine, flush toilet (private or shared), or other)
369	What is the household's most important source of earnings during the last 12 months? (Subsistence farming, organisational support (e.g., food air, WFP, NGOs, etc.), or other; Remittances; Non-agricultural enterprises; Wage employment; Commercial farming, property income, or transfers (pension, allowances, social security benefits, etc.))
317	Does any member of your household own a house at present? (Yes; No)
257	How old is the female head/spouse in completed years? (31 to 35; 61 or older; 36 to 40; 41 to 45; 46 to 50; 51 to 55; 26 to 30; 56 to 60; 0 to 25; No female head/spouse)
239	How many household members are 6-years-old or younger? (Two or more; One; None)
231	Do you have a hand-washing facility at the toilet? (No toilet; No; Yes, with water only; Yes, with water and soap)
218	Does any member of your household own a motor cycle or a motor vehicle at present? (No; Motor cycle only; Motor vehicle (regardless of motorcycle)

Figure 3 (cont.): Poverty indicators by uncertainty coefficient

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
212	Does any member of your household own a bicycle, motor cycle, or motor vehicle at present? (No; Bicycle only; Motorcycle and/or motor vehicle (regardless of bicycle))
205	Can the male head/spouse read and write with understanding in any language? (Unable to read and write, or uses Braille; No male head/spouse; Able to read and write, or able to read only)
200	Does any member of your household own furniture/furnishings at present? (No; Yes)
174	What is the present marital status of the female head/spouse? (Widow; Married polygamously; Married monogamously; Divorced/separated; No female head/spouse; Never-married)
142	What is the structure of household headship? (Female head/spouse only; Both male and female heads/spouses; Male head/spouse only)
126	Does any member of your household own a motor vehicle at present? (No; Yes)
124	What is the present marital status of the male head/spouse? (No male head/spouse; Married polygamously; Married monogamously; Widower; Divorced/separated; Never-married)
108	Does any member of your household own a bicycle or motor cycle at present? (No; Bicycle only; Motor cycle (regardless of bicycle))
103	How many rooms does your household use for sleeping? (Two, three, or four bedrooms; One bedroom, or five or more)
94	Does any member of your household own a motor cycle at present? (No; Yes)
91	How old is the male head/spouse in completed years? (41 to 45; 46 to 50; 51 to 55; 61 or older; No male head/spouse; 31 to 35; 36 to 40; 56 to 60; 0 to 25; 26 to 30)
78	Do any household members attend a private school or a school run by an NGO/religious organization? (No; Yes)
70	Do any household members attend a boarding school, a private school, or a school run by an NGO/religious organization? (No; Yes)

Figure 3 (cont.): Poverty indicators by uncertainty coefficient

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
45	Does any member of your household own land at present? (Yes; No)
37	Do any household members attend a boarding school? (No; Yes)
27	Does any member of your household own jewelry and watches at present? (No; Yes)
25	Does any member of your household own other buildings at present? (No; Yes)
18	Does any member of your household own a bicycle at present? (No; Yes)
12	Did any member of your household sleep under a mosquito net last night? (No; Yes)

Source: 2009/10 National Household Survey and the national poverty line

Tables for
the National Poverty Line

(and tables pertaining to all eight poverty lines)

Figure 4 (National line): Estimated poverty likelihoods associated with scores

If a household's score is . . .	. . . then the likelihood (%) of being below the poverty line is:
0–4	94.2
5–9	90.5
10–14	87.4
15–19	74.0
20–24	65.1
25–29	47.9
30–34	38.1
35–39	27.3
40–44	15.1
45–49	10.7
50–54	6.7
55–59	2.9
60–64	0.8
65–69	0.5
70–74	0.7
75–79	0.0
80–84	0.0
85–89	0.0
90–94	0.0
95–100	0.0

Figure 5 (National line): Derivation of estimated poverty likelihoods associated with scores

Score	Households below poverty line		All households at score		Poverty likelihood (estimated, %)
0–4	582	÷	618	=	94.2
5–9	373	÷	412	=	90.5
10–14	746	÷	854	=	87.4
15–19	2,109	÷	2,851	=	74.0
20–24	2,736	÷	4,203	=	65.1
25–29	3,214	÷	6,709	=	47.9
30–34	3,217	÷	8,444	=	38.1
35–39	2,763	÷	10,135	=	27.3
40–44	1,587	÷	10,509	=	15.1
45–49	1,173	÷	11,016	=	10.7
50–54	638	÷	9,511	=	6.7
55–59	252	÷	8,844	=	2.9
60–64	64	÷	8,109	=	0.8
65–69	33	÷	7,278	=	0.5
70–74	31	÷	4,744	=	0.7
75–79	0	÷	2,399	=	0.0
80–84	0	÷	2,273	=	0.0
85–89	0	÷	566	=	0.0
90–94	0	÷	72	=	0.0
95–100	0	÷	452	=	0.0

Number of all households normalized to sum to 100,000.

Figure 6a: Distribution of household poverty likelihoods across expenditure ranges demarcated by national poverty lines per adult equivalent per day

	Likelihood of having expenditure in ranges demarcated by national poverty lines per day per adult equivalent				
	<Food	=>Food and <100% Natl.	=>100% Natl. and <150% Natl.	=>150% Natl. and <200% Natl.	=>200% Natl.
Score	<UGX1,011	=>UGX1,011 and <UGX1,387	=>UGX1,387 and <UGX2,081	=>UGX2,081 and <UGX2,775	=>UGX2,775
0–4	87.6	6.5	5.8	0.0	0.0
5–9	82.0	8.4	9.5	0.0	0.0
10–14	62.7	24.7	12.6	0.0	0.0
15–19	51.6	22.4	23.9	1.0	1.2
20–24	35.5	29.6	21.0	9.7	4.2
25–29	25.0	22.9	25.8	16.5	9.8
30–34	11.3	26.8	31.8	15.8	14.3
35–39	12.0	15.2	37.6	20.3	14.8
40–44	4.3	10.8	32.1	25.8	27.0
45–49	4.0	6.7	30.5	25.7	33.2
50–54	1.8	4.9	27.9	22.5	42.9
55–59	0.7	2.2	15.5	23.3	58.4
60–64	0.2	0.6	16.7	16.0	66.5
65–69	0.0	0.5	5.7	12.6	81.2
70–74	0.0	0.7	5.3	7.6	86.5
75–79	0.0	0.0	1.8	1.1	97.1
80–84	0.0	0.0	0.0	3.9	96.1
85–89	0.0	0.0	0.0	0.0	100.0
90–94	0.0	0.0	0.0	0.0	100.0
95–100	0.0	0.0	0.0	0.0	100.0

Note: All poverty likelihoods in percentage units.

Figure 6b: Distribution of household poverty likelihoods across expenditure ranges demarcated by national poverty lines per person per day

	Likelihood of having expenditure in ranges demarcated by international 2005 PPP poverty lines per day per capita			
	<USAID	=>USAID and <$1.25	=>$1.25 and <$2.50	=>$2.50
Score	<UGX781	=>UGX781 and <UGX1,374	=>UGX1,374 and <UGX2,747	=>UGX2,747
0–4	78.9	21.1	0.0	0.0
5–9	70.9	21.2	7.9	0.0
10–14	47.7	52.3	0.0	0.0
15–19	45.3	47.1	6.5	1.2
20–24	31.9	50.7	17.4	0.0
25–29	24.9	42.1	28.4	4.6
30–34	13.7	48.0	33.0	5.2
35–39	13.4	41.9	37.7	7.0
40–44	4.2	33.8	48.5	13.5
45–49	3.9	27.4	52.4	16.3
50–54	0.5	24.1	53.5	21.9
55–59	0.9	10.4	50.2	38.5
60–64	0.0	6.2	41.2	52.6
65–69	0.0	2.5	29.6	67.9
70–74	0.0	2.8	11.5	85.7
75–79	0.0	0.0	9.3	90.7
80–84	0.0	0.0	5.7	94.3
85–89	0.0	0.0	0.0	100.0
90–94	0.0	0.0	0.0	100.0
95–100	0.0	0.0	0.0	100.0

Note: All poverty likelihoods in percentage units.

Figure 7 (National line): Bootstrapped differences between estimated and true poverty likelihoods for households in a large sample (n = 16,384) with confidence intervals, scorecard applied to the validation sample

	Difference between estimate and true value			
		Confidence interval (+/– percentage points)		
Score	Diff.	90-percent	95-percent	99-percent
0–4	–0.8	4.1	5.3	6.8
5–9	–5.1	4.2	4.4	6.3
10–14	+11.7	7.8	9.3	12.1
15–19	+11.6	4.6	5.5	7.2
20–24	+6.8	3.4	4.0	5.3
25–29	+2.2	2.8	3.3	4.3
30–34	+2.7	2.4	2.9	3.7
35–39	+1.2	2.1	2.6	3.4
40–44	–1.4	1.5	1.9	2.5
45–49	–6.3	4.0	4.2	4.5
50–54	+2.9	0.7	0.9	1.1
55–59	–1.1	0.9	1.0	1.3
60–64	–0.3	0.4	0.5	0.7
65–69	–0.9	0.8	0.8	1.0
70–74	+0.7	0.0	0.0	0.0
75–79	+0.0	0.0	0.0	0.0
80–84	+0.0	0.0	0.0	0.0
85–89	+0.0	0.0	0.0	0.0
90–94	+0.0	0.0	0.0	0.0
95–100	+0.0	0.0	0.0	0.0

Figure 8 (National line): Differences and precision of differences for bootstrapped estimates of poverty rates for groups of households at a point in time, by sample size, scorecard applied to the validation sample

Sample Size	Difference between estimate and true value			
		Confidence interval (+/– percentage points)		
n	Diff.	90-percent	95-percent	99-percent
1	–0.6	66.4	66.4	83.6
4	+0.3	28.9	35.8	45.0
8	+0.3	19.9	24.3	35.1
16	+0.6	14.2	17.1	23.5
32	+0.5	10.5	12.4	17.5
64	+0.5	7.3	9.2	11.9
128	+0.5	5.3	6.2	8.0
256	+0.4	3.8	4.6	5.7
512	+0.4	2.6	3.2	4.0
1,024	+0.5	1.8	2.0	2.7
2,048	+0.4	1.3	1.6	2.0
4,096	+0.4	0.9	1.1	1.6
8,192	+0.4	0.6	0.8	1.0
16,384	+0.5	0.5	0.5	0.7

Figure 9 (All poverty lines): Differences, precision of differences, and the α factor for bootstrapped estimates of poverty rates for groups of households at a point in time, scorecard applied to the validation sample

	Poverty line								
	National				USAID	Intl. 2005 PPP			Sulaiman
	Food	100%	150%	200%	'Extreme'	$1.25	$2.50		$1.25/day
Estimate minus true value									
Scorecard applied to validation sample	+0.5	+0.5	+0.6	+2.0	–0.1	+0.3	+0.3		+0.3
Precision of difference									
Scorecard applied to validation sample	0.4	0.5	0.6	0.6	0.4	0.6	0.6		0.5
α factor for standard errors									
Scorecard applied to validation sample	1.01	0.90	0.97	0.97	1.00	0.97	1.04		0.86
Precision is measured as 90-percent confidence intervals in units of +/– percentage points.									
Differences and precision estimated from 1,000 bootstraps of size n = 16,384.									
α is estimated from 1,000 bootstrap samples of n = 256, 512, 1,024, 2,048, 4,096, 8,192, and 16,384.									

Figure 10 (All poverty lines): Possible types of outcomes from targeting by poverty score

True poverty status	Targeting segment: Targeted	Targeting segment: Non-targeted
Below poverty line	**Inclusion** Under poverty line Correctly Targeted	**Undercoverage** Under poverty line Mistakenly Non-targeted
Above poverty line	**Leakage** Above poverty line Mistakenly Targeted	**Exclusion** Above poverty line Correctly Non-targeted

Figure 11 (National line): Households by targeting classification and score, along with "Total Accuracy" and BPAC, scorecard applied to the validation sample

Score	Inclusion: < poverty line correctly targeted	Undercoverage: < poverty line mistakenly non-targeted	Leakage: => poverty line mistakenly targeted	Exclusion: => poverty line correctly non-targeted	Total Accuracy Inclusion + Exclusion	BPAC See text
0–4	0.6	18.8	0.0	80.6	81.2	–93.8
5–9	1.0	18.4	0.1	80.6	81.6	–89.6
10–14	1.6	17.7	0.2	80.4	82.0	–81.8
15–19	3.5	15.9	1.2	79.4	82.9	–57.5
20–24	6.0	13.4	3.0	77.7	83.6	–23.1
25–29	8.8	10.6	6.8	73.8	82.6	+26.3
30–34	11.8	7.6	12.3	68.3	80.1	+36.3
35–39	14.5	4.9	19.8	60.9	75.3	–2.0
40–44	16.4	3.0	28.4	52.2	68.6	–46.6
45–49	18.2	1.2	37.6	43.1	61.2	–94.0
50–54	18.7	0.7	46.6	34.0	52.7	–140.6
55–59	19.1	0.2	55.0	25.7	44.8	–183.8
60–64	19.3	0.1	62.9	17.7	37.0	–225.0
65–69	19.4	0.0	70.1	10.5	29.9	–262.1
70–74	19.4	0.0	74.9	5.8	25.1	–286.6
75–79	19.4	0.0	77.3	3.4	22.7	–299.0
80–84	19.4	0.0	79.5	1.1	20.5	–310.7
85–89	19.4	0.0	80.1	0.5	19.9	–313.6
90–94	19.4	0.0	80.2	0.5	19.8	–314.0
95–100	19.4	0.0	80.6	0.0	19.4	–316.3

Inclusion, undercoverage, leakage, and exclusion normalized to sum to 100.

Figure 12 (National line): For a given score cut-off, the percentage of all households who are targeted (that is, have a score equal to or less than the cut-off), the percentage of targeted households who are poor (that is, below the poverty line), the percentage of poor households who are targeted, and the number of poor households who are successful targeted (coverage) per non-poor household mistakenly targeted (leakage), scorecard applied to the validation sample

Targeting cut-off	% all households who are targeted	% targeted who are poor	% of poor who are targeted	Poor households targeted per non-poor household targeted
0–4	0.6	95.8	3.1	22.6:1
5–9	1.0	94.9	5.0	18.7:1
10–14	1.9	87.4	8.5	6.9:1
15–19	4.7	73.9	18.1	2.8:1
20–24	8.9	66.6	30.7	2.0:1
25–29	15.6	56.3	45.5	1.3:1
30–34	24.1	48.8	60.7	1.0:1
35–39	34.2	42.3	74.7	0.7:1
40–44	44.7	36.6	84.4	0.6:1
45–49	55.8	32.6	93.9	0.5:1
50–54	65.3	28.6	96.4	0.4:1
55–59	74.1	25.8	98.8	0.3:1
60–64	82.2	23.4	99.5	0.3:1
65–69	89.5	21.6	100.0	0.3:1
70–74	94.2	20.6	100.0	0.3:1
75–79	96.6	20.0	100.0	0.3:1
80–84	98.9	19.6	100.0	0.2:1
85–89	99.5	19.5	100.0	0.2:1
90–94	99.5	19.5	100.0	0.2:1
95–100	100.0	19.4	100.0	0.2:1

Tables for the Food Poverty Line

Figure 4 (Food line): Estimated poverty likelihoods associated with scores

If a household's score is . . .	. . . then the likelihood (%) of being below the poverty line is:
0–4	87.6
5–9	82.0
10–14	62.7
15–19	51.6
20–24	35.5
25–29	25.0
30–34	11.3
35–39	12.0
40–44	4.3
45–49	4.0
50–54	1.8
55–59	0.7
60–64	0.2
65–69	0.0
70–74	0.0
75–79	0.0
80–84	0.0
85–89	0.0
90–94	0.0
95–100	0.0

Figure 7 (Food line): Bootstrapped differences between estimated and true poverty likelihoods for households in a large sample (n = 16,384) with confidence intervals, scorecard applied to the validation sample

	Difference between estimate and true value			
		Confidence interval (+/– percentage points)		
Score	Diff.	90-percent	95-percent	99-percent
0–4	+1.6	6.7	7.9	10.0
5–9	+29.6	11.7	14.3	19.2
10–14	+30.2	7.6	9.5	12.4
15–19	+10.3	4.8	5.7	7.2
20–24	+3.9	3.3	3.9	5.2
25–29	–4.1	3.4	3.6	4.2
30–34	+0.1	1.4	1.6	2.3
35–39	–0.5	1.8	2.1	2.9
40–44	+0.3	0.7	0.9	1.2
45–49	–0.6	0.8	1.0	1.3
50–54	+1.1	0.3	0.3	0.4
55–59	–0.9	0.7	0.7	0.8
60–64	–0.4	0.4	0.4	0.5
65–69	+0.0	0.0	0.0	0.0
70–74	+0.0	0.0	0.0	0.0
75–79	+0.0	0.0	0.0	0.0
80–84	+0.0	0.0	0.0	0.0
85–89	+0.0	0.0	0.0	0.0
90–94	+0.0	0.0	0.0	0.0
95–100	+0.0	0.0	0.0	0.0

Figure 8 (Food line): Differences and precision of differences for bootstrapped estimates of poverty rates for groups of households at a point in time, by sample size, scorecard applied to the validation sample

Sample Size	Difference between estimate and true value			
		Confidence interval (+/− percentage points)		
n	Diff.	90-percent	95-percent	99-percent
1	+0.2	52.6	61.7	79.2
4	+0.6	22.5	28.2	44.4
8	+0.7	15.3	20.5	29.7
16	+0.9	10.9	13.4	18.7
32	+0.7	8.2	10.3	13.9
64	+0.5	5.6	7.1	9.9
128	+0.5	4.1	4.9	6.2
256	+0.4	3.0	3.5	4.6
512	+0.4	2.1	2.5	3.6
1,024	+0.4	1.5	1.8	2.4
2,048	+0.4	1.1	1.3	1.6
4,096	+0.4	0.7	0.9	1.1
8,192	+0.4	0.5	0.6	0.8
16,384	+0.5	0.4	0.4	0.6

Figure 11 (Food line): Households by targeting classification and score, along with "Total Accuracy" and BPAC, scorecard applied to the validation sample

Score	Inclusion: < poverty line correctly targeted	Undercoverage: < poverty line mistakenly non-targeted	Leakage: => poverty line mistakenly targeted	Exclusion: => poverty line correctly non-targeted	Total Accuracy Inclusion + Exclusion	BPAC See text
0–4	0.5	8.5	0.1	90.9	91.4	–87.2
5–9	0.8	8.2	0.2	90.8	91.6	–79.6
10–14	1.3	7.7	0.6	90.4	91.7	–64.8
15–19	2.5	6.6	2.3	88.7	91.2	–20.2
20–24	3.8	5.2	5.1	85.8	89.6	+41.3
25–29	5.4	3.6	10.3	80.7	86.1	–13.9
30–34	6.5	2.6	17.6	73.4	79.8	–95.8
35–39	7.6	1.4	26.6	64.4	72.0	–195.4
40–44	8.2	0.9	36.6	54.4	62.6	–306.0
45–49	8.7	0.3	47.1	43.9	52.6	–422.4
50–54	8.8	0.2	56.5	34.5	43.3	–526.8
55–59	9.0	0.0	65.1	25.8	34.8	–623.0
60–64	9.0	0.0	73.2	17.8	26.8	–712.5
65–69	9.0	0.0	80.5	10.5	19.5	–793.3
70–74	9.0	0.0	85.2	5.8	14.8	–845.9
75–79	9.0	0.0	87.6	3.4	12.4	–872.5
80–84	9.0	0.0	89.9	1.1	10.1	–897.8
85–89	9.0	0.0	90.5	0.5	9.5	–904.1
90–94	9.0	0.0	90.5	0.5	9.5	–904.9
95–100	9.0	0.0	91.0	0.0	9.0	–909.9

Inclusion, undercoverage, leakage, and exclusion normalized to sum to 100.

Figure 12 (Food line): For a given score cut-off, the percentage of all households who are targeted (that is, have a score equal to or less than the cut-off), the percentage of targeted households who are poor (that is, below the poverty line), the percentage of poor households who are targeted, and the number of poor households who are successful targeted (coverage) per non-poor household mistakenly targeted (leakage), scorecard applied to the validation sample

Targeting cut-off	% all households who are targeted	% targeted who are poor	% of poor who are targeted	Poor households targeted per non-poor household targeted
0–4	0.6	86.1	5.9	6.2:1
5–9	1.0	78.5	9.0	3.7:1
10–14	1.9	68.3	14.3	2.2:1
15–19	4.7	51.8	27.2	1.1:1
20–24	8.9	42.5	42.1	0.7:1
25–29	15.6	34.4	59.8	0.5:1
30–34	24.1	26.8	71.6	0.4:1
35–39	34.2	22.2	84.5	0.3:1
40–44	44.7	18.2	90.6	0.2:1
45–49	55.8	15.6	96.4	0.2:1
50–54	65.3	13.5	97.5	0.2:1
55–59	74.1	12.1	99.5	0.1:1
60–64	82.2	11.0	100.0	0.1:1
65–69	89.5	10.1	100.0	0.1:1
70–74	94.2	9.6	100.0	0.1:1
75–79	96.6	9.3	100.0	0.1:1
80–84	98.9	9.1	100.0	0.1:1
85–89	99.5	9.1	100.0	0.1:1
90–94	99.5	9.1	100.0	0.1:1
95–100	100.0	9.0	100.0	0.1:1

Tables for
150% of the National Poverty Line

Figure 4 (150% of the national line): Estimated poverty likelihoods associated with scores

If a household's score is . . .	. . . then the likelihood (%) of being below the poverty line is:
0–4	100.0
5–9	100.0
10–14	100.0
15–19	97.9
20–24	86.1
25–29	73.7
30–34	69.9
35–39	64.8
40–44	47.2
45–49	41.1
50–54	34.6
55–59	18.3
60–64	17.5
65–69	6.2
70–74	6.0
75–79	1.8
80–84	0.0
85–89	0.0
90–94	0.0
95–100	0.0

Figure 7 (150% of the national line): Bootstrapped differences between estimated and true poverty likelihoods for households in a large sample (n = 16,384) with confidence intervals, scorecard applied to the validation sample

	Difference between estimate and true value			
		Confidence interval (+/– percentage points)		
Score	Diff.	90-percent	95-percent	99-percent
0–4	+0.0	0.0	0.0	0.0
5–9	+1.5	2.1	2.4	3.2
10–14	+0.1	0.1	0.1	0.1
15–19	+2.5	1.5	1.8	2.5
20–24	+6.2	2.6	3.1	4.2
25–29	–7.2	4.6	4.8	5.2
30–34	+0.1	2.6	3.0	3.7
35–39	+9.9	2.4	2.9	4.0
40–44	–3.3	2.8	3.1	3.8
45–49	–6.7	4.5	4.7	5.3
50–54	+6.9	2.4	2.8	3.7
55–59	+0.9	1.7	1.9	2.6
60–64	–2.1	2.4	3.0	4.0
65–69	+1.4	0.9	1.1	1.5
70–74	+3.6	0.9	1.1	1.5
75–79	+1.8	0.0	0.0	0.0
80–84	–0.9	0.8	0.8	1.0
85–89	+0.0	0.0	0.0	0.0
90–94	+0.0	0.0	0.0	0.0
95–100	+0.0	0.0	0.0	0.0

Figure 8 (150% of the national line): Differences and precision of differences for bootstrapped estimates of poverty rates for groups of households at a point in time, by sample size, scorecard applied to the validation sample

Sample Size	Difference between estimate and true value			
		Confidence interval (+/− percentage points)		
n	Diff.	90-percent	95-percent	99-percent
1	–1.2	65.1	75.8	90.0
4	+0.4	36.6	43.4	54.2
8	+0.1	26.2	30.5	38.6
16	+0.6	19.5	23.4	31.3
32	+0.6	13.3	16.0	21.7
64	+0.6	9.9	11.5	15.4
128	+0.6	7.0	8.2	11.6
256	+0.7	4.8	5.7	7.4
512	+0.7	3.5	4.1	5.4
1,024	+0.7	2.4	2.9	3.7
2,048	+0.7	1.8	2.1	2.6
4,096	+0.6	1.3	1.5	1.9
8,192	+0.6	0.9	1.0	1.4
16,384	+0.6	0.6	0.7	0.9

Figure 11 (150% of the national line): Households by targeting classification and score, along with "Total Accuracy" and BPAC, scorecard applied to the validation sample

Score	Inclusion: < poverty line correctly targeted	Undercoverage: < poverty line mistakenly non-targeted	Leakage: => poverty line mistakenly targeted	Exclusion: => poverty line correctly non-targeted	Total Accuracy Inclusion + Exclusion	BPAC See text
0–4	0.6	41.8	0.0	57.6	58.2	–97.1
5–9	1.0	41.4	0.0	57.6	58.6	–95.2
10–14	1.9	40.5	0.0	57.6	59.5	–91.1
15–19	4.6	37.8	0.2	57.4	62.0	–78.1
20–24	7.9	34.5	1.1	56.5	64.4	–60.4
25–29	13.2	29.1	2.4	55.2	68.4	–31.8
30–34	19.2	23.2	4.9	52.8	72.0	+2.2
35–39	25.1	17.3	9.1	48.5	73.6	+40.0
40–44	30.5	11.9	14.2	43.4	73.9	+66.4
45–49	35.6	6.7	20.1	37.5	73.2	+52.6
50–54	38.4	4.0	26.9	30.7	69.1	+36.6
55–59	40.4	2.0	33.7	23.9	64.4	+20.5
60–64	41.8	0.6	40.4	17.2	59.0	+4.6
65–69	42.2	0.1	47.3	10.4	52.6	–11.5
70–74	42.3	0.0	51.9	5.7	48.1	–22.4
75–79	42.3	0.0	54.3	3.3	45.7	–28.1
80–84	42.4	0.0	56.5	1.1	43.5	–33.4
85–89	42.4	0.0	57.1	0.5	42.9	–34.7
90–94	42.4	0.0	57.2	0.5	42.8	–34.9
95–100	42.4	0.0	57.6	0.0	42.4	–36.0

Inclusion, undercoverage, leakage, and exclusion normalized to sum to 100.

Figure 12 (150% of the national line): For a given score cut-off, the percentage of all households who are targeted (that is, have a score equal to or less than the cut-off), the percentage of targeted households who are poor (that is, below the poverty line), the percentage of poor households who are targeted, and the number of poor households who are successful targeted (coverage) per non-poor household mistakenly targeted (leakage), scorecard applied to the validation sample

Targeting cut-off	% all households who are targeted	% targeted who are poor	% of poor who are targeted	Poor households targeted per non-poor household targeted
0–4	0.6	100.0	1.5	Only poor targeted
5–9	1.0	99.2	2.4	127.8:1
10–14	1.9	99.3	4.4	149.5:1
15–19	4.7	96.2	10.7	25.2:1
20–24	8.9	88.0	18.5	7.3:1
25–29	15.6	84.6	31.2	5.5:1
30–34	24.1	79.8	45.4	4.0:1
35–39	34.2	73.3	59.2	2.7:1
40–44	44.7	68.2	72.0	2.1:1
45–49	55.8	63.9	84.1	1.8:1
50–54	65.3	58.8	90.6	1.4:1
55–59	74.1	54.5	95.4	1.2:1
60–64	82.2	50.8	98.6	1.0:1
65–69	89.5	47.2	99.7	0.9:1
70–74	94.2	44.9	99.9	0.8:1
75–79	96.6	43.8	99.9	0.8:1
80–84	98.9	42.8	100.0	0.7:1
85–89	99.5	42.6	100.0	0.7:1
90–94	99.5	42.6	100.0	0.7:1
95–100	100.0	42.4	100.0	0.7:1

Tables for
200% of the National Poverty Line

Figure 4 (200% of the national line): Estimated poverty likelihoods associated with scores

If a household's score is . . .	. . . then the likelihood (%) of being below the poverty line is:
0–4	100.0
5–9	100.0
10–14	100.0
15–19	98.8
20–24	95.8
25–29	90.2
30–34	85.7
35–39	85.2
40–44	73.0
45–49	66.8
50–54	57.1
55–59	41.6
60–64	33.5
65–69	18.8
70–74	13.5
75–79	2.9
80–84	3.9
85–89	0.0
90–94	0.0
95–100	0.0

Figure 7 (200% of the national line): Bootstrapped differences between estimated and true poverty likelihoods for households in a large sample (n = 16,384) with confidence intervals, scorecard applied to the validation sample

	Difference between estimate and true value			
		Confidence interval (+/– percentage points)		
Score	Diff.	90-percent	95-percent	99-percent
0–4	+0.0	0.0	0.0	0.0
5–9	+0.0	0.0	0.0	0.0
10–14	+0.1	0.1	0.1	0.1
15–19	+0.1	0.8	1.0	1.3
20–24	+2.3	1.6	1.9	2.6
25–29	–1.9	1.6	1.8	2.5
30–34	+2.9	2.5	2.9	3.7
35–39	+10.8	2.3	2.7	3.5
40–44	–3.2	2.5	2.6	2.8
45–49	–4.8	3.4	3.5	4.0
50–54	+2.5	2.5	3.0	4.0
55–59	+4.9	2.6	2.9	4.0
60–64	+0.5	2.7	3.2	4.3
65–69	+8.6	1.3	1.6	2.0
70–74	+0.4	2.4	2.9	3.7
75–79	+2.6	0.3	0.3	0.4
80–84	+2.9	0.7	0.7	1.0
85–89	+0.0	0.0	0.0	0.0
90–94	+0.0	0.0	0.0	0.0
95–100	+0.0	0.0	0.0	0.0

Figure 8 (200% of the national line): Differences and precision of differences for bootstrapped estimates of poverty rates for groups of households at a point in time, by sample size, scorecard applied to the validation sample

Sample Size	Difference between estimate and true value			
		Confidence interval (+/– percentage points)		
n	Diff.	90-percent	95-percent	99-percent
1	+0.2	65.7	75.8	88.4
4	+0.9	36.4	43.7	55.7
8	+1.5	26.1	31.4	42.3
16	+1.7	19.3	22.8	29.6
32	+1.9	14.0	16.0	19.9
64	+2.0	9.6	11.7	14.6
128	+2.0	7.0	8.0	10.5
256	+2.0	4.9	5.6	7.8
512	+2.1	3.4	4.0	5.6
1,024	+2.1	2.4	2.9	3.8
2,048	+2.1	1.8	2.1	2.9
4,096	+2.0	1.2	1.4	1.8
8,192	+2.0	0.9	1.1	1.4
16,384	+2.0	0.6	0.7	0.9

Figure 11 (200% of the national line): Households by targeting classification and score, along with "Total Accuracy" and BPAC, scorecard applied to the validation sample

Score	Inclusion: < poverty line correctly targeted	Undercoverage: < poverty line mistakenly non-targeted	Leakage: => poverty line mistakenly targeted	Exclusion: => poverty line correctly non-targeted	Total Accuracy Inclusion + Exclusion	BPAC See text
0–4	0.6	58.2	0.0	41.2	41.8	–97.9
5–9	1.0	57.8	0.0	41.2	42.2	–96.5
10–14	1.9	56.9	0.0	41.2	43.1	–93.6
15–19	4.7	54.1	0.1	41.1	45.8	–84.0
20–24	8.6	50.2	0.3	40.8	49.4	–70.2
25–29	14.8	44.0	0.8	40.3	55.1	–48.2
30–34	22.1	36.7	2.0	39.2	61.3	–21.4
35–39	29.9	28.9	4.3	36.9	66.8	+9.0
40–44	37.8	21.1	7.0	34.2	72.0	+40.3
45–49	45.5	13.4	10.3	30.9	76.3	+72.1
50–54	50.5	8.4	14.8	26.4	76.8	+74.8
55–59	54.5	4.3	19.6	21.6	76.0	+66.6
60–64	57.2	1.6	25.0	16.2	73.4	+57.5
65–69	58.2	0.6	31.3	9.9	68.1	+46.8
70–74	58.7	0.1	35.5	5.7	64.4	+39.7
75–79	58.8	0.0	37.9	3.3	62.1	+35.6
80–84	58.8	0.0	40.1	1.1	59.9	+31.9
85–89	58.8	0.0	40.7	0.5	59.3	+30.9
90–94	58.8	0.0	40.7	0.5	59.3	+30.8
95–100	58.8	0.0	41.2	0.0	58.8	+30.0

Inclusion, undercoverage, leakage, and exclusion normalized to sum to 100.

Figure 12 (200% of the national line): For a given score cut-off, the percentage of all households who are targeted (that is, have a score equal to or less than the cut-off), the percentage of targeted households who are poor (that is, below the poverty line), the percentage of poor households who are targeted, and the number of poor households who are successful targeted (coverage) per non-poor household mistakenly targeted (leakage), scorecard applied to the validation sample

Targeting cut-off	% all households who are targeted	% targeted who are poor	% of poor who are targeted	Poor households targeted per non-poor household targeted
0–4	0.6	100.0	1.1	Only poor targeted
5–9	1.0	100.0	1.8	Only poor targeted
10–14	1.9	99.8	3.2	416.2:1
15–19	4.7	98.7	7.9	77.5:1
20–24	8.9	96.1	14.6	24.8:1
25–29	15.6	94.6	25.2	17.4:1
30–34	24.1	91.8	37.6	11.3:1
35–39	34.2	87.4	50.9	6.9:1
40–44	44.7	84.4	64.2	5.4:1
45–49	55.8	81.5	77.3	4.4:1
50–54	65.3	77.3	85.8	3.4:1
55–59	74.1	73.5	92.6	2.8:1
60–64	82.2	69.6	97.3	2.3:1
65–69	89.5	65.1	99.0	1.9:1
70–74	94.2	62.3	99.9	1.7:1
75–79	96.6	60.8	99.9	1.6:1
80–84	98.9	59.5	100.0	1.5:1
85–89	99.5	59.1	100.0	1.4:1
90–94	99.5	59.1	100.0	1.4:1
95–100	100.0	58.8	100.0	1.4:1

Tables for
USAID "Extreme" Poverty Line

Figure 4 (USAID "extreme" line): Estimated poverty likelihoods associated with scores

If a household's score is . . .	. . . then the likelihood (%) of being below the poverty line is:
0–4	78.9
5–9	70.9
10–14	47.7
15–19	45.3
20–24	31.9
25–29	24.9
30–34	13.7
35–39	13.4
40–44	4.2
45–49	3.9
50–54	0.5
55–59	0.9
60–64	0.0
65–69	0.0
70–74	0.0
75–79	0.0
80–84	0.0
85–89	0.0
90–94	0.0
95–100	0.0

Figure 7 (USAID "extreme" line): Bootstrapped differences between estimated and true poverty likelihoods for households in a large sample (n = 16,384) with confidence intervals, scorecard applied to the validation sample

	Difference between estimate and true value			
		Confidence interval (+/– percentage points)		
Score	Diff.	90-percent	95-percent	99-percent
0–4	+3.2	8.7	10.2	13.6
5–9	+28.3	11.4	13.6	18.5
10–14	+25.4	5.8	7.1	8.5
15–19	+0.2	5.0	5.7	6.8
20–24	–4.9	4.1	4.4	5.0
25–29	–2.6	2.8	3.3	3.9
30–34	+1.2	1.5	1.7	2.5
35–39	–0.4	1.8	2.3	2.9
40–44	+0.8	0.7	0.8	1.0
45–49	–1.2	1.1	1.2	1.3
50–54	–0.1	0.3	0.3	0.4
55–59	–0.8	0.7	0.7	0.9
60–64	–0.3	0.2	0.2	0.3
65–69	+0.0	0.0	0.0	0.0
70–74	+0.0	0.0	0.0	0.0
75–79	+0.0	0.0	0.0	0.0
80–84	+0.0	0.0	0.0	0.0
85–89	+0.0	0.0	0.0	0.0
90–94	+0.0	0.0	0.0	0.0
95–100	+0.0	0.0	0.0	0.0

Figure 8 (USAID "extreme" line): Differences and precision of differences for bootstrapped estimates of poverty rates for groups of households at a point in time, by sample size, scorecard applied to the validation sample

Sample Size	Difference between estimate and true value			
		Confidence interval (+/– percentage points)		
n	Diff.	90-percent	95-percent	99-percent
1	–0.3	48.2	59.1	71.8
4	–0.1	22.1	27.7	40.3
8	+0.1	15.2	19.8	29.2
16	+0.2	11.0	13.2	18.4
32	+0.0	7.8	9.9	13.8
64	–0.1	5.7	6.7	10.1
128	–0.1	4.1	4.8	6.4
256	–0.2	3.0	3.6	4.6
512	–0.1	2.2	2.6	3.2
1,024	–0.2	1.5	1.9	2.4
2,048	–0.1	1.0	1.2	1.6
4,096	–0.1	0.7	0.9	1.2
8,192	–0.1	0.5	0.6	0.9
16,384	–0.1	0.4	0.4	0.6

Figure 11 (USAID "extreme" line): Households by targeting classification and score, along with "Total Accuracy" and BPAC, scorecard applied to the validation sample

Score	Inclusion: < poverty line correctly targeted	Undercoverage: < poverty line mistakenly non-targeted	Leakage: => poverty line mistakenly targeted	Exclusion: => poverty line correctly non-targeted	Total Accuracy Inclusion + Exclusion	BPAC See text
0–4	0.5	8.8	0.1	90.6	91.1	–88.1
5–9	0.7	8.5	0.3	90.4	91.2	–81.1
10–14	1.1	8.1	0.8	90.0	91.1	–67.7
15–19	2.4	6.8	2.3	88.4	90.8	–22.9
20–24	3.9	5.3	5.1	85.7	89.6	+38.9
25–29	5.4	3.8	10.2	80.5	86.0	–10.7
30–34	6.6	2.6	17.5	73.3	79.9	–89.5
35–39	7.9	1.4	26.4	64.4	72.3	–185.4
40–44	8.3	0.9	36.4	54.4	62.7	–294.1
45–49	8.9	0.3	46.8	44.0	52.9	–406.9
50–54	9.0	0.2	56.2	34.5	43.6	–508.9
55–59	9.2	0.0	64.9	25.9	35.1	–602.8
60–64	9.2	0.0	73.0	17.8	27.0	–690.3
65–69	9.2	0.0	80.3	10.5	19.7	–769.1
70–74	9.2	0.0	85.0	5.8	15.0	–820.5
75–79	9.2	0.0	87.4	3.4	12.6	–846.5
80–84	9.2	0.0	89.7	1.1	10.3	–871.1
85–89	9.2	0.0	90.2	0.5	9.8	–877.2
90–94	9.2	0.0	90.3	0.5	9.7	–878.0
95–100	9.2	0.0	90.8	0.0	9.2	–882.9

Inclusion, undercoverage, leakage, and exclusion normalized to sum to 100.

Figure 12 (USAID "extreme" line): For a given score cut-off, the percentage of all households who are targeted (that is, have a score equal to or less than the cut-off), the percentage of targeted households who are poor (that is, below the poverty line), the percentage of poor households who are targeted, and the number of poor households who are successful targeted (coverage) per non-poor household mistakenly targeted (leakage), scorecard applied to the validation sample

Targeting cut-off	% all households who are targeted	% targeted who are poor	% of poor who are targeted	Poor households targeted per non-poor household targeted
0–4	0.6	77.5	5.2	3.4:1
5–9	1.0	69.3	7.7	2.3:1
10–14	1.9	58.1	11.9	1.4:1
15–19	4.7	50.5	25.9	1.0:1
20–24	8.9	43.5	42.1	0.8:1
25–29	15.6	34.7	58.7	0.5:1
30–34	24.1	27.4	71.4	0.4:1
35–39	34.2	23.0	85.2	0.3:1
40–44	44.7	18.6	90.3	0.2:1
45–49	55.8	16.0	96.8	0.2:1
50–54	65.3	13.8	97.8	0.2:1
55–59	74.1	12.4	99.7	0.1:1
60–64	82.2	11.2	100.0	0.1:1
65–69	89.5	10.3	100.0	0.1:1
70–74	94.2	9.8	100.0	0.1:1
75–79	96.6	9.6	100.0	0.1:1
80–84	98.9	9.3	100.0	0.1:1
85–89	99.5	9.3	100.0	0.1:1
90–94	99.5	9.3	100.0	0.1:1
95–100	100.0	9.2	100.0	0.1:1

Tables for
$1.25/day 2005 PPP Poverty Line

Figure 4 ($1.25/day line): Estimated poverty likelihoods associated with scores

If a household's score is . . .	. . . then the likelihood (%) of being below the poverty line is:
0–4	100.0
5–9	92.1
10–14	100.0
15–19	92.3
20–24	82.6
25–29	67.0
30–34	61.8
35–39	55.3
40–44	38.0
45–49	31.3
50–54	24.6
55–59	11.3
60–64	6.2
65–69	2.5
70–74	2.8
75–79	0.0
80–84	0.0
85–89	0.0
90–94	0.0
95–100	0.0

Figure 7 ($1.25/day line): Bootstrapped differences between estimated and true poverty likelihoods for households in a large sample (n = 16,384) with confidence intervals, scorecard applied to the validation sample

	Difference between estimate and true value			
		Confidence interval (+/– percentage points)		
Score	Diff.	90-percent	95-percent	99-percent
0–4	+0.0	0.0	0.0	0.0
5–9	–6.0	4.0	4.0	4.0
10–14	+0.3	0.3	0.3	0.4
15–19	+3.2	2.5	2.9	3.9
20–24	+6.2	2.8	3.3	4.7
25–29	–5.0	3.7	3.9	4.2
30–34	+0.7	2.6	3.1	4.0
35–39	+9.3	2.3	2.8	3.7
40–44	–3.2	2.8	2.9	3.8
45–49	–6.3	4.3	4.5	5.1
50–54	+5.9	2.1	2.4	3.3
55–59	+0.5	1.4	1.6	2.0
60–64	–3.1	2.6	2.8	3.3
65–69	+0.0	0.8	0.9	1.2
70–74	+0.9	0.9	1.0	1.3
75–79	+0.0	0.0	0.0	0.0
80–84	+0.0	0.0	0.0	0.0
85–89	+0.0	0.0	0.0	0.0
90–94	+0.0	0.0	0.0	0.0
95–100	+0.0	0.0	0.0	0.0

Figure 8 ($1.25/day line): Differences and precision of differences for bootstrapped estimates of poverty rates for groups of households at a point in time, by sample size, scorecard applied to the validation sample

Sample Size	Difference between estimate and true value			
		Confidence interval (+/− percentage points)		
n	Diff.	90-percent	95-percent	99-percent
1	+0.4	62.0	71.2	88.2
4	+0.7	34.0	41.5	53.7
8	+0.3	25.2	29.8	41.2
16	+0.7	17.9	21.9	29.0
32	+0.4	12.9	14.9	20.5
64	+0.4	9.2	10.8	14.5
128	+0.4	6.5	8.3	10.3
256	+0.4	4.7	5.7	7.6
512	+0.4	3.3	3.9	5.2
1,024	+0.4	2.3	2.8	3.6
2,048	+0.4	1.7	2.1	2.5
4,096	+0.3	1.2	1.4	2.0
8,192	+0.3	0.8	1.1	1.4
16,384	+0.3	0.6	0.7	0.9

Figure 11 ($1.25/day line): Households by targeting classification and score, along with "Total Accuracy" and BPAC, scorecard applied to the validation sample

Score	Inclusion: < poverty line correctly targeted	Undercoverage: < poverty line mistakenly non-targeted	Leakage: => poverty line mistakenly targeted	Exclusion: => poverty line correctly non-targeted	Total Accuracy Inclusion + Exclusion	BPAC See text
0–4	0.6	33.7	0.0	65.7	66.3	–96.4
5–9	1.0	33.3	0.0	65.7	66.7	–94.0
10–14	1.9	32.4	0.0	65.7	67.5	–89.1
15–19	4.4	29.9	0.4	65.3	69.7	–73.5
20–24	7.5	26.8	1.4	64.3	71.8	–52.0
25–29	12.3	22.0	3.4	62.3	74.6	–18.7
30–34	17.5	16.8	6.6	59.1	76.6	+21.2
35–39	22.4	11.9	11.8	53.8	76.2	+65.0
40–44	26.6	7.7	18.1	47.6	74.2	+47.2
45–49	30.5	3.8	25.2	40.5	71.0	+26.5
50–54	32.2	2.1	33.0	32.7	64.9	+3.8
55–59	33.5	0.8	40.6	25.1	58.6	–18.3
60–64	34.0	0.3	48.2	17.5	51.5	–40.5
65–69	34.2	0.1	55.3	10.4	44.6	–61.1
70–74	34.3	0.0	59.9	5.8	40.1	–74.7
75–79	34.3	0.0	62.3	3.4	37.7	–81.7
80–84	34.3	0.0	64.6	1.1	35.4	–88.3
85–89	34.3	0.0	65.2	0.5	34.8	–90.0
90–94	34.3	0.0	65.2	0.5	34.8	–90.2
95–100	34.3	0.0	65.7	0.0	34.3	–91.5

Inclusion, undercoverage, leakage, and exclusion normalized to sum to 100.

Figure 12 ($1.25/day line): For a given score cut-off, the percentage of all households who are targeted (that is, have a score equal to or less than the cut-off), the percentage of targeted households who are poor (that is, below the poverty line), the percentage of poor households who are targeted, and the number of poor households who are successful targeted (coverage) per non-poor household mistakenly targeted (leakage), scorecard applied to the validation sample

Targeting cut-off	% all households who are targeted	% targeted who are poor	% of poor who are targeted	Poor households targeted per non-poor household targeted
0–4	0.6	100.0	1.8	Only poor targeted
5–9	1.0	98.8	3.0	82.1:1
10–14	1.9	98.6	5.4	71.4:1
15–19	4.7	92.3	12.7	12.0:1
20–24	8.9	84.1	21.9	5.3:1
25–29	15.6	78.4	35.7	3.6:1
30–34	24.1	72.6	51.0	2.7:1
35–39	34.2	65.4	65.2	1.9:1
40–44	44.7	59.5	77.6	1.5:1
45–49	55.8	54.8	89.0	1.2:1
50–54	65.3	49.4	94.0	1.0:1
55–59	74.1	45.2	97.7	0.8:1
60–64	82.2	41.4	99.1	0.7:1
65–69	89.5	38.2	99.8	0.6:1
70–74	94.2	36.4	100.0	0.6:1
75–79	96.6	35.5	100.0	0.6:1
80–84	98.9	34.7	100.0	0.5:1
85–89	99.5	34.5	100.0	0.5:1
90–94	99.5	34.5	100.0	0.5:1
95–100	100.0	34.3	100.0	0.5:1

Tables for
$2.50/day 2005 PPP Poverty Line

Figure 4 ($2.50/day line): Estimated poverty likelihoods associated with scores

If a household's score is . . .	. . . then the likelihood (%) of being below the poverty line is:
0–4	100.0
5–9	100.0
10–14	100.0
15–19	98.8
20–24	100.0
25–29	95.5
30–34	94.8
35–39	93.0
40–44	86.5
45–49	83.7
50–54	78.1
55–59	61.5
60–64	47.4
65–69	32.1
70–74	14.3
75–79	9.3
80–84	5.7
85–89	0.0
90–94	0.0
95–100	0.0

Figure 7 ($2.50/day line): Bootstrapped differences between estimated and true poverty likelihoods for households in a large sample (n = 16,384) with confidence intervals, scorecard applied to the validation sample

	Difference between estimate and true value			
		Confidence interval (+/– percentage points)		
Score	Diff.	90-percent	95-percent	99-percent
0–4	+0.0	0.0	0.0	0.0
5–9	+0.0	0.0	0.0	0.0
10–14	+0.0	0.0	0.0	0.0
15–19	–1.2	0.6	0.6	0.6
20–24	+1.2	0.6	0.8	1.0
25–29	–4.4	2.3	2.3	2.3
30–34	–0.4	1.0	1.2	1.5
35–39	+4.9	1.9	2.3	3.1
40–44	–2.3	1.8	1.9	2.1
45–49	–1.7	1.6	1.8	2.4
50–54	+8.3	2.2	2.7	3.6
55–59	+0.5	2.9	3.3	4.2
60–64	–3.3	3.0	3.3	4.0
65–69	+13.6	1.9	2.2	2.8
70–74	–13.8	8.4	8.6	9.1
75–79	+4.9	1.5	1.7	2.2
80–84	–19.1	12.5	13.0	14.4
85–89	–0.9	1.0	1.2	1.4
90–94	+0.0	0.0	0.0	0.0
95–100	+0.0	0.0	0.0	0.0

Figure 8 ($2.50/day line): Differences and precision of differences for bootstrapped estimates of poverty rates for groups of households at a point in time, by sample size, scorecard applied to the validation sample

Sample Size	Difference between estimate and true value			
		Confidence interval (+/– percentage points)		
n	Diff.	90-percent	95-percent	99-percent
1	–0.7	69.2	84.7	93.6
4	–0.5	34.6	42.8	59.2
8	+0.2	25.0	31.5	42.7
16	+0.2	18.5	22.9	30.1
32	+0.1	13.9	16.1	22.3
64	+0.2	9.5	11.8	15.4
128	+0.2	6.9	7.9	10.6
256	+0.3	4.8	5.8	7.6
512	+0.4	3.4	4.2	5.6
1,024	+0.4	2.4	2.9	4.0
2,048	+0.3	1.7	2.0	2.6
4,096	+0.3	1.2	1.4	1.9
8,192	+0.3	0.9	1.1	1.4
16,384	+0.3	0.6	0.7	1.0

Figure 11 ($2.50/day line): Households by targeting classification and score, along with "Total Accuracy" and BPAC, scorecard applied to the validation sample

Score	Inclusion: < poverty line correctly targeted	Undercoverage: < poverty line mistakenly non-targeted	Leakage: => poverty line mistakenly targeted	Exclusion: => poverty line correctly non-targeted	Total Accuracy Inclusion + Exclusion	BPAC See text
0–4	0.6	70.0	0.0	29.3	30.0	–98.3
5–9	1.0	69.6	0.0	29.3	30.4	–97.1
10–14	1.9	68.8	0.0	29.3	31.2	–94.7
15–19	4.7	65.9	0.0	29.3	34.1	–86.6
20–24	8.9	61.8	0.1	29.3	38.2	–74.8
25–29	15.6	55.1	0.1	29.3	44.8	–55.8
30–34	23.6	47.1	0.5	28.8	52.4	–32.5
35–39	32.8	37.8	1.4	28.0	60.8	–5.1
40–44	42.1	28.6	2.7	26.7	68.8	+22.9
45–49	51.4	19.2	4.3	25.0	76.4	+51.7
50–54	58.0	12.6	7.2	22.1	80.1	+74.5
55–59	63.4	7.3	10.7	18.6	82.1	+84.9
60–64	67.3	3.4	14.9	14.4	81.7	+78.9
65–69	69.1	1.6	20.4	8.9	78.0	+71.1
70–74	70.2	0.4	24.0	5.3	75.5	+66.0
75–79	70.4	0.3	26.2	3.1	73.5	+62.9
80–84	70.6	0.0	28.3	1.1	71.7	+60.0
85–89	70.7	0.0	28.8	0.5	71.2	+59.2
90–94	70.7	0.0	28.9	0.5	71.1	+59.1
95–100	70.7	0.0	29.3	0.0	70.7	+58.5

Inclusion, undercoverage, leakage, and exclusion normalized to sum to 100.

Figure 12 ($2.50/day line): For a given score cut-off, the percentage of all households who are targeted (that is, have a score equal to or less than the cut-off), the percentage of targeted households who are poor (that is, below the poverty line), the percentage of poor households who are targeted, and the number of poor households who are successful targeted (coverage) per non-poor household mistakenly targeted (leakage), scorecard applied to the validation sample

Targeting cut-off	% all households who are targeted	% targeted who are poor	% of poor who are targeted	Poor households targeted per non-poor household targeted
0–4	0.6	100.0	0.9	Only poor targeted
5–9	1.0	100.0	1.5	Only poor targeted
10–14	1.9	100.0	2.7	Only poor targeted
15–19	4.7	100.0	6.7	Only poor targeted
20–24	8.9	99.4	12.6	162.2:1
25–29	15.6	99.5	22.0	217.3:1
30–34	24.1	98.0	33.4	47.8:1
35–39	34.2	95.9	46.5	23.6:1
40–44	44.7	94.1	59.5	15.8:1
45–49	55.8	92.2	72.8	11.8:1
50–54	65.3	88.9	82.1	8.0:1
55–59	74.1	85.6	89.7	5.9:1
60–64	82.2	81.8	95.2	4.5:1
65–69	89.5	77.2	97.8	3.4:1
70–74	94.2	74.5	99.4	2.9:1
75–79	96.6	72.8	99.6	2.7:1
80–84	98.9	71.4	100.0	2.5:1
85–89	99.5	71.0	100.0	2.5:1
90–94	99.5	71.0	100.0	2.4:1
95–100	100.0	70.7	100.0	2.4:1

Tables for
Sulaiman's (2009) $1.25/day 2005 PPP Poverty Line

Figure 4 (Sulaiman $1.25/day line): Estimated poverty likelihoods associated with scores

If a household's score is . . .	. . . then the likelihood (%) of being below the poverty line is:
0–4	97.1
5–9	89.5
10–14	78.9
15–19	58.4
20–24	55.3
25–29	38.1
30–34	29.2
35–39	16.7
40–44	13.3
45–49	6.3
50–54	5.4
55–59	3.1
60–64	0.0
65–69	0.0
70–74	0.0
75–79	0.0
80–84	0.0
85–89	0.0
90–94	0.0
95–100	0.0

Figure 7 (Sulaiman $1.25/day line): Bootstrapped differences between estimated and true poverty likelihoods for households in a large sample (n = 16,384) with confidence intervals, scorecard applied to the validation sample

	Difference between estimate and true value			
		Confidence interval (+/– percentage points)		
Score	Diff.	90-percent	95-percent	99-percent
0–4	+2.7	2.1	2.5	3.2
5–9	+2.2	3.3	4.0	4.8
10–14	+4.7	4.4	5.0	6.5
15–19	–10.4	6.7	7.1	7.4
20–24	+8.7	2.5	2.9	3.7
25–29	+4.6	2.1	2.4	3.1
30–34	+2.5	1.7	2.1	2.8
35–39	–4.0	2.7	2.9	3.1
40–44	–0.2	1.5	1.7	2.3
45–49	–3.7	2.5	2.6	3.1
50–54	+1.1	0.9	1.2	1.6
55–59	+0.2	0.8	1.0	1.3
60–64	–1.6	1.1	1.2	1.4
65–69	–0.6	0.5	0.6	0.6
70–74	+0.0	0.0	0.0	0.0
75–79	+0.0	0.0	0.0	0.0
80–84	+0.0	0.0	0.0	0.0
85–89	+0.0	0.0	0.0	0.0
90–94	+0.0	0.0	0.0	0.0
95–100	+0.0	0.0	0.0	0.0

Figure 8 (Sulaiman $1.25/day line): Differences and precision of differences for bootstrapped estimates of poverty rates for groups of households at a point in time, by sample size, scorecard applied to the validation sample

Sample Size	Difference between estimate and true value			
		Confidence interval (+/− percentage points)		
n	Diff.	90-percent	95-percent	99-percent
1	+1.4	63.1	71.0	92.0
4	+0.8	29.0	34.9	45.0
8	+0.9	20.3	24.8	30.7
16	+0.3	15.5	18.1	23.2
32	+0.2	10.6	12.9	15.8
64	+0.2	7.8	8.7	11.2
128	+0.3	5.1	6.0	7.6
256	+0.4	3.6	4.4	5.6
512	+0.3	2.6	3.2	4.1
1,024	+0.3	1.8	2.2	2.7
2,048	+0.2	1.3	1.5	2.0
4,096	+0.2	0.9	1.1	1.5
8,192	+0.3	0.6	0.8	1.0
16,384	+0.3	0.5	0.6	0.7

Figure 11 (Sulaiman $1.25/day line): Households by targeting classification and score, along with "Total Accuracy" and BPAC, scorecard applied to the validation sample

Score	Inclusion: < poverty line correctly targeted	Undercoverage: < poverty line mistakenly non-targeted	Leakage: => poverty line mistakenly targeted	Exclusion: => poverty line correctly non-targeted	Total Accuracy Inclusion + Exclusion	BPAC See text
0–4	1.9	19.9	0.1	75.9	77.8	–82.0
5–9	3.4	18.4	0.3	75.7	79.1	–67.5
10–14	4.7	17.1	0.7	75.3	79.9	–53.7
15–19	7.0	14.8	1.7	74.3	81.3	–28.0
20–24	10.1	11.7	4.8	71.2	81.3	+14.9
25–29	12.7	9.0	10.2	65.8	78.5	+53.0
30–34	16.1	5.6	17.9	58.1	74.2	+17.6
35–39	18.5	3.3	26.8	49.2	67.7	–23.1
40–44	20.0	1.7	35.7	40.3	60.4	–64.0
45–49	20.9	0.8	44.0	32.0	52.9	–102.4
50–54	21.4	0.3	51.2	24.8	46.2	–135.4
55–59	21.6	0.1	58.5	17.5	39.1	–169.0
60–64	21.7	0.0	64.7	11.4	33.1	–197.2
65–69	21.8	0.0	69.2	6.8	28.6	–218.1
70–74	21.8	0.0	72.4	3.6	25.4	–232.8
75–79	21.8	0.0	74.4	1.6	23.3	–242.2
80–84	21.8	0.0	75.3	0.8	22.5	–245.9
85–89	21.8	0.0	75.7	0.4	22.1	–247.8
90–94	21.8	0.0	75.7	0.4	22.1	–247.8
95–100	21.8	0.0	76.0	0.0	21.8	–249.5

Inclusion, undercoverage, leakage, and exclusion normalized to sum to 100.

Figure 12 (Sulaiman $1.25/day line): For a given score cut-off, the percentage of all households who are targeted (that is, have a score equal to or less than the cut-off), the percentage of targeted households who are poor (that is, below the poverty line), the percentage of poor households who are targeted, and the number of poor households who are successful targeted (coverage) per non-poor household mistakenly targeted (leakage), scorecard applied to the validation sample

Targeting cut-off	% all households who are targeted	% targeted who are poor	% of poor who are targeted	Poor households targeted per non-poor household targeted
0–4	0.6	93.0	2.6	13.2:1
5–9	1.0	90.1	4.3	9.1:1
10–14	1.9	84.8	7.3	5.6:1
15–19	4.7	78.3	17.0	3.6:1
20–24	8.9	66.6	27.4	2.0:1
25–29	15.6	54.6	39.2	1.2:1
30–34	24.1	46.6	51.6	0.9:1
35–39	34.2	40.2	63.2	0.7:1
40–44	44.7	35.4	72.7	0.5:1
45–49	55.8	31.7	81.2	0.5:1
50–54	65.3	28.9	86.7	0.4:1
55–59	74.1	26.4	89.9	0.4:1
60–64	82.2	24.6	92.9	0.3:1
65–69	89.5	23.4	96.2	0.3:1
70–74	94.2	22.6	97.8	0.3:1
75–79	96.6	22.1	98.2	0.3:1
80–84	98.9	21.9	99.7	0.3:1
85–89	99.5	21.8	99.8	0.3:1
90–94	99.5	21.8	99.9	0.3:1
95–100	100.0	21.8	100.0	0.3:1