Simple Poverty Scorecard®
Rwanda

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26 November 2010

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Abstract

The Simple Poverty Scorecard® uses ten low-cost indicators from Rwanda's 2005/6 Integrated Household Living Standards 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 bias and precision are reported for a range of poverty lines. The scorecard is a practical way for pro-poor programs in Rwanda to measure poverty rates, to track changes in poverty rates over time, and to segment clients for targeted services.

Acknowledgements

This paper was funded by the Ford Foundation via a grant to Grameen Foundation (GF). Data are from the *Institut National de la Statistique du Rwanda*. Thanks go to Nigel Biggar, Frank DeGiovanni, Clare O'Brien, Tony Sheldon, Jeff Toohig, and Cindy Yang. The Simple Poverty Scorecard® is the same as what GF calls the Progress out of Poverty Index® (PPI®). The PPI® is a performance-management tool that GF promotes to help institutions achieve their social objectives more effectively.

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Simple Poverty Scorecard®

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

Indicator	Value	Points	Score
1. How many household members are 17-years-old or less?	A. Five or more	0	
	B. Four	1	
	C. Three	7	
	D. Two	8	
	E. One	13	
	F. None	20	
2. Have all household members ages 7 to 17 been to school in the last 12 months?	A. No	0	
	B. Yes	2	
	C. No one in age range	3	
3. What is the highest grade that the female head/spouse has successfully completed?	A. Never attended school	0	
	B. Attended and completed none, one, or two years	2	
	C. Years 3 or 4 of primary	3	
	D. Years 5 or 6 of primary	5	
	E. There is no female head/spouse	5	
	F. Anything after 6 years of primary	9	
4. What is the status of the male head/spouse in his main occupation?	A. Agricultural wage worker, or does not work	0	
	B. There is no male head/spouse	3	
	C. Self-employed in agriculture, or unpaid worker (homemaker, apprentice, volunteer, etc.)	4	
	D. Non-agricultural wage worker	5	
	E. Self-employed in non-agriculture	8	
5. What is the main material of the floor?	A. Packed earth	0	
	B. Wood, cement, tiles, bricks, stone, or other	7	
6. How many rooms does the household occupy (do not count bathrooms, water closets, or kitchen)?	A. One	0	
	B. Two or three	5	
	C. Four	7	
	D. Five	9	
	E. Six or more	12	
7. What is the main source of lighting for the household?	A. Burning wood, or other	0	
	B. Home-made kerosene or fuel-oil lamp (*agatadowa*)	8	
	C. Candles, gas lamp, electrical grid, or generator	13	
8. What is the main fuel used for cooking?	A. Firewood, field waste, or other	0	
	B. Charcoal, LPG, electricity, or kerosene	16	
9. Does the household own a radio or radio-cassette player?	A. No	0	
	B. Yes	3	
10. How many ares of agricultural land does the household own or use?	A. 0 to 10	0	
	B. 11 to 35	1	
	C. 36 to 60	2	
	D. 61 to 100	4	
	E. 101 to 150	6	
	F. 151 or more	9	

Score:

Simple Poverty Scorecard®
Rwanda

1. Introduction

This paper presents the Simple Poverty Scorecard®. Pro-poor programs in Rwanda can use it to estimate the likelihood that a household has expenditure below a given poverty line, to measure groups' poverty rates at a point in time, to track changes in groups' poverty rates over time, and to segment clients for targeted services.

The direct approach to poverty measurement via surveys is difficult and costly, asking households about a lengthy list of expenditure items. As a case in point, Rwanda's 2005/6 Household Living Standards Survey (*Enquête Intégrale sur les Conditions de Vie des Ménages*, EICV) runs 75 pages. The expenditure module covers hundreds of items, and enumerators visit each household 11 times to record food expenditure. An example set of questions are "Has the household purchased corn on the cob in the past 12 months? If yes, in how many months? How much have you spent on corn on the cob since the last visit? Has the household consumed corn on the cob that it produced itself in the past 12 months? If yes, in how many months? How much of your own corn on the cob have you consumed since the last visit? For what price could you have sold this corn on the cob? Now then, has the household purchased dry corn in the past 12 months? . . .".

In contrast, the indirect approach via the scorecard is simple, quick, and inexpensive. It uses ten verifiable indicators (such as "What is the main material of the floor?" or "How many ares of agricultural land does the household own or use?") to get a score that is highly correlated with poverty status as measured by the exhaustive survey.

The Simple Poverty 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 organizations are typically subjective and relative (such as participatory wealth ranking by skilled field workers) or blunt (such as rules based on land-ownership or housing quality). Measurements from these approaches are not comparable across organizations, they may be costly, and their accuracy and precision are unknown.

Pro-poor organizations can use the Simple Poverty Scorecard® to measure the share of their participants below a given poverty line, such as the Millennium Development Goals' $1.25/day poverty line at 2005 purchase-power parity. USAID microenterprise partners can use it to report how many of its participants are among the poorest half of people below the national poverty line. Organizations can also use it to measure movement across a poverty line (Daley-Harris, 2009). In all these cases, the Simple Poverty Scorecard® provides an expenditure-based, objective tool with known accuracy. While expenditure surveys are costly even for governments, many 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 three decades, but they are rarely used to inform decisions at the local level, 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 usually about as accurate as complex ones.

The technical approach here is 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 accuracy tests are simple and commonplace in statistical practice and in the for-profit field of credit-risk scoring, they have rarely been applied to poverty-assessment tools.

The scorecard is based on the 2005/6 EICV conducted by the *Institut Nationale de la Statistique du Rwanda*. 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 be used to estimate three basic quantities. First, it can estimate a particular household's "poverty likelihood", that is, the probability that the household has per-adult-equivalent or per-capita expenditure below a given poverty line.

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

Third, the scorecard can 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) of households over time.

The scorecard can also be used for targeting. To help managers choose the most 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 Rwanda's national poverty line. Scores from this one scorecard are calibrated to poverty likelihoods for seven poverty lines.

The scorecard is constructed and calibrated using some of the data from the 2005/6 EICV, and its accuracy is validated on the rest of the data.

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.[1]

Thus, while the indirect scoring approach is less costly than the direct survey approach, it is also biased. (The survey approach is unbiased by assumption.) There is bias because scoring must assume that the future relationship between indicators and poverty will be the same as in the data used to build the scorecard. Of course, this assumption—ubiquitous and inevitable in predictive modeling—holds only partly.

When applied to the validation sample with bootstrap samples of n = 16,384, the difference between scorecard estimates of groups' poverty rates and the true rates at a point in time is +0.6 percentage points for the national line, and the average absolute difference across all seven lines is 0.9 percentage points. These differences are due to sampling variation and not bias; the average of each difference would be zero if the

[1] Important examples include nationally representative samples at a different point in time or non-nationally representative sub-groups (Tarozzi and Deaton, 2009).

whole 2005/6 EICV were to be repeatedly redrawn and divided into sub-samples before repeating the entire process of building and calibrating scorecards.

The 90-percent confidence intervals for these estimates are +/–0.6 percentage points or less. For $n = 1{,}024$, the 90-percent intervals are +/–2.2 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 through time, and Section 8 covers targeting. Section 9 places the new scorecard here in the context of an existing exercise for Rwanda, and Section 10 is a summary.

2. Data and poverty lines

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

2.1 Data

The scorecard is based on data from 6,900 households in the 2005/6 EICV conducted from 12 October 2005 to 3 October 2006. This is Rwanda's most recent available national expenditure survey.[2]

For the purposes of the scorecard, the households in the 2005/6 EICV are randomly divided into three sub-samples:

- *Construction* for selecting indicators and points
- *Calibration* for associating scores with poverty likelihoods
- *Validation* for measuring accuracy with 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 household members or by the number of adult equivalents) is below a given poverty line.

[2] Meta-data and documentation at `http://196.44.242.24/eicv/survey0/index.html`, retrieved 25 April 2010.

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 or by the number of adult equivalents 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-capita expenditure (or per-adult-equivalent expenditure) above a poverty line (it is "non-poor") and that the second household has per-capita expenditure (or per-adult-equivalent expenditure) below a poverty line (it is "poor"). The household-level rate counts both households as if they had only one person (or one adult equivalent) 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 (or by the number of adult equivalents) 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 those 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 2 reports poverty rates and poverty lines for Rwanda at both the household-level and the person-level for its provinces (Kigali, Southern, Western, Northern, and Eastern) and for Rwanda as a whole. The scorecard is constructed using the 2005/6 EICV and household-level lines, scores are calibrated to household-level poverty likelihoods, and accuracy is measured for household-level rates. This use of household-level rates reflects the belief that they are relevant for most pro-poor organizations.

Organizations can estimate person-level poverty rates by taking a household-size-weighted average of the household-level poverty likelihoods. It is also possible to construct a scorecard based on person-level lines, calibrate scores to person-level likelihoods, and measure accuracy for person-level rates, but it is not done here.

2.2.2 Poverty lines

Rwanda's national poverty line for use with the 2005/6 EICV is documented in McKay and Greenwell (2007). The approach accounts for differences in prices across time (months when the EICV was in the field) and across provinces. It also uses the concept of *adult equivalents* to adjust for the fact that consumption needs vary by age and sex. Poverty lines developed with this approach for the 1999/2001 EICV are then adjusted to prices as of January 2006 using food and non-food deflators by month and

region. The food deflator is based on the average food basket consumed by the poorest 60 percent of people, using semi-monthly data "collected by the MINAGRI Mercuriale programme of price data collection (previously PASAR: *Programme d'Appui à la Securité Alimentaire au Rwanda*)" (p. 5). Deflators for non-food expenditure items come from Rwanda's official consumer price index, again by month and province.

Using the cost-of-basic-needs approach (Observatoire de la Pauvreté, no date), the food poverty line is defined as the cost of 2,500 Calories based on the average consumption basket observed in the 1999/2001 EICV among the poorest 60 percent of people. For the 2005/6 EICV and with prices as of January 2006, this translates to an average food poverty line of RFW175 per adult equivalent per day, giving all-Rwanda poverty rates of 34.0 percent at the household level and 36.9 percent at the person level (Figure 2).

The national poverty line (sometimes called here "100% of the national line") is defined as the average total expenditure for households whose actual food expenditure is within +/–10 percent of the food poverty line. For Rwanda on average, this is RFW249 per adult equivalent per day, giving all-Rwanda poverty rates of 54.0 percent at the household level and 56.8 percent at the person level (Figure 2).

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 seven lines:

- National
- Food
- 50% of national
- 150% of national
- USAID "extreme"
- $1.25/day 2005 PPP
- $2.50/day 2005 PPP

The USAID "extreme" line is defined as the median expenditure of people (not adult equivalents nor households) below the national line (U.S. Congress, 2002).

The $1.25/day 2005 PPP line is derived from:

- 2005 PPP exchange rate for "individual consumption expenditure by households" (World Bank, 2008): RFW236.75 per $1.00
- January 2006 all-Rwanda consumer price index of 124.3
- Year-over-year inflation from January 2005 to January 2006 of 5.2 percent.[3] Assuming linear change in the price index, the average CPI in 2005 is then 121.2

Given this, the $1.25/day 2005 PPP line for Rwanda as a whole during the 2005/6 EICV is (Sillers, 2006):

$$(\text{2005 PPP exchange rate}) \cdot \$1.25 \cdot \left(\frac{\text{CPI}_{\text{Jan. 2006}}}{\text{CPI}_{\text{2005 average}}} \right) =$$
$$\left(\frac{\text{RFW236.75}}{\$1.00} \right) \cdot \$1.25 \cdot \left(\frac{124.3}{121.2} \right) = \text{RFW303.51}.$$

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

[3] `http://statistics.gov.rw/images/CPIpdf/publication0107en.pdf`, retrieved 25 April 2010.

The 2005 PPP lines just discussed apply to Rwanda as a whole. They are adjusted for cost-of-living differences across provinces using:

- L, a given all-Rwanda 2005 PPP poverty line
- π_i, the January 2006 deflator for province i
- w_i, the person-level population weight for region i
- N, number of provinces (5)

The cost-of-living-adjusted 2005 PPP poverty line L_i for province i is then:

$$L_i = \frac{L \cdot \pi_i}{(\sum_{i=1}^{N} \pi_i \cdot w_i) / \sum_{i=1}^{N} w_i}.$$

For each of the seven poverty lines, Figure 2 shows the all-Rwanda lines as well as the lines for the provinces. This paper uses the national line to construct the scorecard.

3. Scorecard construction

For Rwanda, about 100 potential indicators are initially prepared in the areas of:

- Family composition (such as household size)
- Education (such as the highest grade completed by the female head/spouse)
- Housing (such as floor material)
- Ownership of durable goods (such as radios and radio-cassette players)

Each indicator is first reviewed with the entropy-based "uncertainty coefficient" (Goodman and Kruskal, 1979) that measures how well the indicator predicts poverty on its own. Figure 3 lists all the candidate indicators, ranked by uncertainty coefficient.

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, ownership of a radio or radio-cassette player 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 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), including improvement in accuracy, likelihood of acceptance by users (determined by simplicity, cost of collection, and "face validity" 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 Rwanda. Evidence from India and Mexico (Schreiner, 2006 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 (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 scoring is actually 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 have similar targeting accuracy, thanks to the empirical phenomenon known as the "flat maximum" (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 a lot of "extra" 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. "Extra" 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 worker using the paper scorecard would:

- Record participant identifiers and household size
- Read each question from the scorecard
- Circle the response and its points
- Write the points 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

Of course, field workers must be trained. The quality of outputs depends on the quality of inputs. If organizations or field workers 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 random audits (Matul and Kline, 2003).[4] IRIS Center (2007a) and Toohig (2008) are useful nuts-and-bolts guides for budgeting, training field workers and supervisors, logistics, sampling, interviewing, piloting, recording data, and controlling quality.

[4] If an organization does not want field workers 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.

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. 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 an automobile. 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 conditional cash-transfer program in Mexico, 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 the suggested procedure for the scorecard in Rwanda.

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.

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 in the field and then filed at an office
- On paper in the field and then keyed into a database or spreadsheet at an office
- On portable electronic devices in the field and downloaded to a database

The subjects to be scored can be:

- All participants (or all new participants)
- A representative sample of all participants (or of all new participants)
- All participants (or all new participants) in a representative sample of branches
- A representative sample of all participants (or of all new participants) in a representative sample of branches
- A representative sample of participants relevant for a given business question

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 worker 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 are illustrated by BRAC and ASA, two microlenders in Bangladesh who each have more than 7 million participants and who are applying the Simple Poverty Scorecard® (Chen and Schreiner, 2009b). Their design is that loan officers in a random sample of branches score all 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 50,000–100,000 participants each.

5. Estimates of household poverty likelihoods

The sum of scorecard points for a household is called the *score*. For Rwanda, 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 must be 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 35–39 have a poverty likelihood of 51.8 percent, and scores of 40–44 have a poverty likelihood of 42.1 percent (Figure 4).

The poverty likelihood associated with a score varies by poverty line. For example, scores of 35–39 are associated with a poverty likelihood of 51.8 percent for the national line but 27.1 percent for the food line.[5]

5.1 Calibrating scores with poverty likelihoods

A given score is non-parametrically 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.

[5] Starting with Figure 4, many figures have seven versions, one for each of the seven poverty lines. To keep them straight, they are grouped by poverty line. Single tables pertaining to all poverty lines are placed with the tables for the national line.

For the example of the national line (Figure 5), there are 17,299 (normalized) households in the calibration sub-sample with a score of 35–39, of whom 8,966 (normalized) are below the poverty line. The estimated poverty likelihood associated with a score of 35–39 is then 51.8 percent, because 8,966 ÷ 17,299 = 51.8 percent.

To illustrate with the national line and a score of 40–44, there are 11,499 (normalized) households in the calibration sample, of whom 4,844 (normalized) are below the line (Figure 5). Thus, the poverty likelihood for this score is 4,844 ÷ 11,499 = 42.1 percent.

The same method is used to calibrate scores with estimated poverty likelihoods for the other six poverty lines.

Figures 6a and 6b show, for all scores, the likelihood that expenditure falls in a range demarcated by two adjacent poverty lines.[6] For example, the daily expenditure of an adult equivalent in a household with a score of 35–39 falls in the following ranges with probability:

- 10.3 percent below 50% of the national line
- 7.9 percent between 50% of the national line and the USAID "extreme" line
- 8.9 percent between the USAID "extreme" line and the food line
- 24.7 percent between the food line and 100% of the national line
- 26.7 percent between 100% and 150% of the national line
- 21.5 percent above 150% of the national line

[6] Figure 6a is for the per-adult-equivalent national lines, and Figure 6b is for the per-person 2005 PPP lines.

For the international 2005 PPP lines in per-capita terms, a household with a score of 35–39 falls in the following ranges with probability:

- 72.8 percent below the $1.25/day 2005 PPP line
- 24.4 percent between the $1.25/day and $2.50/day 2005 PPP lines
- 2.8 percent above the $2.50/day 2005 PPP line

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 Rwanda 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 non-parametric 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 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 poverty likelihood. 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.[7]

Of course, the relationship between indicators and poverty does change to some unknown extent with time and also across sub-groups in Rwanda's population, so the scorecard will generally be biased when applied after October 2006 (the last month of fieldwork for the 2005/6 EICV) or when applied with non-nationally representative sub-groups.

[7] 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 as well as confidence intervals for the differences.

For the national line, the average poverty likelihood across bootstrap samples for scores of 35–39 in the validation sample is too low by 0.2 percentage points. For scores of 40–44, the estimate is too high by 1.0 percentage point.[8]

The 90-percent confidence interval for the differences for scores of 35–39 is +/– 1.5 percentage points (Figure 7). This means that in 900 of 1,000 bootstraps, the difference between the estimate and the true value is between –1.7 and +1.3 percentage

[8] 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 building and calibration.

points (because –0.2 – 1.5 = –1.7, and –0.2 + 1.5 = +1.3). In 950 of 1,000 bootstraps (95 percent), the difference is –0.2 +/–1.9 percentage points, and in 990 of 1,000 bootstraps (99 percent), the difference is
–0.2 +/–2.6 percentage points.

For all scores, Figure 7 shows differences—sometimes large ones—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 Rwanda's population. For targeting, however, 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 balance 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 EICV fieldwork in October 2006. That is, it may fit the data from the 2005/6 EICV 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 2005/6 EICV. Or the scorecard may be overfit in the sense that it is not robust

to changes in the relationships between indicators and poverty over time or when it is applied to non-nationally representative samples.

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 greater complexity.

Most errors in individual households' likelihoods, however, cancel out in the estimates of groups' poverty rates (see later sections). Furthermore, at least some of the differences come from non-scorecard sources such as changes in the relationships between indicators and poverty, sampling variation, changes in poverty lines, inconsistencies in data quality across time, and imperfections in cost-of-living adjustments across time and geography. These factors 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, 2010 and that they have scores of 20, 30, and 40, corresponding to poverty likelihoods of 87.3, 66.5, and 42.1 percent (national line, Figure 4). The group's estimated poverty rate is the households' average poverty likelihood of $(87.3 + 66.5 + 42.1) \div 3 = 65.3$ percent.[9]

6.1 Accuracy of estimated poverty rates at a point in time

For the Rwanda scorecard applied to the validation sample with $n = 16{,}384$, the absolute differences between the estimated poverty rate at a point in time and the true rate are 1.3 percentage points or less (Figure 9, summarizing Figure 8 across poverty lines). The average absolute difference across the seven poverty lines is 0.9 percentage points. At least part of these differences is due to sampling variation in the validation sample and in the division of the 2005/6 EICV into three 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 9). This means that in 900 of 1,000 bootstraps of this size, the difference

[9] 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 66.5 percent. This is not the 65.3 percent found as the average of the three poverty likelihoods associated with each of the three scores.

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 +0.6 – 0.6 = 0.0 to +0.6 + 0.6 = +1.2 percentage points. This is because +0.6 is the average difference, and +/–0.6 is its 90-percent confidence interval. The average difference is +0.6 because the average scorecard estimate is too high by 0.6 percentage points; it estimates a poverty rate of 54.4 percent for the validation sample, but the true value is 53.8 percent (Figure 2).

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 scorecards (Schreiner, 2008a), note that the textbook formula (Cochran, 1977) that relates confidence intervals with standard errors in the case of direct measurement of rates 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 54.1 percent (the average poverty rate in the construction and calibration samples in Figure 2 for the national line), the confidence interval c is $+/- z \cdot \sqrt{\frac{p \cdot (1-p)}{n}} = +/- 1.64 \cdot \sqrt{\frac{0.541 \cdot (1-0.541)}{16{,}384}} =$ +/–0.638 percentage points.

Scorecards, however, do not measure poverty directly, so this formula is not immediately applicable. To derive a formula for the Rwanda scorecard, consider Figure 8, which reports empirical confidence intervals c for the differences for the scorecard applied to 1,000 bootstrap samples of various sample sizes from the validation sample.

For $n = 16{,}384$ and the national line, the 90-percent confidence interval is 0.580 percentage points.[10]

Thus, the 90-percent confidence interval with $n = 16{,}384$ is 0.580 percentage points for the Rwanda scorecard and 0.638 percentage points for direct measurement. The ratio of the two intervals is $0.580 \div 0.638 = 0.91$.

Now consider the same case, but with $n = 8{,}192$. The confidence interval under direct measurement is $+/-1.64 \cdot \sqrt{\frac{0.541 \cdot (1-0.541)}{8{,}192}} = +/-0.903$ percentage points. The empirical confidence interval with the Rwanda scorecard (Figure 8) is 0.835 percentage points. Thus for $n = 8{,}192$, the ratio of the two intervals is $0.835 \div 0.903 = 0.92$.

This ratio of 0.92 for $n = 8{,}182$ is not far from the ratio of 0.91 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 Rwanda scorecard and this poverty line are about 10 percent narrower than confidence intervals for direct estimates via the 2005/6 EICV. 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 Rwanda 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

$$\alpha \cdot \sqrt{\frac{p \cdot (1-p)}{n}}.$$

[10] Due to rounding, Figure 8 displays 0.6, not 0.580.

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 all seven 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.[11] 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 $+/-c$ is $n = \left(\frac{\alpha \cdot z}{c}\right)^2 \cdot \hat{p} \cdot (1 - \hat{p})$.

To illustrate how to use this, suppose $c = 0.04605$ and $z = 1.64$ (90-percent confidence). Then the formula gives $n = \left(\frac{0.90 \cdot 1.64}{0.04605}\right)^2 \cdot 0.541 \cdot (1 - 0.541) = 256$, the same as 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 Rwanda, 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.

In practice after the end of fieldwork for the EICV in October 2006, an organization would select a poverty line (say, the national line), select a desired

[11] IRIS Center (2007a and 2007b) says that a sample size of $n = 300$ is sufficient for USAID reporting. If a scorecard 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 scorecard could be more or less precise than direct measurement.

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 54.0 percent national average in the 2005/6 EICV in Figure 2), look up α (here, 0.90), assume that the scorecard will still work in the future and/or for non-nationally representative sub-groups,[12] and then compute the required sample size. In this illustration, $n = \left(\frac{0.90 \cdot 1.64}{0.02}\right)^2 \cdot 0.540 \cdot (1 - 0.540) = 1{,}353$.

[12] 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 October 2006 will resemble that in the 2005/6 EICV 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 2005/6 EICV, this paper cannot test estimates of change over time for Rwanda, 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 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, 2010, a program samples three households who score 20, 30, and 40 and so have poverty likelihoods of 87.3, 66.5, and 42.1 percent (national line, Figure 4). The group's baseline estimated poverty rate is the households' average poverty likelihood of (87.3 + 66.5 + 42.1) ÷ 3 = 65.3 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, 2011, 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 75.5, 51.8, and 28.1 percent, national line, Figure 4). Their average poverty likelihood at follow-up is now (75.5 + 51.8 + 28.1) ÷ 3 = 51.8 percent, an improvement of 65.3 – 51.8 = 13.5 percentage points.[13]

This suggests that about one in eight participants in this hypothetical example crossed the poverty line in 2010.[14] Among those who started below the line, about one in five (13.5 ÷ 65.3 = 20.7 percent) on net ended up above the line.[15]

[13] Of course, such a huge reduction in poverty in one year is unlikely, but this is just an example to show how the scorecard can be used to estimate change.
[14] 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 2005/6 EICV, 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 Rwanda 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,[16] 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.

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

[16] 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 standard errors 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 both 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 Rwanda.

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 $\hat{p} = 0.540$ (from Figure 2). Then the baseline sample size is $n = 2 \cdot \left(\frac{1.19 \cdot 1.64}{0.02} \right)^2 \cdot 0.540 \cdot (1 - 0.540) =$ 4,731, and the follow-up sample size is also 4,731.

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:[17]

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

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 change in the poverty rate will be zero, which implies $\hat{p}_{12} = \hat{p}_{21} = \hat{p}_*$, giving:

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

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

Because $\hat{p}_*$ could be anything between 0–0.5, more information is needed to apply this formula. Suppose that 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—as in Peru (Schreiner, 2009a)—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 Rwanda scorecard is applied twice (once after October 2006 and then again later) is

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

In Peru (the only other country for which there is an estimate, Schreiner 2009a), 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 2010 and then again in 2013 ($y = 3$). The before-baseline poverty rate is 54.0 percent ($p_{2005/6} = 0.540$, Figure 2), and suppose $\alpha = 1.30$. Then the baseline sample size is $n = 2 \cdot \left(\frac{1.30 \cdot 1.64}{0.02} \right)^2 \cdot \left\{ -0.02 + 0.016 \cdot 3 + 0.47 \cdot \left[0.540 \cdot (1 - 0.540) \right] \right\} = 3{,}290$. The same group of 3,290 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* (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 by 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 weigh 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 by targeting outcome. For an example cut-off of 35–39, outcomes for the national line in the validation sample are:

- Inclusion: 45.9 percent are below the line and correctly targeted
- Undercoverage: 7.9 percent are below the line and mistakenly not targeted
- Leakage: 18.8 percent are above the line and mistakenly targeted
- Exclusion: 27.4 percent are above the line and correctly not targeted

Increasing the cut-off to 40–44 improves inclusion and undercoverage but worsens leakage and exclusion:

- Inclusion: 50.7 percent are below the line and correctly targeted
- Undercoverage: 3.2 percent are below the line and mistakenly not targeted
- Leakage: 25.5 percent are above the line and mistakenly targeted
- Exclusion: 20.7 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 and

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 Rwanda scorecard. For the national line in the validation sample, total net benefit is greatest (73.3) for a cut-off of 35–39, with about three in four households in Rwanda 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).[18]

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

[18] Figure 11 also reports "BPAC", the Balanced Poverty Accuracy Criteria adopted by USAID for certifying poverty-assessment tools. IRIS Center (2005) says that BPAC considers accuracy in terms of estimated poverty rates and in terms of targeting inclusion. BPAC = (Inclusion – |Undercoverage – Leakage|) x [100 ÷ (Inclusion + Undercoverage)].

achieve a desired poverty rate among targeted households. The third column of Figure 12 ("% targeted who are poor") shows, for the Rwanda 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 39 or less would target 64.7 percent of all households (second column) and produce a poverty rate among those targeted of 71.0 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 39 or less, 85.3 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 39 or less, covering 2.4 poor households means leaking to 1 non-poor household.

9. Context of poverty-assessment tools in Rwanda

This section discusses an existing poverty-assessment tool for Rwanda in terms of its goals, methods, poverty definitions, indicators, cost, accuracy, and precision. The 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.

Gwatkin *et al.* (2007) is the only other poverty-assessment tool for Rwanda. To construct it, they apply an approach used in 56 countries with Demographic and Health Surveys (Rutstein and Johnson, 2004). They use Principal Components Analysis to make an asset index from simple, low-cost indicators available for the 9,696 households in the Rwanda 2000 DHS. The PCA index is like the scorecard here except that, because the DHS does not collect data on income or expenditure, it is based on a different conception of poverty, its accuracy vis-à-vis expenditure-based poverty is unknown, and it can only be assumed to be a proxy for long-term wealth/economic status.[19] Well-known examples of the PCA asset-index approach include Ferguson *et al.* (2003), Sahn and Stifel (2000 and 2003), and Filmer and Pritchett (2001).

[19] 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), and they rank households much the same. Tests of how well rankings by PCA indices correspond with rankings by expenditure-based scorecards include Lindelow (2006), Wagstaff and Watanabe (2003), and Montgomery *et al.* (2000).

The 12 indicators in Gwatkin *et al.* are similar to those in the new scorecard here in terms of their simplicity, low cost, and verifiability:

- Characteristics of the residence:
  - Main material of the floor
  - Type of fuel used for cooking
  - Type of source of drinking water
  - Type of toilet arrangement
  - Presence of electricity
- Ownership of consumer durables:
  - Radios
  - Televisions
  - Refrigerators
  - Telephones
  - Bicycles
  - Motorcycles
  - Cars or trucks

Gwatkin *et al.* discuss three basic uses for their index:

- Segmenting households by quintiles to see how health, population, and nutrition vary with socio-economic status
- Monitoring (via exit surveys) how well local health-service posts reach the poor
- Measuring 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 the index are similar to those of the scorecard here.

Still, the Gwatkin *et al.* index is more difficult and costly because it cannot be computed by hand in the field, as it has 82 point values, half of them negative, and all with five decimal places.

Unlike the PCA index, the scorecard here is linked directly to an absolute, expenditure-based poverty line. Thus, while both approaches can rank households, only the scorecard can estimate expenditure-based poverty status.

In essence, Gwatkin *et al.*—like all PCA asset indices—define poverty in terms of the indicators in their index. Thus, the index can be seen not as a proxy standing in for something else (such as expenditure) but rather as a direct measure 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 as an expenditure-based definition.

10. Conclusion

Pro-poor programs in Rwanda can use the Simple Poverty Scorecard® to segment clients for targeted services as well as to estimate the:

- Likelihood that a household has consumption below a given poverty line
- Poverty rate of a group of households at a point in time
- Change in the poverty rate of a group of households over in time[20]

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 monitor and manage their social performance.

The scorecard is built with part of the data from Rwanda's 2005/6 EICV, tested on a different part of the 2005/6 EICV, and calibrated to seven 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. Of course, the scorecard's estimates of changes 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 1.3 percentage points or less and averages—across the seven poverty lines—about 0.9 percentage points. For n = 16,384 and 90-percent confidence, the precision of these differences is +/–0.6 percentage points or better.

[20] Scorecard estimates of change are not necessarily estimates of program impact.

If a program wants to use the scorecard for targeting, then the results here provide the information needed to select a cut-off that fits its 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 (most likely below a poverty line) to 100 (least likely below a poverty line). 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 summary, the Simple Poverty Scorecard® is a practical, objective way for pro-poor programs in Rwanda 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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Figure 2: Sample sizes, poverty lines, and poverty rates for all of Rwanda and by province, sub-sample, poverty line, and household-level/person-level

			Poverty rates (% with expenditure below a poverty line) and poverty lines (RFW/adult equivalent/day or RFW/person/day)						
			National line (per adult equivalent)				USAID	Intl. 2005 PPP (per person)	
	Level	Sample size	100%	Food	50%	150%	'Extreme'	$1.25/day	$2.50/day
Poverty lines:									
All Rwanda		6,900	249	175	124	373	134	304	607
Kigali		1,707	249	175	124	373	126	303	607
Southern Province		1,653	243	171	121	364	126	296	592
Western Province		1,059	227	160	113	340	119	277	554
Northern Province		1,455	265	186	132	397	153	323	646
Eastern Province		1,026	269	189	135	404	163	328	657
Poverty Rates:									
All Rwanda	Households	6,900	54.0	34.0	18.0	73.9	26.1	69.8	89.7
	People		56.8	36.9	19.6	75.6	28.3	71.7	90.2
Construction									
Selecting indicators and points	Households	2,256	54.1	34.2	18.4	73.7	26.3	70.3	90.1
	People		57.5	37.3	20.4	75.8	28.9	72.4	90.5
Calibration									
Associating scores with likelihoods	Households	2,323	54.1	34.1	18.2	73.7	26.2	69.5	89.6
	People		56.6	36.8	19.7	74.9	28.3	71.0	89.8
Validation									
Measuring accuracy	Households	2,321	53.8	33.8	17.4	74.1	25.7	69.6	89.3
	People		56.3	36.5	18.8	76.0	27.7	71.9	90.5
Change in poverty rate (percentage points)									
Construction/calibration to validation	Households		+0.3	+0.4	+0.9	–0.4	+0.5	+0.4	+0.6

Source: 2005/6 EICV. The USAID "extreme" line is per person. Provincial lines are averages of household lines at the person level.

Figure 3: Poverty indicators by uncertainty coefficient

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
1,312	What is the main source of lighting for the household? (Burning wood, or other; Home-made kerosene or fuel-oil lamp (*agatadowa*); Candles, gas lamp, electrical grid, or generator)
916	What is the main material of the floor? (Packed earth; Wood, cement, tiles, bricks, stone, or other)
772	What is the main fuel used for cooking? (Firewood, field waste, or other; Charcoal, LPG, electricity, or kerosene)
699	Does the household own a living-room set or a wardrobe? (No; Yes)
686	Does the household have a telephone? (No; Yes)
663	What is the highest grade that the female head/spouse has successfully completed? (Never attended school; Attended and completed none, one, or two years; Years 3 or 4 of primary; Years 5 or 6 of primary; There is no female head/spouse; Anything after 6 years of primary)
644	What is the area of the residence (square meters)? (24 or less; 25 to 34; 35 to 44; 45 to 64; 65 or more)
637	What is the highest grade that a household member has completed successfully? (Never attended school; Attended and completed none, one, or two years; Years 3 or 4 of primary; Years 5 or 6 of primary; Anything after 6 years of primary)
636	How many household members work in agriculture, be it for wages or as self-employment? (Three or more; Two; One; None)
635	What is the main material of the exterior walls? (Adobe with cement, stones, plastic sheeting, or other; Adobe bricks, or planks; Adobe without cement; Adobe bricks with cement, clay bricks, or cinder blocks)
625	Does the household own a living-room set? (No; Yes)
609	If any household member works in agriculture, be it for wages or as self-employment, does the household have any cattle? (One or more household members work in agriculture, but the household does not have any cattle; One or more household members work in agriculture, and the household has cattle; No household member works in agriculture)

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

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
594	In what residential stratum does the household live? (Rural; Other urban; Kigali)
574	What is the status of the female head/spouse in her main occupation? (Wage worker in agriculture; Self-employed in agriculture; Unpaid (homemaker, apprentice, volunteer, etc.; Self-employed non-agricultural worker, or does not work; No female head/spouse; Wage worker in non-agriculture)
558	If any household member works in agriculture, be it for wages or as self-employment, does the household have any cattle or sheep? (One or more household members work in agriculture, but the household does not have any cattle or sheep; One or more household members work in agriculture, and the household has cattle or sheep; No household member works in agriculture)
497	If any household member works in agriculture, be it for wages or as self-employment, does the household have any chickens? (One or more household members work in agriculture, but the household does not have any chickens; One or more household members work in agriculture, and the household has chickens; No household member works in agriculture)
493	In what type of neighborhood do you live? (Detached house, or other; Old grouping; *Umudugudu* ; Platted subdivision, or squatter colony)
487	What is the highest grade that the male head/spouse has successfully completed? (Never attended school; Attended and completed none, one, or two years; There is no female head/spouse; Years 3 or 4 of primary; Years 5 or 6 of primary; Anything after 6 years of primary)
479	In what province does the household live? (Southern Province; Western Province; Northern Province; Eastern Province; Kigali)
476	How many household members are 18-years-old or less? (Five or more; Four; Three; Two; One; None)

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

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
474	If any household member works in agriculture, be it for wages or as self-employment, does the household have any cattle, sheep, goats, pigs, rabbits, or chickens? (One or more household members work in agriculture, but the household does not have any cattle, sheep, goats, pigs, rabbits, or chickens; One or more household members work in agriculture, and the household has cattle, sheep, goats, pigs, rabbits, or chickens; No household member works in agriculture)
473	If any household member works in agriculture, be it for wages or as self-employment, does the household have any goats or chickens? (One or more household members work in agriculture, but the household does not have any goats or chickens; One or more household members work in agriculture, and the household has goats or chickens; No household member works in agriculture)
472	What is the main material of the roof? (Straw or thatch; Other; Tile; Corrugated tin, or concrete)
465	How many household members are 17-years-old or less? (Five or more; Four; Three; Two; One; None)
461	If any household member works in agriculture, be it for wages or as self-employment, does the household have any goats? (One or more household members work in agriculture, but the household does not have any goats; One or more household members work in agriculture, and the household has goats; No household member works in agriculture)
445	If any household member works in agriculture, be it for wages or as self-employment, does the household have any rabbits? (One or more household members work in agriculture, but the household does not have any rabbits; One or more household members work in agriculture, and the household has rabbits; No household member works in agriculture)

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

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
443	If any household member works in agriculture, be it for wages or as self-employment, does the household have any pigs? (One or more household members work in agriculture, but the household does not have any pigs; One or more household members work in agriculture, and the household has pigs; No household member works in agriculture)
442	If any household member works in agriculture, be it for wages or as self-employment, does the household have any goats, pigs, or rabbits? (One or more household members work in agriculture, but the household does not have any goats, pigs, or rabbits; One or more household members work in agriculture, and the household has goats, pigs, or rabbits; No household member works in agriculture)
442	If any household member works in agriculture, be it for wages or as self-employment, does the household own or use any agricultural land? (One or more household members work in agriculture, but the household does not have any land; One or more household members work in agriculture, and the household has land; No household member works in agriculture)
437	If any household member works in agriculture, be it for wages or as self-employment, does the household have any sheep? (One or more household members work in agriculture, but the household does not have any sheep; One or more household members work in agriculture, and the household has sheep; No household member works in agriculture)
435	How many household members have an agricultural job in which they are self-employed or receive wages? (None; One or more is a wage worker, but none are self-employed; One or more is a wage worker, and one or more is self-employed; One or more is self-employed, but none is a wage worker)
434	What is the source of drinking water for the household? (Ordinary wells, or unprotected spring ; River/stream/lake/ocean; Tube wells; Free public standpipe; Protected spring; Purchased from tap, subscribes to Electrogaz, or other)

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

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
434	How many rooms does the household occupy (do not count bathrooms, water closets, or kitchen)? (One; Two or three; Four; Five; Six or more)
423	How many household members are 16-years-old or less? (Five or more; Four; Three; Two; One; None)
417	Does the household own a radio-cassette player? (No; Yes)
412	Does the household own a radio or radio-cassette player? (No; Yes)
403	What is the status of the male head/spouse in his main occupation? (Agricultural wage worker, or does not work; There is no male head/spouse; Self-employed in agriculture, or unpaid worker (homemaker, apprentice, volunteer, etc.); Non-agricultural wage worker; Self-employed in non-agriculture)
401	How many household members are 15-years-old or less? (Five or more; Four; Three; Two; One; None)
389	How many household members are 14-years-old or less? (Four or more; Three; Two; One; None)
382	Do all household members ages 7 to 12 go to school? (No; Yes; No one in age range)
377	Does the household own a wardrobe? (No; Yes)
376	Do all household members ages 7 to 13 go to school? (No; Yes; No one in age range)
374	How does the household dispose of its garbage? (Thrown in the fields of the household; Composted by the household; Trash service, thrown somewhere other than in the fields of the household, burned by the household, or other; Collection by neighborhood association)
371	How many household members have an agricultural job in which they are self-employed? (One or more; None)
361	How many household members are 13-years-old or less? (Four or more; Three; Two; One; None)
343	How many household members are 12-years-old or less? (Four or more; Three; Two; One; None)
340	Do all household members ages 7 to 14 go to school? (No; Yes ; No one in age range)
330	Do all household members ages 7 to 15 go to school? (No; Yes ; No one in age range)

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

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
326	What type of toilet arrangement does the household have? (No toilet arrangement, or other; Uncovered latrines; Covered latrines; Flush toilet with septic tank)
326	Have all household members ages 7 to 17 been to school in the last 12 months? (No; Yes; No one in age range)
324	How many household members have an agricultural job for which they are paid wages? (Two or more; One; None)
315	How many household members are there? (Eight or more; Seven; Six; Five; Four; Three; Two; One; None)
304	Does any household member go to a free subsidized or private primary school? (Public or free subsidized; No one goes to school; Private)
302	Do all household members ages 7 to 11 go to school? (No; Yes; No one in age range)
293	How old is the female head/spouse? (40 to 44; 45 to 49; 35 to 39; 65 or more; 30 to 34; 50 to 64; 25 to 29; 24 or less; No female head/spouse)
291	How many household members are 11-years-old or less? (Three or more; Two; One; None)
283	Do all household members ages 7 to 16 go to school? (No; Yes; No one in age range)
281	Do all household members ages 7 to 18 go to school? (No; Yes; No one in age range)
258	What is the tenancy status of the household in its residence? (Given for free, squatter, rent-to-own, refugee or temporary camp, or other; Owner; Renter, or given in exchange for service)
228	How many ares of agricultural land does the household own or use? (0 to 10; 11 to 35; 36 to 60; 61 to 100; 101 to 150; 151 or more)
205	How many household members have a non-agricultural job for which they are paid wages? (None; One or more)
202	How many household members have a job in which they are self-employed (agricultural or non-agricultural)? (One; Two or more; None)

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

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
199	Does the household own a radio? (No; Yes)
192	Does the household own a living-room set, radio, radio-cassette player, bed, wardrobe, table, or chair? (No; Yes)
190	Who does the residence belong to? (Relative of the household head; Househol ; State, private firm or business, or other)
175	What is the marital status of the female head/spouse? (Married, more than one spouse; Divorced or separated; Cohabiting; Widow; Married, one spouse; Single, never-married; No female head/spouse)
168	How old is the male head/spouse? (No male head/spouse; 41 to 45; 46 or more; 36 to 40; 31 to 35; 26 to 30; 25 or less)
167	What is the marital status of the male head/spouse? (Married, more than one spouse; Cohabiting; No male head/spouse; Married, one spouse, or divorced or separated; Single, never-married, or widower)
167	What type of residence do you live in? (Single-family detached house; Other)
161	How many household members have a non-agricultural job in which they are self-employed? (None; One or more)
160	Can the female head/spouse do written calculations? (No; Yes; No female head/spouse)
144	Has the female head/spouse worked at least one hour in the past seven days? (Yes; No; No female head/spouse)
144	Can the female head/spouse read a letter or a short note? (No; Yes; No female head/spouse)
143	How many beds does the household own? (None; One or more)
142	Does the household have any shovels or rakes? (No; Yes)
114	What is the structure of household headship? (Female head/spouse only; Both male and female heads/spouses; Male head/spouse only)
107	Does the household have any cattle? (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)
97	How many household members are 5-years-old or less? (Two or more; One; None)
79	How many tables does the household own? (None; One or more)
74	How many chairs does the household own? (None; One or more)
65	Has the male head/spouse worked at least one hour in the past seven days? (No; No male head/spouse; Yes)
50	Does the household have any cattle or sheep? (No; Yes)
45	Does the household have any hatchets, axes, or pick-axes? (No; Yes)
35	What is the religion of the household head? (No religion; Other Christian; Protestant; Seventh-Day Adventist; Catholic; Jehovah Witness, Muslim, traditional/animist, or other)
32	Can the male head/spouse do written calculations? (No; Yes; No male head/spouse)
30	Can any household member do written calculations? (No; Yes)
29	Can the male head/spouse read a letter or a short note? (No male head/spouse; Yes; No)
28	Does the household have any pigs? (Yes; No)
26	How many household members worked at least one hour in the past seven days? (None; One; Two; Three; Four; Five or more)
26	Does the household have any sickles? (No; Yes)
23	Does the household have any rabbits? (Yes; No)
16	Does the household have any chickens? (No; Yes)
14	Does the household have any goats, pigs, or rabbits? (No; Yes)
9	How many household members have a job for which they are paid wages (agricultural or non-agricultural)? (Two or more; One; None)
7	Can any household member read a letter or a short note? (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)
5	Does the household have any cattle, sheep, goats, pigs, rabbits, or chickens? (Yes; No)
5	Does the household have any machetes? (No; Yes)
0	Does the household have any goats? (No; Yes)
0	Does the household have any goats or chickens? (No; Yes)
0	Does the household have any sheep? (No; Yes)
0	Does the household have any machetes, hatchets, axes, pick-axes, sickles, or rakes? (No; Yes)

Source: 2005/6 EICV and the national poverty line

National Poverty Line Tables

(and Tables Pertaining to All Seven 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	100.0
5–9	100.0
10–14	91.2
15–19	93.2
20–24	87.3
25–29	75.5
30–34	66.5
35–39	51.8
40–44	42.1
45–49	28.1
50–54	21.8
55–59	4.2
60–64	7.5
65–69	1.6
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 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	0	÷	0	=	100.0
5–9	372	÷	372	=	100.0
10–14	1,753	÷	1,922	=	91.2
15–19	4,945	÷	5,303	=	93.2
20–24	7,596	÷	8,703	=	87.3
25–29	11,298	÷	14,967	=	75.5
30–34	10,723	÷	16,130	=	66.5
35–39	8,966	÷	17,299	=	51.8
40–44	4,844	÷	11,499	=	42.1
45–49	2,276	÷	8,093	=	28.1
50–54	1,109	÷	5,091	=	21.8
55–59	125	÷	2,987	=	4.2
60–64	169	÷	2,255	=	7.5
65–69	36	÷	2,302	=	1.6
70–74	0	÷	1,427	=	0.0
75–79	0	÷	937	=	0.0
80–84	0	÷	493	=	0.0
85–89	0	÷	106	=	0.0
90–94	0	÷	115	=	0.0
95–100	0	÷	0	=	0.0

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

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

	Likelihood of having expenditure in range demarcated by poverty lines per day per adult equivalent					
	<50% Natl.	=>50% Natl. and <USAID	=>USAID and <Food	=>Food and <100% Natl.	=>100% Natl. and <150% Natl.	=>150% Natl.
Score	<RFW124	=>RFW124 and <RFW134	=>RFW134 and <RFW175	=>RFW175 and <RFW249	=>RFW249 and <RFW373	=>RFW373
0–4	100.0	0.0	0.0	0.0	0.0	0.0
5–9	87.5	12.5	0.0	0.0	0.0	0.0
10–14	78.2	5.5	1.6	5.8	5.0	3.8
15–19	63.1	9.7	8.5	11.9	2.4	4.4
20–24	40.3	14.9	10.3	21.8	7.8	4.9
25–29	26.4	14.4	11.6	23.1	15.4	9.1
30–34	19.2	11.4	12.0	23.8	22.5	11.1
35–39	10.3	7.9	8.9	24.7	26.7	21.5
40–44	5.5	4.2	5.6	26.8	29.4	28.5
45–49	1.6	0.6	3.5	22.5	30.8	41.1
50–54	2.6	2.4	7.0	9.8	16.3	61.9
55–59	0.0	1.5	0.0	2.7	22.3	73.5
60–64	2.0	0.0	2.3	3.2	8.9	83.6
65–69	0.0	0.0	0.0	1.6	1.3	97.2
70–74	0.0	0.0	0.0	0.0	3.9	96.2
75–79	0.0	0.0	0.0	0.0	2.3	97.7
80–84	0.0	0.0	0.0	0.0	0.0	100.0
85–89	0.0	0.0	0.0	0.0	0.0	100.0
90–94	0.0	0.0	0.0	0.0	0.0	100.0
95–100	0.0	0.0	0.0	0.0	0.0	100.0

All poverty likelihoods in percentage units.

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

	Likelihood of having expenditure in range demarcated by poverty lines per day per person		
	<$1.25/day	**=>$1.25/day and <$2.50/day**	**=>$2.50/day**
Score	**<RFW304**	**=>RFW304 and <RFW607**	**=>RFW607**
0–4	100.0	0.0	0.0
5–9	100.0	0.0	0.0
10–14	96.2	1.6	2.2
15–19	94.8	2.7	2.6
20–24	94.6	3.5	1.9
25–29	89.2	7.0	3.8
30–34	85.6	12.4	2.1
35–39	72.8	24.4	2.8
40–44	63.9	31.8	4.3
45–49	49.7	35.5	14.8
50–54	32.4	44.3	23.2
55–59	18.4	46.5	35.1
60–64	15.2	38.3	46.5
65–69	1.6	23.8	74.7
70–74	3.3	24.9	71.8
75–79	0.0	4.6	95.4
80–84	0.0	6.3	93.7
85–89	0.0	0.0	100.0
90–94	0.0	0.0	100.0
95–100	0.0	0.0	100.0

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	+0.0	0.0	0.0	0.0
5–9	+0.0	0.0	0.0	0.0
10–14	+5.2	3.9	4.6	5.8
15–19	+0.7	1.4	1.7	2.3
20–24	–2.0	1.7	1.8	2.1
25–29	–3.5	2.4	2.6	2.9
30–34	+5.1	1.6	2.0	2.6
35–39	–0.2	1.5	1.9	2.6
40–44	+1.0	1.9	2.3	3.0
45–49	+4.6	2.0	2.3	3.2
50–54	+2.4	2.5	2.9	4.0
55–59	–0.9	1.9	2.2	2.8
60–64	–9.4	6.8	7.1	7.8
65–69	–0.0	1.1	1.2	1.6
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 (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	+1.3	64.4	73.7	85.7
4	+1.1	35.5	41.1	53.2
8	+0.6	24.4	29.7	39.0
16	+1.0	18.1	21.1	25.0
32	+0.6	13.2	15.7	20.6
64	+0.6	9.0	11.2	15.7
128	+0.7	6.4	7.7	10.0
256	+0.5	4.6	5.4	7.0
512	+0.6	3.3	3.9	4.9
1,024	+0.6	2.2	2.6	3.6
2,048	+0.6	1.6	1.9	2.5
4,096	+0.6	1.1	1.4	1.9
8,192	+0.6	0.8	1.0	1.3
16,384	+0.6	0.6	0.7	0.9

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 line (per adult equivalent)									USAID		Intl. 2005 PPP (per person)				
	100%		Food		50%		150%			'Extreme'		$1.25/day		$2.50/day		
Estimate minus true value																
Scorecard applied to validation sample	+0.6		+0.8		+1.1		–1.3			+1.0		–0.5		–1.0		
Precision of difference																
Scorecard applied to validation sample	0.6		0.6		0.5		0.5			0.5		0.5		0.3		
α for sample size																
Scorecard applied to validation sample	0.90		0.93		0.99		0.86			0.92		0.85		0.73		
Precision is measured as 90-percent confidence intervals in units of +/– percentage points.																
Differences and precision estimated from 500 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.																
The USAID "extreme" line is in per-person units.																

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	0.0	53.8	0.0	46.2	46.2	–100.0
5–9	0.4	53.5	0.0	46.2	46.5	–98.6
10–14	2.1	51.7	0.2	46.0	48.1	–91.8
15–19	7.0	46.8	0.6	45.6	52.6	–72.9
20–24	14.7	39.2	1.6	44.5	59.2	–42.5
25–29	26.6	27.3	4.7	41.5	68.0	+7.4
30–34	36.7	17.1	10.7	35.5	72.1	+56.2
35–39	45.9	7.9	18.8	27.4	73.3	+65.1
40–44	50.7	3.2	25.5	20.7	71.3	+52.6
45–49	52.6	1.2	31.7	14.5	67.1	+41.2
50–54	53.5	0.4	35.9	10.3	63.7	+33.3
55–59	53.6	0.2	38.8	7.4	61.0	+28.0
60–64	53.8	0.0	40.8	5.3	59.1	+24.2
65–69	53.8	0.0	43.1	3.1	56.9	+20.0
70–74	53.8	0.0	44.5	1.7	55.5	+17.3
75–79	53.8	0.0	45.5	0.7	54.5	+15.6
80–84	53.8	0.0	45.9	0.2	54.1	+14.7
85–89	53.8	0.0	46.0	0.1	54.0	+14.5
90–94	53.8	0.0	46.2	0.0	53.8	+14.3
95–100	53.8	0.0	46.2	0.0	53.8	+14.3

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 successfully 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	0.0	100.0	0.0	Only poor targeted
5–9	0.4	100.0	0.7	Only poor targeted
10–14	2.3	91.9	3.9	11.3:1
15–19	7.6	92.0	13.0	11.6:1
20–24	16.3	90.1	27.3	9.1:1
25–29	31.3	84.9	49.3	5.6:1
30–34	47.4	77.4	68.1	3.4:1
35–39	64.7	71.0	85.3	2.4:1
40–44	76.2	66.5	94.1	2.0:1
45–49	84.3	62.4	97.7	1.7:1
50–54	89.4	59.8	99.3	1.5:1
55–59	92.4	58.0	99.6	1.4:1
60–64	94.6	56.9	99.9	1.3:1
65–69	96.9	55.5	100.0	1.2:1
70–74	98.3	54.7	100.0	1.2:1
75–79	99.3	54.2	100.0	1.2:1
80–84	99.8	54.0	100.0	1.2:1
85–89	99.9	53.9	100.0	1.2:1
90–94	100.0	53.8	100.0	1.2:1
95–100	100.0	53.8	100.0	1.2:1

Food Poverty Line Tables

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	100.0
5–9	100.0
10–14	85.4
15–19	81.3
20–24	65.5
25–29	52.4
30–34	42.7
35–39	27.1
40–44	15.3
45–49	5.7
50–54	12.0
55–59	1.5
60–64	4.3
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 5 (Food line): Derivation of estimated poverty likelihoods associated with scores

Score	Households below poverty line		All households at score		Poverty likelihood (estimated, %)
0–4	0	÷	0	=	100.0
5–9	372	÷	372	=	100.0
10–14	1,641	÷	1,922	=	85.4
15–19	4,313	÷	5,303	=	81.3
20–24	5,703	÷	8,703	=	65.5
25–29	7,838	÷	14,967	=	52.4
30–34	6,882	÷	16,130	=	42.7
35–39	4,688	÷	17,299	=	27.1
40–44	1,763	÷	11,499	=	15.3
45–49	458	÷	8,093	=	5.7
50–54	610	÷	5,091	=	12.0
55–59	44	÷	2,987	=	1.5
60–64	97	÷	2,255	=	4.3
65–69	0	÷	2,302	=	0.0
70–74	0	÷	1,427	=	0.0
75–79	0	÷	937	=	0.0
80–84	0	÷	493	=	0.0
85–89	0	÷	106	=	0.0
90–94	0	÷	115	=	0.0
95–100	0	÷	0	=	0.0

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

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	+0.0	0.0	0.0	0.0
5–9	+0.0	0.0	0.0	0.0
10–14	+0.4	3.9	4.7	5.7
15–19	+5.9	2.5	3.0	3.6
20–24	–9.4	5.7	5.9	6.2
25–29	–5.5	3.6	3.8	4.1
30–34	+9.5	1.6	1.9	2.6
35–39	+2.4	1.4	1.6	2.1
40–44	+1.4	1.3	1.5	1.9
45–49	–4.3	2.9	3.0	3.2
50–54	+6.6	1.5	1.8	2.3
55–59	–3.1	2.5	2.7	3.0
60–64	+4.3	0.0	0.0	0.0
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	+2.9	62.6	69.2	87.8
4	+1.2	35.8	41.9	53.2
8	+0.4	25.6	30.0	37.0
16	+0.8	17.7	20.6	27.7
32	+0.9	13.0	15.1	18.8
64	+0.8	8.6	10.1	12.9
128	+0.8	6.2	7.3	9.6
256	+0.8	4.4	5.2	7.0
512	+0.8	3.3	4.0	5.1
1,024	+0.8	2.2	2.7	3.6
2,048	+0.7	1.6	1.9	2.4
4,096	+0.8	1.1	1.3	1.7
8,192	+0.8	0.8	0.9	1.2
16,384	+0.8	0.6	0.7	0.9

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	0.0	33.8	0.0	66.2	66.2	–100.0
5–9	0.4	33.4	0.0	66.2	66.6	–97.8
10–14	2.1	31.7	0.2	66.0	68.1	–87.1
15–19	6.0	27.8	1.6	64.6	70.7	–59.7
20–24	12.4	21.4	3.9	62.3	74.6	–15.2
25–29	20.8	13.0	10.4	55.8	76.6	+54.1
30–34	26.3	7.5	21.1	45.1	71.4	+37.6
35–39	30.8	3.0	33.9	32.3	63.1	–0.2
40–44	32.5	1.3	43.7	22.5	55.1	–29.2
45–49	33.5	0.3	50.8	15.4	48.8	–50.4
50–54	33.7	0.1	55.7	10.5	44.2	–64.7
55–59	33.8	0.0	58.6	7.6	41.4	–73.2
60–64	33.8	0.0	60.8	5.4	39.2	–79.9
65–69	33.8	0.0	63.1	3.1	36.9	–86.7
70–74	33.8	0.0	64.5	1.7	35.5	–91.0
75–79	33.8	0.0	65.5	0.7	34.5	–93.7
80–84	33.8	0.0	66.0	0.2	34.0	–95.2
85–89	33.8	0.0	66.1	0.1	33.9	–95.5
90–94	33.8	0.0	66.2	0.0	33.8	–95.8
95–100	33.8	0.0	66.2	0.0	33.8	–95.8

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 successfully 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	0.0	100.0	0.0	Only poor targeted
5–9	0.4	100.0	1.1	Only poor targeted
10–14	2.3	90.5	6.1	9.5:1
15–19	7.6	79.4	17.8	3.8:1
20–24	16.3	75.8	36.6	3.1:1
25–29	31.3	66.6	61.6	2.0:1
30–34	47.4	55.5	77.8	1.2:1
35–39	64.7	47.6	91.1	0.9:1
40–44	76.2	42.7	96.3	0.7:1
45–49	84.3	39.7	99.0	0.7:1
50–54	89.4	37.7	99.7	0.6:1
55–59	92.4	36.6	100.0	0.6:1
60–64	94.6	35.7	100.0	0.6:1
65–69	96.9	34.9	100.0	0.5:1
70–74	98.3	34.4	100.0	0.5:1
75–79	99.3	34.0	100.0	0.5:1
80–84	99.8	33.9	100.0	0.5:1
85–89	99.9	33.8	100.0	0.5:1
90–94	100.0	33.8	100.0	0.5:1
95–100	100.0	33.8	100.0	0.5:1

50% of the National Poverty Line Tables

Figure 4 (50% 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	87.5
10–14	78.2
15–19	63.1
20–24	40.3
25–29	26.4
30–34	19.2
35–39	10.3
40–44	5.5
45–49	1.6
50–54	2.6
55–59	0.0
60–64	2.0
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 5 (50% of the national line): Derivation of estimated poverty likelihoods associated with scores

Score	Households below poverty line		All households at score		Poverty likelihood (estimated, %)
0–4	0	÷	0	=	87.5
5–9	326	÷	372	=	87.5
10–14	1,504	÷	1,922	=	78.2
15–19	3,347	÷	5,303	=	63.1
20–24	3,510	÷	8,703	=	40.3
25–29	3,957	÷	14,967	=	26.4
30–34	3,100	÷	16,130	=	19.2
35–39	1,784	÷	17,299	=	10.3
40–44	628	÷	11,499	=	5.5
45–49	127	÷	8,093	=	1.6
50–54	131	÷	5,091	=	2.6
55–59	0	÷	2,987	=	0.0
60–64	46	÷	2,255	=	2.0
65–69	0	÷	2,302	=	0.0
70–74	0	÷	1,427	=	0.0
75–79	0	÷	937	=	0.0
80–84	0	÷	493	=	0.0
85–89	0	÷	106	=	0.0
90–94	0	÷	115	=	0.0
95–100	0	÷	0	=	0.0

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

Figure 7 (50% 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	–12.5	6.2	6.2	6.2
10–14	+5.6	4.5	5.3	7.2
15–19	+13.4	3.0	3.6	4.4
20–24	–5.6	4.0	4.3	4.7
25–29	–1.7	1.7	1.9	2.7
30–34	+3.7	1.2	1.5	1.9
35–39	+1.4	0.9	1.1	1.4
40–44	+1.8	0.7	0.9	1.0
45–49	–1.5	1.1	1.2	1.3
50–54	+1.1	0.8	0.9	1.1
55–59	+0.0	0.0	0.0	0.0
60–64	+2.0	0.0	0.0	0.0
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 (50% 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	+4.1	56.9	71.9	86.4
4	+1.9	28.6	35.1	47.5
8	+1.2	21.5	25.0	31.8
16	+1.4	14.5	16.9	21.9
32	+1.2	10.6	12.4	16.6
64	+1.2	7.4	8.3	10.8
128	+1.2	5.2	6.5	7.9
256	+1.2	3.8	4.6	6.0
512	+1.2	2.7	3.3	4.3
1,024	+1.1	1.9	2.2	2.9
2,048	+1.1	1.4	1.6	2.2
4,096	+1.1	1.0	1.2	1.6
8,192	+1.1	0.7	0.8	1.0
16,384	+1.1	0.5	0.6	0.8

Figure 11 (50% 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	0.0	17.4	0.0	82.6	82.6	–100.0
5–9	0.4	17.0	0.0	82.6	83.0	–95.7
10–14	1.8	15.6	0.5	82.1	84.0	–76.3
15–19	4.5	12.9	3.1	79.5	84.0	–30.6
20–24	8.4	9.0	7.9	74.7	83.1	+41.9
25–29	12.5	4.9	18.8	63.8	76.3	–7.9
30–34	14.9	2.5	32.5	50.1	65.0	–86.8
35–39	16.6	0.8	48.1	34.5	51.0	–176.7
40–44	17.1	0.3	59.1	23.5	40.5	–239.9
45–49	17.3	0.1	66.9	15.7	33.0	–284.8
50–54	17.4	0.0	72.0	10.6	28.0	–313.7
55–59	17.4	0.0	75.0	7.6	25.0	–330.9
60–64	17.4	0.0	77.2	5.4	22.8	–343.9
65–69	17.4	0.0	79.5	3.1	20.5	–357.1
70–74	17.4	0.0	81.0	1.7	19.0	–365.3
75–79	17.4	0.0	81.9	0.7	18.1	–370.7
80–84	17.4	0.0	82.4	0.2	17.6	–373.5
85–89	17.4	0.0	82.5	0.1	17.5	–374.1
90–94	17.4	0.0	82.6	0.0	17.4	–374.8
95–100	17.4	0.0	82.6	0.0	17.4	–374.8

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

Figure 12 (50% of the natonal 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 successfully 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	0.0	100.0	0.0	Only poor targeted
5–9	0.4	100.0	2.1	Only poor targeted
10–14	2.3	79.4	10.5	3.9:1
15–19	7.6	59.0	25.8	1.4:1
20–24	16.3	51.4	48.2	1.1:1
25–29	31.3	39.9	71.8	0.7:1
30–34	47.4	31.5	85.7	0.5:1
35–39	64.7	25.6	95.2	0.3:1
40–44	76.2	22.4	98.1	0.3:1
45–49	84.3	20.6	99.7	0.3:1
50–54	89.4	19.5	100.0	0.2:1
55–59	92.4	18.8	100.0	0.2:1
60–64	94.6	18.4	100.0	0.2:1
65–69	96.9	17.9	100.0	0.2:1
70–74	98.3	17.7	100.0	0.2:1
75–79	99.3	17.5	100.0	0.2:1
80–84	99.8	17.4	100.0	0.2:1
85–89	99.9	17.4	100.0	0.2:1
90–94	100.0	17.4	100.0	0.2:1
95–100	100.0	17.4	100.0	0.2:1

150% of the National Poverty Line Tables

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	96.2
15–19	95.6
20–24	95.1
25–29	90.9
30–34	89.0
35–39	78.5
40–44	71.5
45–49	58.9
50–54	38.1
55–59	26.5
60–64	16.4
65–69	2.8
70–74	3.9
75–79	2.3
80–84	0.0
85–89	0.0
90–94	0.0
95–100	0.0

Figure 5 (150% of the national line): Derivation of estimated poverty likelihoods associated with scores

Score	Households below poverty line		All households at score		Poverty likelihood (estimated, %)
0–4	0	÷	0	=	100.0
5–9	372	÷	372	=	100.0
10–14	1,850	÷	1,922	=	96.2
15–19	5,070	÷	5,303	=	95.6
20–24	8,277	÷	8,703	=	95.1
25–29	13,606	÷	14,967	=	90.9
30–34	14,347	÷	16,130	=	89.0
35–39	13,578	÷	17,299	=	78.5
40–44	8,223	÷	11,499	=	71.5
45–49	4,765	÷	8,093	=	58.9
50–54	1,939	÷	5,091	=	38.1
55–59	792	÷	2,987	=	26.5
60–64	370	÷	2,255	=	16.4
65–69	65	÷	2,302	=	2.8
70–74	55	÷	1,427	=	3.9
75–79	22	÷	937	=	2.3
80–84	0	÷	493	=	0.0
85–89	0	÷	106	=	0.0
90–94	0	÷	115	=	0.0
95–100	0	÷	0	=	0.0

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

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	+0.0	0.0	0.0	0.0
10–14	+5.0	3.4	4.0	5.3
15–19	–4.4	2.2	2.2	2.2
20–24	+0.4	1.1	1.3	1.7
25–29	–3.9	2.4	2.4	2.6
30–34	–0.9	1.0	1.2	1.5
35–39	–0.9	1.3	1.6	2.1
40–44	–3.1	2.4	2.5	2.9
45–49	+10.1	2.4	2.8	3.7
50–54	–5.5	4.2	4.5	4.8
55–59	–7.3	5.5	5.8	6.3
60–64	–6.0	5.2	5.6	6.5
65–69	+0.7	1.2	1.4	1.8
70–74	–1.2	2.3	2.9	4.0
75–79	–0.0	1.5	1.7	2.2
80–84	–29.5	20.4	21.3	23.8
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	–0.1	59.8	75.4	83.3
4	–0.8	28.9	35.1	46.7
8	–0.9	20.7	24.5	31.7
16	–0.8	15.1	18.1	23.1
32	–1.1	10.5	12.7	16.3
64	–1.2	7.5	9.0	11.6
128	–1.1	5.4	6.3	8.3
256	–1.3	3.7	4.3	5.5
512	–1.3	2.6	3.1	4.0
1,024	–1.2	2.0	2.3	2.9
2,048	–1.2	1.3	1.6	2.1
4,096	–1.3	1.0	1.1	1.6
8,192	–1.3	0.7	0.8	1.1
16,384	–1.3	0.5	0.6	0.8

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	0.0	74.1	0.0	25.9	25.9	–100.0
5–9	0.4	73.8	0.0	25.9	26.2	–99.0
10–14	2.2	71.9	0.1	25.8	28.0	–93.9
15–19	7.5	66.6	0.1	25.8	33.3	–79.6
20–24	15.8	58.3	0.5	25.4	41.1	–56.7
25–29	30.0	44.2	1.3	24.6	54.6	–17.4
30–34	44.4	29.7	2.9	22.9	67.4	+23.9
35–39	58.1	16.0	6.6	19.3	77.4	+65.7
40–44	66.5	7.6	9.7	16.2	82.8	+87.0
45–49	70.5	3.6	13.8	12.1	82.6	+81.4
50–54	72.7	1.5	16.7	9.2	81.8	+77.5
55–59	73.5	0.6	18.8	7.0	80.6	+74.6
60–64	73.9	0.2	20.7	5.1	79.0	+72.0
65–69	74.0	0.2	23.0	2.9	76.8	+69.0
70–74	74.0	0.1	24.3	1.5	75.6	+67.2
75–79	74.1	0.1	25.2	0.6	74.7	+66.0
80–84	74.1	0.0	25.6	0.2	74.4	+65.4
85–89	74.1	0.0	25.8	0.1	74.2	+65.3
90–94	74.1	0.0	25.9	0.0	74.1	+65.1
95–100	74.1	0.0	25.9	0.0	74.1	+65.1

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

Figure 12 (150% of the natonal 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 successfully 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	0.0	100.0	0.0	Only poor targeted
5–9	0.4	100.0	0.5	Only poor targeted
10–14	2.3	96.1	3.0	24.5:1
15–19	7.6	98.8	10.1	83.4:1
20–24	16.3	96.9	21.3	31.0:1
25–29	31.3	95.9	40.4	23.3:1
30–34	47.4	93.8	60.0	15.1:1
35–39	64.7	89.8	78.4	8.9:1
40–44	76.2	87.3	89.8	6.9:1
45–49	84.3	83.7	95.1	5.1:1
50–54	89.4	81.3	98.0	4.4:1
55–59	92.4	79.6	99.2	3.9:1
60–64	94.6	78.1	99.7	3.6:1
65–69	96.9	76.3	99.8	3.2:1
70–74	98.3	75.3	99.8	3.0:1
75–79	99.3	74.6	99.9	2.9:1
80–84	99.8	74.3	100.0	2.9:1
85–89	99.9	74.2	100.0	2.9:1
90–94	100.0	74.1	100.0	2.9:1
95–100	100.0	74.1	100.0	2.9:1

USAID "Extreme" Poverty Line Tables

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	100.0
5–9	100.0
10–14	83.8
15–19	72.8
20–24	55.2
25–29	40.8
30–34	30.7
35–39	18.2
40–44	9.7
45–49	2.2
50–54	5.0
55–59	1.5
60–64	2.0
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 5 (USAID "extreme" line): Derivation of estimated poverty likelihoods associated with scores

Score	Households below poverty line		All households at score		Poverty likelihood (estimated, %)
0–4	0	÷	0	=	100.0
5–9	372	÷	372	=	100.0
10–14	1,610	÷	1,922	=	83.8
15–19	3,863	÷	5,303	=	72.8
20–24	4,805	÷	8,703	=	55.2
25–29	6,105	÷	14,967	=	40.8
30–34	4,945	÷	16,130	=	30.7
35–39	3,148	÷	17,299	=	18.2
40–44	1,114	÷	11,499	=	9.7
45–49	178	÷	8,093	=	2.2
50–54	255	÷	5,091	=	5.0
55–59	44	÷	2,987	=	1.5
60–64	46	÷	2,255	=	2.0
65–69	0	÷	2,302	=	0.0
70–74	0	÷	1,427	=	0.0
75–79	0	÷	937	=	0.0
80–84	0	÷	493	=	0.0
85–89	0	÷	106	=	0.0
90–94	0	÷	115	=	0.0
95–100	0	÷	0	=	0.0

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

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	+0.0	0.0	0.0	0.0
5–9	+0.0	0.0	0.0	0.0
10–14	+1.8	4.0	4.8	6.2
15–19	+4.1	2.8	3.2	4.1
20–24	–6.3	4.3	4.5	5.1
25–29	–1.8	1.8	2.1	2.9
30–34	+5.6	1.5	1.7	2.2
35–39	+2.6	1.1	1.4	1.7
40–44	+2.3	1.0	1.2	1.4
45–49	–4.0	2.5	2.6	2.8
50–54	+2.7	0.9	1.0	1.3
55–59	+1.5	0.0	0.0	0.0
60–64	+2.0	0.0	0.0	0.0
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	+3.5	62.3	68.5	89.4
4	+1.5	31.5	36.9	49.5
8	+0.8	23.1	27.1	34.5
16	+1.3	16.2	19.1	25.3
32	+1.2	11.1	13.3	17.8
64	+1.1	7.9	9.3	12.1
128	+1.0	5.8	7.0	9.1
256	+1.0	4.4	5.0	6.3
512	+1.0	3.1	3.6	4.8
1,024	+1.0	2.0	2.4	3.2
2,048	+1.0	1.4	1.7	2.4
4,096	+1.0	1.0	1.2	1.6
8,192	+1.0	0.7	0.8	1.1
16,384	+1.0	0.5	0.6	0.8

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	0.0	25.7	0.0	74.3	74.3	–100.0
5–9	0.4	25.3	0.0	74.3	74.7	–97.1
10–14	2.0	23.7	0.3	74.0	76.0	–83.3
15–19	5.6	20.2	2.0	72.2	77.8	–48.9
20–24	10.8	14.9	5.5	68.8	79.7	+5.6
25–29	17.1	8.6	14.2	60.1	77.2	+44.9
30–34	21.2	4.6	26.2	48.0	69.2	–2.0
35–39	24.0	1.7	40.7	33.6	57.7	–58.1
40–44	25.0	0.7	51.2	23.1	48.1	–99.0
45–49	25.6	0.1	58.7	15.6	41.2	–128.2
50–54	25.7	0.0	63.7	10.6	36.3	–147.5
55–59	25.7	0.0	66.6	7.6	33.4	–159.2
60–64	25.7	0.0	68.9	5.4	31.1	–167.9
65–69	25.7	0.0	71.2	3.1	28.8	–176.9
70–74	25.7	0.0	72.6	1.7	27.4	–182.4
75–79	25.7	0.0	73.6	0.7	26.4	–186.1
80–84	25.7	0.0	74.1	0.2	25.9	–188.0
85–89	25.7	0.0	74.2	0.1	25.8	–188.4
90–94	25.7	0.0	74.3	0.0	25.7	–188.8
95–100	25.7	0.0	74.3	0.0	25.7	–188.8

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 successfully 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	0.0	100.0	0.0	Only poor targeted
5–9	0.4	100.0	1.4	Only poor targeted
10–14	2.3	87.3	7.8	6.9:1
15–19	7.6	73.1	21.6	2.7:1
20–24	16.3	66.6	42.2	2.0:1
25–29	31.3	54.7	66.5	1.2:1
30–34	47.4	44.6	82.3	0.8:1
35–39	64.7	37.2	93.5	0.6:1
40–44	76.2	32.8	97.3	0.5:1
45–49	84.3	30.4	99.5	0.4:1
50–54	89.4	28.8	100.0	0.4:1
55–59	92.4	27.8	100.0	0.4:1
60–64	94.6	27.2	100.0	0.4:1
65–69	96.9	26.5	100.0	0.4:1
70–74	98.3	26.1	100.0	0.4:1
75–79	99.3	25.9	100.0	0.3:1
80–84	99.8	25.8	100.0	0.3:1
85–89	99.9	25.7	100.0	0.3:1
90–94	100.0	25.7	100.0	0.3:1
95–100	100.0	25.7	100.0	0.3:1

$1.25/day 2005 PPP Poverty Line Tables

Figure 4 ($1.25/day 2005 PPP 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	96.2
15–19	94.8
20–24	94.6
25–29	89.2
30–34	85.6
35–39	72.8
40–44	63.9
45–49	49.7
50–54	32.4
55–59	18.4
60–64	15.2
65–69	1.6
70–74	3.3
75–79	0.0
80–84	0.0
85–89	0.0
90–94	0.0
95–100	0.0

Figure 5 ($1.25/day 2005 PPP line): Derivation of estimated poverty likelihoods associated with scores

Score	Households below poverty line		All households at score		Poverty likelihood (estimated, %)
0–4	0	÷	0	=	100.0
5–9	372	÷	372	=	100.0
10–14	1,850	÷	1,922	=	96.2
15–19	5,025	÷	5,303	=	94.8
20–24	8,230	÷	8,703	=	94.6
25–29	13,347	÷	14,967	=	89.2
30–34	13,800	÷	16,130	=	85.6
35–39	12,595	÷	17,299	=	72.8
40–44	7,347	÷	11,499	=	63.9
45–49	4,019	÷	8,093	=	49.7
50–54	1,652	÷	5,091	=	32.4
55–59	549	÷	2,987	=	18.4
60–64	343	÷	2,255	=	15.2
65–69	36	÷	2,302	=	1.6
70–74	47	÷	1,427	=	3.3
75–79	0	÷	937	=	0.0
80–84	0	÷	493	=	0.0
85–89	0	÷	106	=	0.0
90–94	0	÷	115	=	0.0
95–100	0	÷	0	=	0.0

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

Figure 7 ($1.25/day 2005 PPP 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	+5.0	3.4	4.0	5.3
15–19	–4.0	2.3	2.3	2.4
20–24	+0.2	1.1	1.4	1.7
25–29	–3.5	2.2	2.3	2.5
30–34	–2.9	1.9	2.0	2.2
35–39	+1.4	1.4	1.7	2.3
40–44	+1.3	1.9	2.2	3.1
45–49	+8.6	2.3	2.7	3.8
50–54	–2.6	2.8	3.2	4.2
55–59	–5.4	4.4	4.7	5.5
60–64	–5.4	4.9	5.2	6.6
65–69	–3.7	2.9	3.1	3.6
70–74	–1.8	2.3	2.9	4.0
75–79	–1.5	1.3	1.5	1.8
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 2005 PPP 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	–0.5	61.6	68.0	86.8
4	–0.4	30.6	36.7	48.7
8	–0.3	22.8	26.4	32.4
16	–0.1	16.0	19.0	23.0
32	–0.4	11.1	13.1	16.8
64	–0.4	8.3	10.2	12.5
128	–0.4	5.9	7.0	8.8
256	–0.6	4.0	4.8	6.4
512	–0.6	2.9	3.4	4.4
1,024	–0.5	2.0	2.4	3.0
2,048	–0.5	1.4	1.7	2.1
4,096	–0.5	1.0	1.2	1.6
8,192	–0.5	0.7	0.9	1.1
16,384	–0.5	0.5	0.6	0.8

Figure 11 ($1.25/day 2005 PPP 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	0.0	69.6	0.0	30.4	30.4	–100.0
5–9	0.4	69.2	0.0	30.4	30.8	–98.9
10–14	2.2	67.4	0.1	30.3	32.5	–93.5
15–19	7.4	62.2	0.2	30.2	37.7	–78.4
20–24	15.7	53.9	0.6	29.8	45.5	–54.1
25–29	29.5	40.1	1.7	28.7	58.2	–12.6
30–34	43.7	25.9	3.7	26.7	70.5	+30.9
35–39	56.2	13.4	8.5	21.9	78.1	+73.7
40–44	63.3	6.3	12.9	17.5	80.9	+81.5
45–49	66.7	2.9	17.6	12.8	79.6	+74.7
50–54	68.5	1.1	20.9	9.5	78.0	+70.0
55–59	69.1	0.5	23.3	7.1	76.2	+66.5
60–64	69.4	0.2	25.2	5.2	74.6	+63.7
65–69	69.5	0.1	27.4	3.0	72.5	+60.6
70–74	69.6	0.0	28.8	1.6	71.2	+58.6
75–79	69.6	0.0	29.7	0.7	70.3	+57.3
80–84	69.6	0.0	30.2	0.2	69.8	+56.6
85–89	69.6	0.0	30.3	0.1	69.7	+56.5
90–94	69.6	0.0	30.4	0.0	69.6	+56.3
95–100	69.6	0.0	30.4	0.0	69.6	+56.3

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

Figure 12 ($1.25/day 2005 PPP 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 successfully 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	0.0	100.0	0.0	Only poor targeted
5–9	0.4	100.0	0.5	Only poor targeted
10–14	2.3	96.1	3.2	24.5:1
15–19	7.6	97.7	10.7	43.2:1
20–24	16.3	96.1	22.5	25.0:1
25–29	31.3	94.4	42.4	16.9:1
30–34	47.4	92.2	62.8	11.9:1
35–39	64.7	86.8	80.7	6.6:1
40–44	76.2	83.1	91.0	4.9:1
45–49	84.3	79.2	95.9	3.8:1
50–54	89.4	76.6	98.4	3.3:1
55–59	92.4	74.8	99.3	3.0:1
60–64	94.6	73.3	99.7	2.8:1
65–69	96.9	71.7	99.9	2.5:1
70–74	98.3	70.7	100.0	2.4:1
75–79	99.3	70.1	100.0	2.3:1
80–84	99.8	69.7	100.0	2.3:1
85–89	99.9	69.7	100.0	2.3:1
90–94	100.0	69.6	100.0	2.3:1
95–100	100.0	69.6	100.0	2.3:1

$2.50/day 2005 PPP Poverty Line Tables

Figure 4 ($2.50/day 2005 PPP 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	97.8
15–19	97.5
20–24	98.1
25–29	96.2
30–34	97.9
35–39	97.2
40–44	95.7
45–49	85.2
50–54	76.8
55–59	64.9
60–64	53.5
65–69	25.3
70–74	28.2
75–79	4.6
80–84	6.3
85–89	0.0
90–94	0.0
95–100	0.0

Figure 5 ($2.50/day 2005 PPP line): Derivation of estimated poverty likelihoods associated with scores

Score	Households below poverty line		All households at score		Poverty likelihood (estimated, %)
0–4	0	÷	0	=	100.0
5–9	372	÷	372	=	100.0
10–14	1,879	÷	1,922	=	97.8
15–19	5,168	÷	5,303	=	97.5
20–24	8,534	÷	8,703	=	98.1
25–29	14,401	÷	14,967	=	96.2
30–34	15,792	÷	16,130	=	97.9
35–39	16,814	÷	17,299	=	97.2
40–44	11,003	÷	11,499	=	95.7
45–49	6,892	÷	8,093	=	85.2
50–54	3,909	÷	5,091	=	76.8
55–59	1,939	÷	2,987	=	64.9
60–64	1,208	÷	2,255	=	53.5
65–69	582	÷	2,302	=	25.3
70–74	402	÷	1,427	=	28.2
75–79	43	÷	937	=	4.6
80–84	31	÷	493	=	6.3
85–89	0	÷	106	=	0.0
90–94	0	÷	115	=	0.0
95–100	0	÷	0	=	0.0

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

Figure 7 ($2.50/day 2005 PPP 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	–2.2	1.1	1.1	1.1
15–19	–2.6	1.3	1.3	1.3
20–24	–1.0	0.8	0.8	0.8
25–29	–3.1	1.7	1.7	1.8
30–34	–1.0	0.6	0.7	0.7
35–39	+1.2	0.6	0.7	0.9
40–44	+0.8	0.8	1.0	1.4
45–49	+2.9	1.8	2.2	2.9
50–54	–8.5	5.2	5.3	5.8
55–59	–5.3	4.4	4.6	5.2
60–64	+9.1	4.8	5.6	7.1
65–69	–6.0	5.1	5.7	6.9
70–74	+6.4	4.5	5.4	7.3
75–79	–5.8	5.2	5.6	7.0
80–84	–30.7	20.8	21.7	23.5
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 ($2.50/day 2005 PPP 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	44.1	60.1	85.4
4	–0.7	18.1	24.2	37.3
8	–1.0	11.9	15.3	21.5
16	–1.0	8.9	11.1	15.0
32	–0.9	6.7	7.8	10.2
64	–0.9	4.8	5.7	7.2
128	–0.9	3.2	3.7	5.3
256	–1.0	2.3	2.8	3.8
512	–1.0	1.7	2.1	2.6
1,024	–1.0	1.2	1.4	1.9
2,048	–1.0	0.8	1.0	1.3
4,096	–1.0	0.6	0.7	0.9
8,192	–1.0	0.4	0.5	0.6
16,384	–1.0	0.3	0.3	0.5

Figure 11 ($2.50/day 2005 PPP 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	0.0	89.3	0.0	10.7	10.7	–100.0
5–9	0.4	89.0	0.0	10.7	11.0	–99.2
10–14	2.3	87.0	0.0	10.7	13.0	–94.9
15–19	7.6	81.7	0.0	10.7	18.3	–83.0
20–24	16.2	73.1	0.1	10.6	26.8	–63.6
25–29	31.1	58.2	0.2	10.5	41.6	–30.2
30–34	47.0	42.3	0.4	10.3	57.3	+5.7
35–39	63.5	25.8	1.2	9.5	73.0	+43.5
40–44	74.4	14.9	1.8	8.9	83.3	+68.6
45–49	81.0	8.3	3.2	7.4	88.5	+85.1
50–54	85.2	4.1	4.1	6.5	91.8	+95.4
55–59	87.2	2.1	5.2	5.5	92.7	+94.2
60–64	88.1	1.2	6.5	4.2	92.3	+92.7
65–69	88.8	0.5	8.1	2.5	91.3	+90.9
70–74	89.1	0.2	9.2	1.4	90.5	+89.7
75–79	89.2	0.1	10.1	0.6	89.8	+88.7
80–84	89.3	0.0	10.5	0.2	89.5	+88.3
85–89	89.3	0.0	10.6	0.1	89.4	+88.2
90–94	89.3	0.0	10.7	0.0	89.3	+88.0
95–100	89.3	0.0	10.7	0.0	89.3	+88.0

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

Figure 12 ($2.50/day 2005 PPP 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 successfully 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	0.0	100.0	0.0	Only poor targeted
5–9	0.4	100.0	0.4	Only poor targeted
10–14	2.3	100.0	2.6	Only poor targeted
15–19	7.6	100.0	8.5	Only poor targeted
20–24	16.3	99.6	18.2	252.8:1
25–29	31.3	99.5	34.8	188.5:1
30–34	47.4	99.2	52.6	119.4:1
35–39	64.7	98.2	71.1	54.1:1
40–44	76.2	97.7	83.3	42.1:1
45–49	84.3	96.2	90.7	25.0:1
50–54	89.4	95.4	95.4	20.6:1
55–59	92.4	94.4	97.6	16.9:1
60–64	94.6	93.1	98.6	13.5:1
65–69	96.9	91.6	99.4	10.9:1
70–74	98.3	90.6	99.8	9.6:1
75–79	99.3	89.9	99.9	8.9:1
80–84	99.8	89.5	100.0	8.5:1
85–89	99.9	89.4	100.0	8.5:1
90–94	100.0	89.3	100.0	8.4:1
95–100	100.0	89.3	100.0	8.4:1