Simple Poverty Scorecard® Poverty-Assessment Tool Paraguay

Mark Schreiner

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Abstract

The Simple Poverty Scorecard-brand poverty-assessment tool uses 10 low-cost indicators from Paraguay's 2011 Permanent Household Survey to estimate the likelihood that a household has income below a given poverty line. Field workers can collect responses in about ten minutes. The scorecard's accuracy is reported for a range of poverty lines. The scorecard is a practical way for pro-poor programs in Paraguay to measure poverty rates, to track changes in poverty rates over time, and to segment clients for differentiated treatment.

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Simple Poverty Scorecard® Poverty-Assessment Tool

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

Indicator	Response	Points	Score
1. How many household members are there?	A. Six or more	0	
	B. Five	5	
	C. Four	11	
	D. Three	19	
	E. One or two	30	
2. In the last 7 days, how many household members did any type of work, be it as an employee, in self-employment, business owner, or unremunerated family worker?	A. None	0	
	B. One	4	
	C. Two or more	15	
3. In the last 7 days in their main occupation, how many household members were wage or salary workers, or business owners with employees?	A. None	0	
	B. One or more	7	
4. In the last 7 days, how many household members worked in their main occupation as farmers, hired agricultural workers, or fishers?	A. Two or more	0	
	B. One	5	
	C. None	9	
5. What is the main material of the floor of the residence?	A. Dirt, or other	0	
	B. Cement	1	
	C. Wood, bricks, or ordinary tile or paving stones	4	
	D. Mosaic tile, ceramic tile, granite, carpet, or hardwood	8	
6. How many bedrooms does the residence have?	A. One	0	
	B. Two	3	
	C. Three	9	
	D. Four or more	12	
7. What is the main cooking fuel used by the household?	A. Charcoal, kerosene, alcohol, or other	0	
	B. Firewood	7	
	C. LPG, electricity, or none (does not cook)	8	
8. To where does waste water from the residence's bathroom drain?	A. No bathroom	0	
	B. Surface of ground, open pit, ditch, creek, or other	0	
	C. Ordinary closed/dry pit latrine (any type)	2	
	D. Closed pit, septic tank that filters into ground, or sanitary-sewer system	2	
9. Does the household have a washing machine?	A. No	0	
	B. Yes	2	
10. Does the household have an motorcycle or an automobile, truck, or pick-up?	A. None	0	
	B. Only motorcycle	2	
	C. Only automobile, truck, or pick-up	6	
	D. Motorcycle as well as automobile, truck, or pick-up	7	

Worksheet:
Household Roster and Employment

At the start of the interview, read to the respondent: *Please tell me the names and ages of all persons, regardless of any blood relationship, who normally sleep in this residence, eat most of their meals here, and share expenses together. Include all people—including children or others who are away for school or work—who consider this as their permanent residence. Do not include temporary visitors, lodgers, and domestic servants who sleep in their own residences.*

Write each household member's name and age. Count the members, mark the response to the first scorecard indicator, and record the number of household members in the scorecard header.

For each member 10-years-old or older, ask the three work-status questions and circle "Yes" or "No". (If a person did not do any work in the last seven days, then skip the second and third questions.) Then count the number of members who answer "Yes" for each question and mark the corresponding responses for the second, third, and fourth scorecard indicators.

Name	Age	In the last 7 days, did <name> do any work, be it as an employee, in self-employment, business owner, or unremunerated family worker?		In the last 7 days in his/her main occupation, was <name> a wage or salary worker, or a business owner with employees?		In the last 7 days, did <name> work in his/her main occupation as a farmer, hired agricultural worker, or fisher?	
1.		Yes	No	Yes	No	Yes	No
2.		Yes	No	Yes	No	Yes	No
3.		Yes	No	Yes	No	Yes	No
4.		Yes	No	Yes	No	Yes	No
5.		Yes	No	Yes	No	Yes	No
6.		Yes	No	Yes	No	Yes	No
7.		Yes	No	Yes	No	Yes	No
8.		Yes	No	Yes	No	Yes	No
9.		Yes	No	Yes	No	Yes	No
10.		Yes	No	Yes	No	Yes	No
11.		Yes	No	Yes	No	Yes	No
12.		Yes	No	Yes	No	Yes	No
Total "Yes":							

Look-up table to convert scores to poverty likelihoods

	Poverty likelihood (%)						
		National			USAID	Intl. 2005 PPP	
Score	Food	100%	150%	200%	'Extreme'	$1.25	$2.50
0–4	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5–9	100.0	100.0	100.0	100.0	100.0	100.0	100.0
10–14	100.0	100.0	100.0	100.0	100.0	100.0	100.0
15–19	84.9	95.9	100.0	100.0	84.9	27.9	84.9
20–24	77.9	94.0	99.5	100.0	76.4	25.8	76.4
25–29	73.8	94.1	99.5	100.0	68.0	24.9	65.2
30–34	67.8	85.8	94.9	98.8	57.7	20.6	55.2
35–39	41.2	73.0	89.4	95.4	37.7	5.6	30.8
40–44	33.2	67.0	87.2	94.3	29.3	4.2	23.8
45–49	19.9	42.6	69.7	83.1	18.0	2.1	13.1
50–54	11.2	25.7	52.8	75.0	8.2	0.5	7.5
55–59	1.9	14.4	38.2	56.8	2.3	0.2	1.2
60–64	0.6	6.1	26.6	45.2	1.1	0.1	0.5
65–69	0.1	3.3	14.2	24.9	0.6	0.0	0.1
70–74	0.0	2.6	9.1	18.6	0.1	0.0	0.0
75–79	0.0	0.2	4.0	10.8	0.0	0.0	0.0
80–84	0.0	0.0	0.0	3.0	0.0	0.0	0.0
85–89	0.0	0.0	0.0	0.0	0.0	0.0	0.0
90–94	0.0	0.0	0.0	0.0	0.0	0.0	0.0
95–100	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Simple Poverty Scorecard® Poverty-Assessment Tool Paraguay

1. Introduction

Pro-poor programs in Paraguay can use the Simple Poverty Scorecard poverty-assessment tool to estimate the likelihood that a household has income below a given poverty line, to estimate a population's poverty rate at a point in time, to track changes in a population's poverty rate over time, and to segment participants for differentiated treatment.

The direct approach to poverty measurement via surveys is difficult and costly, asking households to complete a lengthy questionnaire. As a case in point, Paraguay's 2011 Permanent Household Survey (*Encuesta Permanente de Hogares*, EPH) runs 44 pages.

In comparison, 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 of the residence?" or "Does the household have a washing machine?") to get a score that is highly correlated with poverty status as measured by the exhaustive EPH survey.

The scorecard differs from "proxy means tests" (Coady, Grosh, and Hoddinott, 2004) 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 blunt (such as rules based on land-ownership or housing quality) or subjective and relative (such as participatory wealth ranking facilitated by skilled field workers). Measurements from these approaches are not comparable across villages nor across organizations nor across time, they may be costly, and their bias and precision are unknown.

The scorecard can be used to measure the share of a pro-poor organization's participants who are 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 scoring with the USAID "extreme" line to report how many of their participants are "very poor".[1] Scoring can also be used to measure movement across a poverty line over time. In all these cases, the scorecard provides an income-based, objective tool with known accuracy. While income surveys are costly even for governments, some local pro-poor organizations may be able to implement an inexpensive poverty-assessment tool to help with poverty 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, then they must first trust that it works. Transparency and simplicity build trust. Getting "buy-in" matters; proxy means tests and regressions on the "determinants

[1] USAID defines households as "very poor" if their per-capita income is below the highest of the $1.25/day 2005 PPP line (PYG4,040 in Paraguay, Figure 1) or the USAID "extreme" line that divides people in households below Paraguay's national poverty line into two equal-size groups (PYG9,447).

of poverty" have been around for three decades, but they are rarely used to inform decisions at the local level. This is 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`" and with points with negative values and many decimal places). Thanks to the predictive-modeling phenomenon known as the "flat maximum", simple, transparent scorecards can be about as accurate as complex, opaque ones (Schreiner, 2012).

Beyond its simplicity and transparency, the scorecard's technical approach 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 data from the 2011 EPH from Paraguay's *Dirección General de Estadística, Encuestas y Censos* (DGEEC). 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
- Applicable in all regions of Paraguay

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 about 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-capita income 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 both 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 an appropriate targeting cut-off for their purposes, this paper reports several measures of targeting accuracy for a range of possible cut-offs.

This paper presents a single scorecard whose indicators and points are derived from household income data and Paraguay'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 half of the data from the 2011 EPH, and its accuracy is validated on the other half of the data.

All three scoring estimators are *unbiased*. That is, they match the true value on average in repeated samples when constructed from (and applied to) a single, constant population. Like all predictive models, the specific scorecard here misses the mark to

some extent when constructed from a single sample (such as the 2011 EPH) and when applied to a different population.[2]

Thus, while the indirect scoring approach is less costly than the direct survey approach, it is also biased when applied in practice. (The survey approach is unbiased by definition.) There is bias because the scorecard is constructed from a single sample and because scoring must assume that the future relationships between indicators and poverty in all possible groups of households will be the same as in the construction data. Of course, this assumption—ubiquitous and inevitable in predictive modeling—holds only partly.

When applied to the validation sample with bootstraps of $n = 16{,}384$, the difference between scorecard estimates of groups' poverty rates and the true rates at a point in time is +0.8 percentage points for the national line. The average absolute difference across all seven lines is 0.4 percentage points. These differences are due to sampling variation and not biased estimators; the average difference would be zero if the whole 2011 EPH were to be repeatedly redrawn and divided into sub-samples before repeating the entire process of constructing and validating 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 ±2.5 percentage points or less.

[2] Important examples include nationally representative samples at a different point in time or sub-groups that are not nationally representative (Tarozzi and Deaton, 2009).

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 scorecard in the context of past exercises for Paraguay. The last section is a summary.

2. Data and poverty lines

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

2.1 Data

The scorecard is based on data from the 4,894 households in the 2011 EPH. This is Paraguay's most recently available national income survey.

For the purposes of the scorecard, the households in the 2011 EPH are randomly divided into two sub-samples:

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

2.2 Poverty rates

A *poverty rate* is the share of units in households in which total household income (divided by the number of household members) is below a given poverty line. The unit is either the household itself or a person in the household. Each household member has the same poverty status (or estimated poverty likelihood) as does the household as a whole.

Suppose a pro-poor organization serves two households. The first household is poor (its per-capita income is less than a given poverty line), and it has three members,

one of whom is a participant with the organization. The second household is non-poor and has four members, two of whom are participants.

Poverty rates are either at the household-level or person-level. If the organization defines its participants as households (say, because all household members are affected by any member's being a participant), then the household level is relevant. The estimated household-level poverty rate is the equal-weighted average of poverty statuses (or estimated poverty likelihoods) across households with clients. In the example here, this is $\frac{1 \cdot 1 + 1 \cdot 0}{1 + 1} = \frac{1}{2} = 0.5 = 50$ percent. In the "$1 \cdot 1$" term in the numerator, the first "1" is the first household's weight, and the second "1" is the first household's poverty status (poor). In the "$1 \cdot 0$" term in the numerator, the "1" is the second household's weight, and the "0" is the second household's poverty status (non-poor). The "$1 + 1$" in the denominator is the sum of the weights.

Alternatively, a person-level rate is relevant if an organization defines all people in households that benefit from its services as participants. In the example here, the person-level rate is the household-size-weighted average of poverty statuses for households with clients, or $\frac{3 \cdot 1 + 4 \cdot 0}{3 + 4} = \frac{3}{7} = 0.43 = 43$ percent. In the "$3 \cdot 1$" term in the numerator, the "3" is the first household's weight because it has three members, and the "1" is its poverty status (poor). In the "$4 \cdot 0$" term in the numerator, the "4" is the second household's weight because it has four members, and the zero is its poverty status (non-poor). The "$4 + 3$" in the denominator is the sum of the weights.

As a final (common) example, an organization may count as participants only those with whom it deals with directly. For the example here, this means that some—but not all—household members are counted. The person-level rate is now the participant-weighted average of the poverty statuses of households with clients, or $\frac{1 \cdot 1 + 2 \cdot 0}{1 + 2} = \frac{1}{3} = 0.33 = 33$ percent. As in previous examples, the first "1" in the "$1 \cdot 1$" in the numerator is the first household's weight because it has one client, and the second "1" is its poverty status (poor). In the "$2 \cdot 0$" term in the numerator, the "2" is the second household's weight because it has two clients, and the zero is its poverty status (non-poor). The "$2 + 1$" in the denominator is the sum of the weights.

To summarize, estimated poverty rates are weighted averages of households' poverty statuses (or estimated poverty likelihoods), where the weights are the number of relevant units in the household. When reporting, organizations should explain who they count as a participant and why.

The scorecard is constructed using the 2011 EPH and poverty status at the household level. Scores are calibrated to household-level poverty likelihoods, and accuracy is measured for household-level rates. Person-level poverty rates can be estimated as the 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.

2.3 Poverty lines

Paraguay's national poverty line (sometimes called here "100% of the national line) is defined for three poverty-line regions: Asunción, Other Urban, and Rural (Figure 1). According to DGEEC (2009), the derivation of Paraguay's poverty lines is based broadly on Ravaillion (1998).[3] In each poverty-region, a food line (*línea de pobreza extrema*) is defined as the cost of a basic food basket that provides a nutritional standard of Calories and protein. This is the basket consumed by a nation-wide reference group of households in the 1997/8 Integrated Household Survey (*Encuesta Integrada de Hogares*, EIH) with per-capita income between the 25th to 55th percentiles,[4] scaled to meet the nutritional standard. For Paraguay overall, the food line in prices as of October 2011 is PYG9,376 per person per day, giving a household-level poverty rate of 13.6 percent and a person-level rate of 18.0 percent (Figure 1).[5]

The national poverty line (which could be called the food-plus-non-food line) is defined as the food line multiplied by the ratio of total expenditure to food expenditure observed for households in the reference group.

Both the food line and the food-plus-non-food (national) line are derived in prices as of February 1998. These are updated to October 2011 using two consumer price indexes (one for food, one for non-food) for Asunción from the Banco Central de Paraguay. The national line for 2011 is PYG14,488 per person per day, giving a

[3] See also p. 6 of World Bank (2010).
[4] The reference group is determined iteratively, as in Pradhan *et al.* (2001).
[5] The person-level rates for the food line and national line match DGEEC (2012).

household-level poverty rate of 26.3 percent and a person-level rate of 32.4 percent (Figure 1).

The national line is used to construct the scorecard. 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:

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

The USAID "extreme" line is defined as the median income of people (not households) in a given poverty-line region who are below the national line (United States Congress, 2004).

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

- 2005 PPP exchange rate of PYG2,127.80 per $1.00 (World Bank, 2008)
- Consumer Price Index for Asunción in October 2011 of 573.5
- 2005 monthly average CPI in Asunción of 377.6[6]

Given this, the $1.25/day 2005 PPP line for Paraguay in prices as of October 2011 is (Sillers, 2006):

$$(\text{2005 PPP exchange rate}) \cdot \$1.25 \cdot \left(\frac{\text{CPI}_{\text{Oct. 2011}}}{\text{CPI}_{\text{2005 average}}} \right) =$$

$$\left(\frac{\text{PYG2,127.80}}{\$1.00} \right) \cdot \$1.25 \cdot \left(\frac{573.5}{377.6} \right) = \text{PYG4,040.}$$

[6] CPIs come from data provided by DGEEC that is available on request.

This 2005 PPP line applies to Paraguay as a whole. It is adjusted for cost-of-living differences across the three poverty-line regions using:

- L, the all-Paraguay \$1.25/day 2005 PPP poverty line (PYG4,040)
- i, an index to Paraguay's three poverty-line regions
- π_i, the national poverty line for poverty-line region i (Figure 1)
- π_{all}, the average national poverty line for Paraguay overall (PYG14,488)

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

$$L_i = \frac{L \cdot \pi_i}{\pi_{all}}.$$

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

USAID microenterprise partners who use the scorecard should report poverty rates to USAID based on the USAID "extreme" line. This is because USAID defines "very poor" as those households whose income is below the highest of two lines:

- \$1.25/day 2005 PPP (PYG4,040)
- The USAID "extreme" line that divides people in households below the national line into two equal-size groups (PYG9,447).

3. Scorecard construction

For Paraguay, about 100 candidate 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 washing machines or motor vehicles)
- Employment (such as the number of household members who work)
- Agriculture (such as the number of household members working in agriculture)

Figure 2 lists the candidate indicators, ordered by the entropy-based "uncertainty coefficient" (Goodman and Kruskal, 1979) that measures how well a given indicator predicts poverty on its own.

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, the ownership of a washing machine 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 statistical power is taken as "c", a measure of its ability to rank by poverty status (SAS Institute Inc., 2004).

One of these one-indicator scorecards is then selected based on several factors (Schreiner *et al.*, 2004; Zeller, 2004). These include improvement in accuracy, likelihood of acceptance by users (determined by simplicity, cost of collection, and "face validity" in terms of experience, theory, and common sense), sensitivity to changes in poverty status, variety among indicators, applicability across regions, and verifiability.

A series of two-indicator scorecards are then built, each based on the one-indicator scorecard selected from the first round, 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 similar 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.[7] The use of non-statistical criteria can improve robustness through time and helps ensure that indicators are simple, sensible, and acceptable to users.

[7] The statistical criterion for selecting an indicator is not the p value of its coefficients but rather its contribution to the ordering of households by poverty status.

The single scorecard here applies to all of Paraguay. Evidence from India and Mexico (Schreiner, 2006 and 2005a), Sri Lanka (Narayan and Yoshida, 2005), and Jamaica (Grosh and Baker, 1995) suggests that segmenting poverty-assessment tools by urban/rural does not improve targeting accuracy much, although it may improve the bias and precision 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 imply a lot of additional work and if the whole process generally seems to make sense.

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

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

The scorecard is ready to be photocopied. A field worker using Paraguay's paper scorecard would:

- Record the participant's and field worker's identifiers and relevant dates
- Complete the household roster/employment worksheet
- Record household size and the responses to the first, second, third, and fourth indicators based on the household roster/employment worksheet
- 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 data entry and filing

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).[8] IRIS Center (2007a) and Toohig

[8] If an organization does not want field workers to know the points associated with indicators, then it can use a version of the scorecard without points and apply the points later at the central office. Schreiner (2011) argues that in Colombia (Camacho and Conover, 2011), hiding points did little to deter cheating and that cheating by the user's central office was more damaging than cheating by field agents and respondents.

(2008) are useful nuts-and-bolts guides for budgeting, training field workers and supervisors, logistics, sampling, interviewing, piloting, recording data, and controlling quality.

In particular, while collecting scorecard indicators is relatively easier than alternatives, it is still absolutely difficult. Training and explicit definitions of terms and concepts in the scorecard is essential, and field workers should scrupulously study and follow the "Guidelines for the Interpretation of Indicators" found at the end of this paper, as they are an integral part of the Simple Poverty Scorecard tool.

For the example of Nigeria, Onwujekwe, Hanson, and Fox-Rushby (2006) find 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 (or avoided in the first place) by field agents who verify responses with a home visit, and this is the suggested procedure for the scorecard in Paraguay.

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, informed, of course, by cost considerations.

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 a central office
- Paper in the field and then keyed into a database or spreadsheet at an office
- Portable electronic devices in the field and uploaded to a database

Given a population relevant for a particular business question, the participants to be scored can be:

- All relevant participants (census)
- A representative sample of all relevant participants
- All relevant participants in a representative sample of relevant field offices
- A representative sample of all relevant participants in a representative sample of relevant field offices

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:

- As a once-off project (precluding measuring change)
- Once a year (or at some other 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 tool for Bangladesh (Schreiner, 2013). 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. They record responses on paper in the field before sending the forms to a central office to be entered into a database and converted to poverty likelihoods. ASA's and BRAC's sampling plans cover 25,000–50,000 participants each.

5. Estimates of household poverty likelihoods

The sum of scorecard points for a household is called the *score*. For Paraguay, 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 40–44 have a poverty likelihood of 67.0 percent, and scores of 45–49 have a poverty likelihood of 42.6 percent (Figure 3).

The poverty likelihood associated with a score varies by poverty line. For example, scores of 40–44 are associated with a poverty likelihood of 67.0 percent for the national line but of 94.3 percent for 200% of the national line.[9]

5.1 Calibrating scores with poverty likelihoods

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

[9] Starting with Figure 3, 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 4), there are 7,277 (normalized) households in the calibration sub-sample with a score of 40–44, of whom 4,875 (normalized) are below the poverty line. The estimated poverty likelihood associated with a score of 40–44 is then 67.0 percent, because 4,875 ÷ 7,277 = 67.0 percent.

To illustrate with the national line and a score of 45–49, there are 10,443 (normalized) households in the calibration sample, of whom 4,452 (normalized) are below the line (Figure 4). Thus, the poverty likelihood for this score is 4,452 ÷ 10,443 = 42.6 percent.

The same method is used to calibrate scores with estimated poverty likelihoods for the other six poverty lines.[10]

Figure 5 shows, for all scores, the likelihood that income falls in a range demarcated by two adjacent poverty lines.

For example, the daily per-capita income of a household with a score of 40–44 falls in the following ranges with probability:

- 4.2 percent below $1.25/day
- 19.6 percent between $1.25/day and $2.50/day
- 9.5 percent between $2.50/day and the food line
- 33.8 percent between the food line and 100% of the national line
- 20.2 percent between 100% and 150% of the national line
- 7.2 percent between 150% and 200% of the national line
- 5.7 percent above 200% of the national line

[10] To ensure that poverty likelihoods always decrease as scores increase, it is sometimes necessary to average likelihoods iteratively across series of adjacent scores before grouping scores into ranges. This preserves unbiasedness, and it keeps users from balking when sampling variation in score ranges with few households leads to higher scores being linked with higher poverty likelihoods.

Even though the scorecard is constructed partly based on judgment, the calibration process produces poverty likelihoods that are objective, that is, derived from quantitative poverty lines and from survey data on income. 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 Paraguay scorecard are transformed coefficients from a Logit regression, (untransformed) scores are not converted to poverty likelihoods via the Logit formula of 2.718281828^{score} x $(1+ 2.718281828^{score})^{-1}$. 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 over time, 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 and of changes in poverty rates between two points in time.[11]

Of course, the relationships between indicators and poverty do change to some unknown extent over time and also across sub-groups in Paraguay's population, so the scorecard will generally be biased when applied after December 2011 (the last month of fieldwork for the 2011 EPH) or when applied with non-nationally representative sub-groups.

[11] 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, given the assumption of constant relationships between indicators and poverty over time and the assumption of a sample that is representative of Paraguay overall? To find out, 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 with income below a poverty line
- For each score, record the difference between the estimated poverty likelihood (Figure 3) 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 6 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 40–44 in the validation sample is too high by 14.9 percentage points. For scores of 45–49, the estimate is too high by 9.6 percentage points.[12]

[12] 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 range would be zero if samples were repeatedly drawn from the population and split into sub-samples before repeating the entire process of scorecard construction/calibration and validation.

The 90-percent confidence interval for the differences for scores of 40–44 is ±2.7 percentage points (national line, Figure 6). This means that in 900 of 1,000 bootstraps, the difference between the estimate and the true value is between +12.2 and +17.6 percentage points (because +14.9 – 2.7 = +12.2, and +14.9 + 2.7 = +17.6). In 950 of 1,000 bootstraps (95 percent), the difference is +14.9 ± 3.1 percentage points, and in 990 of 1,000 bootstraps (99 percent), the difference is +14.9 ± 4.5 percentage points.

For most scores, Figure 6 shows differences—some of them large—between estimated poverty likelihoods and true values. This is because the validation sub-sample is a single sample that—thanks to sampling variation—differs in distribution from the construction/calibration sub-samples and from Paraguay'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. The scorecard here is unbiased, but it may still be *overfit* when applied after the end of the EPH fieldwork in December 2011. That is, it may fit the data from the 2011 EPH 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 2011 EPH. Or the scorecard may be overfit in the sense that it is not robust when relationships between indicators and poverty change 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 reduce overfitting, at the cost of greater complexity.

Most errors in individual households' likelihoods do cancel out in the estimates of groups' poverty rates (see later sections). Furthermore, at least some of the differences will 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, 2013 and that they have scores of 20, 30, and 40, corresponding to poverty likelihoods of 94.0, 85.8, and 67.0 percent (national line, Figure 3). The group's estimated poverty rate is the households' average poverty likelihood of $(94.0 + 85.8 + 67.0) \div 3 = 82.3$ percent.

Be careful; the group's poverty rate is *not* the poverty likelihood associated with the average score. Here, the average score is 30, which corresponds to a poverty likelihood of 85.8 percent. This differs from the 82.3 percent found as the average of the three individual poverty likelihoods associated with each of the three scores. Unlike poverty likelihoods, scores are ordinal symbols, like letters in the alphabet or colors in the spectrum. Scores are not cardinal numbers, and so scores cannot be added up or averaged across households. Only three operations are valid for scores: conversion to poverty likelihoods, distributional analysis (Schreiner, 2012), or comparison—if desired—with a cut-off for targeting. The best rule to follow is: Always use poverty likelihoods, never scores.

6.1 Accuracy of estimated poverty rates at a point in time

For the Paraguay 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 0.8 percentage points or less (Figure 8, summarizing Figure 7 across poverty lines). The average absolute difference across the seven poverty lines is 0.4 percentage points. At least part of these differences is due to sampling variation in the division of the 2011 EPH into two sub-samples.

When estimating poverty rates at a point in time, the bias reported in Figure 8 should be subtracted from the average poverty likelihood to make the estimate unbiased. For Paraguay's scorecard and the national line, bias is +0.8 percentage points, so the unbiased estimate in the three-household example above is 82.3 – (+0.8) = 81.5 percent.

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 8). This means that in 900 of 1,000 bootstraps of this size, the estimate (after subtracting off bias) is within 0.6 percentage points or less of the true value.

For example, suppose that the average poverty likelihood in a sample of n = 16,384 with the Paraguay scorecard and the national line is 82.3 percent. Then estimates in 90 percent of samples of n = 16,384 would be expected to fall in the range of 82.3 – (+0.8) – 0.5 = 81.0 percent to 82.3 – (+0.8) + 0.5 = 82.0 percent, with the most likely true value being the unbiased estimate in the middle of this range (82.3 – (+0.8) = 81.5 percent). This is because the original (biased) estimate is 82.3 percent, bias is +0.8 percentage points, and the 90-percent confidence interval for the national line is ±0.5 percentage points.

6.2 Formula for standard errors for estimates of poverty rates

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

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

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

z is from the Normal distribution and is $\begin{cases} 1.28 \text{ for confidence levels of 80 percent} \\ 1.64 \text{ for confidence levels of 90 percent} \\ 1.96 \text{ for confidence levels of 95 percent} \end{cases}$,

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

$\hat{p}$ is the estimated proportion of households below the poverty line in the sample,

ϕ is the finite population correction factor of $\sqrt{\frac{N - n}{N - 1}}$,

N is the population size, and

n is the sample size.

For example, Paraguay's 2011 EPH estimates a household-level poverty rate for the national line of $\hat{p} = 26.3$ percent (Figure 1) by direct measurement. If this estimate

came from a sample of $n = 16{,}384$ households from a population N of 1,615,309 (the number of households in Paraguay), then the finite population correction ϕ is

$\sqrt{\frac{1{,}615{,}309 - 16{,}384}{1{,}615{,}309 - 1}} = 0.9949$ which can be taken as one (1). If the desired confidence level is 90-percent ($z = 1.64$), then the confidence interval $\pm c$ is

$$\pm\, z \cdot \sqrt{\frac{\hat{p} \cdot (1 - \hat{p})}{n}} \cdot \sqrt{\frac{N - n}{N - 1}} = \pm 1.64 \cdot \sqrt{\frac{0.263 \cdot (1 - 0.263)}{16{,}384}} \cdot 1 = \pm 0.564 \text{ percentage points.}$$

The scorecard, however, does not measure poverty directly, so this formula is not applicable. To derive a formula for the Paraguay scorecard, consider Figure 7, which reports empirical confidence intervals $\pm c$ for the differences for the scorecard applied to 1,000 bootstrap samples of various sizes from the validation sample. For example, with $n = 16{,}384$ and the national line, the 90-percent confidence interval is 0.525 percentage points.[13]

Thus, the 90-percent confidence interval with $n = 16{,}384$ is ± 0.525 percentage points for the Paraguay scorecard and ± 0.564 percentage points for direct measurement. The ratio of the two intervals is $0.525 \div 0.564 = 0.93$.

[13] Due to rounding, Figure 7 displays 0.5, not 0.525.

Now consider the same case, but with $n = 8{,}192$. The confidence interval under direct measurement is $\pm 1.64 \cdot \sqrt{\frac{0.263 \cdot (1 - 0.263)}{8{,}192}} \cdot 1 = \pm 0.798$ percentage points. The empirical confidence interval with the Paraguay scorecard (Figure 7) is 0.765 percentage points. Thus for $n = 8{,}192$, the ratio of the two intervals is $0.765 \div 0.798 = 0.96$.

This ratio of 0.96 for $n = 8{,}192$ is not far from the ratio of 0.93 for $n = 16{,}384$. Across all sample sizes of 256 or more for the national line in Figure 7, the average ratio turns out to be 0.95, implying that confidence intervals for indirect estimates of poverty rates via the Paraguay scorecard and this poverty line are 5 percent narrower than confidence intervals for direct estimates via the 2011 EPH. This 0.95 appears in Figure 8 as the "α factor" because if $\alpha = 0.95$, then the formula for confidence intervals c for the Paraguay scorecard is $\pm c = \pm z \cdot \alpha \cdot \sigma$. That is, the formula for the standard error σ for point-in-time estimates of poverty rates via scoring is

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

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 six of the seven poverty lines in Figure 8.

The formula relating confidence intervals with standard errors for the scorecard can be rearranged to give a formula for determining sample size before measurement. If $\tilde{p}$ is the expected poverty rate before measurement, then the formula for sample size n from a population of size N that is based on the desired confidence level that

corresponds to z and the desired confidence interval $\pm c$ is

$n = N \cdot \left(\frac{z^2 \cdot \alpha^2 \cdot \widetilde{p} \cdot (1 - \widetilde{p})}{z^2 \cdot \alpha^2 \cdot \widetilde{p} \cdot (1 - \widetilde{p}) + c^2 \cdot (N - 1)} \right)$. If the population N is "large" relative to the sample size n, then the finite population correction factor ϕ can be taken as one, and the formula becomes $n = \left(\frac{\alpha \cdot z}{c} \right)^2 \cdot \widetilde{p} \cdot (1 - \widetilde{p})$.

To illustrate how to use this, suppose the population N is 1,615,309 (the number of households in Paraguay overall while the 2011 EPH was in the field), suppose $c = 0.04145$, $z = 1.64$ (90-percent confidence), and the relevant poverty line is the national line so that the most sensible expected poverty rate $\widetilde{p}$ is Paraguay's overall poverty rate for the national line (26.3 percent, Figure 1) and the α factor is 0.95 (Figure 8). Then the sample-size formula gives

$n = 1{,}615{,}309 \cdot \left(\frac{1.64^2 \cdot 0.95^2 \cdot 0.263 \cdot (1 - 0.263)}{1.64^2 \cdot 0.95^2 \cdot 0.263 \cdot (1 - 0.263) + 0.04145^2 \cdot (1{,}615{,}309 - 1)} \right) = 274$, which is not too far from the sample size of 256 observed for these parameters in Figure 7 for the national line. Taking the finite population correction factor ϕ as one (1) gives the same answer, as $n = \left(\frac{0.95 \cdot 1.64}{0.04145} \right)^2 \cdot 0.263 \cdot (1 - 0.263) = 274$.[14]

[14] Although USAID has not specified required confidence levels nor intervals, IRIS Center (2007a and 2007b) says that a sample size of $n = 300$ is sufficient for USAID reporting. USAID microenterprise partners in Paraguay should report using the USAID "extreme" line. Given the α factor of 0.99 for this line (Figure 8), an expected before-measurement household-level poverty rate of 12.2 percent (the all-Paraguay rate for

Of course, the α factors in Figure 8 are specific to Paraguay, 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 EPH in December 2011, an organization would select a poverty line (say, the national line), note their participants' population size (say, $N = 10{,}000$ participants), select a desired confidence level (say, 90 percent, or $z = 1.64$), select a desired confidence interval (say, ±2.0 percentage points, or $c = 0.02$), make an assumption about $\widetilde{p}$ (perhaps based on a previous measurement such as the national average of 26.3 percent in the 2011 EPH in Figure 1), look up α (here, 0.95, Figure 8), assume that the scorecard will still work in the future and/or for non-nationally representative sub-groups,[15] and then compute the required sample size.

In this illustration, $n = 10{,}000 \cdot \left(\frac{1.64^2 \cdot 0.95^2 \cdot 0.263 \cdot (1 - 0.263)}{1.64^2 \cdot 0.95^2 \cdot 0.263 \cdot (1 - 0.263) + 0.02^2 \cdot (10{,}000 - 1)} \right) =$ 1,053.

2011, Figure 1), and a confidence level of 90 percent, then $n = 300$ implies a confidence interval of $\pm\, 0.99 \cdot 1.64 \cdot \sqrt{\frac{0.122 \cdot (1 - 0.122)}{300}} = \pm 3.1$ percentage points.

[15] 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 December 2011 will resemble that in the 2011 EPH 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 2011 EPH, this paper cannot test estimates of change over time for Paraguay, 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, 2013, a program samples three households who score 20, 30, and 40 and so have poverty likelihoods of 94.0, 85.8, and 67.0 percent (national line, Figure 3). Adjusting for the national line's known bias of +0.8 percentage points, the group's baseline estimated poverty rate is the households' average poverty likelihood of [(94.0 + 85.8 + 67.0) ÷ 3] – (+0.8) = 81.5 percent.

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

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

By way of illustration, suppose that a year later on Jan. 1, 2014, the program samples three additional households who are in the same population as the three original households (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 94.1, 73.0, and 42.6 percent, national line, Figure 3). Adjusting for bias, their average poverty likelihood at follow-up is now [(94.1 + 73.0 + 42.6) ÷ 3] – (+0.8) = 69.1 percent, an improvement of 81.5 – 69.1 = 12.4 percentage points.[16]

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

Thus, about one in eight participants in this hypothetical example crossed the poverty line in 2013.[17] Among those who started below the line, about one in six or seven (12.4 ÷ 81.5 = 15.2 percent) on net ended up above the line.[18]

7.3 Accuracy for estimated change in two independent samples

With only the 2011 EPH, it is not possible to measure the accuracy of the Paraguay scorecard's estimates of changes in groups' poverty rates over time. In practice, of course, local pro-poor organizations can still use the Paraguay scorecard to estimate change. The rest of this section suggests approximate formulas for standard errors 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:

$$\pm c = \pm z \cdot \sigma = \pm z \cdot \alpha \cdot \sqrt{\frac{2 \cdot \hat{p} \cdot (1 - \hat{p})}{n}} \cdot \sqrt{\frac{N - n}{N - 1}} .$$

z, c, $\hat{p}$ and N are defined as above, n is the sample size at both baseline and follow-up,[19] and α is the average (across a range of bootstrapped sample sizes) of the

[17] This is a net figure; some people start above the line and end below it, and vice versa.
[18] The scorecard does not reveal the reasons for this change.
[19] This means that, for 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.

ratio of the observed confidence interval from a poverty-assessment tool and the theoretical confidence interval under direct measurement.

As before, the formula for standard errors can be rearranged to give a formula for sample sizes before indirect measurement via a scorecard, where $\widetilde{p}$ is based on previous measurements and is assumed equal at both baseline and follow-up: $n = 2 \cdot N \cdot \left(\frac{z^2 \cdot \alpha^2 \cdot \widetilde{p} \cdot (1 - \widetilde{p})}{z^2 \cdot \alpha^2 \cdot \widetilde{p} \cdot (1 - \widetilde{p}) + c^2 \cdot (N - 1)} \right)$. If ϕ can be taken as one, then the formula becomes $n = 2 \cdot \left(\frac{\alpha \cdot z}{c} \right)^2 \cdot \widetilde{p} \cdot (1 - \widetilde{p})$.

For countries for which this α has been measured (Schreiner, 2010, 2009a, 2009b, 2009c, 2009d, 2009e, and 2008b; Chen and Schreiner, 2009; and Schreiner and Woller, 2010a and 2010b), 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 Paraguay.

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 ($c = \pm 0.02$), the poverty line is the national line, $\alpha = 1.19$, $\hat{p} = 0.263$ (from Figure 1), and the population N is large enough relative to the expected sample size n that the finite population correction factor ϕ can be taken as one. Then the baseline

sample size is $n = 2 \cdot \left(\frac{1.19 \cdot 1.64}{0.02}\right)^2 \cdot 0.263 \cdot (1 - 0.263) \cdot 1 = 3{,}692$, and the follow-up sample size is also 3,692.

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:[20]

$$\pm c = \pm z \cdot \sigma = \pm z \cdot \alpha \cdot \sqrt{\frac{\hat{p}_{12} \cdot (1 - \hat{p}_{12}) + \hat{p}_{21} \cdot (1 - \hat{p}_{21}) + 2 \cdot \hat{p}_{12} \cdot \hat{p}_{21}}{n}} \cdot \sqrt{\frac{N - n}{n - 1}},$$

where z, c, α, N, and n are defined as usual, $\hat{p}_{12}$ is the share of all sampled households that move from below the poverty line to above it, and $\hat{p}_{21}$ is the share of all sampled households that move from above the line to below it.

The formula for confidence intervals 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 will cross the poverty line $\tilde{p}_{12}$ and $\tilde{p}_{21}$. Before measurement, it is reasonable to assume that the change in the poverty rate will be zero, which implies $\tilde{p}_{12} = \tilde{p}_{21} = \tilde{p}_*$, giving:

$$n = 2 \cdot \left(\frac{\alpha \cdot z}{c}\right)^2 \cdot \tilde{p}_* \cdot \sqrt{\frac{N - n}{n - 1}}.$$

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

Because $\widetilde{p}_*$ could be anything between 0–0.5, more information is needed to apply this formula. Suppose that the observed relationship between $\widetilde{p}_*$, the number of years y between baseline and follow-up, and $p_{\text{pre-baseline}} \cdot \left(1 - p_{\text{pre-baseline}}\right)$ is—as in Peru (Schreiner, 2009a)—close to:

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

Given this, a sample-size formula for a group of households to whom the Paraguay scorecard is applied twice (once after December 2011 and then again later) is

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

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 ($c = \pm 0.02$), the poverty line is the national line, the sample will first be scored in 2013 and then again in 2016 ($y = 3$), and the population N is so large relative to the expected sample size n that the finite population correction factor ϕ can be taken as one (1). The pre-baseline poverty rate is taken as 26.3 percent ($p_{2012} = 0.263$, Figure 1), and suppose $\alpha = 1.30$. Then the baseline sample size is

$n = 2 \cdot \left(\frac{1.30 \cdot 1.64}{0.02}\right)^2 \cdot \left\{-0.02 + 0.016 \cdot 3 + 0.47 \cdot \left[0.263 \cdot (1 - 0.263)\right]\right\} \cdot 1 = 2{,}707$. The same group of 2,707 households is scored at follow-up as well.

8. Targeting

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

There is a distinction between *targeting status* (scoring at or below a targeting cut-off) and *poverty status* (having income below a poverty line). Poverty status is a fact that depends on whether income 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 9 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 10 shows the distribution of households by targeting outcome for Paraguay. For an example cut-off of 40–44, outcomes for the national line in the validation sample are:

- Inclusion: 14.4 percent are below the line and correctly targeted
- Undercoverage: 11.8 percent are below the line and mistakenly not targeted
- Leakage: 6.0 percent are above the line and mistakenly targeted
- Exclusion: 67.8 percent are above the line and correctly not targeted

Increasing the cut-off to 45–49 improves inclusion and undercoverage but worsens leakage and exclusion:

- Inclusion: 18.3 percent are below the line and correctly targeted
- Undercoverage: 7.8 percent are below the line and mistakenly not targeted
- Leakage: 12.5 percent are above the line and mistakenly targeted
- Exclusion: 61.4 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 10 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 10 shows "Total Accuracy" for all cut-offs for the Paraguay scorecard. For the national line in the validation sample, total net benefit is greatest (82.2) for a cut-off of 44 or less, with about four in five households in Paraguay 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).[21]

[21] Figure 11 also reports "BPAC", discussed in the next section.

As an alternative to assigning benefits and costs to targeting outcomes and then choosing a cut-off to maximize total net benefit, a program could set a cut-off to achieve a desired poverty rate among targeted households. The third column of Figure 11 ("% targeted who are poor") shows, for the Paraguay 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 44 or less would target 20.4 percent of all households (second column) and produce a poverty rate among those targeted of 70.4 percent (third column).

Figure 11 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 with the validation sample and a cut-off of 44 or less, 54.9 percent of all poor households are covered.

The final targeting measure in Figure 11 is the number of successfully targeted poor households for each non-poor household mistakenly targeted (right-most column). For the national line with the validation sample and a cut-off of 44 or less, covering 2.4 poor households means leaking to 1 non-poor household.

9. Context of poverty-assessment tools in Paraguay

This section discusses six existing poverty-assessment tools for Paraguay in terms of their goals, methods, poverty definitions, data, indicators, cost, and accuracy. The advantages of the scorecard are its use of the latest available nationally representative data, its usually equal-or-slightly-greater accuracy, its focus on feasibility for local, pro-poor organizations, and its reporting of bias and precision, including formulas for standard errors.

9.1 Gwatkin et al.

Gwatkin *et al.* (2007) construct a poverty-assessment tool for Paraguay with an approach that they use 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 5,683 households in the Paraguay 1990 DHS. The PCA index is like the scorecard except that, because the DHS does not collect data on income, it is based on a different conception of poverty, its accuracy vis-à-vis income-based poverty is unknown, and it can only be assumed to be a proxy for long-term wealth/economic status.[22] Well-known examples of the PCA asset-index

[22] Nevertheless, the indicators are similar and the "flat maximum" is important, so carefully built PCA indexes and income-based poverty-assessment tools may pick up the same underlying construct (perhaps "permanent income", see Bollen, Glanville, and Stecklov, 2007), and may they rank households much the same. Tests of how well

approach include Filmer and Scott (2012), Stifel and Christiaensen (2007), Zeller *et al.* (2006), Ferguson *et al.* (2003), Filmer and Pritchett (2001), and Sahn and Stifel (2000 and 2003).

The 11 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:
  - Type of floors
  - Type of walls
  - Source of drinking water
  - Toilet arrangement
  - Presence of electricity
- Ownership of consumer durables:
  - Radios
  - Televisions
  - Refrigerators
  - Bicycles
  - Motorcycles
  - Cars

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 PCA index are similar to those of the scorecard here.

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rankings correspond between PCA indexes and income-based poverty-assessment tools include Lindelow (2006), Wagstaff and Watanabe (2003), and Montgomery *et al.* (2000).

Still, the Gwatkin *et al.* index is more difficult and costly because it cannot be computed by hand in the field, as it has 58 point values (half of them negative, and all with five decimal places) which must be added up to get a household's score.

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

In essence, Gwatkin *et al.*—like all PCA asset indexes—define poverty in terms of the indicators and points in their index. Thus, the index is not a proxy standing in for something else (such as income) but rather a direct measure of a non-income-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 a income-based definition.

The asset-index approach defines people as *poor* if their assets (physical, human, financial, and social) fall below a threshold. Arguments for the asset-based view include Carter and Barrett (2006), Schreiner and Sherraden (2006), Sahn and Stifel (2003), and Sherraden (1991). The main points in its favor are that:

- Asset ownership is easier to measure accurately than income
- Access to resources in the long term—and thus capacity to produce income and to consume—depends on the control of assets
- Assets get at capability more directly, the difference between, say, "Does your income permit adequate sanitation?" versus "Does your toilet have a septic tank?"

While the asset view and the income/consumption view are distinct, they are also tightly linked. After all, income/consumption are flows of resources received/consumed from the use of stocks of assets. Both views are low-dimensional

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

9.2 Paraguay's *Tekoporã* Index

Paraguay targets its *Tekoporã* conditional cash-transfer program to households using two PCA-based "quality-of-life" indexes (*índice de calidad de vida*), one urban and one rural. Like the scorecard here, the *Tekoporã* index's points are scaled and rounded so that scores range from 0 (most poor) to 100 (least poor). Like the Gwatkin *et al.* asset index (but unlike the scorecard), the *Tekoporã* index defines poverty not in terms of income-based poverty lines but rather in terms of its own indicators and points. Nevertheless, the index concentrates households with income under the food and national poverty lines in low scores at least as well as a poverty-assessment tool tested by Pérez Ribas, Issamu Hirata, and Veras Soares (2010).[23] The index's 31 indicators are (World Bank, 2010):

- Demographics:
  - — Number of household members 5-years-old or younger
  - — Main language spoken by the household head
- Education:
  - — Years completed by the male head/spouse
  - — Years completed by the female head/spouse
  - — Share of human capital lost by households members 6- to 24-years-old

[23] This poverty-assessment tool is not discussed more here because of lack of details on it.

- Employment:
  - Type of occupation of the male head/spouse
  - Type of occupation of the female head/spouse
- Characteristics of the residence:
  - Ratio of the number of household members to the number of rooms
  - Type of floor
  - Type of walls
  - Type of roof
  - Type of cooking fuel
  - Whether there is a kitchen
  - Whether there is a bathroom
  - Whether there is an electrical connection
  - Source of drinking water
  - Toilet arrangement
  - Method of disposal of garbage
- Ownership of consumer durables:
  - Land-line telephone
  - Cellular telephone
  - Refrigerator
  - Washing machine
  - Air conditioner
  - Water heater
  - Motorcycle
  - Car
  - Pick-up
  - Truck
- Health:
  - Share of household members with access to a doctor in the past three months
  - Share of household members with health insurance
  - Number of household members 5-years-old or younger who possess a vaccination certificate

Most *Tekoporã* indicators are simple and verifiable, except for the share of human capital lost, the ratio of the number of household members to the number of rooms, and access to a doctor in the past three months.

How does targeting with the *Tekoporã* index compare with targeting by the scorecard?[24] World Bank (2010, Table 5.5) reports inclusion and exclusion for the *Tekoporã* index applied to all of Paraguay,[25] and the scorecard achieves better results. In particular, for a cut-off of 40 points and the national line, the *Tekoporã* index has inclusion of 15 percent and exclusion of 57 percent, versus 18 and 62 percent for the scorecard. Likewise, for a cut-off of 25 points and the national line, the *Tekoporã* index has inclusion of 4 percent and exclusion of 77 percent, versus 5 and 71 percent for the scorecard. For the food line and a cut-off of 25 points, *Tekoporã* has inclusion of 9 percent (versus 12) and exclusion of 68 percent (versus 69). Finally, for the food line and a cut-off of 25 points, *Tekoporã* has inclusion of 3 percent (versus 4) and exclusion of 83 percent (versus 84).

For both poverty lines, the scorecard targets better than the *Tekoporã* index. This is not surprising, as the scorecard is constructed specifically to order households by their likelihood of having income below a poverty line, while the PCA-based *Tekoporã* index is not constructed for this purpose. Besides being more accurate, the scorecard is simpler and thus less costly to use, as it has only one scorecard for all of Paraguay (rather than two) and only 10 indicators (rather than 31). World Bank (2010) strongly recommends that Paraguay update the *Tekoporã* index and segment it more finely by

[24] The *Tekoporã* indexes cannot be used to estimate income-based poverty rates.
[25] The World Bank's tests use person-level poverty rates of 31 percent for the national line and 15 percent for the food line. For an apples-to-apples comparison, poverty lines in the 2011 EPH are decreased proportionally until they give these same rates.

regions, but the results here suggest that using the scorecard would be easier, less costly, and more accurate.

9.3 IRIS Center

USAID commissioned IRIS Center (2009) to build a "Poverty Assessment Tool" (PAT) for the use of USAID's microenterprise partners in Paraguay when reporting their participants' poverty rates. The PAT is constructed with half of the 8,131 households in the 2000/1 EIH; the other half is reserved for out-of-sample validation. The PAT supports two poverty lines:

- USAID "extreme" line, with a household-level poverty rate of 13.1 percent
- National line, with a household-level poverty rate of 26.3 percent

In general, the PAT is like the scorecard here, except that it:

- Uses older data
- Estimates expenditure quantiles
- Supports estimates for only two poverty lines
- Hides scorecard points from end-users
- Does not report formula for standard errors

After comparing several statistical approaches,[26] IRIS settles on quantile regression. The PAT estimates the expected value of the 33th percentile of the logarithm of per-capita household income, conditional on scorecard responses. IRIS calls the household "poor" if this estimate is less than a given poverty line.

[26] All methods have roughly the same accuracy, thanks to the "flat max".

The PAT's 15 indicators are simple and verifiable:

- Household demographics:
  - — Household size (and its square)
  - — Age of the household head (and its square)
  - — Marital status of the household head
- Education: Share of household members who are literate
- Characteristics of the residence:
  - — Geographic region
  - — Number of rooms
  - — Type of floor
  - — Type of roof
  - — Source of drinking water
  - — Type of cooking fuel
- Asset ownership:
  - — Food processor
  - — VCR
  - — Air conditioner
  - — Car
  - — Number of chickens

IRIS reports accuracy in terms of bias, targeting (inclusion, undercoverage, leakage, and exclusion), and the Balanced Poverty Accuracy Criterion, USAID's standard for certifying PATs. BPAC's formula (IRIS Center, 2005) considers accuracy in terms of bias (undercoverage – leakage) and targeting (inclusion). The formula is $\text{BPAC} = 100 \cdot \left(\frac{\text{Inclusion} - \mid \text{Undercoverage} - \text{Leakage} \mid}{\text{Inclusion} + \text{Undercoverage}} \right)$. A higher BPAC is preferred.

How does accuracy compare for the PAT versus the scorecard? An apples-to-apples test requires that both the PAT and the scorecard be applied to poverty lines that give similar poverty rates. By chance, the 2011 household-level poverty rate for the food line (13.6 percent, Figure 1) is almost the same as the 2000/1 rate for the USAID "extreme" line (13.1 percent). Furthermore, the 2011 rate for the national line (26.3

percent) is exactly the same as the 2000/1 rate for the national line, as Paraguay made no net progress against poverty in the intervening decade.

In terms of bias, both the PAT and the scorecard are unbiased.

In terms of precision, IRIS reports a 95-percent ($z = 1.96$) confidence interval of $\pm c = \pm(+3.81 - (-1.08)) \div 2 = \pm 2.46$ percentage points for the difference between the PAT's estimates and true values in 1,000 bootstrapped out-of-sample tests (each with $n = 4{,}065$) for their 2000/1 USAID "extreme" line. With direct measurement, the 95-percent confidence interval is $\pm 1.96 \cdot \sqrt{\frac{0.131 \cdot (1 - 0.131)}{4{,}065}} \cdot 1 = \pm 1.0$ percentage points. Thus, an estimate of the α factor for the PAT for this poverty line is $2.46 \div 1.0 = 2.46$. For the scorecard and the food line, the α factor is 0.97. Thus, the PAT is less precise, with confidence intervals for estimated poverty rates about 2.5 times wider. Seen another way, the 95-percent confidence interval for the food line for a sample of about $n = 4{,}000$ for the scorecard (Figure 7) is 0.8 percentage points (versus 2.46 for the PAT).

In terms of targeting, IRIS reports inclusion of 6.0 percent and exclusion of 80.5 percent for the 2000/1 USAID "extreme" line. For comparison, the scorecard—for a cut-off of 39 or less—gives better inclusion (6.5 percent) and better exclusion (81.3 percent). Considering the slight differences in poverty rates (13.1 percent in 2000/1 versus 13.6 percent in 2011), targeting accuracy is about the same for the two tools.

When targeting based on the national line, IRIS reports inclusion of 15.2 percent and exclusion of 65.9 percent. Again, the scorecard does about as well; with a cut-off of 44 or less, inclusion is 14.4 percent, and exclusion is 67.8 percent.

Overall, the two tools are tied on bias and targeting, and the scorecard has better precision. Of course, the comparison is imperfect because it uses two data sets a decade apart. In practice, the relationships between indicators and poverty change over time, so the new scorecard here should be more accurate in applications after 2011.

Even though IRIS reports targeting accuracy for the PAT and even though the BPAC formula considers targeting accuracy, IRIS says that the PAT should not be used for targeting.[27]

IRIS also doubts that the PAT can be useful for measuring changes in poverty rates, noting that "it is unclear that the tools will be able to identify real changes in poverty over time due to their inherent measurement errors. Unless the changes in the poverty rate are exceptionally large and the tools exceptionally accurate, the changes identified are likely to be contained within the margin of error."[28]

In contrast, these possible uses are supported for the scorecard. This paper reports targeting accuracy as well as margins of error for measures of change over time so that users can decide for themselves whether accuracy is adequate for their purposes.

[27] `http://www.povertytools.org/faq/faq.html#11`, retrieved 19 February 2009.
[28] `http://www.povertytools.org/faq/faq2.html`, retrieved 7 December 2012.

9.4 Robles (2001)

Robles (2001) constructs a "expert" poverty-assessment tool. It is "expert" because they select indicators and points not with data but rather "by hand". The goal is to help businesses to segment potential markets in greater Asunción. Like Gwatkin *et al.*'s asset index, Robles' tool defines poverty (or socio-economic status) in terms of its own indicators and points rather than in terms of income and a poverty line.

The 16 indicators in Robles (2001) are:

- Education: Years completed by the household head
- Employment: Combination of:
  - Work status (employed, unemployed, not in labor force)
  - Type of work (Wage/salary, self-employed, business owner, etc.)
  - Number of workers in the business
- Characteristics of the residence: Combination of the quality of material used for:
  - Floor
  - Wall
  - Roof
- Asset ownership:
  - Stereo system
  - Color television
  - VCR
  - Gas stove
  - Sewing machine
  - Refrigerator
  - Washing machine
  - Vaccum cleaner
  - Air conditioner
  - Bicycle
  - Motorcycle
  - Car
  - Pick-up truck

Robles (2001) resembles the scorecard here in that most indicators are simple and quick to collect, all points are zeroes or positive integers, and the total score ranges from 0 (poorest) to 100 (least poor). The two tools also differ in that Robles (2001):

- Omits household size, which is the strongest indicator in the scorecard
- Has 14 response options for employment, and 33 for education
- Embeds a mini-tool that combines the types of construction materials for the floor, walls, and roof, with the mini-score from that entering the larger tool

9.5 Robles and Santander (2004)

Robles and Santander (2004) apply to Paraguay the "poverty mapping" approach of Elbers, Lanjouw, and Lanjouw (2003) and Hentschel *et al.* (2000). They seek to inform geographic targeting of poverty programs down to the district level.

To do this, Robles and Santander use data on income and indicators for the 9,591 households in the 2003 EPH to build 18 poverty-assessment tools (one for each department in Paraguay, excluding Boquerón and Alto Paraguay and including Asunción). Candidate indicators are drawn from those that are in both the 2003 EPH (which collected income data from August through December) and the 2002 Census (*Censo de Población y Viviendas*, fielded 28 August) and that have similar answer distributions across the two sources. Additional candidate indicators are community-level averages derived from the Census. The 18 tools are constructed using generalized least-squares regressions of the indicators on the natural logarithm of per-capita aggregate household income. Indicators are selected via a stepwise method, not based

on their ability to predict poverty rates nor to order households by income but rather on the statistical significance of their associated coefficients.

Robles and Santander do not report their indicators, but they probably resemble those for the poverty map in Robles (1999) based on the 2002 Census and the 1997/8 EIH.[29] The 22 indicators in Robles (1999) are simple, inexpensive, and verifiable:

- Demographics:
  - — Number of household members
  - — Number of household members 11-years-old or younger
  - — Marital status of the household head
  - — Age of the household head
  - — Whether the household head was born in Caaguazú
- Education: Years of education completed by the household head
- Employment:
  - — Number of household members who work
  - — Whether the household head works in agriculture
- Characteristics of the residence:
  - — Urban/rural
  - — Type of residence
  - — Number of bedrooms
  - — Whether there is a bathroom
  - — Whether there is an electrical connection
  - — Type of roof
  - — Type of cooking fuel
  - — Source of drinking water
  - — Type of toilet arrangement
- Asset ownership:
  - — Refrigerator
  - — Telephone
  - — Water heater
  - — Air conditioner
  - — Car or pick-up truck

[29] Unlike Robles and Santander, Robles (1999) does not use community-level indicators.

Robles and Santander apply their 18 poverty-assessment tools to household-level census data to get estimates of income for all households in Paraguay. Poverty rates (and other measures of income-based well-being) are then estimated for Paraguay's 236 districts and Asunción's 68 barrios with less bias and greater precision than would be possible with the 2003 EPH alone. The results are reported as colored poverty maps that quickly show—in a way that is clear for non-specialists—how poverty varies across Paraguay.

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

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

Strengths of poverty mapping include that it:

- Has formally established theoretical properties
- Can be applied straightforwardly to measures of well-being (such as the poverty gap) that go beyond just head-count poverty rates
- Requires data on fewer households for tool construction and calibration
- Includes community-level indicators, increasing accuracy and precision
- Uses only indicators that appear in a census
- Reports bias and standard errors (although without sample sizes and formula)

Strengths of the scorecard include that it:

- Is simpler in terms of both construction and application
- Tests accuracy empirically
- Associates poverty likelihoods with scores non-parametrically
- Uses judgment and theory in scorecard construction to reduce overfitting[30]
- Reports simple formulas for standard errors

The basic difference between the two approaches is that poverty mapping seeks to help governments design and target pro-poor policies, while the scorecard seeks to help local pro-poor organizations to manage their social performance.[31] On a technical level, Robles and Santander estimate income directly, whereas the scorecard (as in this paper) estimates poverty likelihoods.

In practice, the most relevant advantages of the scorecard for Paraguay presented here are that it:

- Uses the most recent available data
- Is simpler and easier to understand and so is more likely to be adopted and used
- Is just one scorecard, rather than 18 tools
- Presents the complete scorecard transparently
- Can be used by non-specialists in local, pro-poor organizations

[30] A scorecard is *overfit* if it is tailored too closely to the construction sample and any random patterns it may have, leading to inaccuracies when applied at later times or with different populations. Robles and Santander risk overfitting by using stepwise regression and by dividing data from the 2003 EPH among 18 tools.

[31] Another apparent difference is that the developers of poverty mapping (Demombynes *et al.*, 2008; Elbers, Lanjouw, and Lanjouw, 2003) say that its poverty-assessment tools are too inaccurate to be used for targeting individual households. In contrast, Schreiner (2008c) supports such targeting as a legitimate, potentially useful application of the scorecard. The developers of poverty mapping, however, may have taken a small step away from their original position (Elbers *et al.*, 2007).

The scorecard's main disadvantage is that it is not constructed in cooperation with the government, the largest and most important potential anti-poverty actor in Paraguay. Of course, the government is free to use the scorecard. For example, Robles and Santander note that their poverty map could be used to target districts/barrios and then another tool—such as the scorecard here—could be used to target individual households in the targeted area.

9.6 Robles (2003)

The eight-indicator poverty-assessment tools in Robles (2003) is the one that most closely resembles the scorecard. It is made with data from the 2,746 housholds in the 2000/1 EIH who live in the service area of CORPOSANA, a state-owned water utility. The purpose is to test a way to target subsidies for water-use fees and connection costs to help CORPOSANA's privatization to benefit the poor.

Like the scorecard here, Robles (2003) uses Logit to relate indicators to the probability that a household has income under the national poverty line. Unlike the scorecard here, however, poverty likelihoods are found via the Logit formula.

Six of the tool's eight simple, verifiable indicators are related to the residence and were already used by CORPOSANA to target subsidies:

- Demographics: Number of household members 15-years-old or younger
- Education: Years of education completed by the household head
- Characteristics of the residence:
  - Number of rooms
  - Type of floor
  - Type of walls
  - Type of roof
  - Source of drinking water
  - Type of toilet arrangement

As in this paper, Robles (2003) transparently reports the tool indicators and weights. He does not, however, report accuracy in terms of bias or precision, as his goal is to simulate targeting results for the tool versus alternative methods. In general, the new scorecard here is to be preferred because it uses more recent data and reports accuracy more completely.

10. Conclusion

Pro-poor programs in Paraguay can use the scorecard to segment clients for differentiated treatment as well as to estimate:

- The likelihood that a household has income below a given poverty line
- The poverty rate of a population at a point in time
- The change in the poverty rate of a population over time

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

The scorecard is built with half of the data from Paraguay's 2011 EPH, tested on the other half, and calibrated to seven poverty lines.

Bias 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 0.8 percentage points or less and averages—across the seven poverty lines—about 0.4 percentage points. Unbiased estimates may be had by subtracting this known bias from the original poverty-rate estimates. For $n = 16{,}384$ and 90-percent confidence, the precision of these differences is ± 0.6 percentage points or better.

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 scorecard is a practical, objective way for pro-poor programs in Paraguay to estimate income-based 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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Guidelines for the Interpretation of Scorecard Indicators

The following is taken from:

Dirección General de Estadística, Encuestas y Censos. (2011) *Manual de Encuestador: Encuesta Permanente de Hogares (EPH) 2011*, Asunción. ("the *Manual*")

General guidelines for the interviewer

According to pp. 3–5 of the *Manual*, "The enumerator's work requires special interpersonal skills such as friendliness and the flexibility to adapt to the wide range of situations that will be encountered when interviewing, and of course, a deep sense of responsability. Enumerators must also be discreet and maintain confidentiality, as they will have access to private information that they cannot reveal."

Responsabilities of the enumerator

- "Study and follow the instructions in the *Manual* . . . [including this one]
- Do not ever ask for (nor accept) any form of remuneration from respondents
- To ensure the validity of the data collected, conduct the interview yourself. Do not take anyone along to an interview who should not be there in an official capacity
- Use the interview only to obtain the data required by the survey. It is prohibited to take the opportunity of being in the respondent's homestead for the interview to do unrelated things such as buying, selling, advertising, asking questions for some other survey, etc."

How to conduct an interview

The following interviewing guidelines come from pp. 6–8 of the *Manual*.

"The first impression that you give to the respondent—and your first actions and words—are key for encouraging the respondent's good-faith cooperation. Keep in mind the following guidelines:

"Introduce yourself appropriately. After giving your name, establish your legitimacy by showing your credential with the name of your employer. Tell the respondent the goals of the survey before you start working through the questionnaire.

"To establish a healthy rapport with the respondent, it is unwise to begin with phrases such as "Are you very busy?", "Could you spare me a few minutes?", or "Would you be willing to answer a few questions?" These sorts of questions invite rejection. It is better to have a prepared statement that invites acceptance, such as "I would like to ask you a few questions. . . ."

"An effective introduction might go like this. 'Good morning. I am an enumerator with [organization], and we are surveying [all/a sample] of our participants to gather data about how they live. . . . I would like to ask you a few questions, and I hope that you will have the courtesy to respond for me.'

"If your supervisor or anyone else from your organization is accompanying you to observe the interview, then you should also introduce him/her to the respondent at the start of the interview. Good explanations play an important role in generating the good faith needed to encourage careful responses to your questions.

"Survey responses are to be kept confidential. The interview with the member(s) of the household must be done in private. . . . The presence of other people—such as neighbors or visitors—may also interfere with the survey and reduce data quality.

"Before asking any questions, inform the respondent that his/her responses will be kept strictly confidential. . . . Explain that no identifying information will be published that could link the responses with the respondent.

"Be neutral. The questionnaire has been carefully designed to avoid suggesting answers to the respondent. Therefore, you must read each question completely and exactly as it is written.

"Be discreet. Do not ever suggest, be it by your facial expression or your tone of voice, that the respondent has given an inappropriate answer.

"Be prepared to deal with refusal of some items. If the respondent does not want to respond to a question, then continue normally with the next one. Once you have asked all questions, go back and politely try to get answers for the ones you skipped.

"Be in control. As the enumerator, you are in charge of the interview, and you should guide and direct it. If the respondent rambles on without answering a question or talks about things that do not pertain to the survey, then it is wise to refrain from interrupting. Nevertheless, use tact and try to bring the discussion back to the interview

as soon as you can. Of course, you must maintain a cordial atmosphere. If the respondent feels that you are a nice, respectable person who is not easily intimidated, then he/she will be more likely to respond without causing trouble.

"Be prepared for evasive answers. Sometimes, a respondent will give vague or imprecise answers or just say, "I don't know". When this happens, try to encourage the respondent, to build up his/her confidence, and to help him/her feel more comfortable before continuing with the next question.

"Read the questions exactly as they are written in the questionnaire, in the same words, and in the same order as they appear. If you change anything, you might inadvertently change the meaning of the question. If the respondent does not understand the question, then you should repeat it slowly and clearly.

"Probe when responses are incomplete or unsatisfactory. Sometimes, the respondent will give an answer that, from the point of view of the survey, is inadequate. This might happen, for example, if the response is incomplete, off-topic, or if the respondent simply does not know the answer. Use follow-up questions to get a better response. This process of digging deeper is called *probing*. When you probe, use neutral words so as not to suggest specific answers.

"Do not assume answers. Regardless of the socio-economic or other characteristics of the respondent, location, or quality of the residence, you should not assume that you know any answers to any questions without actually asking the respondent. Do not let yourself form preconceived notions of what answers should be.

"Do not rush the interview. Ask questions slowly so that the respondent understands. After asking a question, wait; give the respondent time to think. If he/she feels hurried or that there is not enough time to formulate a careful response, then he/she may give careless answers. If you suspect that the respondent is giving answers without thinking in an attempt to get the interview over with, say, 'There is no rush. Your opinion is very important, so please think about your answers carefully.'

"Know how to end the interview. When all questions have been asked, review the questionnaire carefully, checking for omitted questions or incomplete answers. If needed to complete the questionnaire, you can ask questions again. Before leaving, thank the respondent for his/her cooperation and say good-bye, mentioning that, in the future, a supervisor may come to visit them again to check your work."

Who are the respondents?

According to page 16 of the *Manual*, the respondent is "preferably the male head/spouse of the household or the female head/spouse. If neither of these is available, then seek a substitute. This should be a household member who is at least 15-years-old and who is able to respond for all household members."

According to p. 27 of the *Manual*, "The respondent should never be someone who is not a household member or who does not know much about the household. For example, the respondent should not be a domestic servant, guest, neighbor, visitor, etc."

Guidelines for specific scorecard indicators

1. How many household members are there?
    A. Six or more
    B. Five
    C. Four
    D. Three
    E. One or two

According to p. 2 of the *Manual*, a *household* is "one person or a group of people, regardless of any blood relationship, who normally live in a particular residence, occupying it wholly or partially, and who together fulfill their nutritional needs (eating from a common pot)."

On p. 16 of the *Manual*, this definition of *household* from p. 2 is repeated word-for-word, adding at the very end the phrase "or things of this type".

According to p. 16 of the *Manual*, a person is a *normal resident* of the household if he/she "eats and sleeps in the residence on a permanent basis, or if he/she has lived there for at least three of the last 12 months, that is, if that is where the person lives most of the time. People who do not live with the other household members in the same residence are not *normal residents*, even if they send money or food to any household members being interviewed."

According to p. 65 of the *Manual*, the *last 12 months* refers to "the 12 months immediately preceding the month of the interview. For example, if the interview takes place in October 2013, then the reference period starts in October 2012 and continues through September 2013."

According to p. 17 of the *Manual*, "Ask for all the people who usually eat and/or sleep in the household. . . . Record all members of the household, including those who are sometimes mistakenly omitted, such as newborns, young children, and the elderly."

According to pp. 18–19 of the *Manual*, *household members* are all those who "normally reside with the household for at least three of the 12 months preceding the interview, except for lodgers and domestic servants who sleep in their own residences.

"The rubric of *household member* includes all people who:

- Normally live in the residence
- Usually live in the residence, even though they may be temporarily absent on the day of the interview for reasons such as work, vacation, illness, school, etc. Count domestic servants if they live in the residence for most of the year
- Riverine sailors who work between ports within Paraguay

"Do not count as *household members* people in the following categories:

- People who normally live elsewhere but who, by chance, temporarily happen to be in the residence of the household on the day of the interview. Examples include visitors, people present on business, etc.
- People who live in the residence but who—due to their work—stay most of their time somewhere else. Examples include ocean-going sailors and teachers, nurses, watchmen, etc. who work in a place other than where they live
- People who live in the interviewed household but who, on the day of the interview, have been committed to a mental institution, health center, old-age home, hospital for the chronically ill, prison, etc.

<u>Special cases</u>

"The criteria for determining the normal place of residence for people (and their families) who are citizens of foreign countries and who are temporarily in Paraguay is that they should be included if they are currently working as contractors for the Paraguayan government or for private companies.

"Do not count:

- People living in an embassy, delegation, chancery, or consulate
- People working in Paraguay as contractors for foreign governments or for international organizations
- People visiting or travelling in Paraguay and who are not studying nor working

Families with two or more residences

When a person has two or more residences, count him/her as a resident of the place where he/she spends most of the week. For example, suppose that the parents of a youth live in Las Piedras County in the rural area of Ita. The youth, however, lives with an aunt in a nearby town in order to attend high school there. The youth regularly returns to the parents' home on weekends to visit. If the parents' household is being interviewed, then the youth is not counted as a household member. In contrast, if the aunt's household is being interviewed, then the youth is counted as a household member, because the youth spends most of the time each week there.

2. In the last 7 days, how many household members did any type of work, be it as an employee, in self-employment, business owner, or unremunerated family worker?
    A. None
    B. One
    C. Two or more

According to pp. 67–68 of the *Manual*, "Salaried employees are considered to have worked in the last seven days even if they have not actually worked as long as they continue to have a formal attachment to their job. The criteria for determining formal attachment are:

- Uninterrupted payment of wages or salaries
- Assurance of being able to return to employment once the reason for their current absence expires or as of a date set by previous agreement
- Having the right, under certain circumstances and according to the length of absence from work, to be compensated without being obliged to accept other work

"Self-employed workers who have a business in manufacturing, retail or wholesale trade, agriculture, or the provision of services are considered to have worked in the last seven days even if they have not actually worked if they did not work due to a lack of demand, bad weather, lack of availability of materials, or for any other reason as long as they did indeed work in the last 30 days and as long as their business has a physical infrastructure and fixed assets such as machines, etc. Examples include beauticians, carpenters, mechanics, iron-workers, shoemakers, etc.

"Self-employed people who did not work in the last seven days are not considered to have worked if they are bricklayers/masons, plumbers, gardeners, electricians, pastry cooks, or occasional workers such as shoe-shiners in the street or itinerant vendors of newspapers, ice cream, etc. It is assumed that the businesses of these workers do not continue to exist once the owners have not worked for seven days."

According to pages 64–65 of the *Manual*, the *last 7 days* refers to "the 7 days immediately preceding the day of the interview. For example, if the interview takes place on Wednesday, October 28, then the reference period begins on Wednesday, October 21 and continues through the day before the interview (Tuesday, October 27). If the respondent has trouble remembering or understanding, help him/her recall that the reference period is 'since last Wednesday through yesterday'."

3. In the last 7 days in their main occupation, were any household members wage or salary workers, or business owners with employees?
    A. None
    B. One or more

According to p. 60 of the *Manual*, a person's *occupation* is "the type of work, profession, or office that the person performed during the reference period, regardless of the form of remuneration (in cash or in kind) received in exchange."

According to p. 75 of the *Manual*, the *main occupation* "is that which the respondent considers it to be. Usually, it is the occupation in which the person works the most hours, or the one with the highest remuneration or the highest status."

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4. In the last 7 days, how many household members worked in their main occupation as farmers, hired agricultural workers, or fishers?
    A. Two or more
    B. One
    C. None

According to p. 60 of the *Manual*, a person's *occupation* is "the type of work, profession, or office that the person performed during the reference period, regardless of the form of remuneration (in cash or in kind) received in exchange."

According to p. 75 of the *Manual*, the *main occupation* "is that which the respondent considers it to be. Usually, it is the occupation in which the person works the most hours, or the one with the highest remuneration or the highest status."

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5. What is the main material of the floor of the residence?
    A. Dirt, or other
    B. Cement
    C. Wood, bricks, or ordinary tile or paving stones
    D. Mosaic tile, ceramic tile, granite, carpet, or hardwood

According to p. 30 of the *Manual*, "this question refers to the main flooring material, that is, the material that accounts for the largest share of floor area. If there happens to be a tie between two or more types of materials, record the highest-quality or highest-value material. [In the scorecard, this is the material with the highest point value.] For example, if a residence has 50 square-meters with ordinary tile or paving stones, and 50 square-meters with mosaic tile, then count the response as mosaic tile, as this is the highest-value material."

6. How many bedrooms does the residence have?
    A. One
    B. Two
    C. Three
    D. Four or more

According to p. 30 of the *Manual*, *bedrooms* are those rooms "used as bedrooms, as well as other rooms used for other purposes but which also have a bed in them where some member of the household usually sleeps. Rooms are not counted as *bedrooms* if someone sleeps there only occasionally. Rooms are still counted as *bedrooms* even if the person who sleeps there is not a household member."

According to p. 29 of the *Manual*, a *room* "is a space in a residence that is enclosed by walls that go from the floor to the ceiling. Examples are bedrooms, dining rooms, front/living rooms, studies, and the quarters of domestic servants.

"If a residence is home to more than one household, count only those bedrooms used exclusively by the household being interviewed.

7. What is the main cooking fuel used by the household?
    A. Charcoal, kerosene, alcohol, or other
    B. Firewood
    C. LPG, electricity, or none (does not cook)

According to pp. 35–36 of the *Manual*, "Record the type of fuel that the household normally uses for cooking. Some households may use two types of fuel (for example, LPG and charcoal). In these cases, ask which one is used most. If the household says that both are used equally, then record the most modern type of fuel (in the previous example, this is LPG)." In general, the *most modern type* is the type with the highest point value in the scorecard.

8. To where does waste water from the residence's bathroom drain?
    A. No bathroom
    B. Surface of ground, open pit, ditch, creek, or other
    C. Ordinary closed/dry pit latrine (any type)
    D. Closed pit, septic tank that filters into ground, or sanitary-sewer system

According to p. 34 of the *Manual*, "A household is considered not to have a bathroom if its members do not have their own toilet arrangement. Such households must, for example, use a neighbor's bathroom, public restroom, etc."

According to pp. 34–35 in the *Manual*, "If the household uses two types of drainage, then record the most modern, the most hygienic, or the most costly." In general, this is the one with the highest point value in the scorecard.

The types of waste-water disposal are defined as follows:

- "*Sanitary sewer*: This is a system of drainage pipes that carries human excrement (feces and urine) and other household waste water safely away from the residence for proper disposal. In addition, it has pumps and provides for the safe treatment and release of sewage
- *Septic tank that filters into ground*: A septic tank is a means of collecting and storing excrement via a waterproof sedimentation tank that is usually buried underground some distance from the residence or toilet. The treated waste usually filters into the sub-soil via perforated tubes leading away from the tank
- *Pit that filters into ground*: This is a pit that has been hermetically sealed and that is connected to the toilet by a simple opening. It is also called a "modern toilet".
- *Surface of ground, open pit, ditch, or creek*: Excrement goes into an open pit, ditch, creek, river, or directly on to the surface of the ground via a system of pipes
- *Ordinary closed/dry pit latrine with a ventilation tube*: This is a dry pit latrine that has a ventilation tube that extends above the roof of the latrine. The open end at the top of the tube is covered with a screen or netting to keep flies out, and the interior of the structure is sealed
- *Ordinary dry/closed pit latrine (with slab, roof, walls, and doors)*: This is a dry pit latrine that uses a hole in the ground for the deposit of excrement and that has a slab that is well-secured on all sides, is simple to clean, and that is set up a little bit higher than the surrounding soil so that surface water does not run into the pit. The slab has a simple opening where people can squat or where a simple toilet seat can be placed
- *Ordinary latrine without a roof or door*: This is a simple hole in the ground for the deposit of excrement. It does not have a slab or a seat
- *Other*: Any toilet arrangement not already covered in the other definitions

"For rooming houses in which the toilet arrangement is shared, record the type provided by the rooming house."

9. Does the household have a washing machine?
    A. No
    B. Yes

According to p. 40 of the *Manual*, a *washing machine* is an "electric appliance that washes clothes, regardless of whether it is semi-automatic or automatic."

According to p. 39 of the *Manual*, "Record whether the household has a washing machine in its possession and available for its use. Count a washing machine if it is used by the household, regardless of whether it was purchased with cash or credit, and regardless of whether it was received as a gift or as payment.

"Do not count washing machines used exclusively for a business or for a household's economic activities. For example, count a washing machine used to clean the laundry of household members, but not a washing machine used to wash the work uniforms of employees who work in a business owned by the household.

"If a washing machine is shared between household and business uses, count it *only if it is used exclusively by the household at least half of the time*. For example, if a washing machine is used 70 percent of the time for business and 30 percent of the time for the household, then do not count it.

"Washing machines that are broken or not working are counted only if it is possible that they will be repaired soon. In general, washing machines should not be counted if they have not been working for more than one year."

According to p. 65 of the *Manual*, an *economic activity* is one "done by household members in the residence or outside of the residence during the reference period, excluding unpaid domestic housework and voluntary services to the community."

10. Does the household have an motorcycle or an automobile, truck, or pick-up?
    A. None
    B. Only motorcycle
    C. Only automobile, truck, or pick-up
    D. Motorcycle as well as automobile, truck, or pick-up

According to p. 40 of the *Manual*, *automobiles, trucks, or pick-ups* are "motor vehicles with four wheels powered by some type of fuel."

Motorcycles are "motor vehicles with two wheels powered by some type of fuel."

According to p. 39 of the *Manual*, "Record whether the household has a motorcycle, automobile, truck, or pick-up in its possession and available for its use. Count a motorcycle, automobile, truck, or pick-up if it is used by the household, regardless of whether is was purchased with cash or credit, and regardless of whether it was were received as a gift or as a payment.

"Do not count motorcycles, automobiles, trucks, or pick-ups used exclusively for a business or for a household's economic activities. For example, you should count a motorcycle used to transport household members, but not a motorcycle used to take milk from the household's farm to market.

"If a motorcycle, automobile, truck, or pick-up is shared between household and business uses, count it *only if it is used exclusively by the household at least half of the time*. For example, if a motorcycle is used 70 percent of the time for business and 30 percent of the time for the household, then do not count it.

"Motorcycles, automobiles, trucks, or pick-ups that are broken or not working are counted only if it is possible that they will be repaired soon. In general, motorcycles, automobiles, trucks, or pick-ups should not be counted if they have not been working for more than one year."

According to p. 65 of the *Manual*, an *economic activity* is one "done by household members in the residence or outside of the residence during the reference period, excluding unpaid domestic housework and voluntary services to the community."

Figure 1: Sample sizes, poverty lines, and poverty rates for all of Paraguay by poverty-line region, sub-sample, poverty line, and household-level/person-level

Sample	# households	% with per-capita daily household income below a poverty line						
		National				USAID	Intl. 2005 PPP	
		Food	100%	150%	200%	'Extreme'	$1.25	$2.50
All Paraguay								
Poverty line (PGY/person/day)	4,894	9,376	14,488	21,732	28,976	9,447	4,040	8,079
Poverty rate, household level (%)		13.6	26.3	43.1	56.1	12.2	2.6	10.4
Poverty rate, person level (%)		18.0	32.4	50.0	62.5	161.5	3.6	13.8
Asunción poverty-line region								
Poverty line (PGY/person/day)	1,423	11,315	18,558	27,837	37,116	13,080	10,349	20,698
Poverty rate, household level (%)		7.3	21.2	41.2	53.7	9.7	1.2	6.0
Poverty rate, person level (%)		10.3	26.0	47.2	59.2	12.9	1.8	8.1
Other urban poverty-line region								
Poverty line (PGY/person/day)	1,714	8,683	13,308	19,962	26,616	914	3,711	7,421
Poverty rate, household level (%)		7.3	17.2	30.7	44.3	7.8	1.0	5.6
Poverty rate, person level (%)		9.6	20.5	35.3	49.0	10.3	1.1	7.2
Rural poverty-line region								
Poverty line (PGY/person/day)	1,757	8,035	11,518	17,277	23,036	6,395	3,212	6,423
Poverty rate, household level (%)		23.1	35.4	52.4	65.3	17.2	4.8	17.4
Poverty rate, person level (%)		29.6	44.8	60.7	73.0	22.3	6.6	22.6
Construction and calibration: Selecting indicators and points, and associating scores with likelihoods								
Poverty rate, household level (%)	2,432	13.6	26.4	43.5	56.1	12.3	2.6	10.4
Poverty rate, person level (%)		18.2	32.6	50.1	62.6	16.4	3.6	14.2
Validation: Measuring accuracy								
Poverty rate, household level (%)	2,462	13.6	26.1	42.8	56.0	12.2	2.6	10.4
Poverty rate, person level (%)		17.8	32.3	49.9	62.4	15.9	3.6	13.5

Source: 2011 *Encuesta Permanente de Hogares*

Figure 2: Poverty indicators by uncertainty coefficient

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
1,495	Does the household have a gas stove, electric stove, or a microwave? (None; Only gas stove, or only electric stove; Only microwave, or gas stove and microwave; Gas stove and electric stove; All, or microwave and electric stove)
1,348	What is the main material of the floor of the residence? (Dirt, or other; Cement; Wood, bricks, or ordinary tile or paving stones; Mosaic tile, ceramic tile, granite, carpet, or hardwood)
1,276	How many household members are 0 to 17-years-old? (Four or more; Three; Two; One; None)
1,243	How many household members are 0 to 15-years-old? (Three or more; Two; One; None)
1,242	How many household members are 0 to 16-years-old? (Four or more; Three; Two; One; None)
1,211	How many household members are 0 to 18-years-old? (Four or more; Three; Two; One; None)
1,197	How many household members are 0 to 14-years-old? (Three or more; Two; One; None)
1,162	What is the main cooking fuel used by the household? (Charcoal, kerosene, alcohol, or other; Firewood; LPG, electricity, or none (does not cook))
1,118	How many household members are 0 to 12-years-old? (Three or more; Two; One; None)
1,114	How many household members are 0 to 13-years-old? (Three or more; Two; One; None)
1,053	Does the household have a television, VCR/DVD, satelite dish, and/or cable? (None, only VCD/DVD, only satelite dish, only cable, only VCR/DVD and satelite dish, only VCR/DVD and cable, only satelite dish and cable, or VCR/DVD, satelite dish, and cable; Only television; Only television and VCR/DVD, only television and a satelite dish, or only television and cable; Television, VCR/DVD, and a satelite dish, television, VCR/DVD, and cable, television, satelite dish, and cable, or all)
1,033	How many household members are 0 to 11-years-old? (Three or more; Two; One; None)
983	In the last 7 days, how many household members worked in their main occupation as scientists and other high-level professionals and intellectuals, technicians and mid-level professionals, clerks and other office workers, or administrators of public or private businesses and members of the executive, legislative, and judicial branches of government? (None; One; Two or more)

Figure 2 (cont.): Poverty indicators by uncertainty coefficient

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
958	Do all household members ages 6 to 14 currently go to school or participate in some kind of class in a public, private, or charter school? (No; Yes, all go to public school; Yes, and at least one goes to private or charter school; No members ages 6 to 14)
945	Do all household members ages 6 to 15 currently go to school or participate in some kind of class in a public, private, or charter school? (No; Yes, all go to public school; Yes, and at least one goes to private or charter school; No members ages 6 to 15)
929	What is the highest level, grade, course, course of studies, or semester that the female head/spouse has completed? (None/did not go to school, or any level of special education, or first grade; Second to fifth grade; Sixth grade; Seventh to twelfth grade, any level of on-line school with a technical or science focus, or special classes, literacy program, or any level of on-line coursework, basic bilingual education for youth and adults, on-line school for youth and adults, or alternative school for youth and adults; Any year of undergraduate in arts and sciences or business administratio; No female head/spouse; Any level of university studies, or any level of technical school, teacher college, professional teacher college, or military/police training)
916	How does drinking water get to the residence? (Piped outside of the residence but in the yard, public standpipe, neighbor, water truck, or other ways; Well in the yard; Piped into the residence; Bottled (mineral) water)
909	Does the household have a water heater or an air conditioner? (No; Yes)
909	Do all household members ages 6 to 17 currently go to school or participate in some kind of class in a public, private, or charter school? (No; Yes, all go to public school; Yes, and at least one goes to private or charter school; No members ages 6 to 17)
902	Do all household members ages 6 to 13 currently go to school or participate in some kind of class in a public, private, or charter school? (No; Yes, all go to public school; Yes, and at least one goes to private or charter school; No members ages 6 to 13)

Figure 2 (cont.): Poverty indicators by uncertainty coefficient

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
900	Do all household members ages 6 to 16 currently go to school or participate in some kind of class in a public, private, or charter school? (No; Yes, all go to public school; Yes, and at least one goes to private or charter school; No members ages 6 to 16)
899	To where does waste water from the residence's bathroom drain? (No bathroom; Surface of ground, open pit, ditch, creek, or other; Ordinary closed/dry pit latrine (any type); Closed pit, septic tank that filters into ground, or sanitary-sewer system)
865	Do all household members ages 6 to 12 currently go to school or participate in some kind of class in a public, private, or charter school? (No; Yes, all go to public school; Yes, and at least one goes to private or charter school; No members ages 6 to 12)
854	Do all household members ages 6 to 18 currently go to school or participate in some kind of class in a public, private, or charter school? (No; Yes, all go to public school; Yes, and at least one goes to private or charter school; No members ages 6 to 18)
849	Do all household members ages 6 to 11 currently go to school or participate in some kind of class in a public, private, or charter school? (No; Yes, all go to public school; Yes, and at least one goes to private or charter school; No members ages 6 to 11)
843	Does the household have a computer with an internet connection? (No; Yes)
834	How does the household usually dispose of its garbage? (Burning, throws it in the yard, vacant lot, ditch, or street, throws it in the public dumpster, throws it in the fields, throws it in the creek, river, or pond, or other; Throws it in a hole; Public collection; Private collection)
825	Does the household have an motorcycle or an automobile, truck, or pick-up? (None; Only motorcycle; Only automobile, truck, or pick-up; Motorcycle as well as automobile, truck, or pick-up?

Figure 2 (cont.): Poverty indicators by uncertainty coefficient

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
812	In the last 7 days, what was the main occupation of the male head/spouse? (Farmers, hired agricultural workers, and fishers; Unskilled laborers; Factory workers; No male head/spouse; Does not work; Skilled craftspeople and artisans; Clerks and other office workers, service workers and retail salespeople, or members of the armed forces; Administrators of public or private businesses and members of the executive, legislative, and judicial branches of government, scientists and high-level professionals and intellectuals, or technicians and mid-level professionals)
774	In the last 7 days, how many household members in their main occupation worked in community, social, and personal services, or financial services, insurance, real estate, and business services, or manufacturing, electricity, gas, and water, transport, logistics, wharehousing, and communications? (None; One; Two or more)
757	How many rooms does the residence have (do not include bathrooms, kitchens, nor rooms or spaces used exclusively for business)? (One; Two; Three; Four; Five; Six or more)
702	How many household members are currently covered by health insurance? (None; One; Two; Three or more)
701	In the last 7 days in their main occupation, how many household members had a written employment contract (whether indefinite-term or fixed-term)? (None; One; Two or more)
696	In the last 7 days, what was the main occupation of the female head/spouse? (Farmers, hired agricultural workers, and fishers; Does not work; Skilled craftspeople and artisans, factory workers, or unskilled laborers; Service workers and retail salespeople, or members of the armed forces; No female head/spouse; Administrators of public or private businesses and members of the executive, legislative, and judicial branches of government, scientists and high-level professionals and intellectuals, technicians and mid-level professionals, or clerks and other office workers)
688	What language does the female head/spouse usually speak at home? (Guaraní; Guaraní and Spanish; No female head/spouse; Spanish; Other, or does not speak)

Figure 2 (cont.): Poverty indicators by uncertainty coefficient

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
677	Does the household have a land-line or cellular telephone? (Neither; Only cellular, or only land-line; Both)
646	In the last 7 days in their main occupation, how many household members were wage or salary workers, or business owners with employees? (None; One or more)
605	What is the highest level, grade, course, course of studies, or semester that the male head/spouse has completed? (None/did not go to school, or any level of special education; First or second grade; Third, fourth, or fifth grade; Sixth grade; Seventh to twelfth grade, any level of on-line school with a technical or science focus, or special classes, literacy program, or any level of on-line coursework, basic bilingual education for youth and adults, on-line school for youth and adults, or alternative school for youth and adults; No male head/spouse; Any level of undergraduate studies in arts and sciences or business administration; Any level of university studies, or any level of technical school, teacher college, professional teacher college, or military/police training)
595	How many household members contribute to a retirement pension fund? (None; One; Two or more)
592	In the last 7 days, how many household members worked in their main occupation as farmers, hired agricultural workers, or fishers? Two or more; One; None)
590	In the last 7 days in their main occupation, how many household members worked in a business or firm that has an employer-identification number? (None; One; Two or more)
584	Do all household members ages 6 to 14 currently go to school? (No; Yes; No members are ages 6 to 14)
579	In the last 7 days, how many household members in their main occupation worked in a business or firm whose main activity was agriculture, animal husbandry, hunting, forestry, or fishing? (Two or more; One; None)
564	What language does the male head/spouse usually speak at home? (Guaraní; Guaraní and Spanish; No male head/spouse; Spanish; Other, or does not speak)
559	How many household members are there? (Six or more; Five; Four; Three; One or two)

Figure 2 (cont.): Poverty indicators by uncertainty coefficient

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
552	Do all household members ages 6 to 15 currently go to school? (No; Yes; No members are ages 6 to 15)
548	In the last 7 days, how many household members in their main occupation worked in community, social, and personal services, or financial services, insurance, real estate, and business services? (None; One; Two or more)
548	Do all household members ages 6 to 12 currently go to school? (No; Yes; No members are ages 6 to 12)
541	Do all household members ages 6 to 11 currently go to school? (No; Yes; No members are ages 6 to 11)
537	Do all household members ages 6 to 13 currently go to school? (No; Yes; No members are ages 6 to 13)
536	In the last 12 months, has any member of the household worked in agriculture, whether self-employment, as a business owner or employer, or as an unpaid worker in a family business? If so, does the household own any agricultural plots? (Someone works in agriculture, but no agricultural land is owned; Someone works in agriculture, and agricultural land is owned; No one works in agriculture)
524	What is the type of activity at the business or firm where the male head/spouse worked in the his main occupation in the last 7 days? (Agriculture, animal husbandry, hunting, forestry, and fishing; No male head/spouse; Does not work; Wholesale and retail trade, or restaurants and hotels; Electricity, gas, and water, or construction; Transport, logistics, warehousing, and communications; Manufacturing; Financial services, insurance, real estate, and business services, or community, social, and personal services)
521	What is the type of activity at the business or firm where the female head/spouse worked in the her main occupation in the last 7 days? (Agriculture, animal husbandry, hunting, forestry, and fishing; Does not work; Manufacturing, electricity, gas, and water, construction, or wholesale and retail trade, and restaurants and hotels; No female head/spouse; Transport, logistics, warehousing, and communications, financial services, insurance, real estate, and business services, or community, social, and personal services)
518	Do all household members ages 6 to 17 currently go to school? (No; Yes; No members are ages 6 to 17)

Figure 2 (cont.): Poverty indicators by uncertainty coefficient

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
516	How many household members are 0 to 6-years-old? (Two or more; One; None)
511	Do all household members ages 6 to 16 currently go to school? (No; Yes; No members are ages 6 to 16)
507	Does the household have a washing machine? (No; Yes)
492	Does the household have a refrigerator? (No; Yes)
486	What is the class or position that the female head/spouse has in her main occupation? (Does not work; Self-employed, unpaid worker in a family business, or domestic servant; Business owner with employees; No female head/spouse; Wage or salary worker in the private sector; Wage or salary worker in the public sector)
472	In the past 12 months, has any member of the household worked in agriculture, whether as self-employed, as a business owner or employer, or as an unpaid worker in a family business? If so, how many pigs, sheep, or goats do you have now? (Someone works in agriculture, and they own pigs, sheep, or goats; Someone works in agriculture, but no one owns pigs, sheep, or goats; No one works in agriculture)
470	In the last 7 days, how many household members in their main occupation worked in a business or firm whose main activity was construction, agriculture, animal husbandry, hunting, forestry, or fishing? (Two or more; One; None)
455	In the last 7 days in their main occupation, how many household members had a indefinite-term, written employment contract? (None; One or more)
448	In the past 12 months, has any member of the household worked in agriculture, whether as self-employed, as a business owner or employer, or as an unpaid worker in a family business? If so, how many bullocks, other cattle, horses, burros, mules, pigs, sheep, or goats do you have now? (Someone works in agriculture, and they own bullocks, other cattle, horses, burros, mules, pigs, sheep, or goats; Someone works in agriculture, but no one owns bullocks, other cattle, horses, burros, mules, pigs, sheep, or goats; No one works in agriculture)

Figure 2 (cont.): Poverty indicators by uncertainty coefficient

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
444	Does that household have any books (other than textbooks for school)? (No; Yes)
442	Do all household members ages 6 to 18 currently go to school? (No; Yes; No members are ages 6 to 18)
435	In the past 12 months, has any member of the household worked in agriculture, whether as self-employed, as a business owner or employer, or as an unpaid worker in a family business? If so, how many bullocks, other cattle, horses, burros, or mules do you have now? (Someone works in agriculture, and they own bullocks, other cattle, horses, burros, or mules; Someone works in agriculture, but no one owns bullocks, other cattle, horses, burros, or mules; No one works in agriculture)
434	In the past 12 months, has any member of the household worked in agriculture, whether as self-employed, as a business owner or employer, or as an unpaid worker in a family business? (Yes; No)
431	What is the main source of drinking water for the members of the household? (Unprotected dug well (without rim and lid), unprotected spring, rainwater, water truck, surface water (river, dam, lake, pond, creek, canal, or irrigation ditch), or other; Protected dug well (with rim and lid); Private network or provider; Artensian well, or protected spring; Community network; Junta de Saneamiento or SENASA; ESSAP (ex-Corposana); Bottled (mineral) water)
395	What is the main material of the roof of the residence? (Straw, wooden boards, palm trunks, cardboard, oilcloth, or wood from pallets or packing crates, or other; Metal sheets; Fiberglass; Tile, or reinforced concrete, tile, or pre-fab concrete)
338	What is the class or position that the male head/spouse has in his main occupation? (Self-employed, unpaid worker in a family business, or domestic servant; No male head/spouse; Does not work; Wage or salary worker in the private sector; Business owner with employees; Wage or salary worker in the public sector)
333	Do any household members currently go to a private or charter school? (No; Yes)
324	What is the type of the residence? (Farm house, makeshift quarters, or other; Detached house, apartment or flat, or rooming house)

Figure 2 (cont.): Poverty indicators by uncertainty coefficient

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
323	What is the main material of the walls of the residence? (Wood, sticks, adobe, palm trunks, cardboard, tarpulin, or wood from pallets or packing crates, there are no walls, or other; Bricks, or cement blocks)
262	How many bedrooms does the residence have? (One; Two; Three; Four or more)
232	In the last 7 days, has the female head/spouse done any type of work, be it as an employee, self-employment, as a business owner, or as an unremunerated family worker? (No; Yes; No female head/spouse)
215	In the last 7 days, how many household members worked in their main occupation as service workers and retail salespeople? (None; One; Two or more)
215	In the last 7 days in their main occupation, how many household members had a fixed-term, written employment contract? (None; One or more)
214	What is the marital status of the female head/spouse? (Cohabiting; Never-married; Married; Separated, or widowed; Divorced, or no female head/spouse)
205	What is the marital status of the male head/spouse? (Cohabiting or separated; No male head/spouse; Married; Widowed; Never-married, or divorced)
168	How old is the female head/spouse? (25 or younger; 26 to 30; 31 to 35; 36 to 40; 41 to 45; 46 to 50; 51 to 55; 56 to 60; 61 to 65; 66 or older; No female head/spouse)
160	Can the male head/spouse read and write? (No; No male head/spouse; Yes)
155	In the last 7 days in their main occupation, how many household members were self-employed (without employees)? (Two or more; One; None)
136	Can the female head/spouse read and write? (No; Yes; No female head/spouse)
122	Does the household have a radio? (No; Yes)
118	In the last 7 days, how many household members did any type of work, be it as an employee, in self-employment, business owner, or unremunerated family worker? (None; One; Two or more)

Figure 2 (cont.): Poverty indicators by uncertainty coefficient

Uncertainty coefficient	Indicator (Answers ordered starting with those most strongly linked with higher poverty likelihoods)
114	Does the residence have a kitchen? (No; Yes)
110	In the last 7 days, how many household members in their main occupation worked in wholesale and retail trade, or restaurants and hotels? (None; One or more)
95	What is the structure of household headship? (Both male and female heads/spouses; Female head/spouse only; Male head/spouse only)
42	Over the last 12 months, what has been your legal tenancy status in your residence? (Ceded, squatter, or owned with a mortgage; Jointly owned, or owned free-and-clear; Rented)
32	How old is the male head/spouse? (31 to 35; 36 to 40; 41 to 45; 46 to 50; 25 or younger; 26 to 30; No male head/spouse; 51 to 55; 56 to 60; 61 to 65; 66 or older)
23	In the last 7 days in their main occupation, how many household members were domestic servants or unpaid workers in a family business? (One or more; None)
22	In the last 7 days, how many household members worked in their main occupation as skilled craftspeople, artisans, or factory workers? (None; One or more)
1	In the last 7 days, has the male head/spouse done any type of work, be it as an employee, self-employment, as a business owner, or as an unremunerated family worker? (No male head/spouse; Yes; No)
0	How many household members can read and write? (None; One or more)
0	In the last 7 days, how many household members worked in their main occupation as unskilled laborers? (One or more; None)

Source: 2011 *Encuesta Permanente de Hogares*

Tables for
100% of the National Poverty Line

(and Tables Pertaining to All Seven Poverty Lines)

Figure 3 (National line): Estimated poverty likelihoods associated with scores

If a household's score is . . .	. . . then the likelihood (%) of being below the poverty line is:
0–4	100.0
5–9	100.0
10–14	100.0
15–19	95.9
20–24	94.0
25–29	94.1
30–34	85.8
35–39	73.0
40–44	67.0
45–49	42.6
50–54	25.7
55–59	14.4
60–64	6.1
65–69	3.3
70–74	2.6
75–79	0.2
80–84	0.0
85–89	0.0
90–94	0.0
95–100	0.0

Figure 4 (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	0	÷	0	=	100.0
10–14	12	÷	12	=	100.0
15–19	276	÷	288	=	95.9
20–24	1,042	÷	1,108	=	94.0
25–29	1,867	÷	1,986	=	94.1
30–34	3,487	÷	4,064	=	85.8
35–39	4,116	÷	5,642	=	73.0
40–44	4,875	÷	7,277	=	67.0
45–49	4,452	÷	10,443	=	42.6
50–54	3,397	÷	13,202	=	25.7
55–59	1,838	÷	12,727	=	14.4
60–64	750	÷	12,397	=	6.1
65–69	405	÷	12,449	=	3.3
70–74	214	÷	8,314	=	2.6
75–79	9	÷	5,374	=	0.2
80–84	0	÷	2,676	=	0.0
85–89	0	÷	1,601	=	0.0
90–94	0	÷	182	=	0.0
95–100	0	÷	259	=	0.0

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

Figure 5: Distribution of household poverty likelihoods across income ranges demarcated by two adjacent poverty lines

	Likelihood of having income in ranges demarcated by poverty lines						
	<$1.25/day	=>$1.25/day and <$2.50/day	=>$2.50/day and <Food	=>Food and <100% Natl.	=>100% Natl. and 150% Natl.	=>150% Natl. and 200% Natl.	=>200% Natl.
Score	<PYG4,040	=>PYG4,040 and <PYG8,079	=>PYG8,079 and <PYG9,376	=>PYG9,376 and <PYG14,488	=>PYG14,488 and <PYG21,732	=>PYG21,732 and <PYG28,976	=>PYG28,976
0–4	100.0	0.0	0.0	0.0	0.0	0.0	0.0
5–9	100.0	0.0	0.0	0.0	0.0	0.0	0.0
10–14	100.0	0.0	0.0	0.0	0.0	0.0	0.0
15–19	27.9	57.0	0.0	11.0	4.1	0.0	0.0
20–24	25.8	50.6	1.5	16.1	5.5	0.5	0.0
25–29	24.9	40.3	8.7	20.2	5.5	0.5	0.0
30–34	20.6	34.5	12.6	18.0	9.1	3.8	1.2
35–39	5.6	25.2	10.4	31.8	16.4	6.0	4.6
40–44	4.2	19.6	9.5	33.8	20.2	7.2	5.7
45–49	2.1	11.0	6.7	22.8	27.1	13.4	16.9
50–54	0.5	7.0	3.8	14.5	27.1	22.2	25.0
55–59	0.2	1.0	0.7	12.6	23.7	18.6	43.2
60–64	0.1	0.4	0.1	5.5	20.5	18.6	54.8
65–69	0.0	0.1	0.0	3.1	10.9	10.7	75.2
70–74	0.0	0.0	0.0	2.6	6.5	9.6	81.4
75–79	0.0	0.0	0.0	0.2	3.8	6.8	89.2
80–84	0.0	0.0	0.0	0.0	0.0	3.0	97.0
85–89	0.0	0.0	0.0	0.0	0.0	0.0	100.0
90–94	0.0	0.0	0.0	0.0	0.0	0.0	100.0
95–100	0.0	0.0	0.0	0.0	0.0	0.0	100.0

Note: All poverty likelihoods in percentage units.

The USAID "extreme" line is very close to the food line, so it is omitted from this figure.

Figure 6 (National line): Bootstrapped differences between estimated and true poverty likelihoods for households in a large sample (n = 16,384) with confidence intervals, scorecard applied to the validation sample

	Difference between estimate and true value			
		Confidence interval (+/– percentage points)		
Score	Diff.	90-percent	95-percent	99-percent
0–4	+0.0	0.0	0.0	0.0
5–9	+0.0	0.0	0.0	0.0
10–14	+0.0	0.0	0.0	0.0
15–19	–4.1	2.1	2.1	2.1
20–24	+1.3	3.5	4.1	5.6
25–29	+21.1	4.7	5.5	7.4
30–34	–5.3	3.5	3.7	4.0
35–39	+9.6	3.0	3.6	4.9
40–44	+14.9	2.7	3.1	4.5
45–49	+9.6	1.9	2.4	3.1
50–54	–10.0	6.0	6.1	6.5
55–59	–6.0	3.9	4.1	4.4
60–64	+1.2	0.8	0.9	1.2
65–69	–0.9	0.8	0.9	1.2
70–74	+1.1	0.6	0.7	0.9
75–79	–0.3	0.4	0.4	0.5
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 7 (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	70.6	79.3	93.3
4	+0.9	34.7	42.7	55.3
8	+1.1	25.0	29.7	42.0
16	+0.9	17.1	21.4	28.1
32	+0.5	12.4	14.7	19.0
64	+0.8	9.2	10.9	14.0
128	+0.8	6.3	7.6	10.0
256	+0.8	4.1	5.0	6.7
512	+0.9	3.1	3.6	4.4
1,024	+0.8	2.1	2.6	3.4
2,048	+0.9	1.6	1.9	2.3
4,096	+0.9	1.1	1.2	1.6
8,192	+0.9	0.8	0.9	1.2
16,384	+0.8	0.5	0.6	0.8

Figure 8 (All poverty lines): Differences, precision of differences, and the α factor from bootstrapped estimates of poverty rates for groups of households at a point in time, scorecard applied to the validation sample

	Poverty line						
		National			USAID	Intl. 2005 PPP	
	Food	100%	150%	200%	'Extreme'	$1.25	$2.50
Estimate minus true value							
Scorecard applied to validation sample	+0.7	+0.8	+0.5	–0.1	+0.3	+0.1	+0.3
Precision of difference							
Scorecard applied to validation sample	0.4	0.5	0.6	0.6	0.4	0.2	0.4
α factor for standard errors							
Scorecard applied to validation sample	0.97	0.95	0.97	0.94	0.99	1.00	0.96
Differences between estimates and true values are displayed in units of percentage points.							
Precision is measured as 90-percent confidence intervals in units of ± percentage points.							
Differences and precision estimated from 1,000 bootstraps of size n = 16,384.							
α is estimated from 1,000 bootstrap samples of n = 256, 512, 1,024, 2,048, 4,096, 8,192, and 16,384.							

Figure 9 (All poverty lines): Possible targeting outcomes

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 10 (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	26.1	0.0	73.9	73.9	–100.0
5–9	0.0	26.1	0.0	73.9	73.9	–100.0
10–14	0.0	26.1	0.0	73.9	73.9	–99.9
15–19	0.3	25.8	0.0	73.9	74.2	–97.7
20–24	1.3	24.8	0.1	73.8	75.1	–89.5
25–29	2.9	23.2	0.5	73.4	76.3	–75.8
30–34	6.5	19.6	1.0	72.9	79.4	–46.6
35–39	10.4	15.7	2.7	71.2	81.6	–10.0
40–44	14.4	11.8	6.0	67.8	82.2	+32.9
45–49	18.3	7.8	12.5	61.4	79.7	+52.1
50–54	22.6	3.6	21.4	52.4	75.0	+18.0
55–59	24.7	1.4	32.0	41.8	66.5	–22.6
60–64	25.4	0.7	43.7	30.1	55.6	–67.3
65–69	26.0	0.2	55.6	18.2	44.2	–112.8
70–74	26.1	0.0	63.8	10.1	36.2	–144.1
75–79	26.1	0.0	69.1	4.7	30.9	–164.5
80–84	26.1	0.0	71.8	2.0	28.2	–174.8
85–89	26.1	0.0	73.4	0.4	26.6	–180.9
90–94	26.1	0.0	73.6	0.3	26.4	–181.6
95–100	26.1	0.0	73.9	0.0	26.1	–182.6

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

Figure 11 (National line): By score cut-off, the percentage of all households who are targeted (that is, have a score at or below the cut-off), the percentage of targeted households who are poor (that is, have income below the poverty line), the percentage of poor households who are targeted, and the number of poor households who are successfully targeted (inclusion) 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	0.0	100.0	0.0	Only poor targeted
10–14	0.0	100.0	0.0	Only poor targeted
15–19	0.3	100.0	1.1	Only poor targeted
20–24	1.4	95.3	5.1	20.1:1
25–29	3.4	86.3	11.2	6.3:1
30–34	7.5	87.3	24.9	6.8:1
35–39	13.1	79.6	39.9	3.9:1
40–44	20.4	70.4	54.9	2.4:1
45–49	30.8	59.4	70.0	1.5:1
50–54	44.0	51.3	86.4	1.1:1
55–59	56.7	43.5	94.5	0.8:1
60–64	69.1	36.8	97.3	0.6:1
65–69	81.6	31.8	99.3	0.5:1
70–74	89.9	29.0	99.9	0.4:1
75–79	95.3	27.4	100.0	0.4:1
80–84	98.0	26.7	100.0	0.4:1
85–89	99.6	26.3	100.0	0.4:1
90–94	99.7	26.2	100.0	0.4:1
95–100	100.0	26.1	100.0	0.4:1

Tables for the

Food Poverty Line

Figure 3 (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	100.0
15–19	84.9
20–24	77.9
25–29	73.8
30–34	67.8
35–39	41.2
40–44	33.2
45–49	19.9
50–54	11.2
55–59	1.9
60–64	0.6
65–69	0.1
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 6 (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	+0.0	0.0	0.0	0.0
15–19	–15.1	7.6	7.6	7.6
20–24	–10.7	7.3	7.7	8.3
25–29	+10.0	4.9	5.9	7.5
30–34	+12.0	3.6	4.3	5.9
35–39	+7.3	2.7	3.3	4.8
40–44	+4.0	2.5	2.9	4.0
45–49	+5.1	1.5	1.8	2.3
50–54	+0.1	1.4	1.7	2.1
55–59	–6.5	3.9	4.1	4.4
60–64	+0.5	0.0	0.1	0.1
65–69	–1.9	1.3	1.3	1.4
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 7 (Food line): Differences and precision of differences for bootstrapped estimates of poverty rates for groups of households at a point in time, by sample size, scorecard applied to the validation sample

Sample Size	Difference between estimate and true value			
		Confidence interval (+/− percentage points)		
n	Diff.	90-percent	95-percent	99-percent
1	+0.3	54.0	65.0	86.7
4	+0.0	27.1	34.0	49.6
8	+0.8	18.8	23.2	31.0
16	+0.6	14.1	17.3	23.4
32	+0.4	10.1	11.9	15.9
64	+0.6	7.2	8.4	11.2
128	+0.6	5.1	6.0	7.6
256	+0.6	3.4	4.3	5.2
512	+0.7	2.5	2.9	4.0
1,024	+0.7	1.7	2.0	2.7
2,048	+0.7	1.2	1.5	1.9
4,096	+0.7	0.8	1.0	1.4
8,192	+0.7	0.6	0.7	1.0
16,384	+0.7	0.4	0.5	0.7

Figure 10 (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	13.6	0.0	86.4	86.4	–100.0
5–9	0.0	13.6	0.0	86.4	86.4	–100.0
10–14	0.0	13.5	0.0	86.4	86.5	–99.8
15–19	0.3	13.3	0.0	86.4	86.7	–95.6
20–24	1.3	12.3	0.1	86.3	87.6	–80.2
25–29	2.6	10.9	0.8	85.7	88.3	–55.6
30–34	5.1	8.5	2.4	84.1	89.1	–7.6
35–39	7.3	6.3	5.8	80.6	88.0	+50.5
40–44	9.5	4.0	10.8	75.6	85.1	+20.1
45–49	11.2	2.3	19.6	66.8	78.1	–44.5
50–54	12.6	1.0	31.4	55.0	67.6	–131.7
55–59	13.3	0.2	43.4	43.0	56.3	–220.3
60–64	13.3	0.2	55.8	30.6	44.0	–311.5
65–69	13.6	0.0	68.0	18.4	32.0	–401.7
70–74	13.6	0.0	76.3	10.1	23.7	–463.0
75–79	13.6	0.0	81.7	4.7	18.3	–502.6
80–84	13.6	0.0	84.4	2.0	15.6	–522.3
85–89	13.6	0.0	86.0	0.4	14.0	–534.1
90–94	13.6	0.0	86.2	0.3	13.8	–535.5
95–100	13.6	0.0	86.4	0.0	13.6	–537.4

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

Figure 11 (Food line): By score cut-off, the percentage of all households who are targeted (that is, have a score at or below the cut-off), the percentage of targeted households who are poor (that is, have income below the poverty line), the percentage of poor households who are targeted, and the number of poor households who are successfully targeted (inclusion) 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	0.0	100.0	0.0	Only poor targeted
10–14	0.0	100.0	0.1	Only poor targeted
15–19	0.3	100.0	2.2	Only poor targeted
20–24	1.4	90.9	9.4	10.0:1
25–29	3.4	77.5	19.4	3.4:1
30–34	7.5	68.0	37.4	2.1:1
35–39	13.1	55.8	53.9	1.3:1
40–44	20.4	46.8	70.3	0.9:1
45–49	30.8	36.4	82.8	0.6:1
50–54	44.0	28.6	92.9	0.4:1
55–59	56.7	23.5	98.2	0.3:1
60–64	69.1	19.3	98.4	0.2:1
65–69	81.6	16.6	100.0	0.2:1
70–74	89.9	15.1	100.0	0.2:1
75–79	95.3	14.2	100.0	0.2:1
80–84	98.0	13.8	100.0	0.2:1
85–89	99.6	13.6	100.0	0.2:1
90–94	99.7	13.6	100.0	0.2:1
95–100	100.0	13.6	100.0	0.2:1

Tables for

150% of the National Poverty Line

Figure 3 (150% of national line): Estimated poverty likelihoods associated with scores

If a household's score is . . .	. . . then the likelihood (%) of being below the poverty line is:
0–4	100.0
5–9	100.0
10–14	100.0
15–19	100.0
20–24	99.5
25–29	99.5
30–34	94.9
35–39	89.4
40–44	87.2
45–49	69.7
50–54	52.8
55–59	38.2
60–64	26.6
65–69	14.2
70–74	9.1
75–79	4.0
80–84	0.0
85–89	0.0
90–94	0.0
95–100	0.0

Figure 6 (150% of national line): Bootstrapped differences between estimated and true poverty likelihoods for households in a large sample (n = 16,384) with confidence intervals, scorecard applied to the validation sample

	Difference between estimate and true value			
		Confidence interval (+/− percentage points)		
Score	Diff.	90-percent	95-percent	99-percent
0–4	+0.0	0.0	0.0	0.0
5–9	+0.0	0.0	0.0	0.0
10–14	+0.0	0.0	0.0	0.0
15–19	+0.0	0.0	0.0	0.0
20–24	+6.8	3.5	4.1	5.6
25–29	+13.6	3.8	4.7	6.2
30–34	+0.9	1.5	1.8	2.4
35–39	+4.2	2.2	2.7	3.5
40–44	+20.2	2.6	3.0	4.1
45–49	+8.6	2.2	2.7	3.6
50–54	–7.4	4.7	4.9	5.2
55–59	–4.3	3.2	3.4	3.8
60–64	–4.5	3.3	3.5	3.9
65–69	–0.2	1.4	1.7	2.4
70–74	–3.2	2.4	2.6	2.9
75–79	+0.3	1.3	1.6	2.0
80–84	–0.6	0.5	0.6	0.7
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 7 (150% of 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	71.6	86.5	92.9
4	+0.8	38.4	44.7	59.9
8	+0.6	26.7	32.3	43.5
16	–0.1	19.7	22.9	33.5
32	–0.3	14.4	17.0	22.9
64	+0.1	10.3	12.9	15.8
128	+0.2	7.3	8.3	10.6
256	+0.3	5.0	6.0	8.0
512	+0.4	3.6	4.4	6.1
1,024	+0.4	2.5	2.9	4.1
2,048	+0.5	1.7	2.1	2.7
4,096	+0.5	1.2	1.5	1.9
8,192	+0.5	0.9	1.1	1.3
16,384	+0.5	0.6	0.7	1.0

Figure 10 (150% of 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	42.8	0.0	57.2	57.2	–100.0
5–9	0.0	42.8	0.0	57.2	57.2	–100.0
10–14	0.0	42.8	0.0	57.2	57.2	–99.9
15–19	0.3	42.5	0.0	57.2	57.5	–98.6
20–24	1.3	41.4	0.1	57.2	58.5	–93.6
25–29	3.2	39.6	0.2	57.0	60.2	–84.7
30–34	6.9	35.8	0.5	56.7	63.7	–66.3
35–39	11.8	30.9	1.3	56.0	67.8	–41.7
40–44	17.0	25.7	3.3	53.9	71.0	–12.5
45–49	23.8	19.0	7.0	50.2	74.0	+27.7
50–54	31.3	11.5	12.7	44.5	75.8	+70.2
55–59	36.4	6.3	20.3	36.9	73.3	+52.5
60–64	39.6	3.1	29.5	27.7	67.4	+31.0
65–69	41.6	1.2	40.0	17.2	58.8	+6.5
70–74	42.6	0.2	47.3	9.9	52.5	–10.7
75–79	42.7	0.0	52.5	4.7	47.4	–22.9
80–84	42.8	0.0	55.2	2.0	44.8	–29.1
85–89	42.8	0.0	56.8	0.4	43.2	–32.8
90–94	42.8	0.0	57.0	0.3	43.0	–33.2
95–100	42.8	0.0	57.2	0.0	42.8	–33.8

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

Figure 11 (150% of national line): By score cut-off, the percentage of all households who are targeted (that is, have a score at or below the cut-off), the percentage of targeted households who are poor (that is, have income below the poverty line), the percentage of poor households who are targeted, and the number of poor households who are successfully targeted (inclusion) 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	0.0	100.0	0.0	Only poor targeted
10–14	0.0	100.0	0.0	Only poor targeted
15–19	0.3	100.0	0.7	Only poor targeted
20–24	1.4	95.3	3.1	20.1:1
25–29	3.4	93.0	7.4	13.4:1
30–34	7.5	93.2	16.2	13.6:1
35–39	13.1	90.4	27.7	9.4:1
40–44	20.4	83.7	39.9	5.1:1
45–49	30.8	77.2	55.7	3.4:1
50–54	44.0	71.1	73.2	2.5:1
55–59	56.7	64.2	85.2	1.8:1
60–64	69.1	57.3	92.7	1.3:1
65–69	81.6	51.0	97.3	1.0:1
70–74	89.9	47.4	99.6	0.9:1
75–79	95.3	44.9	99.9	0.8:1
80–84	98.0	43.7	100.0	0.8:1
85–89	99.6	43.0	100.0	0.8:1
90–94	99.7	42.9	100.0	0.8:1
95–100	100.0	42.8	100.0	0.7:1

Tables for

200% of the National Poverty Line

Figure 3 (200% of national line): Estimated poverty likelihoods associated with scores

If a household's score is . . .	. . . then the likelihood (%) of being below the poverty line is:
0–4	100.0
5–9	100.0
10–14	100.0
15–19	100.0
20–24	100.0
25–29	100.0
30–34	98.8
35–39	95.4
40–44	94.3
45–49	83.1
50–54	75.0
55–59	56.8
60–64	45.2
65–69	24.9
70–74	18.6
75–79	10.8
80–84	3.0
85–89	0.0
90–94	0.0
95–100	0.0

Figure 6 (200% of national line): Bootstrapped differences between estimated and true poverty likelihoods for households in a large sample (n = 16,384) with confidence intervals, scorecard applied to the validation sample

	Difference between estimate and true value			
		Confidence interval (+/− percentage points)		
Score	Diff.	90-percent	95-percent	99-percent
0–4	+0.0	0.0	0.0	0.0
5–9	+0.0	0.0	0.0	0.0
10–14	+0.0	0.0	0.0	0.0
15–19	+0.0	0.0	0.0	0.0
20–24	+0.0	0.0	0.0	0.0
25–29	+14.1	3.8	4.7	6.2
30–34	+2.5	1.3	1.5	2.0
35–39	+2.6	1.5	1.9	2.6
40–44	+13.6	2.3	2.7	3.4
45–49	+1.3	1.7	2.1	2.6
50–54	–1.3	1.6	1.9	2.7
55–59	–4.8	3.4	3.5	3.9
60–64	+2.0	2.2	2.5	3.4
65–69	–5.0	3.4	3.6	4.0
70–74	–7.3	4.8	5.0	5.6
75–79	+3.7	1.6	1.9	2.4
80–84	+0.2	1.1	1.3	1.7
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 7 (200% of 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	–1.9	75.1	82.2	92.3
4	–0.8	36.9	43.8	59.4
8	–0.3	26.7	32.1	43.4
16	–0.9	19.1	22.7	31.1
32	–0.9	14.0	16.7	21.5
64	–0.5	9.6	11.6	15.5
128	–0.3	6.9	8.0	11.2
256	–0.2	4.8	5.5	7.6
512	–0.1	3.4	4.0	5.1
1,024	–0.1	2.3	2.7	3.6
2,048	–0.1	1.7	2.0	2.6
4,096	–0.1	1.2	1.4	1.8
8,192	–0.1	0.8	1.0	1.3
16,384	–0.1	0.6	0.7	0.9

Figure 10 (200% of 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	56.0	0.0	44.0	44.0	–100.0
5–9	0.0	56.0	0.0	44.0	44.0	–100.0
10–14	0.0	56.0	0.0	44.0	44.0	–100.0
15–19	0.3	55.7	0.0	44.0	44.3	–98.9
20–24	1.4	54.6	0.0	44.0	45.4	–95.0
25–29	3.2	52.8	0.2	43.8	47.0	–88.2
30–34	7.1	48.9	0.3	43.7	50.8	–73.9
35–39	12.4	43.6	0.7	43.3	55.7	–54.5
40–44	18.4	37.6	1.9	42.0	60.5	–30.7
45–49	26.9	29.1	3.9	40.1	67.0	+3.0
50–54	36.7	19.3	7.3	36.6	73.3	+44.1
55–59	44.1	11.9	12.7	31.3	75.4	+77.4
60–64	49.4	6.6	19.7	24.3	73.7	+64.8
65–69	53.5	2.5	28.1	15.9	69.4	+49.8
70–74	55.5	0.5	34.4	9.6	65.1	+38.6
75–79	55.9	0.1	39.4	4.6	60.5	+29.7
80–84	56.0	0.0	42.0	2.0	58.0	+25.1
85–89	56.0	0.0	43.6	0.4	56.4	+22.2
90–94	56.0	0.0	43.7	0.3	56.3	+21.9
95–100	56.0	0.0	44.0	0.0	56.0	+21.5

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

Figure 11 (200% of national line): By score cut-off, the percentage of all households who are targeted (that is, have a score at or below the cut-off), the percentage of targeted households who are poor (that is, have income below the poverty line), the percentage of poor households who are targeted, and the number of poor households who are successfully targeted (inclusion) 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	0.0	100.0	0.0	Only poor targeted
10–14	0.0	100.0	0.0	Only poor targeted
15–19	0.3	100.0	0.5	Only poor targeted
20–24	1.4	100.0	2.5	Only poor targeted
25–29	3.4	95.0	5.8	19.1:1
30–34	7.5	95.8	12.8	22.7:1
35–39	13.1	94.8	22.2	18.1:1
40–44	20.4	90.4	32.9	9.5:1
45–49	30.8	87.3	48.0	6.8:1
50–54	44.0	83.3	65.5	5.0:1
55–59	56.7	77.6	78.7	3.5:1
60–64	69.1	71.5	88.2	2.5:1
65–69	81.6	65.6	95.5	1.9:1
70–74	89.9	61.8	99.1	1.6:1
75–79	95.3	58.7	99.8	1.4:1
80–84	98.0	57.2	100.0	1.3:1
85–89	99.6	56.3	100.0	1.3:1
90–94	99.7	56.2	100.0	1.3:1
95–100	100.0	56.0	100.0	1.3:1

Tables for

the USAID "Extreme" Poverty Line

Figure 3 (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	100.0
15–19	84.9
20–24	76.4
25–29	68.0
30–34	57.7
35–39	37.7
40–44	29.3
45–49	18.0
50–54	8.2
55–59	2.3
60–64	1.1
65–69	0.6
70–74	0.1
75–79	0.0
80–84	0.0
85–89	0.0
90–94	0.0
95–100	0.0

Figure 6 (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	+0.0	0.0	0.0	0.0
15–19	–15.1	7.6	7.6	7.6
20–24	–2.1	5.3	6.4	8.4
25–29	+12.7	4.9	5.9	7.9
30–34	+0.7	3.5	4.3	5.6
35–39	+4.5	2.8	3.3	4.0
40–44	+5.9	2.3	2.7	3.7
45–49	+6.5	1.3	1.5	1.9
50–54	–2.3	1.8	2.0	2.3
55–59	–6.1	3.7	3.9	4.2
60–64	+0.3	0.3	0.4	0.5
65–69	–1.5	1.0	1.1	1.2
70–74	+0.1	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 7 (USAID "extreme" line): Differences and precision of differences for bootstrapped estimates of poverty rates for groups of households at a point in time, by sample size, scorecard applied to the validation sample

Sample Size	Difference between estimate and true value			
		Confidence interval (+/− percentage points)		
n	Diff.	90-percent	95-percent	99-percent
1	+0.7	54.2	62.3	83.6
4	+0.4	26.2	33.5	46.4
8	+0.5	18.3	23.3	30.8
16	+0.4	13.5	16.3	22.0
32	+0.1	9.8	11.6	15.0
64	+0.3	6.9	8.1	11.1
128	+0.2	4.9	5.9	7.3
256	+0.3	3.4	4.1	5.1
512	+0.3	2.4	2.8	3.8
1,024	+0.3	1.6	2.0	2.6
2,048	+0.3	1.1	1.4	1.7
4,096	+0.3	0.8	0.9	1.3
8,192	+0.3	0.6	0.7	0.9
16,384	+0.3	0.4	0.5	0.7

Figure 10 (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	12.2	0.0	87.8	87.8	–100.0
5–9	0.0	12.2	0.0	87.8	87.8	–100.0
10–14	0.0	12.2	0.0	87.8	87.8	–99.8
15–19	0.3	11.9	0.0	87.8	88.1	–95.1
20–24	1.2	11.0	0.2	87.6	88.8	–78.8
25–29	2.4	9.8	1.0	86.8	89.2	–52.7
30–34	4.5	7.7	2.9	84.9	89.4	–1.6
35–39	6.5	5.6	6.6	81.3	87.8	+46.0
40–44	8.4	3.8	12.0	75.8	84.2	+1.2
45–49	9.8	2.3	21.0	66.8	76.7	–72.6
50–54	11.1	1.1	32.9	54.9	66.0	–170.6
55–59	11.8	0.3	44.9	42.9	54.7	–269.3
60–64	11.9	0.2	57.2	30.6	42.6	–370.2
65–69	12.2	0.0	69.4	18.4	30.6	–470.8
70–74	12.2	0.0	77.7	10.1	22.3	–539.1
75–79	12.2	0.0	83.1	4.7	16.9	–583.3
80–84	12.2	0.0	85.8	2.0	14.2	–605.3
85–89	12.2	0.0	87.4	0.4	12.6	–618.4
90–94	12.2	0.0	87.6	0.3	12.4	–619.9
95–100	12.2	0.0	87.8	0.0	12.2	–622.1

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

Figure 11 (USAID "extreme" line): By score cut-off, the percentage of all households who are targeted (that is, have a score at or below the cut-off), the percentage of targeted households who are poor (that is, have income below the poverty line), the percentage of poor households who are targeted, and the number of poor households who are successfully targeted (inclusion) 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	0.0	100.0	0.0	Only poor targeted
10–14	0.0	100.0	0.1	Only poor targeted
15–19	0.3	100.0	2.5	Only poor targeted
20–24	1.4	83.4	9.6	5.0:1
25–29	3.4	69.7	19.4	2.3:1
30–34	7.5	60.5	37.1	1.5:1
35–39	13.1	49.9	53.7	1.0:1
40–44	20.4	41.0	68.7	0.7:1
45–49	30.8	31.9	80.8	0.5:1
50–54	44.0	25.2	91.3	0.3:1
55–59	56.7	20.8	97.2	0.3:1
60–64	69.1	17.3	98.2	0.2:1
65–69	81.6	14.9	100.0	0.2:1
70–74	89.9	13.5	100.0	0.2:1
75–79	95.3	12.8	100.0	0.1:1
80–84	98.0	12.4	100.0	0.1:1
85–89	99.6	12.2	100.0	0.1:1
90–94	99.7	12.2	100.0	0.1:1
95–100	100.0	12.2	100.0	0.1:1

Tables for

the $1.25/day 2005 PPP Poverty Line

Figure 3 ($1.25/day line): Estimated poverty likelihoods associated with scores

If a household's score is . . .	. . . then the likelihood (%) of being below the poverty line is:
0–4	100.0
5–9	100.0
10–14	100.0
15–19	27.9
20–24	25.8
25–29	24.9
30–34	20.6
35–39	5.6
40–44	4.2
45–49	2.1
50–54	0.5
55–59	0.2
60–64	0.1
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 6 ($1.25/day line): Bootstrapped differences between estimated and true poverty likelihoods for households in a large sample (n = 16,384) with confidence intervals, scorecard applied to the validation sample

	Difference between estimate and true value			
		Confidence interval (+/– percentage points)		
Score	Diff.	90-percent	95-percent	99-percent
0–4	+0.0	0.0	0.0	0.0
5–9	+0.0	0.0	0.0	0.0
10–14	+0.0	0.0	0.0	0.0
15–19	–62.2	33.6	34.0	34.5
20–24	+8.1	4.4	5.2	6.8
25–29	+7.2	3.7	4.5	5.8
30–34	+4.2	2.5	2.9	3.7
35–39	+1.5	1.0	1.2	1.5
40–44	+1.6	0.9	1.0	1.3
45–49	–1.3	1.1	1.1	1.3
50–54	+0.5	0.0	0.0	0.1
55–59	–1.7	1.2	1.3	1.5
60–64	+0.1	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 7 ($1.25/day line): Differences and precision of differences for bootstrapped estimates of poverty rates for groups of households at a point in time, by sample size, scorecard applied to the validation sample

Sample Size	Difference between estimate and true value			
		Confidence interval (+/− percentage points)		
n	Diff.	90-percent	95-percent	99-percent
1	+0.2	10.3	12.4	61.3
4	+0.4	11.4	17.1	26.5
8	+0.5	8.1	11.3	16.5
16	+0.3	6.4	8.2	10.4
32	+0.1	4.4	5.3	8.0
64	+0.2	3.1	3.8	5.1
128	+0.2	2.3	2.7	3.5
256	+0.1	1.6	2.0	2.5
512	+0.1	1.2	1.4	1.8
1,024	+0.1	0.8	1.0	1.2
2,048	+0.1	0.6	0.7	0.9
4,096	+0.1	0.4	0.5	0.7
8,192	+0.1	0.3	0.3	0.5
16,384	+0.1	0.2	0.2	0.3

Figure 10 ($1.25/day line): Households by targeting classification and score, along with "Total Accuracy" and BPAC, scorecard applied to the validation sample

Score	Inclusion: < poverty line correctly targeted	Undercoverage: < poverty line mistakenly non-targeted	Leakage: => poverty line mistakenly targeted	Exclusion: => poverty line correctly non-targeted	Total Accuracy Inclusion + Exclusion	BPAC See text
0–4	0.0	2.6	0.0	97.4	97.4	–100.0
5–9	0.0	2.6	0.0	97.4	97.4	–100.0
10–14	0.0	2.6	0.0	97.4	97.4	–99.1
15–19	0.2	2.4	0.1	97.3	97.5	–79.5
20–24	0.5	2.1	0.9	96.5	97.0	–26.3
25–29	0.9	1.8	2.5	94.9	95.7	+5.1
30–34	1.6	1.1	5.9	91.5	93.0	–123.1
35–39	1.9	0.7	11.2	86.2	88.1	–323.1
40–44	2.1	0.5	18.2	79.1	81.2	–591.3
45–49	2.5	0.1	28.3	69.0	71.5	–973.2
50–54	2.5	0.1	41.5	55.8	58.4	–1,472.8
55–59	2.6	0.0	54.1	43.3	45.9	–1,950.1
60–64	2.6	0.0	66.5	30.9	33.5	–2,419.8
65–69	2.6	0.0	79.0	18.4	21.0	–2,891.5
70–74	2.6	0.0	87.3	10.1	12.7	–3,206.5
75–79	2.6	0.0	92.6	4.7	7.4	–3,410.1
80–84	2.6	0.0	95.3	2.0	4.7	–3,511.5
85–89	2.6	0.0	96.9	0.4	3.1	–3,572.2
90–94	2.6	0.0	97.1	0.3	2.9	–3,579.1
95–100	2.6	0.0	97.4	0.0	2.6	–3,588.9

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

Figure 11 ($1.25/day line): By score cut-off, the percentage of all households who are targeted (that is, have a score at or below the cut-off), the percentage of targeted households who are poor (that is, have income below the poverty line), the percentage of poor households who are targeted, and the number of poor households who are successfully targeted (inclusion) 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	0.0	100.0	0.0	Only poor targeted
10–14	0.0	100.0	0.4	Only poor targeted
15–19	0.3	80.8	9.2	4.2:1
20–24	1.4	38.2	20.4	0.6:1
25–29	3.4	26.2	33.7	0.4:1
30–34	7.5	21.0	59.4	0.3:1
35–39	13.1	14.7	73.2	0.2:1
40–44	20.4	10.5	80.7	0.1:1
45–49	30.8	8.1	94.4	0.1:1
50–54	44.0	5.7	95.1	0.1:1
55–59	56.7	4.7	100.0	0.0:1
60–64	69.1	3.8	100.0	0.0:1
65–69	81.6	3.2	100.0	0.0:1
70–74	89.9	2.9	100.0	0.0:1
75–79	95.3	2.8	100.0	0.0:1
80–84	98.0	2.7	100.0	0.0:1
85–89	99.6	2.7	100.0	0.0:1
90–94	99.7	2.6	100.0	0.0:1
95–100	100.0	2.6	100.0	0.0:1

Tables for

the $2.50/day 2005 PPP Poverty Line

Figure 3 ($2.50/day line): Estimated poverty likelihoods associated with scores

If a household's score is . . .	. . . then the likelihood (%) of being below the poverty line is:
0–4	100.0
5–9	100.0
10–14	100.0
15–19	84.9
20–24	76.4
25–29	65.2
30–34	55.2
35–39	30.8
40–44	23.8
45–49	13.1
50–54	7.5
55–59	1.2
60–64	0.5
65–69	0.1
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 6 ($2.50/day line): Bootstrapped differences between estimated and true poverty likelihoods for households in a large sample (n = 16,384) with confidence intervals, scorecard applied to the validation sample

	Difference between estimate and true value			
		Confidence interval (+/– percentage points)		
Score	Diff.	90-percent	95-percent	99-percent
0–4	+0.0	0.0	0.0	0.0
5–9	+0.0	0.0	0.0	0.0
10–14	+0.0	0.0	0.0	0.0
15–19	–15.1	7.6	7.6	7.6
20–24	–3.7	5.3	6.1	7.9
25–29	+13.0	4.7	5.7	7.8
30–34	+7.9	3.6	4.3	5.8
35–39	+0.8	2.6	3.3	4.6
40–44	+3.5	2.1	2.6	3.3
45–49	+3.0	1.2	1.4	1.9
50–54	–0.9	1.2	1.5	2.0
55–59	–3.4	2.2	2.4	2.6
60–64	+0.4	0.0	0.1	0.1
65–69	–1.9	1.3	1.3	1.4
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 7 ($2.50/day line): Differences and precision of differences for bootstrapped estimates of poverty rates for groups of households at a point in time, by sample size, scorecard applied to the validation sample

Sample Size	Difference between estimate and true value			
		Confidence interval (+/− percentage points)		
n	Diff.	90-percent	95-percent	99-percent
1	+0.6	50.0	71.0	82.4
4	+0.2	24.6	31.8	44.7
8	+0.5	17.7	22.3	29.5
16	+0.3	12.2	15.3	19.9
32	+0.2	9.2	11.0	14.1
64	+0.2	6.3	7.5	9.9
128	+0.2	4.4	5.2	6.8
256	+0.3	3.0	3.6	4.8
512	+0.3	2.1	2.6	3.4
1,024	+0.3	1.5	1.8	2.3
2,048	+0.3	1.1	1.3	1.7
4,096	+0.3	0.7	0.9	1.1
8,192	+0.3	0.5	0.7	0.9
16,384	+0.3	0.4	0.5	0.6

Figure 10 ($2.50/day line): Households by targeting classification and score, along with "Total Accuracy" and BPAC, scorecard applied to the validation sample

Score	Inclusion: < poverty line correctly targeted	Undercoverage: < poverty line mistakenly non-targeted	Leakage: => poverty line mistakenly targeted	Exclusion: => poverty line correctly non-targeted	Total Accuracy Inclusion + Exclusion	BPAC See text
0–4	0.0	10.4	0.0	89.6	89.6	–100.0
5–9	0.0	10.4	0.0	89.6	89.6	–100.0
10–14	0.0	10.4	0.0	89.6	89.6	–99.8
15–19	0.3	10.1	0.0	89.6	89.9	–94.3
20–24	1.2	9.3	0.2	89.3	90.5	–75.3
25–29	2.2	8.2	1.1	88.4	90.7	–46.0
30–34	4.2	6.3	3.3	86.3	90.4	+11.2
35–39	6.0	4.4	7.0	82.5	88.6	+32.5
40–44	7.6	2.8	12.7	76.8	84.5	–21.9
45–49	8.9	1.5	21.9	67.6	76.6	–109.6
50–54	9.8	0.6	34.2	55.3	65.2	–227.4
55–59	10.2	0.2	46.5	43.0	53.2	–345.4
60–64	10.2	0.2	58.9	30.6	40.9	–463.8
65–69	10.4	0.0	71.1	18.4	28.9	–580.9
70–74	10.4	0.0	79.5	10.1	20.5	–660.4
75–79	10.4	0.0	84.8	4.7	15.2	–711.9
80–84	10.4	0.0	87.5	2.0	12.5	–737.5
85–89	10.4	0.0	89.1	0.4	10.9	–752.8
90–94	10.4	0.0	89.3	0.3	10.7	–754.5
95–100	10.4	0.0	89.6	0.0	10.4	–757.0

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

Figure 11 ($2.50/day line): By score cut-off, the percentage of all households who are targeted (that is, have a score at or below the cut-off), the percentage of targeted households who are poor (that is, have income below the poverty line), the percentage of poor households who are targeted, and the number of poor households who are successfully targeted (inclusion) 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	0.0	100.0	0.0	Only poor targeted
10–14	0.0	100.0	0.1	Only poor targeted
15–19	0.3	100.0	2.9	Only poor targeted
20–24	1.4	83.2	11.2	4.9:1
25–29	3.4	66.2	21.5	2.0:1
30–34	7.5	55.8	39.8	1.3:1
35–39	13.1	46.2	57.9	0.9:1
40–44	20.4	37.5	73.1	0.6:1
45–49	30.8	28.9	85.3	0.4:1
50–54	44.0	22.3	93.9	0.3:1
55–59	56.7	18.0	97.7	0.2:1
60–64	69.1	14.8	97.9	0.2:1
65–69	81.6	12.8	100.0	0.1:1
70–74	89.9	11.6	100.0	0.1:1
75–79	95.3	11.0	100.0	0.1:1
80–84	98.0	10.7	100.0	0.1:1
85–89	99.6	10.5	100.0	0.1:1
90–94	99.7	10.5	100.0	0.1:1
95–100	100.0	10.4	100.0	0.1:1