Technical Note 1
Estimating Sample Size

EDA Rural Systems Pvt Ltd, Gurgaon, India *2006*

Sample size estimation is critical for research. In microfinance it is important for market research, poverty assessment, impact assessment, even auditing. This note explains the method used at EDA for selecting sample size in our research studies, including specific recommendations for Social Rating by M-CRIL.

The formula for estimating sample size for any statistical test is derived from the binomial theorem.[1] Estimated minimum sample size, **N**. for given confidence level and precision is calculated as:

$$N = \frac{Z^2 \times P \times (1-P) \times D}{E^2}$$

(For this formula, percentages should be expressed as decimals e.g. 50% = 0.5)

The notation is explained below.

1 **Z** value (or **Z**-score) is derived from the anticipated confidence level, as shown. **Recommended** value of **Z**-score is **1.96** to give a confidence level of **95%**.

Confidence level	Z-score
90%	1.658
95%	**1.96**
99%	2.58

2 **P** = anticipated proportion that is to be measured. This is an estimated value for what you are about to measure (or the hypothesis you are going to test) using the sample.

For example, if you want to measure the proportion of children who are overweight, then to estimate the sample size you need to 'anticipate' the proportion of children who might be overweight. It will not be exact because that is what you are looking to measure – but it would be a 'reasonable guess' based on experience, other studies or other comparable parameters.

In the case of impact studies, **P** may be estimated at 50%, to reflect the assumption that impact is expected in 50% of the population. A **P** of 50% is also the most conservative estimate ('overestimates' sample size) because the numerator is **P**(1- **P**) and this is highest for **P** = 50%.

With reference to sampling for the Social Rating tool – which covers poverty assessment, client awareness and feedback - we looked at the average proportion of poor (living below $1 a day at purchasing power parity) in various outreach studies (EDA, Imp-Act) and (excluding some outliers) this turned out to be 33%. This roughly reflects (being slightly above) the country poverty ratios in S Asia, and implies a **P** value of 0.33. In countries where the poverty ratio – and expected poverty ratio in microfinance programmes - is significantly less or more, **P** should be adjusted accordingly. To be conservative (or overestimate the sample size) one would use **P** = 0.5. In estimating a minimal sample size, we **recommend using P = 0.33**.

3 **D** = design effect. This reflects the sample design with **D** at 1 for simple random sampling and higher values estimated to compensate for deviation from simple random sampling. The value is usually between 1 to 2 but can go as high as 10 if it is a very purposive sample. The higher the value of the larger the sample size (since it is in the numerator). In other words, the more the method deviates from simple random sampling, then the sample size needs to be higher to obtain a valid estimate of what you are trying to measure.

[1] Levine, David M., Timothy C. Krehbiel, Mark L. Berenson, Business Statistics: A First Course, Pearson Education, 2005

From EDA's research data (outreach of 20 MFIs in India, based on cluster sampling - to represent '*typical*' villages or urban areas in which the MFI operates), we reverse calculated **D** from each MFI's sample for which we know the other values (sample size, and **P** as proportion of poor, etc.). The average **D** value for this cluster sampling method turned out to be 2.5 (2.85 for larger MFIs with >30,000 clients, and 2 for smaller MFIs). For social rating we **recommend using D = 1.5** for random sampling, in between simple and cluster based. **D**-value is also affected by the degree of variation within the sample population, which may be higher in much larger MFIs operating in different areas. The **D** value could be increased (up to 2 or 2.5) to account for this.

4 **E**= precision (or margin of error) The final block in the sampling puzzle. **E** is the precision with which you want to measure something. If you want to know proportion of overweight children in the population within +/- 6%, then your precision is 6%, yielding a range of 12%.

E is related to **P** because if **P** is small then **E** too must be small with a low range. (For example, there is little point in measuring proportion of overweight children – if anticipated to be 10% - with precision of 10%, since a range between 0% and 20% would be too high a margin of error relative to the expected proportion).

Since **E** is squared in the sample size equation and is in the denominator, a small reduction in **E** results in a large increase in sample size. In most statistical studies **E** is kept at 10%. For poverty assessment studies too we **recommend using E=10%**. (Who will pay a large amount for a small improvement in precision?).

Note: E and confidence level can be confusing. The way to understand it is as follows: for poverty assessments when we choose a confidence level of 95%, P of 33% and **E** of 10% and test our sample and get a result which says that the sample proportion of poor is 28% then we can say that "Using this sample, I am 95% confident that the proportion of poor lies within +/-10% of 28%".

Note: Variations within a programme (e.g. rural/urban) can be taken care of in a number of ways:

- By distribution within the sample taking number of people (rural/urban) in the sample proportionate to actual population (This method is known as **PPS** = population proportion to size). Ensure that any such proportionate distribution has at least up to 30 since this is the minimum number for analysis; or
- In case of purposive sampling, you can manipulate (increase) the sample size calculation through **D** (taking **D** as high as 4 or 5); or
- The sample findings can be adjusted by weighting the sample according to the known distribution in the population. For example, if the population distribution of rural:urban is known to be 70:30, and your sample distribution is 50:50, apply 70:30 weights to present the findings.

5 **Summary and examples of calculation**

Confidence level	Z-score	P	D	E	sample size	Remarks
95%	1.96	33%[a]	1.0	10%	85	Simple random sampling
95%	**1.96**	**33%**	**1.5**	**10%**	**127**	**Recommended for Social rating**
95%	1.96	33%	2.0	10%	170	Cluster sampling
95%	1.96	33%	2.5	10%	212	Greater variation
95%	1.96	33%	1.0	5%	340	Higher precision(**E**)
95%	1.96	33%	1.5	5%	510	Higher precision(**E**)
95%	1.96	50%[b]	1.0	10%	96	Higher **P** - Simple random sampling
95%	1.96	50%	1.5	10%	144	
95%	1.96	50%	1.5	5%	576	Higher precision (**E**)

a Poverty profile found across many studies/MFIs

b Higher expected poverty profile, overestimates the sample

The recommended sample size of 127 is manageable within a field trip of 5 days, and at a moderate cost. Higher precision (**E** = 5%) would require a much larger sample. There is inevitably a trade-off between the level of precision and the resources available.

The demystification of sample size estimation can be safely attributed (with 100% confidence) to the efforts of EDA staff.

Frances Sinha, Executive Director; Amit Brar, Team Leader; Kamal Narayan Mishra, Analyst
EDA Rural Systems Pvt Ltd
602 Pacific Square, 32nd Milestone NH8, Gurgaon 122001 INDIA
Telephone: +91 124 230 9493, 230 9707, 230 9493 Fax: +91 124 230 9520
e-mail: **contact@edarural.com**, website: **www.edarural.com**