Robust standard errors for the Foster-Greer-Thorbecke class of poverty indices: SEPOV

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Description

Several inserts to the Stata Technical Bulletin provide programs to estimate a wide array of poverty indices (see for example, Jenkins, 1999, and van Kerm, 1999), but we are aware of no programs which provide estimates of standard errors for these indices. Yet, in order to answer questions of whether poverty has increased or decreased over time, or whether poverty is worse in certain regions, estimates of the sampling variance for the indices are required. Indeed it is hard to think of a poverty-related question, which a policy maker might have, that doesn't require an estimate of whether some difference in indices is statistically significant. This insert provides estimates of standard errors for the Foster-Greer-Thorbecke (1984; hereafter referred to as FGT) class of poverty indices. By default *sepov* reports the headcount, poverty-gap, and squared poverty-gap indices, but the user may request any variant of the FGT indices.

Kakwani (1993) presents a simple method for calculating standard errors for the FGT indices, which this program implements as one option. The Kakwani formula for the variance of P_0, the headcount index, is $P_0(1-P_0)/(n-1)$, where n is the sample size. The formula for all other variance estimates of the FGT indices is $(P_{2a} - P_a^2)/(n-1)$ where P_a is defined below. While the Kakwani standard errors are tremendously useful when one doesn't have access to the unit-record data, an unfortunate aspect of the estimated standard errors is that they assume the sample was collected using a simple random design. Poverty estimates, though, are quite often constructed from nationally representative household survey data, and this type of data almost always comes from a complex sample design.

Howes and Lanjouw (1998) present compelling evidence that estimated standard errors for the FGT poverty indices can have large biases when erroneous assumptions are made on the nature of the sample design. In particular they show that the Kakwani standard errors significantly under-estimate the correct standard errors when the data come from a multi-stage sample design. By using Stata's *svymean* command, *sepov* provides estimated standard errors which are robust to complex survey design, including stratification and multi-stages.

Syntax

sepov *varlist* [*weight*] [**if** *exp*] [**in** *range*] [, **povline**(*varname*) **alpha**(*#*) **strata**(*varname*) **psu**(*varname*) **fpc**(*varname*) **by**(*varlist*) {**complete** | **available**} **subpop**(*varname*) **srssubpop** **nolabel** **level**(#) **ci deff deft meff meft obs size**]

pweights are allowed.

Options

povline(*varname*) specifies the poverty line, which can be either a scalar or a variable. By accepting the poverty line as a variable, we allow for the possibility that the poverty line may vary over the sample. A variable poverty line is one way to incorporate information about spatial price variation in obtaining the bundle of goods described by the poverty line.
alpha(*#*) specifies the type of poverty index. By default sepov reports the headcount, poverty-gap and squared poverty-gap indices, which correspond to alpha taking the values of 0, 1, and 2, respectively. In addition to these, the user may specify any non-negative value of alpha. As alpha increases, the measure becomes more sensitive to inequality among the poor.

All other options are as specified in Stata's *svymean* command. If the user does not specify the strata or primary sampling unit, the resulting standard errors will be the Kakwani standard errors. It is important to note that using the *if* or *in* options may result in incorrect variance estimates, just as with using these options with *svymean*. To obtain correct estimates of the standard errors for poverty decomposed into sub-groups, it is recommended to use the *by* or *subpop* options.

Examples

To illustrate the use of **sepov**, we use data from the 1997 Egypt Integrated Household Survey (EIHS). The variable pcexp_r is a household-level measure of per capita consumption, which is adjusted to control for spatial price variation, and z_r is the poverty line. Wt96ind is a weighting variable which is the product of sample weights resulting from stratification and household size, since we are interested in the welfare of individuals and not households. When we issue the sepov command, the following results:

```
sepov pcexp_r [w=wt96ind], p(z_r)
(sampling weights assumed)
Poverty measures for the variable pcexp_r: Real Per Capita Expenditure
Survey mean estimation

pweight:  wt96ind                                   Number of obs    =      2449
Strata:   <one>                                     Number of strata =         1
PSU:      <observations>                            Number of PSUs   =      2449
                                                    Population size  =  14532.16
------------------------------------------------------------------------------
    Mean |   Estimate    Std. Err.   [95% Conf. Interval]        Deff
---------+--------------------------------------------------------------------
      p0 |   .2651925    .0106545    .2442997    .2860852    1.426075
      p1 |   .0669121    .0035529    .0599451    .0738791    1.465418
      p2 |   .0255641    .0018219    .0219914    .0291368    1.458858
------------------------------------------------------------------------------
```

We learn from the output that, for example, the headcount index is 0.265 and the Kakwani standard error for this index is 0.01. The next example illustrates two additional features. We note again that the Kakwani standard errors listed above are correct only if the data result from a simple random sample. The EIHS data, as with most household survey data, were collected using a complex design (stratified, two-stage design). By specifying the *psu* and *strata* options, the reported standard errors will be corrected for the design effects. We will also specify alpha equal to three, to examine what happens to poverty when gaps between the poverty line are ‘penalized’ more heavily.

sepov pcexp_r [w=wt96ind], p(z_r) psu(psu) strata(strata) a(3)

```
Poverty measures for the variable pcexp_r: Real Per Capita Expenditure
Survey mean estimation
pweight:  wt96ind                                  Number of obs    =      2449
Strata:   strata                                   Number of strata =         5
PSU:      psu                                      Number of PSUs   =       126
                                                   Population size  =  14532.16
------------------------------------------------------------------------------
    Mean |   Estimate    Std. Err.   [95% Conf. Interval]        Deff
---------+--------------------------------------------------------------------
      p0 |   .2651925    .0167525    .2320265    .2983584    3.525606
      p1 |   .0669121    .0060812    .0548727    .0789515    4.293216
      p2 |   .0255641     .003091    .0194447    .0316835    4.198881
      p3 |     .01187    .0017642    .0083774    .0153626     3.68886
------------------------------------------------------------------------------
```

Note that the point estimates for P0, P1, P2 did not change, but that the standard errors all increased. If we consider the headcount index (P0), the estimated standard error increases by 57 percent when we correct for the stratification and two-stage aspects of the sample design.

Methods and Formulas

The FGT poverty index, also referred to as P_a is given by:

$$P_a = 1/n \sum_i I(y_i < z)[(z-y_i)/z]^a$$

where n is the sample size, i subscripts the household or individual, y is the relevant measure of welfare, z is the poverty line, and I is an indicator function which takes the value of one if the statement is true and zero otherwise.

When a=0, the resulting measure is the headcount index which provides an estimate of the proportion of the population living in poverty. When a=1, the FGT index results in the poverty-gap index which provides a measure of the depth of poverty. The squared poverty-gap index, which is sensitive to the extent of inequality among the poor, results when a=2. In addition to these three measures, which are provided by default, the user may specify any non-negative value of a.

FGT (1984) show that for any income vector y, broken down into m subgroup income vectors, $y^{(1)}$, ... , $y^{(m)}$; P_a is additively decomposable with population share weights:

$$P_a(\mathbf{y}; \mathbf{z}) = \sum_{j=1}^{m} (n_j / n)\, P_a(y^{(j)}; \mathbf{z})$$

Exploiting this property is really the innovation of *sepov*. This property allows us to treat each observation as a subgroup, which means that the average value resulting from Stata's summarize or svymean command will be the sample estimate of P_a. *Sepov* passes observation-specific estimates of P_a to Stata's svymean command, which then provides the user with estimates of the poverty indices as well as their standard errors which are robust to design effects.

References

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