

where  $Var_{REP}(t)$  is the sampling variance for the statistic  $t$  computed by the corresponding replication method, and  $Var_{SRS}(t)$  is the sampling variance for the same statistic  $t$  on the same data but considering the sample as a simple random sample. The IEA's IDB Analyzer calculates this design effect for any non-plausible value.

When computing design effects for statistics that involve plausible values, the notion of design effect as given earlier needs to be extended to incorporate the imputation variance. This gives rise to five possible design effect formulae that can be used to describe the influence of the sampling and test designs on the standard errors for a statistic.

The variance for statistics that involves plausible values consist of two components: sampling variance ( $Var_{REP}$ ), calculated using the corresponding replication method, and imputation variance ( $Var_{IMP}$ ), calculated as:

$$Var_{IMP} = \left(1 + \frac{1}{P}\right) * Var(t_p)$$

where  $P$  is the number of plausible values, and  $Var(t_p)$  is the variance across the  $P$  statistics computed using each of the plausible values in the analysis.

The variance of a statistic calculated using plausible values is then calculated as the sum of the sampling and the imputation variances, or  $Var_{REP} + Var_{IMP}$ .

Given these two component, design effects can be defined and calculated as follows:

1. Design Effect 1: Shows the inflation of the total variance that would have occurred due to measurement error if in the sample was considered as a simple random sample.

$$Deff_1(t) = \frac{Var_{SRS}(t) + Var_{IMP}(t)}{Var_{SRS}(t)}$$

2. Design Effect 2: Shows the inflation of the total variance due only to the use of the complex sampling design.

$$Deff_2(t) = \frac{Var_{BRR}(t) + Var_{IMP}(t)}{Var_{SRS}(t) + Var_{IMP}(t)}$$

3. Design Effect 3: Shows the inflation of the sampling variance due to the use of the complex sample design.

$$Deff_3(t) = \frac{Var_{BRR}(t)}{Var_{SRS}(t)}$$

4. Design Effect 4: Shows the inflation of the total variance due to imputation variance.

$$Deff_4(t) = \frac{Var_{BRR}(t) + Var_{IMP}(t)}{Var_{BRR}(t)}$$

5. Design Effect 5: Shows the inflation of the total variance due to the imputation variance and due to the complex sampling design.