

Unequal probability sampling designs

July 10, 2009

This is an example of unequal probability (UP) sampling functions (selection of samples using the Belgian municipalities data set, with equal or unequal probabilities, and comparison of the Horvitz-Thompson estimator accuracy using boxplots). The following sampling schemes are used: Poisson, random systematic, random pivotal, Tillé, Midzuno, systematic, pivotal, and simple random sampling without replacement. Monte Carlo simulations are used to study the accuracy of the Horvitz-Thompson estimator of a population total. The aim of this example is to demonstrate the effect of the incorporation of an auxiliary information in the sampling design. We use:

- some π ps sampling designs with Horvitz-Thompson estimation, using in the sampling design the information on size measures of population elements;
- simple random sampling without replacement with Horvitz-Thompson estimation, where no auxiliary information is used.

```
> b = data(belgianmunicipalities)
> pik = inclusionprobabilities(belgianmunicipalities$Tot04,
+ 200)
> N = length(pik)
> n = sum(pik)
```

Number of simulations (for an accurate result, increase this value):

```
> sim = 10
> ss = array(0, c(sim, 8))
```

Defines the interest variable:

```
> y = belgianmunicipalities$TaxableIncome
```

Simulation and computation of the Horvitz-Thompson estimator:

```
> ht = numeric(8)
> for (i in 1:sim) {
+   cat("Step ", i, "\n")
```

```

+   s = UPpoisson(pik)
+   ht[1] = HTestimator(y[s == 1], pik[s == 1])
+   s = UPrandomsystematic(pik)
+   ht[2] = HTestimator(y[s == 1], pik[s == 1])
+   s = UPrandompivotal(pik)
+   ht[3] = HTestimator(y[s == 1], pik[s == 1])
+   s = UPtille(pik)
+   ht[4] = HTestimator(y[s == 1], pik[s == 1])
+   s = UPmidzuno(pik)
+   ht[5] = HTestimator(y[s == 1], pik[s == 1])
+   s = UPsystematic(pik)
+   ht[6] = HTestimator(y[s == 1], pik[s == 1])
+   s = UPpivotal(pik)
+   ht[7] = HTestimator(y[s == 1], pik[s == 1])
+   s = srswor(n, N)
+   ht[8] = HTestimator(y[s == 1], rep(n/N, n))
+   ss[i, ] = ss[i, ] + ht
+ }

```

Boxplots of the estimators:

```

> colnames(ss) <- c("poisson", "rsyst", "rpivotal",
+   "tille", "midzuno", "syst", "pivotal", "srswor")
> boxplot(data.frame(ss), las = 3)

```

