Weight Calibration across Packages

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Weight calibration

- Last step in creating analysis weights in survey data files
- Adjusting the weights so that they sum to known population totals in different subgroups (age, sex, race, ethnicity, geography, etc.)
- Desirable to minimize changes from the input weights (probability of selection, nonresponse adjustments, frame integration, etc.)

Deville & Sarndal (1992)
Contenders

Stata

- ipfraking (Kolenikov 2014, 2019)
- svycal (official Stata)
- survwgt (Winter 2002)
- sreweight (Pacifico 2014)

R

- survey::calibrate() (Lumley 2010)

SAS

- rake_and_trim() (Izrael, Battaglia, Hoaglin, Frankel, Ball, 2017)
Out of scope

- SUDAAN PROC WGTADJ, PROC WGTADJX
- Stata ipfweight (Bergmann 2011)
- R library(ReGenesees) (Zardetto 2015)
- R library(ipfr) (Ward, Macfarlane 2019)
Expectations

- Produce usable results
- Provide weight diagnostics
- Speed
- Fool proof
Running example
Running example

CPS 2018 March ASEC data

- estimate control totals based on 13353 adults in CA
- calibrate 8403 adults in TX on
  - sex
  - age (14 categories)
  - race/ethnicity (6 categories)
  - education (5 categories)
  - HH income (9 categories)
  - nativity (3 categories)
  - marital status (6 categories)
  - own vs. rent
  - metro area of TX (23 categories)
1. Straight raking
2. Raking with divergent population control totals
3. Raking with bounded weight adjustment ratios [0.3,3]
4. Raking with bounded weight values (2nd and 98th percentile of unrestricted distribution)
5. Linear calibration
6. Linear calibration with trimming
7. (Informative error expected) incorrect specification of control totals
## Performance summary

<table>
<thead>
<tr>
<th>package</th>
<th>TOT</th>
<th>DIV</th>
<th>REL</th>
<th>ABS</th>
<th>LIN</th>
<th>LIN+TR</th>
<th>time</th>
</tr>
</thead>
<tbody>
<tr>
<td>ipfraking</td>
<td>name</td>
<td>+W</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>N</td>
<td>7.14 sec</td>
</tr>
<tr>
<td>svycal</td>
<td>name/=</td>
<td>F</td>
<td>F</td>
<td>N</td>
<td>+</td>
<td>+</td>
<td>0.18 sec</td>
</tr>
<tr>
<td>survwgt</td>
<td>order</td>
<td>NW</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>0.80 sec</td>
</tr>
<tr>
<td>sreweight</td>
<td>order</td>
<td>F</td>
<td>F</td>
<td>N</td>
<td>+</td>
<td>N</td>
<td>0.19 sec</td>
</tr>
<tr>
<td>calibrate</td>
<td>name</td>
<td>-W</td>
<td>.</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>0.35 sec</td>
</tr>
<tr>
<td>rake_and_trim</td>
<td>name+magic</td>
<td>F</td>
<td>-W</td>
<td>+</td>
<td>N</td>
<td>N</td>
<td>61 sec</td>
</tr>
</tbody>
</table>

**N:** no documented functionality exists

**W:** issued reasonable warnings

**F:** failed with cryptic error message / no message
Stata \texttt{survwght}

```stata
foreach x of varlist sex raceth6 educ5 age_cat origin3 hhinc9 own_rent marst metarea {
    qui gen double t_`x' = .
    qui levelof `x'
    foreach c of numlist `r(levels)' {
        if `c' == `metarea'
            local where : colnum mp_`x'_metarea_t[1,where]
        qui replace t_`x' = mp_`x'_metarea_t[1,where] if `x' == `c'
    }
    else {
        local where : colnum mp_`x'_`c'
        qui replace t_`x' = mp_`x'[1,where] if `x' == `c'
    }
}
end of do-file

survwght if sex == 1 & race == 1 & educ == 1 & age_cat == 1 & origin == 1 & hhinc == 1 & own_rent == 1 & marst == 1 & metarea == 1
Warning: variables account reached maximum iterations before convergence.
```

R survey::calibrate()
SAS rake_and_trim()

**** Program terminated at iteration 11 because raking converged ****

The FREQ Procedure

Weighted Distribution After Raking

<table>
<thead>
<tr>
<th>Sex</th>
<th>Output Weight Sum of Weights</th>
<th>Target Total</th>
<th>Sum of Weights Difference</th>
<th>% of Output Weights</th>
<th>Target % of Weights</th>
<th>Difference in %</th>
<th>Marginal Category Difference in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14813715.70</td>
<td>14813331</td>
<td>385.02</td>
<td>49.012</td>
<td>49.011</td>
<td>0.001</td>
<td>0.003</td>
</tr>
<tr>
<td>2</td>
<td>15410993.62</td>
<td>15411379</td>
<td>-385.02</td>
<td>50.988</td>
<td>50.989</td>
<td>-0.001</td>
<td>-0.002</td>
</tr>
</tbody>
</table>

Weighted Distribution After Raking
SAS rake_and_trim()
Weight trimming ≠ methodology
## Misspecified control totals

<table>
<thead>
<tr>
<th>package</th>
<th>Extra in pop</th>
<th>Extra in data</th>
<th>Wrong order</th>
</tr>
</thead>
<tbody>
<tr>
<td>ipfraking</td>
<td>E</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>svycal</td>
<td>E</td>
<td>!!!</td>
<td></td>
</tr>
<tr>
<td>survwgt</td>
<td>N/A</td>
<td>N/A</td>
<td>!!!</td>
</tr>
<tr>
<td>sreweight</td>
<td>E</td>
<td>E</td>
<td>!!!</td>
</tr>
<tr>
<td>calibrate</td>
<td>E</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>rake_and_trim</td>
<td>!?!?</td>
<td>!!!</td>
<td></td>
</tr>
</tbody>
</table>

*E: issued an error and stopped*

*!!!: did not issue an error – results highly suspect!*
Thanks and out

Questions?

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- @StatStas on Twitter