



BOLD
THINKERS
DRIVING
REAL-WORLD
IMPACT

Weight Calibration across Packages

Stas Kolenikov

9/23/2019

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)
- `svyca1` (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

In the original 2019 presentation, there was a picture of a truck with a bumper sticker that said, "Don't CA my TX", but I was asked to remove that picture by a copyright law firm representing the image holder.

<https://www.google.com/search?q=don't+ca+my+tx>

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)



BOLD
THINKERS
DRIVING
REAL AND
IMPACT

Tasks and tests

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

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

N: no documented functionality exists

W: issued reasonable warnings

F: failed with cryptic error message / no message

Stata ipfraking

Stata/MP 16.0 - C:\Users\Kolenikov\Conferences\GASP.2019\cps18_weighted.dta

File Edit Data Graphics Statistics User Window Help

Command

```
. ipfraking [pw=asecwt] if stateip==48, ctotal(cps18_sex cps18_racethn6 cps18_educ5 cps18_age_cat cps18_origin3 cps18_hhinc9 cps18_own_rent cps18_marst) gen(rakedwt) trimhiabs(15000) trimloabs(600)
```

(13,353 missing values generated)
(13,353 missing values generated)
(13,353 missing values generated)

Iteration 1, max rel difference of raked weights = 7.0411749
Iteration 2, max rel difference of raked weights = .67389653
Iteration 3, max rel difference of raked weights = .31736461
Iteration 4, max rel difference of raked weights = .164835
Iteration 5, max rel difference of raked weights = .08939
Iteration 6, max rel difference of raked weights = .05044038
Iteration 7, max rel difference of raked weights = .02830049
Iteration 8, max rel difference of raked weights = .01572813
Iteration 9, max rel difference of raked weights = .00878008
Iteration 10, max rel difference of raked weights = .00488991
Iteration 11, max rel difference of raked weights = .00271917
Iteration 12, max rel difference of raked weights = .00151984
Iteration 13, max rel difference of raked weights = .0008509
Iteration 14, max rel difference of raked weights = .00047476
Iteration 15, max rel difference of raked weights = .00026398
Iteration 16, max rel difference of raked weights = .00014629
Iteration 17, max rel difference of raked weights = .00008082
Iteration 18, max rel difference of raked weights = .00004451
Iteration 19, max rel difference of raked weights = .00002444
Iteration 20, max rel difference of raked weights = .00001338
Iteration 21, max rel difference of raked weights = 7.299e-06
Iteration 22, max rel difference of raked weights = 3.970e-06
Iteration 23, max rel difference of raked weights = 2.153e-06
Iteration 24, max rel difference of raked weights = 1.163e-06
Iteration 25, max rel difference of raked weights = 6.282e-07
The worst relative discrepancy of 2.7e-07 is observed for age_cat == 14
Target value = 764545.81; achieved value = 764545.61
Trimmed due to the upper absolute limit: 121 weights.
Trimmed due to the lower absolute limit: 74 weights.

Summary of the weight changes

	Mean	Std. dev.	Min	Max	CV
Orig weights	2467	943	1133	9870	.3822
Raked weights	3597	3039	600	15000	.8449
Adjust factor	1.4734	0.1528	0.5015	9.5015	

Graph - Graph

Frequency

Calib weights

Frequency

Adjustment factor

Variables Properties

C:\Users\Kolenikov\Conferences\GASP.2019

CAP NUM OVR

10:52 PM
9/22/2019

Stata svycal

```
Stata/MP 16.0 - C:\Users\Kolenikov\Conferences\GASP.2019\cps18_weighted.dta
File Edit Data Graphics Statistics User Window Help
Command
History Command Variables Properties
. svycal rake ibn.sex ibn.racethn6 ibn.educ5 ibn.age_cat ibn.origin3 ibn.hhinc9 ibn.own_rent ibn.marst ///
> [pw=asecwt] if statefip==48, generate(svycalwt) nocons totals( ///
> 1.sex = 14813330.68 2.sex = 15411378.64 ///
> 1.racethn6 = 12400052.47 2.racethn6 = 1665649.68 3.racethn6 = 4731138.97 ///
> 4.racethn6 = 335014.83 5.racethn6 = 439771.25 6.racethn6 = 10653082.12 ///
> 1.educ5 = 4237156.58 2.educ5 = 7062603.95 3.educ5 = 8783383.20 ///
> 4.educ5 = 6651846.95 5.educ5 = 3489718.64 ///
> 1.age_cat = 1427812.21 2.age_cat = 2692454.42 3.age_cat = 3071987.71 ///
> 4.age_cat = 2859233.95 5.age_cat = 2856726.84 6.age_cat = 2557485.26 ///
> 7.age_cat = 2508571.32 8.age_cat = 2435574.39 9.age_cat = 2394585.24 ///
> 10.age_cat = 2236585.55 11.age_cat = 1802990.20 ///
> 12.age_cat = 1268298.67 13.age_cat = 1347857.75 14.age_cat = 764545.81 ///
> 1.origin3 = 14214474.58 2.origin3 = 5584485.04 3.origin3 = 10425749.7 ///
> 1.hhinc9 = 2910673.86 2.hhinc9 = 3957861.36 3.hhinc9 = 4113413.54 ///
> 4.hhinc9 = 3855284.67 5.hhinc9 = 3079011.69 6.hhinc9 = 3056394.29 ///
> 7.hhinc9 = 2296345.18 8.hhinc9 = 3083671.77 9.hhinc9 = 3872052.96 ///
> 1.own_rent = 17591393.55 2.own_rent = 12633315.77 ///
> 1.marst = 14849097.16 2.marst = 487877.77 3.marst = 667292.81 ///
> 4.marst = 2621033.03 5.marst = 1628860.57 6.marst = 9970547.98 ///
> )
note: 6.racethn6 omitted because of collinearity
note: 5.educ5 omitted because of collinearity
note: 14.age_cat omitted because of collinearity
note: 3.origin3 omitted because of collinearity
note: 9.hhinc9 omitted because of collinearity
note: 2.own_rent omitted because of collinearity
note: 6.marst omitted because of collinearity
.
end of do-file
C:\Users\Kolenikov\Conferences\GASP.2019 CAP NUM OVR
11:02 PM 9/22/2019
```

Stata survwgt

```
Stata/MP 16.0 - C:\Users\Kolenikov\Conferences\GASP.2019\cps18_weighted.dta
File Edit Data Graphics Statistics User Window Help
Command
History
Variables
Properties

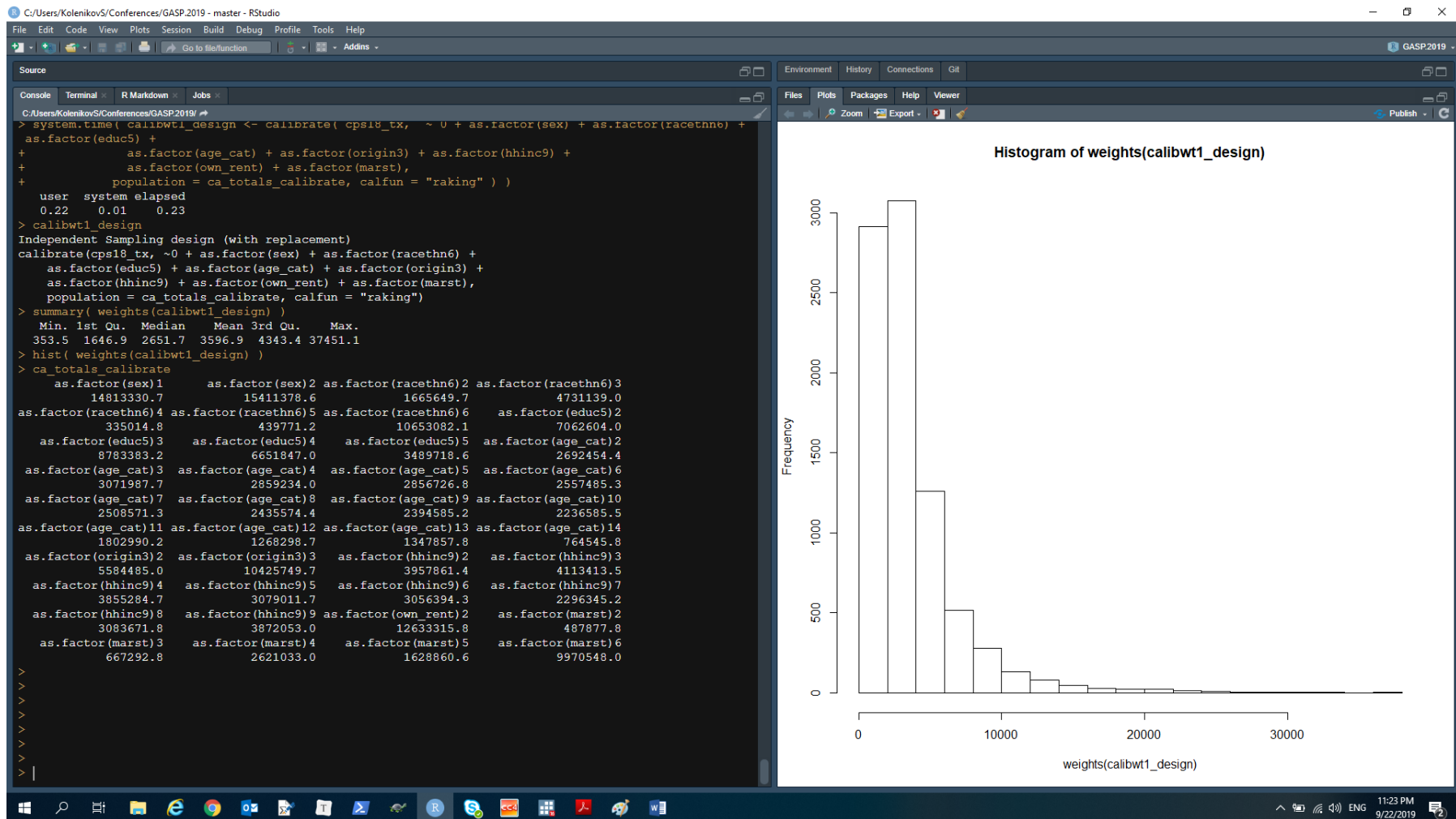
. foreach x of varlist sex raceh6 educ5 age_cat origin3 hhinc9 own_rent marst metarea {
2.   qui gen double t_`x' = .
3.   qui levelsof `x'
4.   foreach c of numlist `r(levels)' {
5.     if "`x'" == "metarea" {
6.       * metarea_tx matrix is named differently
7.       local where : colnumb cps18_metarea_tx "_one:"`c'"
8.       qui replace t_`x' = cps18_metarea_tx[1,`where'] if `x' == `c'
9.     }
10.    else {
11.      local where : colnumb cps18_`x' "_one:"`c'"
12.      qui replace t_`x' = cps18_`x'[1,`where'] if `x' == `c'
13.    }
14.  }
. }

end of do-file

. survwgt rake asewgt, generate(survwgt) by(sex raceh6 educ5 age_cat origin3 hhinc9 own_rent marst ) totvars(t_sex t_raceh6 t_educ5 t_age_cat t_origin3 t_hhinc9 t_own_rent t_marst)
Warning: variable asewgt reached maximum iterations before convergence.

CAP NUM OVR
11:06 PM
9/22/2019
```

R survey::calibrate()



SAS rake_and_trim()

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

The FREQ Procedure

Weighted Distribution After Raking

Sex	Output Weight Sum of Weights	Target Total	Sum of Weights Difference	% of Output Weights	Target % of Weights	Difference in %	Marginal Category Difference in %
1	14813715.70	14813331	385.02	49.012	49.011	0.001	0.003
2	15410993.62	15411379	-385.02	50.988	50.989	-0.001	-0.002

Weighted Distribution After Raking

PAGE 87 OF 90 21658 WORDS ENGLISH (UNITED STATES) 11:16 PM 9/22/2019

SAS rake_and_trim()

The screenshot shows a Windows File Explorer window with the following details:

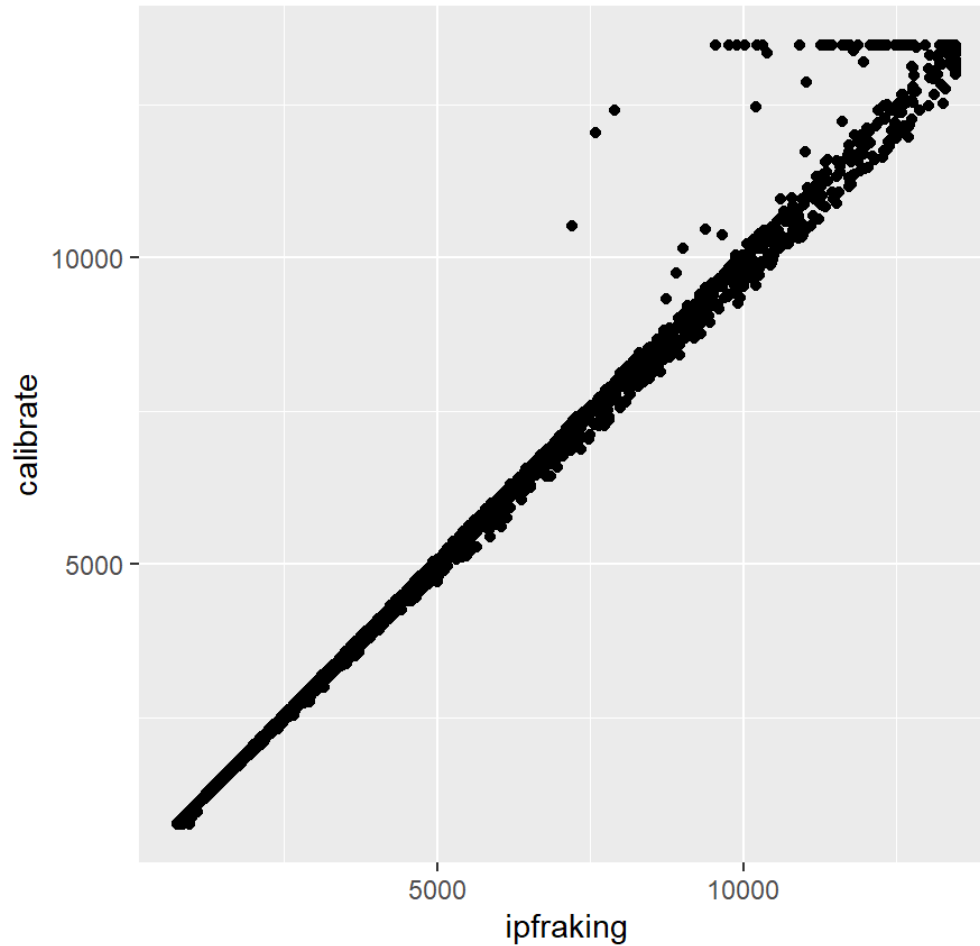
- Address bar: Stas Kolenikov > Conferences > GASP.2019 > SAS
- File list table:

Name	Date modified	Type	Size
cps18_tx_wt1.sas7bdat	9/20/2019 6:20 PM	SAS7BDAT File	13,268 KB
cps18_tx_wt2.sas7bdat	9/22/2019 4:31 PM	SAS7BDAT File	13,268 KB
cps18_tx_wt3.sas7bdat	9/22/2019 5:27 PM	SAS7BDAT File	13,696 KB
cps18_tx_wt4.sas7bdat	9/22/2019 5:58 PM	SAS7BDAT File	13,696 KB
rntwt1	9/20/2019 6:20 PM	Log File	2,680 KB
rntwt1.rtf	9/20/2019 6:12 PM	Rich Text Format	1,765 KB
rntwt2	9/22/2019 4:31 PM	Log File	2,308 KB
rntwt2.rtf	9/22/2019 4:31 PM	Rich Text Format	2,698 KB
rntwt3	9/22/2019 5:27 PM	Log File	18,413 KB
rntwt3.rtf	9/22/2019 5:27 PM	Rich Text Format	7,799 KB
rntwt3a	9/22/2019 4:44 PM	Log File	18,413 KB
rntwt3a.rtf	9/22/2019 4:44 PM	Rich Text Format	7,799 KB
rntwt4	9/22/2019 5:58 PM	Log File	6,230 KB
rntwt4.rtf	9/22/2019 5:58 PM	Rich Text Format	2,918 KB

The Properties dialog box for 'rntwt4.rtf' shows:

- General tab: 3 Files, 0 Folders
- Type: Multiple Types
- Location: All in C:\Users\KolenikovS\Conferences\GASP.2019
- Size: 22.3 MB (23,391,759 bytes)
- Size on disk: 22.3 MB (23,396,352 bytes)
- Attributes: Read-only, Hidden

Weight trimming \neq methodology



BOLD
THINKERS
DRIVING
REAL-WORLD
IMPACT

Misspecified control totals

package	Extra in pop	Extra in data	Wrong order
ipfraking	E	E	
svycal	E	!!!	
survwgt	N/A	N/A	!!!
sreweight	E	E	!!!
calibrate	E	E	
rake_and_trim	!?!?	!!!	

E: issued an error and stopped

!!!: did not issue an error – results highly suspect!

Thanks and out

Questions?

- stas_kolenikov@abtassoc.com
- @StatStas on Twitter