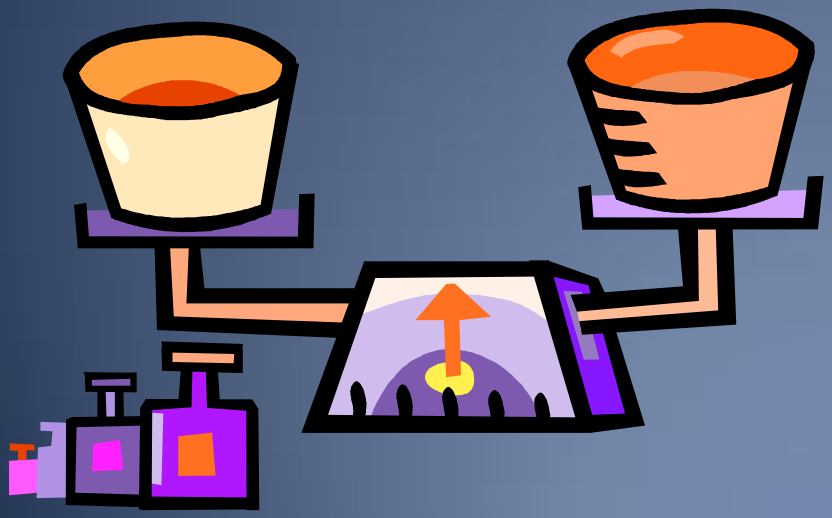
Creating Weights to Improve Survey Population Estimates



Pu-Shih Daniel Chen

Shimon Sarraf

Indiana University
Center for Postsecondary Research

Case Study: NSSEville State University

- Student Population: 2000
- Survey Respondents: 1000

	Population		Respondents	
	Count	**%**	**Count**	**%**
FT/Male	1000	50%	200	20%
FT/Female	750	38%	600	60%
PT/Male	150	8%	125	13%
PT/Female	100	5%	75	8%
	2000		1000	

Goals

- Introduce basic weighting concepts (simple random sample design)
  - Purpose
  - Types
  - Calculations
  - Limitations
- Enhance confidence to do it yourself
- Develop a more critical eye

Purpose of Weights

- Corrects for one type of potential survey bias while estimating populations :

Respondents do not represent population well

- Weights cannot correct all types of survey error (questionnaire design, data collection, sampling, nonresponse effect)

Purpose of Weights (cont.)

- Lack of representation comes from…
  - **Differential response rates**
    - 80% females **respond** but only 50% males (**< 100% RR**)

AND/OR

  - **Unequal probability of selection**
    - 80% of females **selected** but only 50% of males (**100% RR**)

Purpose of Weights (cont.)

- Using weights assumes:
  - Survey item results vary by sub-groups
  - Negligible nonresponse effect
  - Aggregate analysis

Is Weighting Necessary?

Check representation and identify sub-groups

	Population		Respondents
Male	58%	→	33%
Full-time	88%	→	80%

Determine how results vary by sub-groups

Community Service Participation

Gender		Enrollment Status	
Male	20%	Full-Time	80%
Female	60%	Part-Time	40%

Types of Weights

Scale & Proportional

- Representative sample created
- **Population** count

Proportional

- Representative sample created
- **Respondent** count

- Both types of weights produce nearly identical item distributions, averages, and st. deviations
- 50% say "very often" using both weights

Scale Weight Calculation

$$W_i = P_i / R_i$$

Population Counts

	Full-time	Part-time
Male	P1	P3
Female	P2	P4

Respondents Counts

	Full-time	Part-time
Male	R1	R3
Female	R2	R4

Scale Weight Example

W(male/full-time) = 1000/200 = 5
W(male/part-time) = 150/125 = 1.2
W(female/full-time) = 750/600 = 1.25
W(female/part-time) = 100/75 = 1.33

Population Counts

	Full-time	Part-time
Male	1000 P1	150 P3
Female	750 P2	100 P4

Respondents Counts

	Full-time	Part-time
Male	200 R1	125 R3
Female	600 R2	75 R4

Effects of Weighting

- When creating weights, we are trying to identify how many cases each respondent should represent
- Scale weights will make the number of respondents equal to the number of population

Population Counts

	Full-time	Part-time
Male	1000	150
Female	750	100

Respondents Counts

	Full-time	Part-time
Male	200	125
Female	600	75

Adjusting Scale Weights

- The pros and cons of scale weights
- Scale Weights can be transformed into proportional weights so that the number of respondents is preserved

Degree of Freedom	Mean differences needed to achieve statistics significance at p = .05
1	12.71
10	2.23
100	1.98
∞	1.96

Proportional Weight Calculation

$$W_p = \frac{\text{Percent of Population}}{\text{Percent of Respondents}} = \frac{P_i / P_{total}}{R_i / R_{total}} = \frac{0.5}{0.2} = 2.5$$

Population Counts

	Full-time	Part-time
Male	**1000**	150
	50%	7.5%
	37.5%	5%
Female	750	100

Respondents Counts

	Full-time	Part-time
Male	**200**	125
	20%	12.5%
	60%	7.5%
Female	600	75

Scale vs. Proportional Weights

Respondents	Unweighted Counts	Scale		Proportional	
		Weight	Weighted Counts	Weight	Weighted Counts
Male/FT	200	5	1000	2.50	500
Male/PT	125	1.2	150	0.60	75
Female/FT	600	1.25	750	0.63	375
Female/PT	75	1.33	100	0.67	50
TOTAL	**1000**		**2000**		**1000**

Good & Bad News

- Bad News
  - SPSS cannot create weights for you
  - You create weighting variables on your own
- Good News
  - SPSS can determine cell counts
  - Just apply the formula provided to create your weight
  - **SPSS can apply weights for all your analyses**

Determine Cell Counts with SPSS

```
CROSSTABS
  /TABLES=gender  BY enrollment
  /FORMAT= AVALUE TABLES
  /CELLS= COUNT
  /COUNT ROUND CELL .
```

gender * enrollment Crosstabulation

Count

		enrollment		
		Part-time	Full-time	Total
gender	Male	34	320	354
	Female	68	578	646
Total		102	898	1000

Population Counts

	Full-time	Part-time
Male	1000	150
Female	750	100

Respondents Counts

	Full-time	Part-time
Male		
Female		

Weight Calculations Revisited

- Scale & Proportional Weight (NSSE Weight2)

$$W_2 = P_i / R_i$$

- Proportional Weight (NSSE Weight1)

$$W_1 = \frac{P_i}{P_{total}} \Big/ \frac{R_i}{R_{total}}$$

Population Counts

	Full-time	Part-time
Male	P1	P3
Female	P2	P4

Respondents Counts

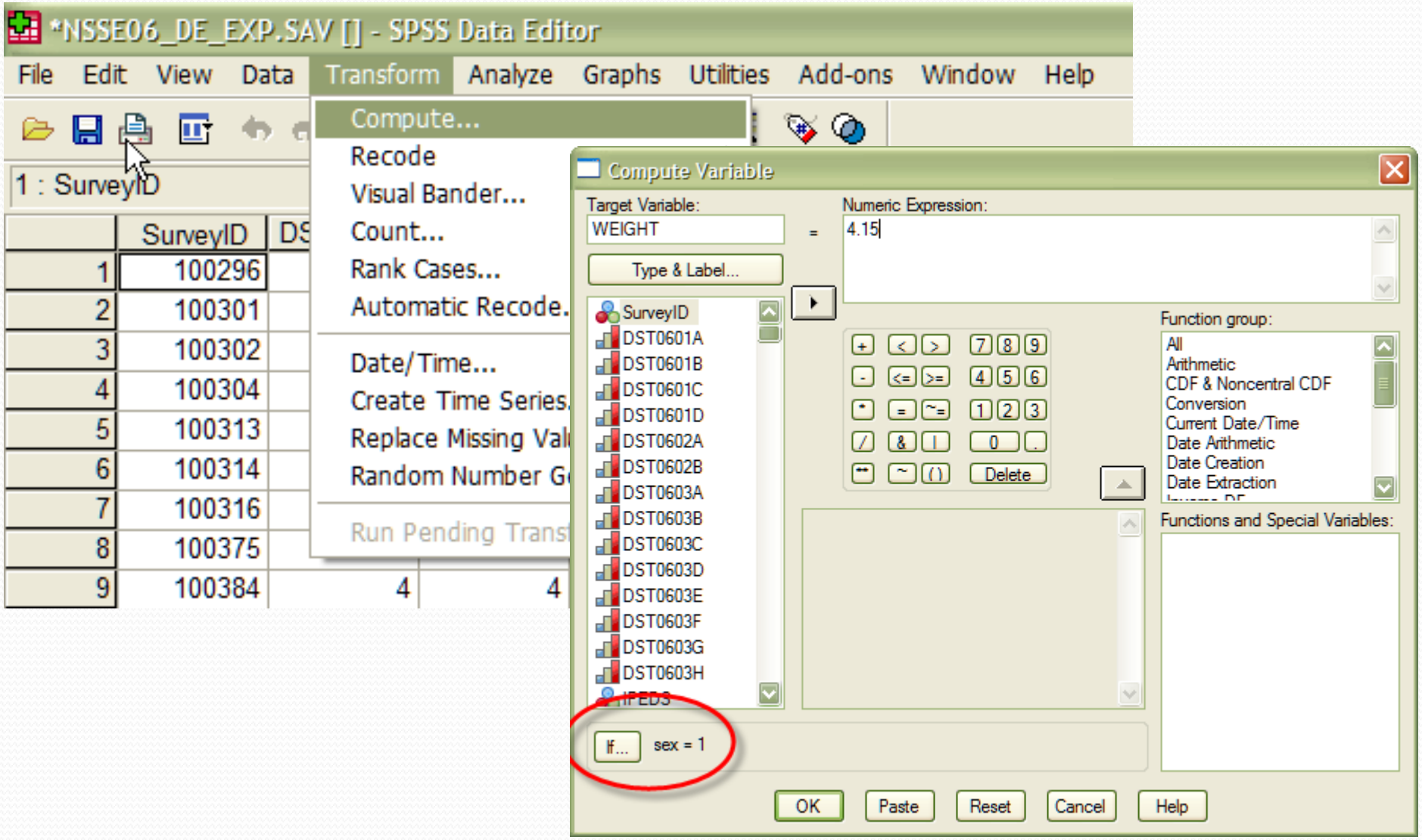
	Full-time	Part-time
Male	R1	R3
Female	R2	R4

Attaching Weights to the Data File

```
******Attach Weights to the data file*****.
IF (gender = 1 and enrollment = 1) WEIGHT = 4.41.
IF (gender = 1 and enrollment = 2) WEIGHT = 3.13.
IF (gender = 2 and enrollment = 1) WEIGHT = 1.47.
IF (gender = 2 and enrollment = 2) WEIGHT = 1.3.

FREQ WEIGHT
    /statistics=sum.
```

Attaching Weights to the Data File



Check the Weights

Statistics

WEIGHT1		
N	Valid	1000
	Missing	0
Sum		1000.36

WEIGHT1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.65	578	57.8	57.8	57.8
	.74	68	6.8	6.8	64.6
	1.56	320	32.0	32.0	96.6
	2.21	34	3.4	3.4	100.0
	Total	1000	100.0	100.0	

Applying Weights in SPSS

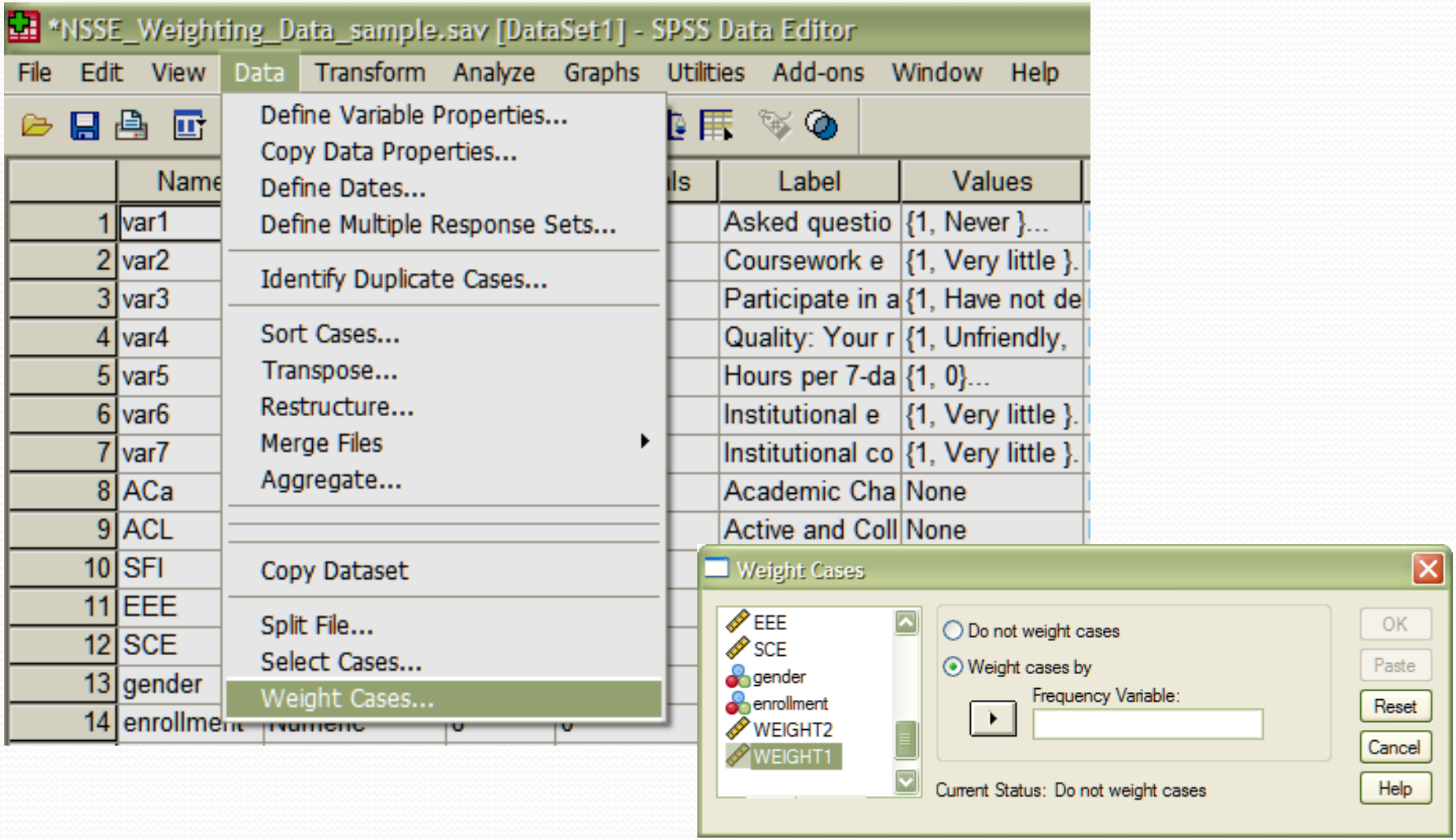
```
*****Apply Weights to Analyses*******.

Weight by WEIGHT1.

* Custom Tables.
CTABLES
  /VLABELS VARIABLES=enrollment ACa ACL SFI EEE SCE DISPLAY=DEFAULT
  /TABLE ACa [MEAN] + ACL [MEAN] + SFI [MEAN] + EEE [MEAN] + SCE [MEAN] BY
  enrollment
  /CATEGORIES VARIABLES=enrollment ORDER=A KEY=VALUE EMPTY=INCLUDE.

Weight off.
```

Applying Weights in SPSS



Weighting Limitations

- Scale weights (count = population):
  - smaller standard errors → more significant results
- If nonresponders very different: inaccurate results
- Not appropriate for all survey items
- Precision may be lost in some situations
- Small cell sizes

To Learn More about Weighting

Basic Overview:

- Maletta, H. (2006). *Weighting*. Retrieved from Raynald Levesque's SPSS website: http://www.spsstools.net/Tutorials/WEIGHTING.pdf

Advanced weighting techniques and implications:

- Thomas, S., Heck, R., & Bauer, K. (2005) Weighting and Adjusting for Design Effects in Secondary Data Analyses. In P. Umbach (Ed.), *Survey Research: Emerging Issues*. New Directions for Institutional Research, Number 127, 51-72.
- Dey, E. L. (1997). Working with low survey response rates: The efficacy of weighting adjustments. *Research in Higher Education*, 38, 215-227.

Questions & Discussion

Contact: **Pu-Shih Daniel Chen, Ph.D.**
pdchen@indiana.edu

Shimon Sarraf
ssarraf@indiana.edu

Presentation materials:
http://nsse.iub.edu/conferences