INSTITUTE FOR SOCIAL RESEARCH • SURVEY RESEARCH CENTER
SURVEY RESEARCH OPERATIONS
UNIVERSITY OF MICHIGAN

Lunch & Learn: Survey Weights

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Paul Schulz

Overview

- Part 1: What is a survey weight?
- Part 2: Components of survey weights
- Part 3: Examples

PART 1: What is a survey weight?

- Weight = The number of additional elements represented by each sampled element.
- Used to make statistical estimates more representative of the whole population, by adjusting for sample design and nonresponse.
- A value assigned to each case in a data file.
- Example: a weight of 10 means this element represents itself and 9 other elements in the population.

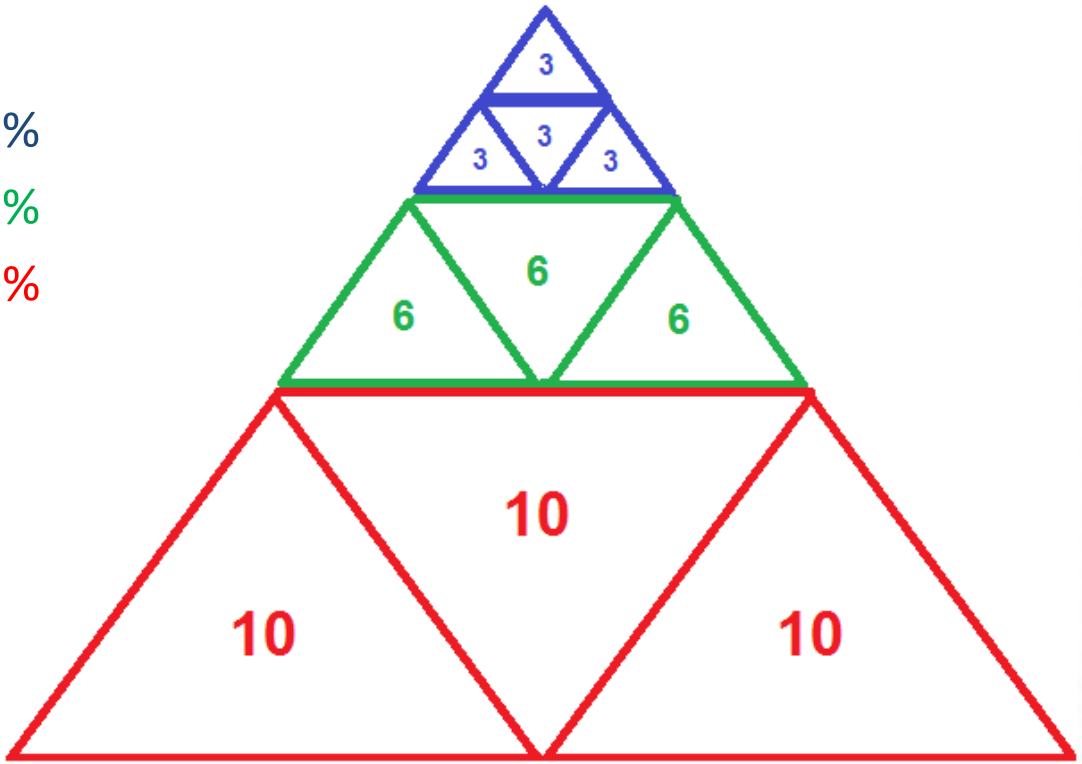
Toy Example: Pyramid Population

Blue area: 12/60 = 20%

Green area: 18/60 = 30%

Red area: 30/60 = 50%

Total Size = 60



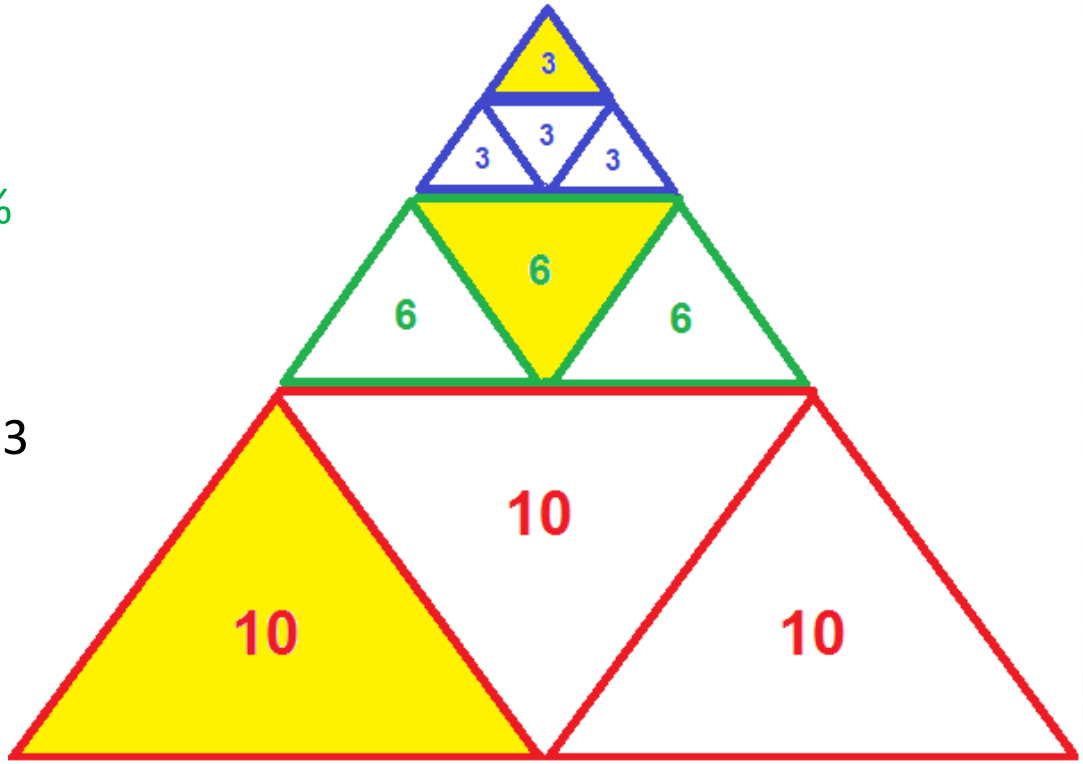
Unweighted Estimates

Blue area: 3/19=15.7%

Green area: 6/19=31.6%

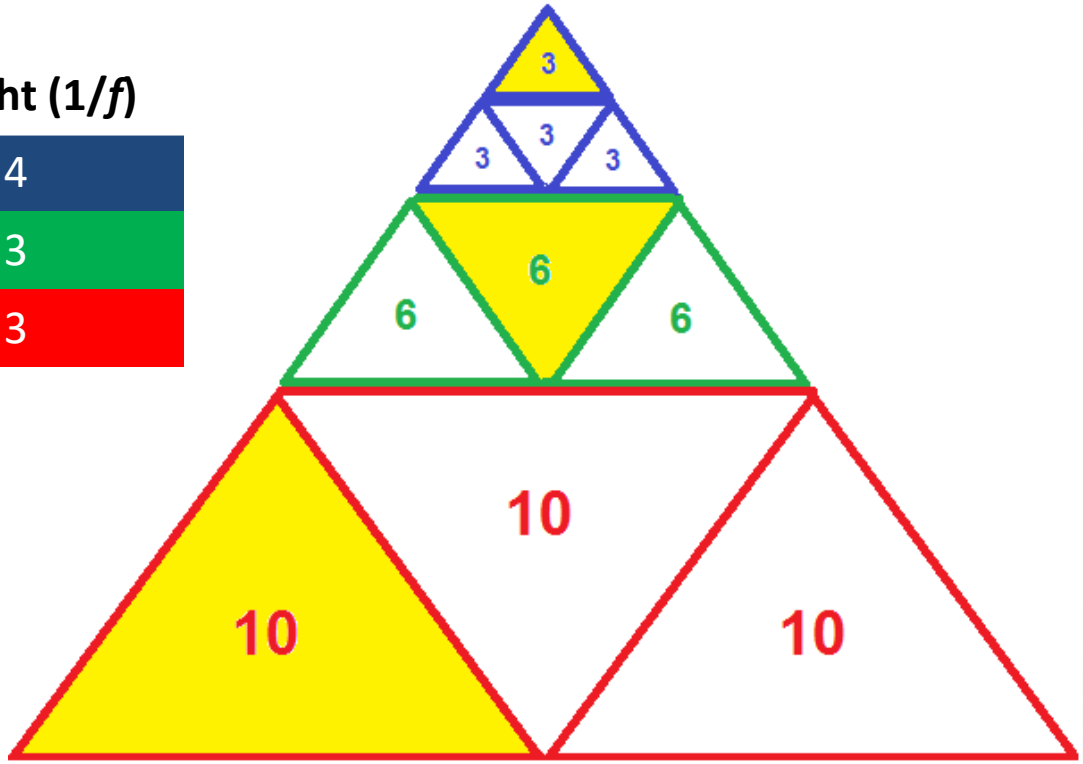
Red area: 10/19=52.6%

Total Size: 19*(10/3)=63.3



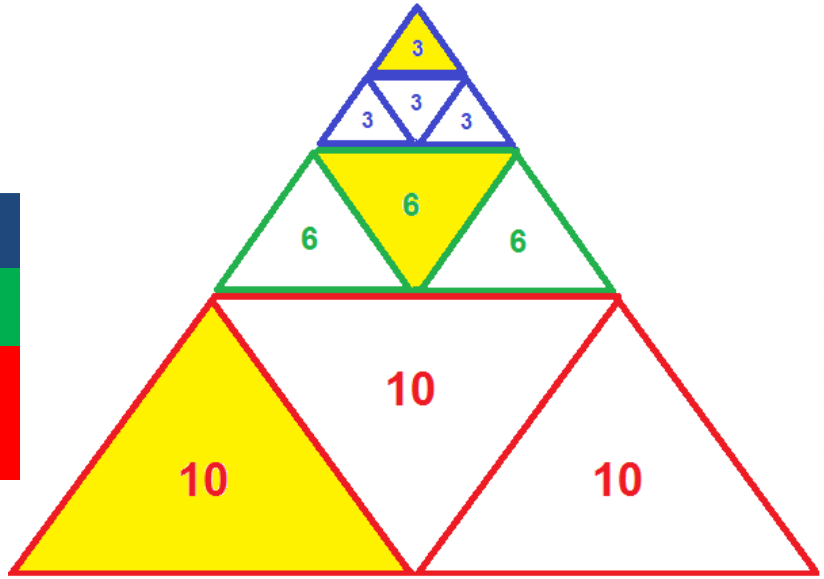
Constructing Weights

Sampling fraction (*f*)	Weight (1/*f*)
1/4	4
1/3	3
1/3	3



Weighted Estimates

	Unweighted Estimate	Weighted Estimate
% Area	15.7%	(3*4)/60=20%
%Area	31.6%	(6*3)/60=30%
% Area	52.6%	(10*3)/60=50%
TOTAL	63.3	3(4)+6(3)+10(3)=60



Weights in Data File

Obs. #	Measured Size	Weight
1	3	4
2	6	3
3	10	3

PART 2: Components of a Survey Weight

1. Design Weights (D_i)
2. Nonresponse Adjustment (NR_i)
3. Calibration Adjustment (C_i)

$$\text{Total Weight } (Wi) = D_i * Nr_i * C_i$$

Component 1: Design Weights

- Also known as base weight.
- “Reverse” effects of sample design.
- Design Weight = 1/(selection probability)
- Given perfect sample frame and no non-response, design weights alone could produce sufficient estimates.

Component 2: Nonresponse Adj.

- When nonresponse is not random, nonresponse adjustment will reduce bias.
- Nonresponse adjustment = 1/(Prob. of Resp.)
- Typically nonresponse is modelled using logistic regression ("propensity model")
- Tradeoff between reducing bias and introducing variance.

Component 3: Calibration Weight

- Calibration is used to create consistency between weighted estimates and external data source (pop. total, etc)
- Post-stratification weight is used to scale data to match known population totals across dimensions of interest.
- Requires external data source (e.g. Census) with a value for each cell of crossed variables of interest.

Post-stratification Example

Gender	Sample %	Pop. %	Pop./Sample	P-S Weight
Male	.40	.50	.50/.40	1.25
Female	.60	.50	.50/.60	.833

Post-stratification Example 2

P-S Weight = Pop. %/Samp. %	Age 18-30 (33%)	Age 31-55 (33%)	Age 55+ (33%)
Male (50%)	.167/.12 = 1.39	.167/.10 = 1.67	.167/.18 = .93
Female (50%)	.167/.20 = .835	.167/.25 = .668	.167/.15 = 1.11

Other Techniques

- Raking – similar to post-stratification; iterative process used when only marginal totals are known.
- Trimming – Limit placed on the size of the weight to reduce variance, but introduces bias.

Part 3: Practical Examples

1. STARRS AAS
2. Double-sample Adjustment

Example 1: STARRS AAS

Sample: Stratified PPS sample of Army units by Army command (Forces Command, European command) with oversample of Special Operations command. Census of Soldiers within each selected unit.

Design weight: Unit-level 1/(Prob. Of Sel.)

NR adjustment: Unit Size/# Responses

Calibration: Post-stratified to known Army totals within command.

Example 2: Double-Sample

Sample: Existing project + ½ sample of NR units

Design weight: 1/(original prob. of selection)

Double samp. adj.:

1 for responding units

0 for for non-selected NR units

2 for selected NR units.

NR adj. and calibration as needed.