

## Design Statements Examples

### Case Study Description

- Case 1. Design=WR, small sampling fractions
- Case 2. Design=WR, small sampling fractions, certainty units
- Case 3. Design=WR, 2 stratification variables
- Case 4. Design=WOR, large sampling fractions
- Case 5. Design=WOR, large and small sampling fractions
- Case 6. Design=WOR, large sampling fractions, certainty units
- Case 7. Design=WOR, large and small sampling fractions, certainty units
- Case 8. Design=WOR, small sampling fractions, (all stage 2 units)
- Case 9. Design=WOR, 100% sampling within all schools at stage 2
- Case 10. Design=WOR, 1<sup>st</sup> and 2<sup>nd</sup> stage stratification, invoke WR at last stage

## Design Statements Examples

### Case Study: Student Sample

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#### Sampling Stages:

Strata - 2 Regions (fixed)

PSU - 3 Schools / Region

$n = 3$  sampled schools per region

$N =$  population number of schools per region

$\frac{n}{N} =$  sampling fraction in each region

SSU - 3 Students / School (Stage 2 Units)

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Data file contains 1 record / Student

# Design Statements Examples

Case Study: Student Sample

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## Case 1. Design = WR, Small Sampling Fractions

$\frac{n}{N}$  is small (<10%, for All Regions)

SUDAAN DESIGN STATEMENTS

**DESIGN = WR**  
**NEST Region School;**

# Design Statements Examples

## Case Study: Student Sample

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### CASE 1.

Data File: (Design variables only)

<u>Region ID</u>	<u>School ID</u>	<u>Student ID</u>
1	10	101
1	10	102
1	10	103
1	20	201
1	20	202
1	20	203
1	30	301
1	30	302
1	30	303
2	40	401
2	40	402
2	40	403
2	50	501
2	50	502
2	50	503
2	60	601
2	60	602
2	60	603

# Design Statements Examples

## Case Study: Student Sample

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### **CASE 2. DESIGN = WR, Small Sampling Fractions, Certainty Units**

$\frac{n}{N}$  is small (<10%, for ALL Regions)

One School Chosen With Certainty  
(Region = 2, School = 60)

**Can still invoke WR sampling:**

#### SAS Recodes:

```
Strata = Region;  
PSU = School ;
```

```
If School = 60 then do;  
    Strata = School ;           /* School #60 now a stratum */  
    PSU = Student;           /* Student = First Random Level  
                             in School #60 */  
end;
```

### SUDAAN DESIGN STATEMENTS

<pre><b>DESIGN = WR</b> <b>NEST Strata PSU ;</b></pre>
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## Design Statements Examples

### Case Study: Student Sample

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#### CASE 2.

Data File:

Region	School	Student	Strata	PSU
1	10	101	1	10
1	10	102	1	10
1	10	103	1	10
1	20	201	1	20
1	20	202	1	20
1	20	203	1	20
1	30	301	1	30
1	30	302	1	30
1	30	303	1	30
2	40	401	2	40
2	40	402	2	40
2	40	403	2	40
2	50	501	2	50
2	50	502	2	50
2	50	503	2	50
-----				
2	60 <i>Certainty</i>	601	60	601
2	60 <i>School</i>	602	60	602
2	60	603	60	603

## Design Statements Examples

### Case Study: Student Sample

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#### **CASE 3. DESIGN = WR, 2 Stratification Variables**

Within each Region, suppose the sample was further stratified into Counties and 3 Counties were selected with certainty; Schools were then randomly selected from each County.

Note: Since Counties were chosen with certainty, County is a fixed effect (or stratification variable), just like Region. School is still the PSU.

#### SUDAAN DESIGN STATEMENTS

<p><b>DESIGN = WR</b> <b>NEST Region County School / PSULEV=3;</b></p>
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The cross-classification of Region \* County (a total of  $2*3=6$  cells) forms the Strata.

PSULEV=3 indicates that School (3rd variable on the NEST statement) is the PSU.

## Design Statements Examples

### Case Study: Student Sample

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#### CASE 4. DESIGN = WOR, Large Sampling Fractions

$\frac{n}{N}$  is large for Region 1 (use WOR option)

$$\text{Region 1: } \frac{n}{N} = \frac{3}{15} = 20\%$$

$$\text{Region 2: } \frac{n}{N} = \frac{3}{100} = 3\%$$

Assume WOR in each Region and at both stages of sample selection (School and Student).

#### SUDAAN DESIGN STATEMENTS

<b>DESIGN</b> = WOR; <b>NEST</b> Region    School; <b>TOTCNT</b> Totsch    Totstud;
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Totsch = Population # schools in each region

Totstud = Population # students in each school



# Design Statements Examples

## Case Study: Student Sample

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### CASE 4.

Data File:

<u>Region</u>	<u>School</u>	<u>Student</u>	<u>Totsch*</u>	<u>Totstud**</u>	<u>Studwgt***</u>
1	10	101	15	250	$(3/15 * 3/250)^{-1}=416.7$
1	10	102	15	250	416.7
1	10	103	15	250	416.7
1	20	201	15	125	$(3/15 * 3/125)^{-1}=208.3$
1	20	202	15	125	208.3
1	20	203	15	125	208.3
1	30	301	15	75	$(3/15 * 3/75)^{-1}=125.0$
1	30	302	15	75	125.0
1	30	303	15	75	125.0
2	40	401	100	150	$(3/100 * 3/150)^{-1}=1,666.7$
2	40	402	100	150	1,666.7
2	40	403	100	150	1,666.7
2	50	501	100	70	$(3/100 * 3/70)^{-1}=777.8$
2	50	502	100	70	777.8
2	50	503	100	70	777.8
2	60	601	100	50	$(3/100 * 3/50)^{-1}=555.6$
2	60	602	100	50	555.6
2	60	603	100	50	555.6

\* =Population # schools in each region

\*\* =Population # students in each school

\*\*\* =Student level weight (assume SRS at each stage)

Total Population = 11,250 students

## Design Statements Examples

### Case Study: Student Sample

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#### **CASE 5. DESIGN = WOR, Large and Small Sampling Fractions**

$\frac{n}{N}$  is large for Region 1 (use WOR option)

$\frac{n}{N}$  is small for Region 2 (can invoke WR sampling here)

$$\text{Region 1: } \frac{n}{N} = \frac{3}{15} = 20\%$$

$$\text{Region 2: } \frac{n}{N} = \frac{3}{100} = 3\%$$

#### SAS Recode:

If Region = 2, then Totsch = -1;

/\* Totsch=-1 tells SUDAAN to compute WR variance estimates for Region 2\*/

$$\text{TOTSCH} = \begin{cases} -1, & \text{Region 2} \\ \text{Population \# of schools,} & \text{Region 1} \end{cases}$$

#### SUDAAN DESIGN STATEMENTS

<b>DESIGN = WOR;</b>
<b>NEST</b> Region      School;
<b>TOTCNT</b> Totsch      Totstud;

# Design Statements Examples

## Case Study: Student Sample

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### CASE 5.

Data File:

Region	School	Student	Totsch	Totstud
1	10	101	15	250
1	10	102	15	250
1	10	103	15	250
1	20	201	15	125
1	20	202	15	125
1	20	203	15	125
1	30	301	15	75
1	30	302	15	75
1	30	303	15	75
-----				
2	40	401	-1	150
2	40	402	-1	150
2	40	403	-1	150
2	50	501	-1	70
2	50	502	-1	70
2	50	503	-1	70
2	60	601	-1	50
2	60	602	-1	50
2	60	603	-1	50

## Design Statements Examples

### Case Study: Student Sample

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#### **CASE 6. DESIGN = WOR, Large Sampling Fractions, Certainty Units**

$\frac{n}{N}$  is large for Region 1 (use WOR option)

Some Certainty Schools (#30 in Region 1, #60 in Region 2)

#### SAS Recode:

- |  |   |  |
|--|---|--|
| 1. Create new Stratum<br>for certainty units | → | If School = 30 or School = 60 then do;<br>Strata = 3;            |
| 2. Set Totsch = 0 or 2                       | → | Totsch = 0; /* or totsch = 2 */<br>end;<br>else Strata = Region; |

$TOTSCH = \begin{cases} 0 \text{ (or 2),} & \text{if in Certainty stratum (Schools 30, 60)} \\ \text{Population \# of schools in each region,} & \text{all non - certainty Strata} \end{cases}$

#### SUDAAN DESIGN STATEMENTS

<b>DESIGN</b>	=	WOR;
<b>NEST</b>	Strata	School;
<b>TOTCNT</b>	Totsch	Totstud;

## Design Statements Examples

### Case Study: Student Sample

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#### CASE 6.

Data File:

	Region	Strata	School	Student	Totsch*	Totstud**
	1	1	10	101	15	250
	1	1	10	102	15	250
	1	1	10	103	15	250
	1	1	20	201	15	125
	1	1	20	202	15	125
	1	1	20	203	15	125
	2	2	40	401	100	150
	2	2	40	402	100	150
	2	2	40	403	100	150
	2	2	50	501	100	70
	2	2	50	502	100	70
	2	2	50	503	100	70
-----						
Certainty Schools: n/n - 2/2 (100%)	1	3	30	301	0 (or 2)	75
	1	3	30	302	0 (or 2)	75
	1	3	30	303	0 (or 2)	75
	2	3	60	601	0 (or 2)	50
	2	3	60	602	0 (or 2)	50
	2	3	60	603	0 (or 2)	50

\* = Population # schools in each stratum

\*\* = Population # students in each school

# Design Statements Examples

## Case Study: Student Sample

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### CASE 7. DESIGN = WOR, Large and Small Sampling Fractions, Certainty Units

$\frac{n}{N}$  is large  $\left(\frac{3}{15}\right)$  for Region 1 (use WOR option)

$\frac{n}{N}$  is small  $\left(\frac{3}{100}\right)$  for Region 2 (can invoke WR sampling)

Some certainty schools (#30 in Region 1, #60 in Region 2)

#### SAS Recode:

- |  |   |  |
|--|---|--|
| 1. Create new Stratum<br>for certainty units | → | If School = 30 or School = 60 then do;<br>Strata = 3;            |
| 2. Set Totsch = 0 or 2                       | → | Totsch = 0; /* or totsch = 2 */<br>end;<br>else Strata = Region; |
| 3. WR sampling for<br>Region 2               | → | If Strata = 2 then totsch = -1;                                  |

TOTSCH =  $\begin{cases} -1, & \text{Region 2} \\ 0 \text{ (or 2),} & \text{Stratum 3 (Schools 30, 60)} \\ 15, & \text{Region 1} \end{cases}$

## SUDAAN DESIGN STATEMENTS

**DESIGN = WOR;**

**NEST**      Strata    School;

**TOTCNT**   Totsch   Totstud;

# Design Statements Examples

## Case Study: Student Sample

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### CASE 7.

Data File:

Region	Strata	School	Student	Totsch	Totstud
1	1	10	101	15	250
1	1	10	102	15	250
1	1	10	103	15	250
1	1	20	201	15	125
1	1	20	202	15	125
1	1	20	203	15	125
-----					
2	2	40	401	-1	150
2	2	40	402	-1	150
2	2	40	403	-1	150
2	2	50	501	-1	70
2	2	50	502	-1	70
2	2	50	503	-1	70
1	3	30	301	0	75
1	3	30	302	0	75
1	3	30	303	0	75
2	3	60	601	0	50
2	3	60	602	0	50
2	3	60	603	0	50



## Design Statements Examples

### Case Study: Student Sample

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#### **CASE 8. DESIGN = WOR, Small Sampling Fractions, (all stage 2 units)**

$\frac{n}{N}$  is large  $\left(\frac{3}{15}\right)$  for Region 1 (use WOR option)

$\frac{n}{N}$  is small, within ALL schools at Stage 2

#### SUDAAN DESIGN STATEMENTS

```
DESIGN = WOR;  
NEST      Region  School;  
TOTCNT  Totsch  _MINUS1_;
```

\_MINUS1\_ invokes WR sampling within ALL schools at Stage 2

	Region 1			Region 2		
School:	10	20	30	40	50	60
$\frac{n}{N}$	$\frac{3}{250}$	$\frac{3}{125}$	$\frac{3}{75}$	$\frac{3}{150}$	$\frac{3}{70}$	$\frac{3}{50}$

## Design Statements Examples

Case Study: Student Sample

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### **CASE 9. DESIGN = WOR, 100% Sampling Within All Schools at Stage 2**

$\frac{n}{N}$  is large  $\left(\frac{3}{15}\right)$  for Region 1 (use WOR option)

$\frac{n}{N} = 100\%$ , within ALL schools at Stage 2

#### SUDAAN DESIGN STATEMENTS

```
DESIGN = WOR;  
NEST      Region School;  
TOTCNT  Totsch  _ZERO_;
```

\_ZERO\_ keyword implies no variance contribution to the statistic from the School level (i.e., census within schools)

## Design Statements Examples

### Case Study: Student Sample

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#### **CASE 10. DESIGN = WOR, 1st and 2nd Stage Stratification, Invoke WR Variance at Last Stage**

##### Stages of Sampling:

- Stage 1: Region and County (Strata and PSU)  
(2 counties / Region)
- Stage 2: Urban/rural and School (2nd Stage Strata and  
Sampling Unit) (2 schools / Urban Status)
- Stage 3: Student (3rd Stage Sampling Units)

##### Suppose:

1.  $\frac{n}{N}$  is large, Stage 1, Region 1 (selection of counties). Use WOR.
2.  $\frac{n}{N}$  is large, Stage 2, (selection of schools within urban/rural  
status). Continue WOR sampling at Stage 2
3.  $\frac{n}{N}$  is small, Stage 3, (selection of students within each school).  
Invoke WR sampling within each school at this stage

### SUDAAN DESIGN STATEMENTS

<b>DESIGN</b> = WOR;
<b>NEST</b> Region    County    Urbrural    School;
<b>TOTCNT</b> Popcnty    _ZERO_   Popsch    _MINUS1_;

# Design Statements Examples

## Case Study: Student Sample

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### CASE 10.

Data File: (Region 1 only)

Region	County	Popcnty	Urbrural	_ZERO_	School	Popsch	Student	_MINUS1_
1	1	4	1	0	10	3	101	-1
1	1	4	1	0	10	3	102	-1
1	1	4	1	0	10	3	103	-1
1	1	4	1	0	20	3	201	-1
1	1	4	1	0	20	3	202	-1
1	1	4	1	0	20	3	203	-1
1	1	4	2	0	30	4	301	-1
1	1	4	2	0	30	4	302	-1
1	1	4	2	0	30	4	303	-1
1	1	4	2	0	40	4	401	-1
1	1	4	2	0	40	4	402	-1
1	1	4	2	0	40	4	403	-1
-----								
1	2	4	1	0	50	5	501	-1
1	2	4	1	0	50	5	502	-1
1	2	4	1	0	50	5	503	-1
1	2	4	1	0	60	5	601	-1
1	2	4	1	0	60	5	602	-1
1	2	4	1	0	60	5	603	-1
1	2	4	2	0	70	3	701	-1
1	2	4	2	0	70	3	702	-1
1	2	4	2	0	70	3	703	-1
1	2	4	2	0	80	3	801	-1
1	2	4	2	0	80	3	802	-1
1	2	4	2	0	80	3	803	-1