IUR Calculation for SHR, SMR, and STrR

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IUR by bootstrap for SMR-type measure

The SMR-type measure is calculated by

$$SMR_j = \frac{\sum_i^{n_j} O_{ji}}{\sum_i^{n_j} E_{ji}},$$

where

- j: $1, \cdots, J$, facility index
- n_j: the number of patients in facility j
- i: patient index
- O_{ji}: observed value for patient i in facility j
- E_{ji}: expected value for patient i in facility j
- SMR_j: SMR for facility j.

To calculate IUR for SMR-type measure, we need to define some other notation:

- b: bootstrap index
- B: total number of bootstraps
- $O_{ji}^{(b)}$: observed value for patient i in facility j for bth bootstrap data
- $E_{ji}^{(b)}$: expected value for patient i in facility j for bth bootstrap data
- $SMR_j^{(b)}$: SMR for facility j for bth bootstrap data,

$$SMR_j^{(b)} = \frac{\sum_i^{n_j} O_{ji}^{(b)}}{\sum_i^{n_j} E_{ji}^{(b)}}.$$

Algorithm:

1. For $b = 1, \cdots, B$, sample data from original data using facility-stratified sampling.
2. Calculate $SMR^{(b)}$ for each bootstrap data.
3. Calculate within-facility variance:

$$\sigma_w^2 = \frac{\sum_j \sum_b (SMR_j^{(b)} - \overline{SMR}_j)^2}{\sum_j (n_j - 1)},$$

   where $\overline{SMR}_j = \sum_b SMR_j^{(b)}/n_j$.

4. $$n' = \frac{\sum_j n_j - \sum_j n_j^2 / \sum_j n_j}{\sum_j n_j - 1}.$$

5. Calculate total variance:

$$\sigma_t^2 = \frac{\sum_j n_j (SMR_j - \overline{SMR})^2}{n'(\sum_j n_j - 1)},$$

   where $\overline{SMR} = \sum_j n_j SMR_j / \sum_j n_j$.

6. Between facility variance $\sigma_b^2 = \sigma_t^2 - \sigma_w^2$.

7. $$IUR = \frac{\sigma_b^2}{\sigma_t^2}.$$

8. Facility IUR,
$$IUR_j = \frac{\sigma_b^2}{\sigma_b^2 + \sigma_w^2/n_j}.$$

Data requirements

Measure	Input	Data requirement	stratify.var
SMR	obs_death, exp_death, facility, stratify.var, stratify_cutoff, year	Remove 'Short' and small facilities (facility expected death < 3)	
SHR	obs_admission, exp_admission, facility, stratify.var, stratify_cutoff, year	Remove 'Short' and small facilities (facility patient year $<$ 5)	
STrR	obs_transyr, exp_transyr, facility, stratify.var, stratify_cutoff, year	Remove 'Short' and small facilities (facility trans_yar<10)	

R code example

SMR

```
rm(list=ls())
uniqname = 'yuanyang'
output_path = 'K:/Users/kecc-yuanyang/IUR0321'
data_path = 'K:/Projects/Dialysis_Reports_Shared/Data/SMR/special_request'
raw_data_name = 'SMRSHR_2014to2017.sas7bdat'

source()
obs_death = "dial_drd" #observed death
exp_death = "expectda" #expeceted death
facility = "provfs" #facility id
death_yar = "DIAL_yar" #death year
year = "year" #data year
```

SHR

```
rm(list=ls())
uniqname = 'yuanyang'
output_path = 'K:/Users/kecc-yuanyang/IUR0321'
data_path = 'K:/Projects/Dialysis_Reports_Shared/Data/SMR/special_request'
raw_data_name = 'SMRSHR_2014to2017.sas7bdat'

obs_admission = "h_admits" #observed admission
exp_admission = "expectta" #expeceted admission
hosp_yar = "h_dy_yar" #hospital YAR
```

```
facility = "provfs" #facility id
year = "year" #data year
```

STrR