A GUIDE TO USING THE NHSN MACROS

Summary

This document describes six macros that have been developed to manually conduct statistical tests to determine whether there is a statistically significant difference between two measures, consistent with the methods used by NHSN. These macros can be used instead of the NHSN Statistics Calculator. Statistical tests used are based on the mid-p value method. Measures that can be computed and compared include rates, ratios, SIRs, SURs, SAARs and others.

Overview

Macros created by NHSN statisticians are listed below:

1. '**`TWORATES`**'- to compare two incidence density rates.
2. '**`proportionCI`**'- to compare a single proportion to a benchmark.
3. '**`SIR`**'- to compare the SIR to 1 or other nominal value.
4. '**`binom`**'- to compare two standardized ratios (e.g., Standardized Infection Ratios).
5. '**`Pcomp`**'- to compare two proportions.
6. '**`rateCIComp`**'- for a single incidence density rate.

The macros are posted on the NHSN website at: Analysis Resources | NHSN | CDC. All macros are ready to run in SAS. Brief descriptions, sample data sets created together with SAS output and corresponding output from the Statistics Calculator are provided below for each macro.

Example: How to use these macros

Suppose you are interested in comparing two CLABSI incidence density rates from the same critical care location (2019 vs. 2020). Information about the two CLABSI rates are below. To run this comparison in SAS using NHSN's macros, follow the steps listed below.

2019 CLABSI rate: <insert numerator, denominator, rate>

2020 CLABSI rate: <insert numerator, denominator, rate>

1. Download the '`TWORATES`' macro from the website below, Analysis Resources | NHSN | CDC and save it on your computer.
2. Create a dataset following the example SAS code provided below. The dataset should include observed CLABSIs reported in 2019, central line days in 2019, observed CLABSIs in 2020 and central line days in 2020.
3. Invoke the macro
4. Print to see results (SAS output).

1. SAS Macro to Compare Two Incidence Density Rates. May 2021

```
/*SAS code Example if you download and save macro on your computer*/
options SASAUTOS="\\path where macro is saved";
options mprint;

data CLABSIexample;
input Observed1 PersonTime1 Observed2 PersonTime2;
cards;
4 39 5 70
;
run;

data CLABSIexample_; set CLABSIexample;
%TWORATES(O1=Observed1,PT1=PersonTime1,O2=Observed2,PT2=PersonTime2);run;

proc print; run;
```

Description	SAS output	Statistics Calculator output
The *'TWORATES'* macro can be used to perform a comparison between two incidence density rates (for example, person-time CLABSI rates).	The SAS System Obs | Observed1 | PersonTime1 | Observed2 | PersonTime2 | MID_P | RATE_RATIO | ll | Ul 1 | 4 | 39 | 5 | 70 | 0.59587 | 0.69643 | 0.17635 | 2.91491	National Healthcare Safety Network Rates between April and July 2020 As of: February 16, 2021 at 9:36 AM Rate 1 | Rate 2 Numerator | 4 | 5 Denominator | 39 | 70 Incidence Density Rate | 1.026 | 0.714 IDR p-value | 0.5959
How to interpret output	The p-value calculated by SAS *("mid-p")* is rounded to 0.596. Because this p-value is greater than 0.05, we would conclude that there is no significant difference between the two CLABSI rates. The "*rate_ratio"* column represents a ratio of the two CLABSI rates and is calculated as rate2/rate1 or .071/.102 = 0.696. The columns called "ll" and "Ul" represent the lower and upper 95% confidence limits around the rate ratio.	The p-value calculated by the Statistics Calculator is 0.596. Because this p-value is greater than 0.05, we would conclude that there is no significant difference between the two CLABSI rates (1.03 vs 0.71).

2. SAS Macro for a Single Proportion to a Benchmark. May 2021

```
   /*SAS code Example if you download and save macro on your computer*/
options SASAUTOS="\\path where macro is saved";
options mprint;

data ClabsiExample; /*Create a data set*/
input Numerator Denominator;
cards;
3 50
;
run;

data ClabsiExample_;set ClabsiExample;
%proportionCI(vX=Numerator,vN=Denominator);run;

proc print;run;
```

Description	SAS output	Statistics Calculator output
The *'proportionCI'* macro can be used to perform 95% confidence interval testing around a single proportion (such as healthcare worker influenza vaccination percentages).	**The SAS System** Obs | Numerator | Denominator | prop_L | prop_U 1 | 3 | 50 | 0.015 | 0.155	**National Healthcare Safety Network** As of: February 16, 2021 at 10:08 AM **Influenza vaccination for July 2020** **Influenza vaccination** **Single Proportion** Numerator: 3 Denominator: 50 Proportion (shown as percentage): 6.0% 95% confidence interval: (1.5, 15.5)
How to interpret output	The columns called *"prop_L"* and *"prop_U"* represent the lower and upper 95% confidence limits around proportion. The proportion here is 3/50 = 0.06.	The proportion (6.0%) and 95% confidence interval around proportion(1.5, 15.5) are shown as percentages.

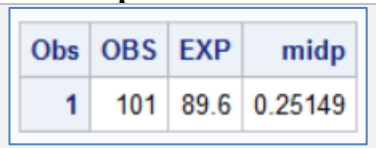
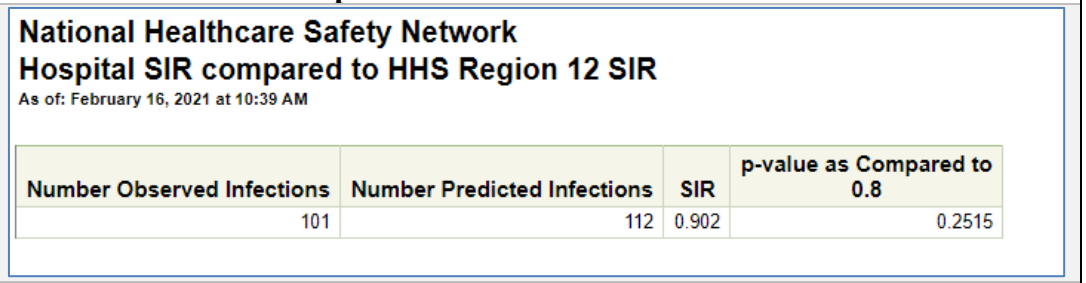
3. SAS Macro to Compare the SIR to 1 or Other Nominal Value. May 2021

```
/*SAS code Example if you download and save macro on your computer*/
options SASAUTOS="\\path where macro is saved";
options mprint;

data ClabsiExample; /*Create a data set*/
input OBS EXP;
cards;
101 112
;
run;

data ClabsiExample_;set ClabsiExample; /*This step calls the macro*/
EXP=EXP*0.8;*<----Assuming a nominal value of 0.80. This could be changed to 1.0;
%sir(OBS,EXP); RUN;

proc print;run;
```

Description	SAS output	Statistics Calculator output
The *'SIR'* macro can be used to compare the SIR to a single nominal value e.g., 0.8		
How to interpret output	The p-value calculated by SAS *("mid-p")* is 0.251. Because this p-value is greater than 0.05, we would conclude that there is no significant difference between the SIR calculated (that is, 101/112=0.902) and the nominal SIR value of 0.8.	The p-value calculated is 0.251. Because this p-value is greater than 0.05, we would conclude that there is no significant difference between the SIR calculated (that is, 101/112=0.902) and the nominal SIR value of 0.8.

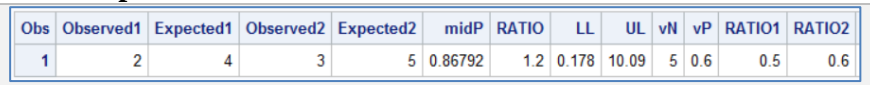
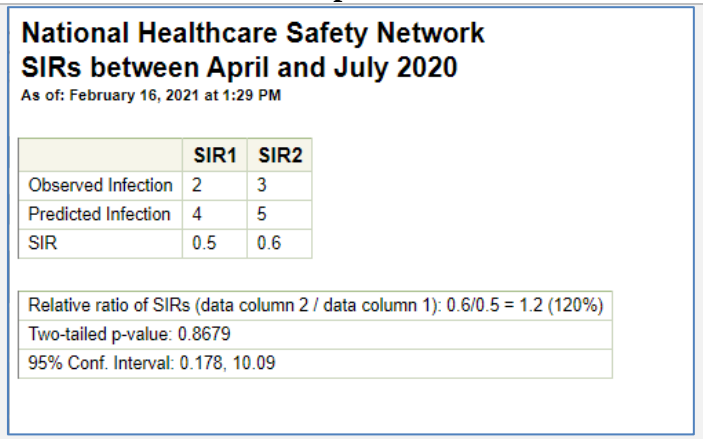
4. [SAS Macro to Compare Two Standardized Ratios. May 2021]

```
/*SAS code Example if you download and save macro on your computer*/
options SASAUTOS="\\path where macro is saved";
options mprint;

data ClabsiExample; /*Create a data set*/
input Observed1 Expected1 Observed2 Expected2;
cards;
2 4 3 5
;
run;

data ClabsiExample_;set ClabsiExample; /*This step calls the macro*/
%binom(o1=Observed1, e1=Expected1, o2=Observed2, e2=Expected2);
run;

proc print;run;
```

Description	SAS output	Statistics Calculator output
The '*BINOM*' macro can be used to perform a comparison between two standardized ratios (for example, SIRs).		
How to interpret output	The p-value calculated by SAS (*"mid-p"*) is 0.868. Because this p-value is greater than 0.05, we would conclude that there is no significant difference between the two SIRs calculated (that is 2/4=0.5 vs 3/5=0.6). <u>Note</u>: *More output is generated in SAS than shown here.*	The two-tailed p-value calculated is 0.868. Because this p-value is greater than 0.05, we would conclude that there is no significant difference between the two SIRs calculated (that is 2/4=0.5 vs 3/5=0.6).

5. SAS Macro to Compare Two Proportions. May 2021

```
/*SAS code Example if you download and save macro on your computer*/
options SASAUTOS="\\path where macro is saved";
options mprint;

data ClabsiExample; /*Create a data set*/
input Event1 Event2  NonEvent1 NonEvent2 ;
cards;
3 4 30 100
;
run;

data ClabsiExample_;set ClabsiExample; /*This step calls the macro*/
%Pcomp(A=Event1, B=Event2, C=NonEvent1, D=NonEvent2);run;

proc print; run;
```

Description	SAS output	Statistics Calculator output
The *'Pcomp'* macro can be used to perform a comparison between two proportions (for example, SSI Rates, Device Utilization Ratios, Percent Resistant).	**The SAS System** Obs: 1 · Event1: 3 · Event2: 4 · NonEvent1: 30 · NonEvent2: 100 · MID_P: 0.2781 · LL_RR: 0.55730 · UL_RR: 10.0247	**National Healthcare Safety Network Rates between April and July 2020** As of: March 17, 2021 at 12:30 AM Rate 1 / Rate 2 Numerator (Number of Events): 3 / 4 Denominator (Number of Trials): 33 / 104 Number of Non-Events (Trials - Events): 30 / 100 Proportion (Events / Trials * 100): 9.1% / 3.8% Proportion p-value: 0.2781
How to interpret output	The p-value calculated by SAS *("mid-p")* is 0.2781. Because this p-value is greater than 0.05, we would conclude that there is no significant difference between the two proportions calculated (that is 3/33 vs 4/104).	The proportion p-value calculated is 0.2781. Because this p-value is greater than 0.05, we would conclude that there is no significant difference between the two proportions calculated (that is 3/33 vs 4/104).

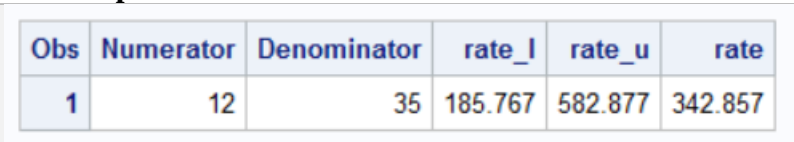
6. SAS Macro for a Single Incidence Density Rate. May 2021

```
/*SAS code Example if you download and save macro on your computer*/
options SASAUTOS="\\path where macro is saved";
options mprint;

data ClabsiExample; /*Create a data set*/
input Numerator Denominator;
cards;
12 35
;
run;


data ClabsiExample_;set ClabsiExample; /*This step calls the macro*/
%rateCIcomp(numer=Numerator, denom=Denominator);run;

proc print;run;
```

Description	SAS output
The '*rateCIcomp*' macro can be used to perform 95% confidence interval testing around a single incidence density rate (such as a CLABSI rate, SIR).	
How to interpret output	The columns called *"rate_l"* and *"rate_u"* represent the lower and upper 95% confidence interval around the rate. The rate here is multiplied by 1000.

Obs	Numerator	Denominator	rate_l	rate_u	rate
1	12	35	185.767	582.877	342.857