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: <u>Analysis Resources | NHSN | CDC</u>. 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, <u>Analysis Resources | NHSN | CDC</u> 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).



Centers for Disease Control and Prevention National Center for Emerging and Zoonotic Infectious Diseases

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(01=Observed1,PT1=PersonTime1,O2=Observed2,PT2=PersonTime2);run;

Description	SAS	S output								Statistics Calcu	lator o	output	
The ' <i>TWORATES</i> ' macro can be used to perform a				The	e SAS Syster	n				National Healt	hcare \$	Safety	Network
comparison between two	Obs	Observed1	PersonTime1	Observed2	PersonTime2	MID_P	RATE_RATIO	II	UI	As of: February 16, 2021 a	April at 9:36 AM	and Ju	ily 2020
example, person-time	1	4	39	5	70	0.59587	0.69643	0.17635	2.91491		Rate 1	Rate 2	
CLABSI rates)										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 rou	nded to 0.	596. E	Because	The p-value ca	lculate	ed by	the Statistics
	this	p-value	is greater	than 0.0	5. we wo	uld co	nclude that	at ther	e is no	Calculator is 0.5	96. Be	cause	this p-value is
	sign	ificant d	ifference h	etweent	he two CI	ABSI	rates The	"rate	ratio"	greater than 0.0	5 we	would	conclude that
	colu	imn renr	econte a rai	tio of the	two CL A	RSI r	tec and ic	calcul	_rano	there is no sign	ificant	differ	ence between
	roto'	2/moto1	-071/10	1001 m	$0 \leq The e$		a colled "	11,2 or		the two CLADS		(1.02)	(0.71)
	rate		or .0/1/.10	$V_2 = 0.0$	96. The C	oiumn • •	s called	n an		the two CLADS	rates	(1.05)	\$ 0.71).
	repr	esent the	e lower an	d upper	95% conf	idence	e limits are	ound t	he rate				
	ratio	Э.											



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;

Description	SAS output	Statistics Calculator output
The <i>'proportionCI'</i> macro can be used to perform 95% confidence interval testing around a single proportion (such as	The SAS System	National Healthcare Safety Network As of: February 16, 2021 at 10:08 AM Influenza vaccination for July 2020
healthcare worker influenza vaccination	Obs Numerator Denominator prop_L prop_U	Influenza vaccination
percentages).	1 3 50 0.015 0.155	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;</pre>
```

Description	SAS output	Statistics Calculator out	put					
The 'SIR' macro can be used to compare the SIR to a single nominal value e g	Obs OBS EXP midp 1 101 89.6 0.25149	National Healthcare Safety Network Hospital SIR compared to HHS Region 12 SIR As of: February 16, 2021 at 10:39 AM						
0.8		Number Observed Infections Number Predicted Infections SIR p-value as Compared to 0.8						
		101	112	0.902	0.2515			
How to interpret	The p-value calculated by SAS (<i>"mid-</i> The p-value calculated is 0.251. Because this p-value is greater than 0.05, we							
output	<i>p")</i> is 0.251. Because this p-value is	would conclude that there	e is no significant differen	ce be	tween the SIR calculated			
	greater than 0.05, we would conclude	(that is, 101/112=0.902) a	and the nominal SIR value	e of 0.	.8.			
	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;
```

Description	SAS output	Statistics Calculator output
The 'BINOM' macro can	Obs Observed1 Expected1 Observed2 Expected2 midP RATIO LL UL vN vP RATIO1 RATIO2	National Healthcare Safety Network
be used to perform a	1 2 4 3 5 0.86792 1.2 0.178 10.09 5 0.6 0.5 0.6	SIRs between April and July 2020
comparison between two		As of: February 16, 2021 at 1:29 PM
standardized ratios (for		
example, SIRs).		Observed Infection 2 3
-		Predicted Infection 4 5
		SIR 0.5 0.6
		Relative ratio of SIRs (data column 2 / data column 1): 0.6/0.5 = 1.2 (120%)
		Two-tailed p-value: 0.8679
		95% Conf. Interval: 0.178, 10.09
How to interpret output	The p-value calculated by SAS (<i>"mid-p"</i>) is 0.868. Because this	The two-tailed p-value calculated is 0.868. Because
	p-value is greater than 0.05, we would conclude that there is no	this p-value is greater than 0.05, we would conclude
	significant difference between the two SIRs calculated (that is	that there is no significant difference between the two
	2/4=0.5 vs $3/5=0.6$). Note: More output is generated in SAS than	SIRs calculated (that is $2/4=0.5$ vs $3/5=0.6$).
	shown here.	



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;
```

Description	S	SAS o	utput							Statistics Calculator out	put		
The <i>'Pcomp'</i> macro can be used to perform a comparison between					The SA	AS System				National Healthcare Saf Rates between April and As of: March 17, 2021 at 12:30 AM	ety Nei 1 July :	twork 2020	
two proportions (for		Obs	Event1	Event2	NonEvent1	NonEvent2	MID_P	LL_RR	UL_RR				
evample SSI Rates		1	3	4	30	100	0 2781	0 66730	10 0247		Rate 1	Rate 2	
		· · ·	5	4	50	100	0.2701	0.55750	10.0247	Numerator (Number of Events)	3	4	
Device Utilization	-									Denominator (Number of Trials)	33	104	
Ratios, Percent										Number of Non-Events (Trials - Events)	30	100	
Resistant).										Proportion (Events / Trials * 100)	9.1%	3.8%	
,										Proportion p-value	0.2781		
How to interpret]	Гhe p-	value ca	lculated	by SAS ("n	<i>nid-p")</i> is 0.2	2781. Be	ecause th	is p-value	The proportion p-value	calcul	lated i	s 0.2781.
output	i	s grea	ater that	n 0.05,	we would	conclude the	at there	is no s	ignificant	Because this p-value is	greate	r than	0.05, we
	d	liffere	ence betw	veen the	two proport	ions calcula	ted (tha	t is 3/33 v	vs 4/104).	would conclude that the	here is	s no s	ignificant
					1 1		,		,	difference between t	he ty	vo pi	oportions
										calculated (that is 3/33 vs	1/10/))	-ronnono
										calculated (that is 5/55 V8	4/104,).	
	1												



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;
```

Description	SAS o	utput				
The ' <i>rateClcomp</i> ' macro can be used to perform 95%	Obs	Numerator	Denominator	rate_l	rate_u	rate
around a single incidence density rate (such as a CLABSI rate, SIR).	1	12	35	185.767	582.877	342.857
How to interpret output	The co upper multip	olumns called 95% confide lied by 1000	d " <i>rate_l</i> " and ence interval ar).	<i>"rate_u</i> ound the	" represe rate. The	nt the low e rate here

