Solution to Exercise 3: Incremental yield from serial smears

Key Learning Points

When you have a hypothesis to test, remember that it may be logical to:

   a. Create and use a subset of the working dataset
   b. Create new variable(s)

Tasks:

- *Determine with a program C_EX03.PGM the incremental yield of cases with serial smears with the denominator being all cases (Part 1)*

- *Determine in the same program for Part 2 the number of suspects with the six essential patterns listed in the table below. Use the following hypothesis to guide you in this part:*

Exercise hypothesis:

H_0:   Not more than 125 third smear examinations have to be made to find one additional case of tuberculosis in each of the four study countries

- *Create a table in spreadsheet by country as follows:*

	Moldova	Mongolia	Uganda	Zimbabwe	Total
Total					
Pattern					
N99					
NN9					
NNN					
NNP					
Npx					
Px					
Prop positive					
Yield					
First					
Second					
Third					
X					
P					
SE(P)					
95% low					

95% high

Smears
    95% low
    95% high

Hypothesis:

- *Interpret the findings*

Solution:

Part 1: After creating the essential patterns and selecting only the cases among examinees with a diagnostic examination, we created the following output:

Incremental yield

Moldova

	Essential patterns		
	N	%	(95% CI)
NNP	34	3.0	(2.2-4.2)
NPx	84	7.4	(6.0-9.1)
Px	1013	89.6	(87.6-91.2)
Total	1131	100.0	

Mongolia

	Essential patterns		
	N	%	(95% CI)
NNP	12	0.7	(0.4-1.2)
NPx	42	2.4	(1.8-3.3)
Px	1663	96.9	(95.9-97.6)
Total	1717	100.0	

Uganda

	Essential patterns		
	N	%	(95% CI)
NNP	107	1.5	(1.2-1.8)
NPx	487	6.7	(6.1-7.3)
Px	6686	91.8	(91.2-92.4)
Total	7280	100.0	

Zimbabwe

Essential patterns

	N	%	(95% CI)
NNP	155	4.5	(3.9-5.2)
NPx	325	9.4	(8.5-10.4)
Px	2969	86.1	(84.9-87.2)
Total	3449	100.0	

In Part 2, the following output was created in EpiData Analysis:

	country	nnp	npx	px	nnn	nn9	tot	sm95low	smpoint	sm95high	hypothesis
1	Moldova	34	84	1013	8424	1579	12713	186.3	248.8	374.3	Refute
2	Mongolia	12	42	1663	12264	708	15397	653.5	1023.0	2354.0	Refute
3	Uganda	107	487	6686	14736	3325	28666	116.7	138.7	171.0	Accept
4	Zimbabwe	155	325	2969	17740	2706	26601	99.8	115.5	136.9	Accept

Interpretation:

The recorded results show that the number of smears that need to be examined to find one additional case on a third serial smear examination that had not been found already on the first two exceeded 125 (one week's work) in Moldova and Mongolia, indicating the inefficiency of the requirement for three smears before declaring a patient smear-negative at least in these two countries.

We used the following program C_EX03.PGM to get these outputs:

```
* Part C, Exercise 3
* This is b_ex03 EpiData Analysis program
* to determine the incremental yield from serial smears

* Data courtesy:
* Moldowa: Dumitru Laticevschi, OR Paris 2003
* Mongolia:  Nymadawa Naranbat, OR Paris 2004
* Uganda:      Achilles Katamba, OR Paris 2003
* Zimbabwe:     Biggie Mabaera, OR Paris 2004

* Written by:    Hans L Rieder
* First version: 12 Feb 2009
* Last revision: 26 Apr 2018

cls
close
logclose

*********************************************
* Prepare data set

cls
close
logclose

read  "c_ex01.rec"

* Definition positive: any AFB in any of three results
* Values: "P" (positive) or "N" (negative)
* or "9" (unknown)

cls
```

```
* Case definition
gen i case=0
if result1>0 and result1<9 then case=1
if result2>0 and result2<9 then case=1
if result3>0 and result3<9 then case=1
label case "Microscopy-defined case"

cls
* Define essential patterns from
* all possible patterns
gen s(3) pattern="NNN"
if result3=9 then pattern="NN9"
if result2=9 then pattern="N99"
if result3>0 and result3<9 then pattern="NNP"
if result2>0 and result2<9 then pattern="NPx"
if result1>0 and result1<9 then pattern="Px"
label pattern "Essential patterns"

keep pattern reason case country
savedata "temp_01.rec" /replace


*************************************
* Analysis part 1
* Look for yield from 1st, 2nd, 3rd smear by country

cls
close
logclose

read  "temp_01.rec"

cls
set echo=off
select reason=0 and case=1
cls
type "Incremental yield" /h2
type "Moldova" /h2
freq pattern /c /ci if country=1
type "Mongolia" /h2
freq pattern /c /ci if country=2
type "Uganda" /h2
freq pattern /c /ci if country=3
type "Zimbabwe" /h2
freq pattern /c /ci if country=4
select
set echo=on


*************************************
* Analysis part 2
* Efficiency of the third smear in finding
*  an additional case: number of smears that
*  need to be examined among all diagnostic
*  examinees to find one additional case

cls
close
logclose

read "temp_01.rec"

aggregate pattern country /save="yield.rec" /replace /close

* Note: a more efficient way to do the following will be shown \
*  in Part D
cls
close
read "yield.rec"
select pattern="NNP"
gen i nnp=n
savedata "nnp.rec" /replace

cls
close
read "yield.rec"
```

```
select pattern="NPx"
gen i npx=n
savedata "npx.rec" /replace

cls
close
read "yield.rec"
select pattern="Px"
gen i px=n
savedata "px.rec" /replace

cls
close
read "yield.rec"
select pattern="NNN"
gen i nnn=n
savedata "nnn.rec" /replace

cls
close
read "yield.rec"
select pattern="NN9"
gen i nn9=n
savedata "nn9.rec" /replace

cls
close
read "yield.rec"
select pattern="N99"
gen i n99=n
savedata "n99.rec" /replace

cls
close
read "nnp.rec"
merge country /file="npx.rec"
merge country /file="px.rec"
merge country /file="nnn.rec"
merge country /file="nn9.rec"
merge country /file="n99.rec"

define tot #####
tot=nnp+npx++px+nnn+nn9+n99

define totpos #####
totpos=nnp+npx++px

drop n pattern mergevar
savedata "pattern.rec" /replace

cls
close
read "pattern.rec"

cls
define p #.#######
p=nnp/(nnp+nnn)

define sep #.#######
sep=sqrt(p*(1-p)/(nnp+nnn))

define cilow #.#######
cilow=p-1.96*sep

define cihigh #.#######
cihigh=p+1.96*sep

define smpoint ###.#
smpoint=1/p

define sm95low ###.#
sm95low=1/cihigh

define sm95high ###.#
sm95high=1/cilow
```

```
cls
             define hypothesis  _____
                     hypothesis="Accept"
if sm95low>125 then hypothesis="Refute"

cls
set display databrowser=on
browse country nnp npx px nnn nn9 n99 tot sm95low smpoint sm95high hypothesis
set display databrowser=off


***************************
* Clean up and erase temporary session files

set echo=off
define yesno # global
yesno=?Delete all temporary files: 1=yes 0=no?
imif yesno=1 then
  close
  cls
  type "Be patient, you will be alerted to completion" /h2
  erase "n99.chk     "
  erase "n99.rec     "
  erase "nn9.chk     "
  erase "nn9.rec     "
  erase "nnn.chk     "
  erase "nnn.rec     "
  erase "nnp.chk     "
  erase "nnp.rec     "
  erase "npx.chk     "
  erase "npx.rec     "
  erase "pattern.chk"
  erase "pattern.rec"
  erase "px.chk      "
  erase "px.rec      "
  erase "temp_01.chk"
  erase "temp_01.rec"
  erase "yield.chk   "
  erase "yield.rec   "
  cls
  type "All temporary files erased" /h2
 else
  type "All temporary files retained" /h2
endif
set echo=on
```