R practice: Meta-analysis (1)

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1 Notes before starting

- The **meta-analysis** is very difficult. It requires very sophisticated manner of statistical thinking. You must pay substantial effort to learn.
- This practice is based on the textbook "Introduction to meta-analysis: the statistical technique to integrate various evidences (in Japanese: *meta anarishisu nyumon: ebidensu no tougou wo mezasu toukei shuho.*)", written by Dr. Toshiro Tango, Asakura-Shoten Pub., 2002. I will mostly pick up the contents of this practice from this textbook.

2 Definition

A statistical analysis to integrate (including the possibility to do so) the various previous studies.

Egger *et al.* (1997) states "something occurring later, more comprehensive, and is often used to name a new but related discipline designated to deal critically with the original one." as "meta".

3 History

The trials to integrate or summarize the previously conducted studies are not new. Sir Wright (1896) developed a new vaccine against typhoid fever and tested the effectiveness of the same vaccine in several different groups. Karl Pearson (1904) re-evaluated the effectiveness of that vaccine ever used.

Table 1.1 shows the 6 studies that Pearson evaluated. Pearson calculated a tetrachoric correlation[*1] for each result.

[*1] This is different from a simple correlation coefficient. Assuming the latent continuous variables behind the two binary variables which obeys bivariate normal distribution, then estimate the correlation coefficient for those continuous variables.

	Inoculated	Non-inoculated	Totals
6. Hospital Staffs in South Africa			
Recovered	30	63	93
Died	2	12	14
Totals	32	75	107
7. Garrison of Ladysmith			
Recovered	27	1160	1187
Died	8	329	337
Totals	35	1489	1524
8. Special Regimens in South Africa			
Recovered	63	61	124
Died	9	21	30
Totals	72	82	154
9. Special Hospitals in South Africa			
Recovered	1088	4453	5541
Died	86	538	624
Totals	1174	4991	6165
10. Various Military Hospitals in South Africa			
Recovered	701	2864	3565
Died	63	510	573
Totals	764	3374	4138
11. Army in India, 1900-1.			
Recovered	73	1052	1125
Died	11	423	434
Totals	84	1475	1559

Pearson's tetrachoric correlation can be calculated by `polychor()` function included in `polycor` package (developed by Dr. John Fox, available from CRAN).

For instance, calculating that of Hospital Staffs in South Africa of table 1.1, type as below.

```
library(polycor)
polychor(matrix(c(30,2,63,12),2,2),std.err=TRUE)
```

Pearson calculated the 6 tetrachoric correlations (with standard errors) and those mean as follows[*2].

```
6. 0.307 (0.128)
7. -0.010 (0.081)
8. 0.300 (0.093)
9. 0.119 (0.023)
10. 0.194 (0.022)
11. 0.248 (0.050)
mean value 0.193
```

The major motivation of this summarizing was that they cannot provide the clear evidences by themselves due to small sample size. This motivation is the same as most current meta-analyses.

Pearson concluded the 0.193 is too small to recommend the concurrent vaccine, although calculating mean is not appropriate now. The appropriate method will be shown later. Anyway, this was the first meta-analysis.

(Continue to 31 Jan, 2011)

[*2] The point estimates of these tetrachoric correlations were the same as the results by `polychor` function, but the standard errors are different. I cannot find the reason until now.