A trend estimation from grouped dose-response data and its application to meta-analysis

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In epidemiological studies of the association between disease and exposure to some agent or hazard, it is often of interest to estimate how much risk increases as exposure increases. Studies that measure the risk at different levels of exposure are usually analyzed by trend estimation using a linear regression analysis. On the other hand, meta-analysis is used to combine together the evidence from several such studies. However, meta-analyses of observational studies often have to rely on the grouped dose-response data available from research reports, where, as a typical data set, the following grouped dose-response data with sample size, mean response $\bar{y}$ and standard error of mean for each group of dose x is available:

Dose x			No.of cases	Mean of y	SE
0	–	I_1	n_1	$\bar{y}_1$	se_1
I_1	–	I_2	n_2	$\bar{y}_2$	se_2
	$\vdots$		$\vdots$	$\vdots$	$\vdots$
I_{m-2}	–	I_{m-1}	n_{m-1}	$\bar{y}_{m-1}$	se_{m-1}
	$>$	I_{m-1}	n_m	$\bar{y}_m$	se_m

If we can assign the dose level for each group of dose, we can easily construct a trend estimator by weighted least squares. However the trend estimate is quite sensitive to the choice of assigned value. Several methods for trend estimation have been proposed for summarized data from case-control studies [1, 2, 3]. In particular, Shi and Copas[3] proposed a likelihood approach where exposure levels of all individuals in a particular study are assumed to be sampled from some *common* distribution. However, the assumption of *common* dose distribution seems to be unacceptable in epidemiological studies. In this presentation, we propose a method which can estimate assigned dose levels together with the trend of interest from the grouped dose-response data shown above, by assuming that x^λ has normal distributions $N(\mu_i, \sigma_i^2)$ with unknown parameters μ_i and σ_i for the i-th study, and an unknown common transformation parameter λ. These parameters are estimated by the maximum likelihood estimation using all studies which will be combined in the meta-analysis. Some numerical illustrations are shown.

References

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