Correspondence

Regression estimate of the adjusted risk ratio

Sir,—Multiple logistic regression (MLR) is a frequently used statistical method for the analysis of epidemiological data to assess the effect of an exposure factor on a dichotomous outcome variable statistically adjusting for biases due to one or more potential confounding covariates.^{1 2} MLR provides an attractive alternative to the classic stratification methods such as the "direct method" and the Mantel-Haenszel procedures, especially when data are sparse or when simultaneous adjustment of several confounders is desired.^{3 4}

One potential drawback of MLR is that it yields an *adjusted odds ratio* ($\hat{O}$) as an estimate of exposure-outcome association. On the other hand, when an *adjusted risk ratio* ($\hat{R}$) can be estimated from a given study—a prospective cohort study, for example—then $\hat{R}$ is preferred index to quantify exposure-outcome association. ($\hat{R}$ is more interpretable than $\hat{O}$.) $\hat{O}$ is often interpreted as though it was $\hat{R}$ by invoking the assumption that the outcome variable is a rare event. The numerical value of $\hat{O}$, however, may be materially different from that of $\hat{R}$ when the outcome variable is not a rare event. Since the outcome variable in many occupational health investigations cannot be considered as rare (the incidence of hearing loss among aircraft technicians, for example), it would be useful to ascertain $\hat{R}$ directly without invoking the rare event assumption.

As I have pointed out previously,⁵ it is possible to ascertain $\hat{R}$ directly based on the MLR model. The method is briefly recapitulated below.

Let Y be a dichotomous outcome (0 = non-occurrence, 1 = occurrence), X_1 a dichotomous exposure factor (0 = non-exposed, 1 = exposed), $X_2 \dots X_m$ are confounding covariates, and n the number of subjects in the cohort. The covariates adjusted occurrence rate for $X_1 = 1$ is:

$$\hat{P}_1 = \frac{1}{n} \sum_{i=1}^n [1 + \exp(-\hat{\alpha} - \hat{\beta}_1 - \sum_{k=2}^m \hat{\beta}_k X_{ki})]^{-1}$$

and the covariates-adjusted occurrence rate for $X_1 = 0$ is:

$$\text{and } \hat{R} = \hat{P}_1 / \hat{P}_0. \text{ (Note that } \hat{O} = \exp(\hat{\beta}_1) \text{)}$$

$$\text{and } \hat{R} = \hat{P}_1 / \hat{P}_0. \text{ (Note that } \hat{O} = \exp(\hat{\beta}_1) \text{)}$$

I have written a FORTRAN program to perform the computations described in this note. The program uses the MLR output statistics as input. The program

listing and user's instructions are available on request.

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Book review

GEMS (Global Environmental Monitoring System): guidelines for the study of dietary intakes of chemical contaminants. (Pp 102, Sw Fr 11.) Geneva: World Health Organisation, 1985.

This book describes methodological principles for techniques that are suitable for obtaining data on food consumption and, separately, the principles for analysis of contaminants in the food. It includes methods for obtaining food consumption data, for analysing prepared diet samples, and for calculating the actual daily intake of contaminants. The analytical techniques overviewed include those for heavy metals and the main pesticide groups. General principles of analytical quality control are emphasised. Analysis for microbially produced contaminants is confined to aflatoxin; methods for other contaminants introduced as a result of food spoilage are not included. Except for some metals, analytical methods for industrial contaminants which may be introduced directly or through air, soil, or water pollution are not given.

In recent years there has been a considerable upsurge in interest in food additives and contaminants among the general public, and this has frequently included criticism (often ill directed and unsoundly based) of government approaches to these problems. This book is aimed at ensuring that, world-wide, agencies with responsibilities for contaminant anal-