The term r_i, which appears in the denominator, means: $r_{1i} + r_{2i}$. In other words, r_i is the total number of subjects alive in both groups and not censored, just before time t.

The term d_i is the total number of subjects who died at time t_i, in both groups combined. In other words, $d_i = d_{1i} + d_{2i}$.

The symbol $\sum$ (summation sign) indicates the addition over each time of death up to and including time t. The summation sign indicates that the following calculation must be made. Please assume that the clinical study has six time periods. This type of clinical study can be represented by a Kaplan–Meier plot where each curve has six points.

The hazard ratio is calculated from the following formula (Eqn (9.3)) (30):

$$h = \frac{O_1/E_1}{O_2/E_2} \tag{9.3}$$

III. DATA FROM THE STUDY OF MACHIN AND GARDNER

Machin and Gardner (31) provide an example of data from a clinical study of 49 subjects with colorectal cancer. Twenty-five of the subjects were treated with study drug, while 24 were controls. The following table discloses the times when a subject died, and times when a subject was censored. The time a subject died is the "survival time."

The raw data provided were as follows:

Events of death: Subjects died on the following months. Repeated numbers mean that more than one subject died on that month. In Group 1, subjects died on months: 6, 6, 10, 10, 12, 12, 12, 12, 24, and 32. In Group 2, subjects died on months: 6, 6, 6, 6, 8, 8, 12, 12, 20, 24, 30, and 42.

Censored subjects: Subjects were censored on the following months. Repeated numbers mean that more than one subject was censored on that month. In Group 1, subjects were censored on month: 1, 5, 9, 10, 12, 13, 15, 16, 20, 24, 27, 34, 36, 36, 44. In Group 2, subjects were censored on month: 3, 12, 15, 16, 18, 18, 22, 28, 28, 28, 30, 33.

In all cases, a subject experiencing the event of interest (death) was a different human being than a subject who was censored. Events and censoring are entered into the calculations, but at different points in the mathematical formulas.

The following table provides numbers (r_{1i}, r_{2i}, and d_i) that occur as intermediates in the calculation of the hazard ratio (Table 9.1).

In approaching the conclusion of the calculation of the hazard ratio, it is found that $O_1 = 10$, $E_1 = 11.37$, $O_2 = 12$, and $E_2 = 10.63$. In arriving at the conclusion of this calculation, it is seen that the HR is as follows (Eqn (9.4)):

$$\text{Hazard ratio} = \frac{O_1/E_1}{O_2/E_2} = \frac{10/11.37}{12/10.63} = 0.78 \tag{9.4}$$

This means that treatment with the study drug is associated with a reduction in deaths to 78% of that found with the control treatment. Dawson and Trapp (32) provide another example of calculating the hazard ratio, along with intermediate numbers that were used during the course of the calculation.

[30]Machin D, Gardner MJ. Calculating confidence intervals for survival time analyses. Brit. Med. J. 1988;296: 1369–71.

[31]Machin D, Gardner MJ. Calculating confidence intervals for survival time analyses. Brit. Med. J. 1988;296: 1369–71.

[32]Dawson B, Trapp RG. Basic and clinical biostatistics. 4th ed. New York, NY: Lange Medical Books; 2004. pp. 229–235.