STA 5364, Report 2.4

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KM Example 4.2 (p. 93-96)

We have it that the Nelson-Aalen estimator for the cumulative hazard function is:

$$\hat{H}(t) = \begin{cases} 0 & \text{if } t < t_1 \\ \sum_{t_1 \le t} \frac{d_i}{n_i} & \text{if } t \ge t_1. \end{cases}$$

To illustrate the use of the Product-Limit estimator and the Nelson–Aalen estimator in providing summary information about survival, consider the data on the efficiency of a bone marrow transplant in acute leukemia. Using the data reported in section 1.3, we shall focus on the disease-free survival probabilities for ALL, AML low risk and AML high risk patients. An individual is said to be disease-free at a given time after transplant if that individual is alive without the recurrence of leukemia. The event indicator for disease-free survival is $\delta_3 = 1$ if the individual has diead or has relapsed ($\delta_3 = \max(\delta_1, \delta_2)$ in Table D.1 of Appendix D)$. The days on study for a patient is the smaller of their relapse or death time.

Figure 4.2 shows a plot of the estimated disease-free survival curves (4.2.1) for the three groups. In this figure, first notice that the curves end at different points, because the largest times on study are different for the three groups (2081 days for ALL, 2569 for AML low risk, and 2640 for AML high risk). Secondly, the figure suggests that AML low risk patients have the best and AML high risk patients the least favorable prognosis. The three year disease-free survival probabilities are 0.3531 (SE = 0.0793) for the ALL group; 0.5470 (SE = 0.0691) for the AML low risk group; and 0.2444 (SE = 0.0641) for the AML high risk group. Whether these apparent differences are statistically significant will be addressed in later sections.

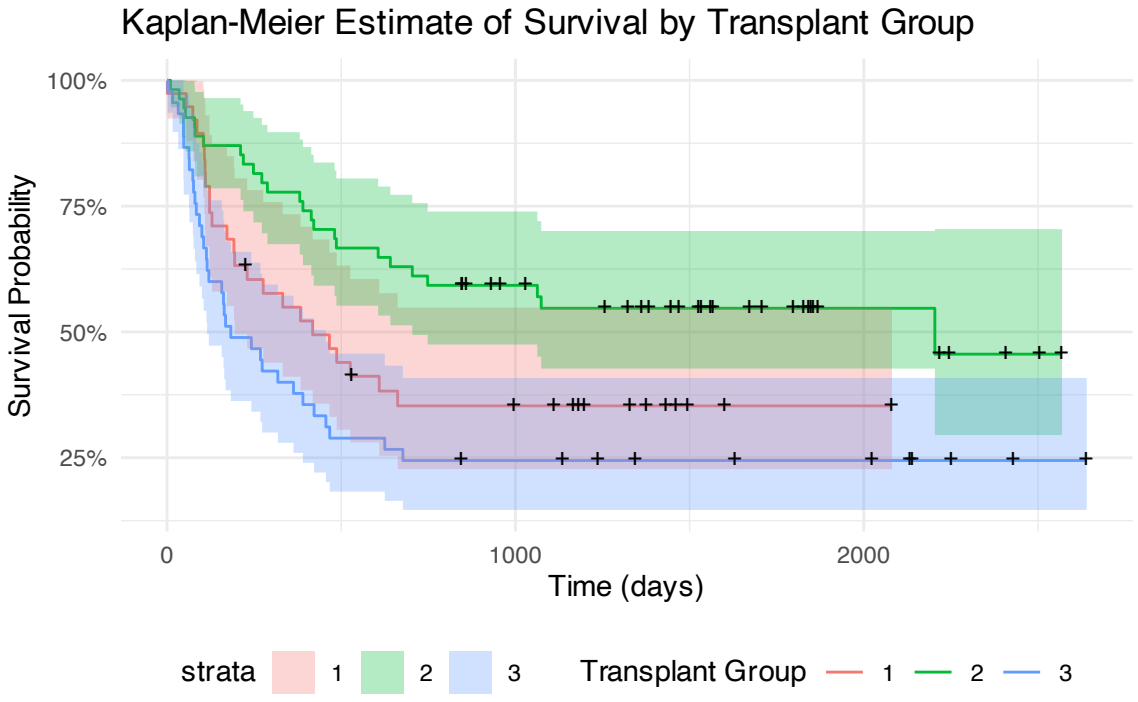

Figure 4.2

Figure 4.3 is a plot of the estimated cumulative hazard rates (4.2.3) for the three disease groups. Again, this plot shows that AML high risk patients have the highest combined relapse and death rate, whereas AML low risk patients have the smallest rate. For each disease group, the cumulative hazard rates appear to be approximately linear in the first two years, suggesting that the hazard rate is approximately constant. A crude estimate of these constant hazard rates is the slopes of the Nelson–Aalen estimators. These estimates give a rate of about 0.04 events per month for ALL patients, 0.02 events per month for AML low risk patients, and 0.06 events per month for AML high risk patients.

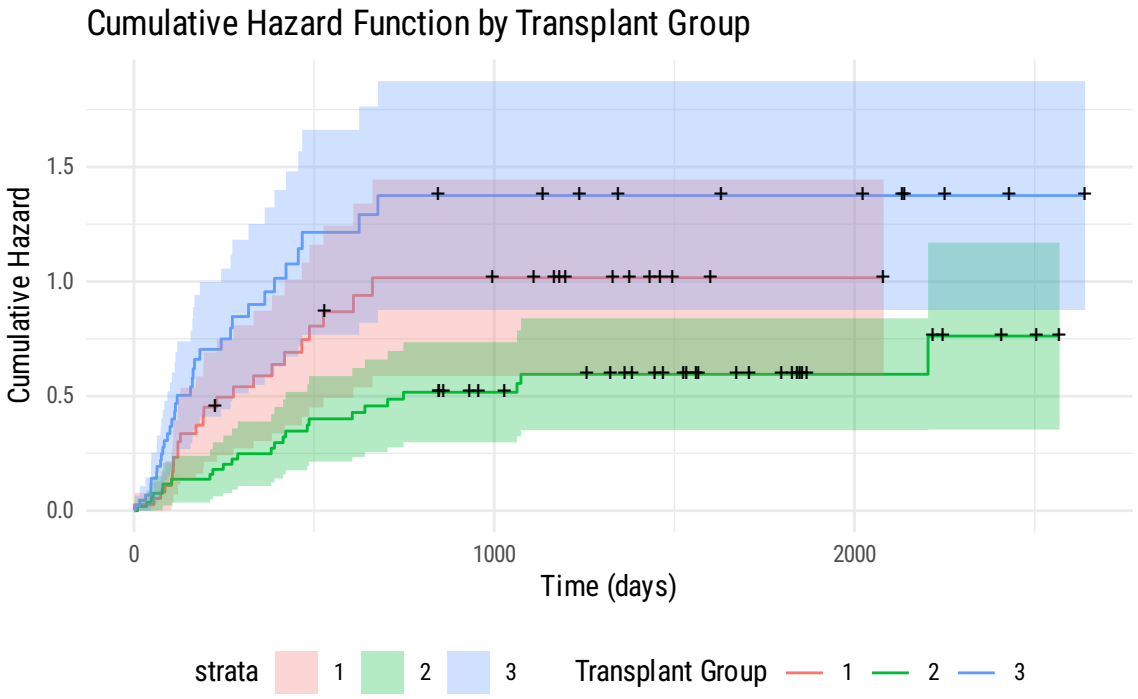

Figure 4.3