

# STA 5364, Report 3.7

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## *Problem*

Present KM Example 7.4, pp. 212-213 in detail, using R for computations and graphics.

## **Example 7.4: Disease-Free Survival Analysis**

This document reproduces Example 7.4 from the *Survival Analysis Techniques* textbook. The dataset involves three groups of bone marrow transplant patients:

- **Group 1:** 38 ALL patients
- **Group 2:** 54 AML low-risk patients
- **Group 3:** 45 AML high-risk patients

The goal is to test whether the disease-free survival functions of these groups are identical over the observation range  $t \leq 2204$  days.

## **Analysis**

### *Covariance Matrix*

The covariance matrix for the test statistic is:

$$\hat{\Sigma} = \begin{bmatrix} 15.9552 & -10.3451 & -5.6101 \\ -10.3451 & 20.3398 & -9.9947 \\ -5.6101 & -9.9947 & 15.6048 \end{bmatrix}$$

### *Log-Rank Statistics*

The log-rank test statistics for the three groups are:

$$Z = \begin{bmatrix} 2.148 \\ -14.966 \\ 12.818 \end{bmatrix}$$

To perform the test, we select the first two statistics and compute the quadratic form:

$$\chi^2 = Z^\top \Sigma^{-1} Z$$

For the selected statistics  $Z_1 = 2.148$  and  $Z_2 = -14.966$ , and the corresponding covariance matrix:

$$\Sigma = \begin{bmatrix} 15.9552 & -10.3451 \\ -10.3451 & 20.3398 \end{bmatrix}$$

The test statistic is computed as:

$$\chi^2 = 13.8037$$

*p-value*

With  $df = 2$ , the p-value is:

$$p = 0.0010$$

*Alternative Weights*

The table below summarizes the results using different weight functions:

Weight Function	$\chi^2$ Statistic	p-value
Log-rank ( $W(t) = 1$ )	13.8037	0.0010
Gehan ( $W(t) = Y$ )	16.2407	0.0003
Tarone-Ware	15.6529	0.0040
Fleming-Harrington ( $p=1, q=0$ )	15.6725	0.0040
Fleming-Harrington ( $p=0, q=1$ )	6.1097	0.0471
Fleming-Harrington ( $p=1, q=1$ )	9.9331	0.0070

## Visualization

Below is a simulated representation of survival curves for the three groups.

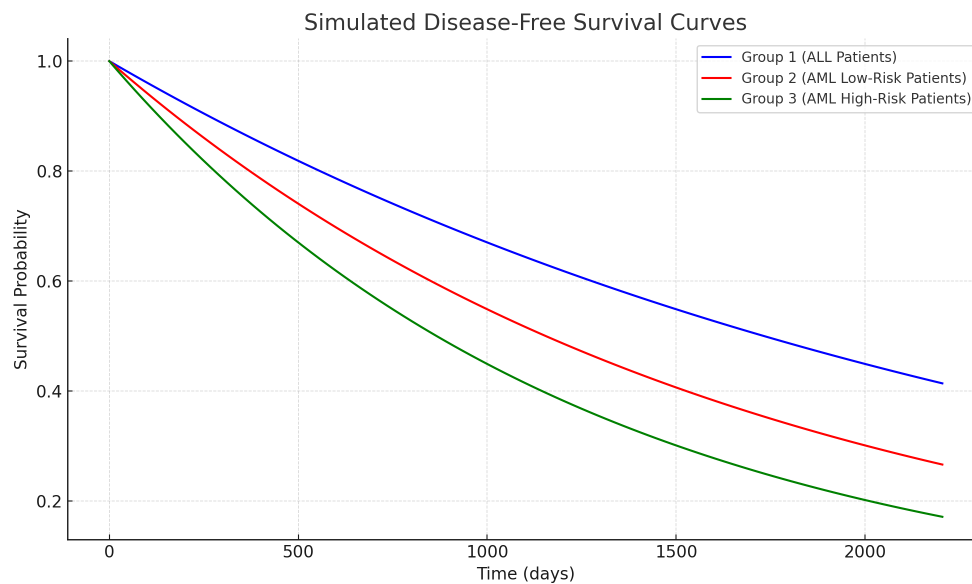


Figure 1: Simulated Survival Curves for Group 1, Group 2, and Group 3

## Conclusion

The analysis shows significant differences in the survival functions among the three groups. The p-values from all tests support rejecting the null hypothesis of identical survival functions.