

BREAKDOWN TIMES

1. Problem Formulation

Accelerated life testing of products and materials is used to get information quickly on a life distribution. Accelerated testing is achieved by subjecting the test units to conditions that are more severe than the normal ones. This results in shorter lives than would be observed under normal conditions. The results obtained at the more severe or accelerated conditions are then extrapolated to the normal conditions to obtain an estimate of the life distribution under normal conditions. Such testing provides savings in time and expense compared with testing at normal conditions. Indeed, for many products and materials, life at normal conditions is so great that testing at those conditions is completely out of the question.

In an industrial laboratory, an experiment was conducted to obtain the times (in minutes) to breakdown of 76 samples of an insulating fluid subjected to various constant elevated test voltages. At each test voltage, a number of times to breakdown (in minutes) were observed. Elevated test voltages were employed to save time in collecting the breakdown data. In applications, the voltages are so low that the average time to a breakdown runs millions of years. The experiment was carried out at seven different voltage levels, spaced two kilovolts (kV) apart from 26 to 38 kV.

The main purpose of the experiment was to investigate the distribution of time to breakdown for the insulating fluid and to relate this to the voltage level. Quite clearly, breakdown times tend to decrease as the voltage increases, and any model for this situation would have to reflect this.

The problem was studied by W.B. Nelson and the results were published in "Graphical Analysis of Accelerated Life Test Data", *IEEE Transactions in Reliability*, R21, No.1, pages 2-11, 1972.

The data from the experiment are available in the SPSS file break.sav located in the STAT 252 directory on the FTP server.

The following is a description of the variables in the data file:

<u>Column</u>	<u>Name of Variable</u>	<u>Description of Variable</u>
1	TIME	Time to breakdown (in minutes)
2	VOLTAGE	Voltage Level (in kV)
3	CODE	1 when VOLTAGE = 26 2 when VOLTAGE = 28 3 when VOLTAGE = 30 4 when VOLTAGE = 32 5 when VOLTAGE = 34 6 when VOLTAGE = 36 7 when VOLTAGE = 38

We will use SPSS to answer the following questions using the data:

1. How does the distribution of time to breakdown depend on voltage?
2. Can we obtain better estimates of the mean breakdown time for the batches subjected to a particular voltage level than the average from the batches?