TUTORIAL SHEET 8

Reliability and Related Functions

1. The following data are hours to failure of ten aircraft components.

0.09	0.40	0.66	1.00	1.32
1.33	1.54	1.76	2.50	3.50

Use Minitab to confirm that an exponential distribution fits the data and estimate the value of λ.

Using this value of λ, calculate the probability that this component

(i) will fail before 1 hour of operation

(ii) will still be working after 2 hours of operation

(iii) will fail sometime between 1½ and 2½ hours.

Write down the hazard function and the MTBF.

2. Fourteen components were used in a life-test experiment and their times to failure (in 10^6 hours) were as follows:

0.20	0.30	0.41	0.42	0.47	0.55	0.61
0.62	0.79	0.84	0.85	0.90	0.96	1.20

Does a Weibull distribution fit the data? If so, estimate the parameters α and β. Sketch the slope of the hazard function h(t) for this value of β and interpret it.

Write down the reliability function and use it to find the probability that a component will last for more than 750,000 hours.

Find also the expected lifetime (i.e. the MTBF) for this component.

3. Retrieve the *six_lifetimes.mtw* worksheet. You have already shown that the exponential distribution is a good model for the lifetime of component B, while a Weibull distribution is a good model for the lifetime of component D (once the outlier is removed). These two components will be used to illustrate the use of the Distribution Overview Plot in Minitab.

Go to *Stat→Reliability/Survival→Distribution Overview Plot* and enter the column containing the exponential lifetime data in the *Variables* box. Select the *Parametric Analysis* option and choose *Exponential* in the drop down box. Make sure you can interpret the plots which then appear.

Repeat this with the Weibull lifetime data for component D. Confirm that the MTBF given on the probability plot is indeed $\alpha\Gamma(1 + 1/\beta)$.

Finally, compare the reliability behaviour of the two types of part F. To do this, check the '*By variable*' box and enter the column where the type indicator is stored.

(stat889/dlf)