STAT 496, Spring 2009

Homework Assignment #8, Due by Friday, May 1

1. A study is done on the time to failure for turbine engine windings. The engine windings are put on test at high temperature (100^{o}C) and their times to failure (hours) are recorded. Several of the engines have censored times because they were removed from the study prior to failing. Below are the data for the forty engines that were tested. With the exception of plotting the survivor function, this problem should be done by hand.

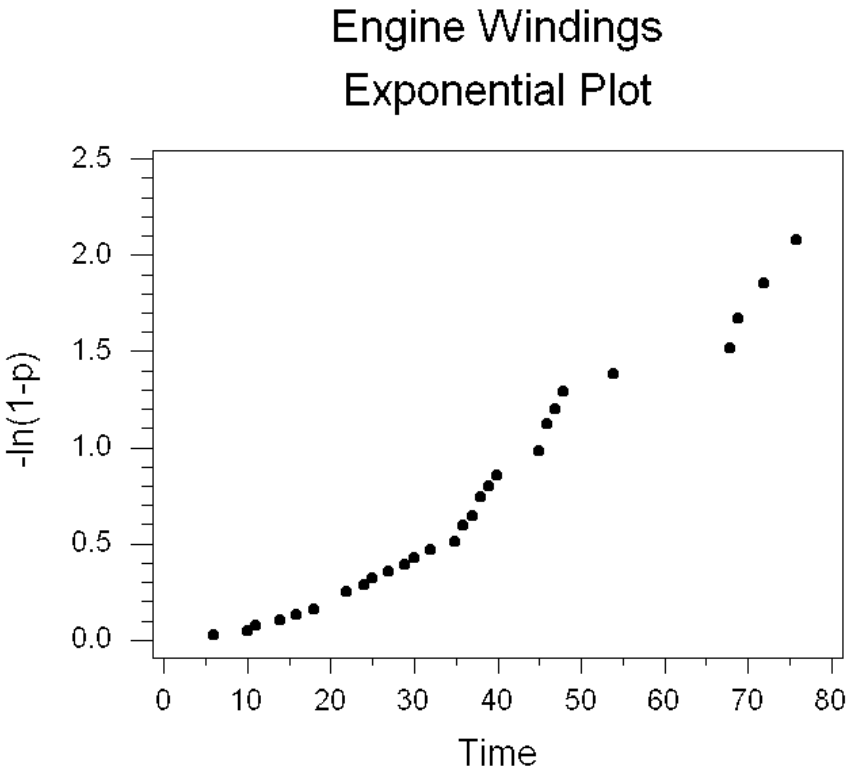
Time	Censor?	Time	Censor?	Time	Censor?	Time	Censor?
6	No	25	No	38	No	62	Yes
10	No	27	No	39	No	64	Yes
11	No	29	No	40	No	68	No
14	No	30	No	45	No	69	No
16	No	32	No	45	No	72	No
18	No	35	No	46	No	76	No
18	No	36	No	46	No	77	Yes
18	No	36	No	47	No	84	Yes
22	No	37	No	48	No	97	Yes
24	No	38	No	54	No	101	Yes

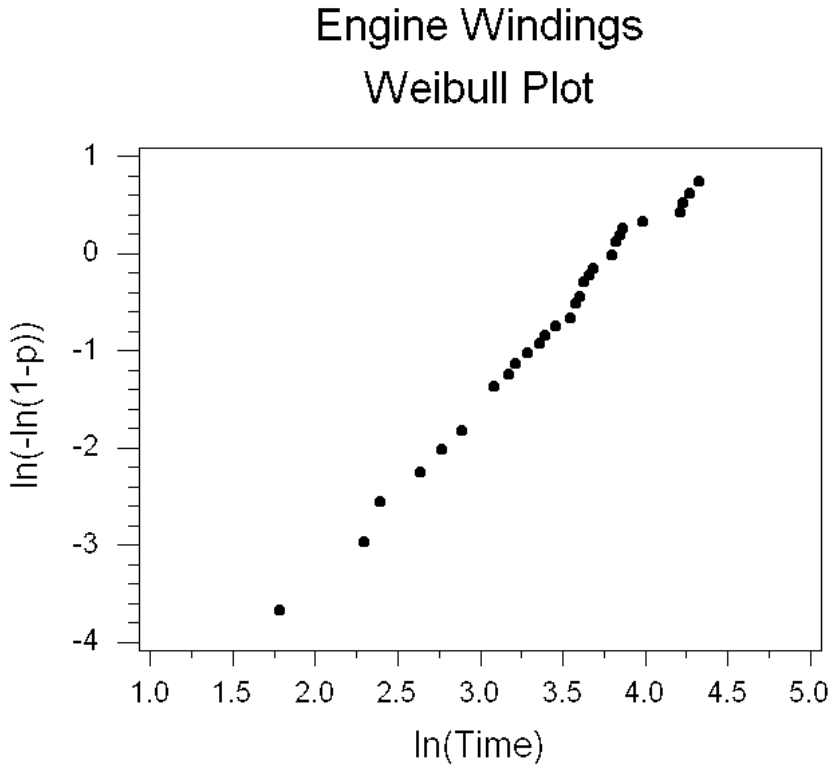
   a) Construct an estimate of the survivor function and plot this. Do the calculations for the probability of survival by hand. It will be helpful if you construct a table similar to the one for the censored data bearing example given in Tape 26. You may use JMP or another program to actually plot the survivor function.
   b) Estimate the chance that an engine winding will survive for 30 hours. Include an approximate 95% confidence interval for this estimate.
   c) Estimate the 50th percentile (median) time to failure using the estimated survivor function.

On the next page are two plots. Use these to answer the following questions.

   d) Which distribution, exponential or Weibull, appears to fit the data the best? Why?
   e) From the exponential plot estimate the value of the parameter λ.
   f) Use the estimated value of λ from e) to compute the probability that an engine winding will survive 30 hours.
   g) According to the exponential model with the value of λ from e), what is the median time to failure?
   h) From the Weibull plot estimate the values of the parameters λ and β.
   i) Use the values of the estimates of λ and β from h) to compute the probability that an engine winding will survive 30 hours.
   j) According to the Weibull model, what is the median time to failure?
   k) How much different are the estimates of the survival probability at 30 hours and the median time to failure based on the survivor function and the two models, exponential and Weibull?

2. Use JMP, or another program, to analyze these data. Turn in annotated computer output indicating what part of the output corresponds to each of the questions above.


Engine Windings
Exponential Plot
-ln(1-p)
2.5
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
50
60
70
80
Time


Engine Windings
Weibull Plot
ln(-ln(1-p))
1
0
-1
-2
-3
-4
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
ln(Time)