620.370 Statistics for Mechanical Engineers — Semester 2, 2009

Homework set 8

Problems to be discussed at next week's tutorial: Quiz 8; 138, 143, 147, 148, 152.

Homework questions

8.1 A significance test gives a P-value of 0.04. From this we can

[A.] reject H_0 at the 1% level;

[B.] reject H_0 at the 5% level;

[C.] say that the probability that H_0 is false is 0.04;

[D.] say that the probability that H_0 is true is 0.04;

[E.] none of the above.

Questions 8.2–8.4 refer to the following information:

Each day for 20 days, a random sample of 8 items from the day's production is selected and measured; and each day the average of the 8 measurements ($\bar{x}$) and the range of the 8 measurements (R) are calculated and recorded. It is assumed that the individual observations are normally distributed with mean μ and variance σ^2.
At the end of the 20 days, it is found that the average of the daily averages, $\bar{\bar{x}} = 36.0$; and the average of the daily ranges, $\bar{R} = 10.0$.

8.2 The mean value for the daily range, $\mathrm{E}(R) = k\sigma$, where k is equal to:

[A.] 1.424; [B.] 1.704; [C.] 2.848; [D.] 3.000; [E.] 5.999.

8.3 The upper control limit for the $\bar{x}$-chart is:

[A.] 38.50; [B.] 39.72; [C.] 42.51; [D.] 44.54; [E.] 46.53.

8.4 The upper control limit for the R-chart is:

[A.] 10.6; [B.] 11.2; [C.] 18.2; [D.] 18.6; [E.] 19.2.

8.5 A sample of 100 items was selected on each of 10 consecutive days and the number of defective items were found to be: 5, 10, 6, 4, 3, 5, 2, 8, 7, 5.

The upper limit for the p-chart based on these data is

[A.] 0.077; [B.] 0.101; [C.] 0.123; [D.] 0.199; [E.] 0.271.

8.6 Yield stress measurements on 35 steel rods with 10 mm diameters gave the following results (in $\mathrm{N/mm^2}$):

463.0	479.6	495.9	496.1	466.2	486.6	508.8	495.2	487.1
453.8	470.6	511.4	518.8	480.5	491.1	463.4	476.4	483.5
450.9	495.0	482.3	465.1	491.1	448.3	482.6	475.3	467.9
483.6	492.9	482.9	496.0	493.4	501.0	488.8	490.7	

(a) Test the hypothesis that the mean yield stress for these bars is $490\,\mathrm{N/mm^2}$. Specify the P-value and give a 95% confidence interval for the mean yield stress.

(b) State any assumptions you are making in carrying out your test.

(c) How could you check the validity of the assumptions you have made?

Quiz 8

Q8.1 An assumption on which the t-test of $\mu = \mu_0$ is based, is that

[A.] σ^2 is known;

[B.] the data variable is normally distributed;

[C.] the χ^2-test can also be used to test the significance of the results obtained;

[D.] the significance level is 0.05;

[E.] the sample size $n \geqslant 30$.

Q8.2 In a test of H_0: $p = 0.55$ against H_1: $p > 0.55$ where p denotes the probability that a new insect spray will kill a mosquito within one minute, a sample of 20 mosquitoes is to be subjected to the spray. We decide to reject H_0 if 14 or more mosquitoes are dead within one minute.
If the new insect spray actually has a 75% chance of effecting a kill within one minute, then the corresponding power of the test to two decimal places is equal to

[A.] 0.13; [B.] 0.55; [C.] 0.70; [D.] 0.75; [E.] 0.79.

Q8.3 A significance test was performed to test H_0: $\mu = 2$ versus H_1: $\mu \neq 2$ based on a random sample of 16 observations. The test statistic is $t = -2.125$. The P–value for this test is in the interval:

[A.] (0, 0.01); [B.] (0.01, 0.025); [C.] (0.025, 0.05); [D.] (0.05, 0.1); [E.] (0.1, 1).

Q8.4 A 95% confidence interval for a mean μ of a random variable, based upon the t-distribution is found to be $(4.1, 4.9)$. Without any further calculations, the P-value for the test of H_0: $\mu = 5$ versus H_1: $\mu \neq 5$ can be claimed to be

[A.] $P \geqslant 0.05$; [B.] $0.01 \leqslant P < 0.05$; [C.] $0.001 \leqslant P < 0.01$; [D.] $P < 0.001$;
[E.] can't say without knowing sample size.

Q8.5 Each day a random sample of 11 items from the day's production is selected and measured; and each day the inter-quartile range of the 11 measurements ($\mathrm{IQR} = x_{(9)} - x_{(3)}$) is calculated and recorded. Assume that the individual observations are normally distributed with mean μ and variance σ^2.

$\mathrm{E}(\mathrm{IQR}) = k\sigma$, where k is equal to

[A.] 0.729; [B.] 1.062; [C.] 1.458; [D.] 1.586; [E.] 3.124.