P452: Computational Physics
Assignment 3

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3) We have mean for the data as:

$$\bar{x} = \frac{\sum x_i}{N}$$

$$= \frac{1}{5}(77 + 150 + 210 + 125 + 38)$$

$$= \frac{600}{5} = 120$$

Expected observations for each grade following a normal distribution:

$0.15 \times 600 = 90 \longrightarrow A$
$0.24 \times 600 = 144 \longrightarrow B$
$0.38 \times 600 = 228 \longrightarrow C$
$0.18 \times 600 = 108 \longrightarrow D$
$0.05 \times 600 = 30 \longrightarrow F$

We know that no. of dofs are:

$$\text{Dofs} = N - 1 = 5 - 1$$
$$= 4$$

Calculating χ^2:

$$\chi^2 = \sum_{i=1}^{N} \frac{[(\text{expected no.})_i - (\text{observed no.})]^2}{(\text{expected no.})_i}$$

$$\Rightarrow \chi^2 = 8.36$$

With 4 dofs,

Significance level (in %)	χ^2_{crit}
5	9.49
10	7.78

$\therefore \chi^2_{crit(5\%)} > \chi^2$ & $\chi^2_{crit(10\%)} < \chi^2$

$\Rightarrow$ The distribution remains normal for 5%, but normality is lost for 10%

4) $\bar{x}_A = \frac{1}{N_A} \sum x_{Ai} = 4.71 \text{ cm}$

$\bar{x}_B = \frac{1}{N_B} \sum x_{Bi} = 4.74 \text{ cm}$

$\sigma_A^2 = .10$

$\sigma_B^2 = .07$

F-test

$F = \frac{\sigma_A^2}{\sigma_B^2} = \underline{1.85}$

For $N_A = 13$ & $N_B = 7$,

$F_{crit} = 2.84$

$\because F < F_{crit}$

$\therefore$ The null hypothesis can NOT be rejected, i.e., both the samples may belong to the same populations

t-test

We have dof's $= N_A + N_B - 2$

$= \underline{18}$

We find the variance for both samples:

$$\sigma_{tot}^2 = \frac{(N_A - 1)\sigma_A^2 + (N_B - 1)\sigma_B^2}{N_A + N_B - 2}$$

$$= \frac{12 \times 0.01 + 6 \times .07}{18}$$

$$= \underline{0.54}$$

We have the T value as:

$$T = \frac{\bar{x}_A - \bar{x}_B}{\sqrt{\sigma_{tot}^2 \left(\frac{1}{N_A} + \frac{1}{N_B}\right)}} = \underline{-0.074}$$

For $N_A = 13$ & $N_B = 7$,

$T_{crit} = 2.20$

$\therefore |T| < T_{crit}$

$\therefore$ The null hypothesis can NOT be rejected, i.e., both the samples may belong to the same population

Hence, both the F-test & t-test indicate that the data belongs to the same population