Decision-Making Practices

1) Estimation of the required number of samples

In order to **increase precision**, the size of confidence interval **(C.I.)** around a statistical parameter (say the mean) should be **decreased**.

To apply this, a **pilot sample** n_1 of a pre-investigation project must be used to conduct a preliminary statistical analysis.

With the help of the Student's **t-distribution table**, the **required number of samples** can be estimated **by minimizing the half of the width (d) of C.I.**

To minimize **d**, **n** must be increased.

If the pilot number of samples is n_1, the **approximate total required number of samples**, **n**, is derived as follows:

$$d = t_{(\frac{\alpha}{2}, v_1)} \frac{s_1}{\sqrt{n}}$$

$$n = \frac{\left\{ t^2_{(\frac{\alpha}{2}, v_1)} s_1^2 \right\}}{d^2}$$

Decision-Making Practices

2) Comparison of two means

It is revealed by testing hypothesis using the **t-distribution**

It is a useful test to understand if a **significant difference** occurs between **the means of two populations** (i.e. geological phenomena).

The result of this test may be supported by other geological observations.

The test is performed by:

1) Computing **estimated t-statistics (t_{est})**

$$t_{est} = \frac{\bar{x}_1 - \bar{x}_2}{S\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \qquad S = \sqrt{\frac{n_1 S_1^2 + n_2 S_2^2}{n_1 + n_2 - 2}}$$

2) Predicting the **critical t-value** (t_c)from the **Student's t-table**

$$t_c = t_{(\frac{\alpha}{2}, \nu)}$$

a) 3) Testing the hypothesis:

a) If $t_{est} < t_c$ ➔ Accept **Null (No Difference) Hypothesis H_o** (i.e. the two means are equal)
b) If $t_{est} > t_c$ ➔ Reject **Null Hypothesis H_o** and accept the **Alternative Hypothesis H_a** (i.e. the two means are not equal)

4) This test requires geological supportive evidence.

Decision-Making Practices

3) Comparison of two variances

It is revealed by testing hypothesis using the **F-distribution** or Fisher's distribution (After R. A. Fisher who discovered it).

It is a useful test to understand if a **significant difference** occurs between **the variances of two populations** (i.e. geological phenomena).

The result of this test may be supported by other geological observations.

The test is performed by:

1) Computing estimated F-statistics (F_{est})

$$F_{est} = \frac{S_1^2}{S_2^2} \qquad\qquad S_1 > S_2$$

2) Predicting the critical F-value (F_c)from the F-table

$$F_c = F(\alpha, \upsilon_1, \upsilon_2)$$

a) 3) Testing the hypothesis:

a- If $F_{est} < F_c$ ➔ Accept Null (No Difference) Hypothesis H_o (i.e. the two variances are equal)

b- If $F_{est} > F_c$ ➔ Reject Null Hypothesis H_o and accept the Alternative Hypothesis H_a (i.e. the two variances are not equal)

Example: A sandstone unit is believed to be deposited under certain depositional conditions (*This is a hypothesis!*). An experiment was run in the laboratory using a flume tank to understand the depositional conditions. The statistical parameters of the resulted "laboratory sandy deposit" can be compared with the sandstone's statistics. If the **t-test** and **F-test** show no significant difference between the statistical parameters of both sandstone unit and laboratory sandy deposit; then, similar depositional conditions might be effective during the time of sandstone deposition ➔ **Might Help in understanding depositional environments.**