Reusable Learning Object (RLO)

Objective of this Reusable Learning Object:

The objective of the RLO is to clarify what is expected and to include a model answer for a hypothesis test question. This is an assessment literacy activity.

Reusable Learning Object Format:

The reusable learning object consists of a video and an accompanying Microsoft Word document. The video and the accompanying word document (pages 2 to 7 below) will be on Moodle and the students can review them as often as required.

The video walks the students through an example of a “Two sample, equal variance t-test” question.

I did an example of this question in class with the students and I have used a photo of the handwritten notes that I created in class, (using the document camera). I incorporated the handwritten notes so that the RLO would look and feel like the actual output from a written exam.

Reusable Learning Object Location:

The video I created is located on my GMIT Stream channel.

The word document is on my GMIT Moodle page including a link to the video.

Rachel Mc Carthy, April 2019

Hypothesis Testing: Assessment 1 **25 Marks**

A quality technician wants to verify if there is a statistical difference between the average length from Machine A and the average length from Machine B, at a 95% confidence level.
Five samples were measured from each machine, the results are given in the table below, (length was measured in millimetres).

She has already verified, using an F-test, that the variance of Machine A is equal to the variance of Machine B. The pooled standard deviation (s_p) is 0.46mm.

Machine A	Machine B
22.1	24.2
23.4	23.9
22.7	24.5
23.1	25.0
22.9	24.8

(a) **(3 Marks)**
What type of hypothesis test should the technician carry out?

(b) **(5 Marks)**
Write the null and the alternate hypothesis.

(c) **(10 Marks)**
Perform the relevant statistical test using the data and the information above.

(d) **(4 Marks)**
What is the conclusion of the hypothesis test?

(e) **(3 Marks)**
Should the technician recommend that either Machine A or Machine B could be used to manufacture parts that are intended to have the same average length and why?

Formula required:

$$t = \frac{\overline{X}_1 - \overline{X}_2}{s_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

$DF = n_1 + n_2 - 2$

Machine A (mm)	Machine B (mm)
22.1	24.2
23.4	23.9
22.7	24.5
23.1	25.0
22.9	24.8

(a) **(3 Marks)**

What type of hypothesis test should the technician carry out?

Is the average of Machine A the same as the average of Machine B at the 95% Confidence Level $\alpha = 0.05$
Assume equal variance

(1) what hypothesis test: 2 sample t-test (independent sample) equal variance

(b) **(5 Marks)**

Write the null and the alternate hypothesis.

H_0: The avg. of Machine A is equal to the avg. of Machine B.

H_1: The avg of MA is not equal to M.B.

$H_0: \mu_A = \mu_B$
$H_1: \mu_A \neq \mu_B$

(c) **(10 Marks)**

Perform the relevant statistical test using the data and the information above.

$$t = \frac{\overline{X}_1 - \overline{X}_2}{s_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

$t = \dfrac{\bar{X}_1 - \bar{X}_2}{s_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$

$s_p = 0.46\ mm$

$\bar{X}_1 = 22.84\ mm$

$\bar{X}_2 = 24.48\ mm$

$n_1 = 5$

$n_2 = 5$

$$t = \frac{22.84 - 24.48}{0.46\sqrt{\frac{1}{5} + \frac{1}{5}}}$$

$$t = \frac{-1.64}{0.46\sqrt{\frac{1}{10}\ \frac{2}{5}\ 0.4}}$$

$$t = \frac{-1.64}{0.46 \times 0.632}$$

$$t = \frac{-1.64}{0.2909} = t = -5.65$$

calculated test statistic

$D.F. = n_1 + n_2 - 2$

$D.F = 5 + 5 - 2$

$= 10 - 2$

$\boxed{D.F. = 8}$

Is the average of Machine A the same as the average of Machine B at the 95% Confidence Level $\alpha = 0.05$

Assume equal variance

Two Tailed Test

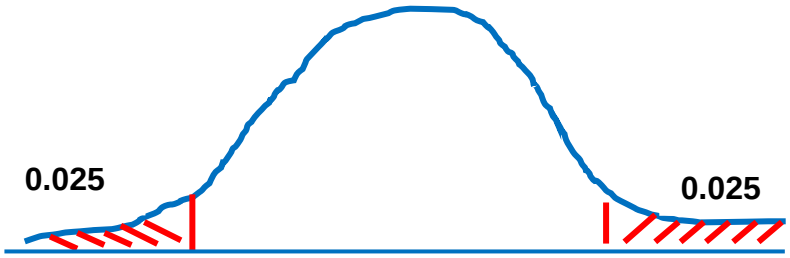
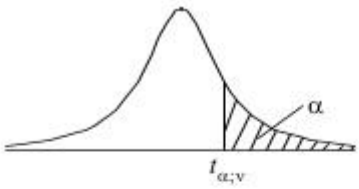


Table of the Student's *t*-distribution

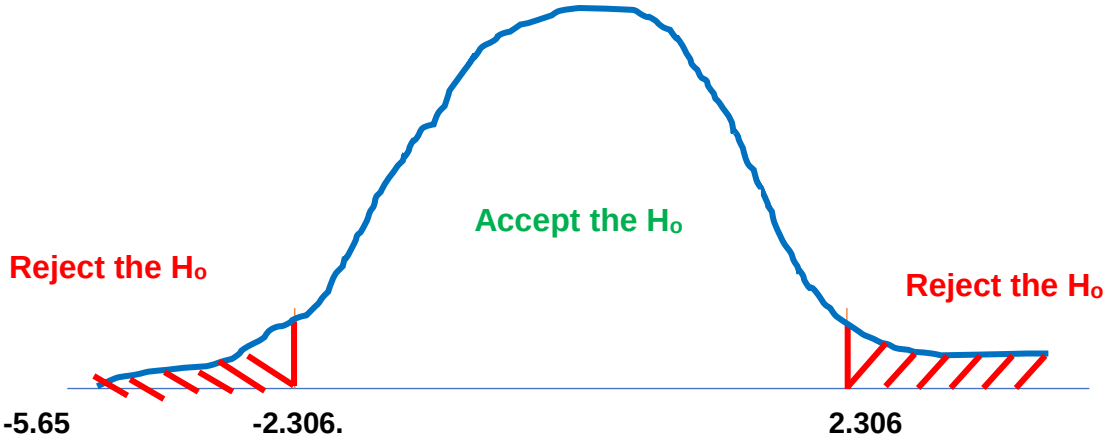
The table gives the values of $t_{\alpha;\nu}$ where

$\Pr(T_\nu > t_{\alpha;\nu}) = \alpha$, with ν degrees of freedom

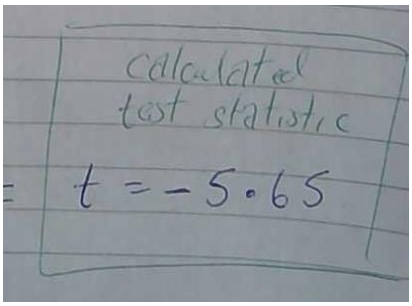


ν \ α	0.1	0.05	0.025	0.01	0.005	0.001	0.0005
1	3.078	6.314	12.076	31.821	63.657	318.310	636.620
2	1.886	2.920	4.303	6.965	9.925	22.326	31.598
3	1.638	2.353	3.182	4.541	5.841	10.213	12.924
4	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	1.372	1.812	2.228	2.764	3.169	4.144	4.587

Critical Value from t-table

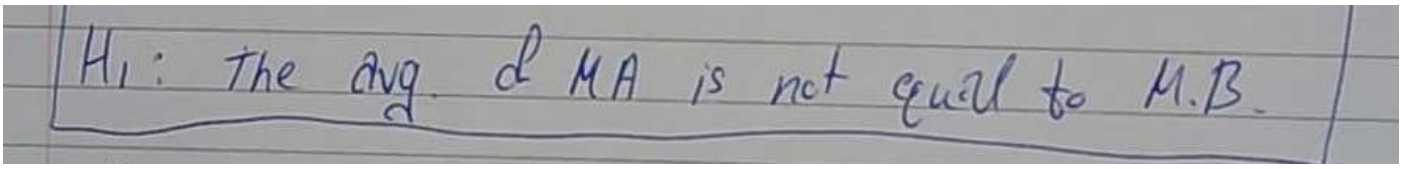


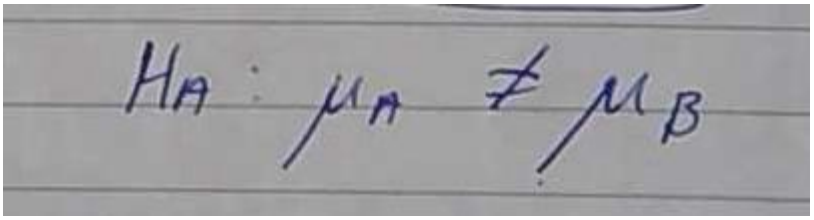
Test Statistic **Lower Critical Value** **Upper Critical Value**

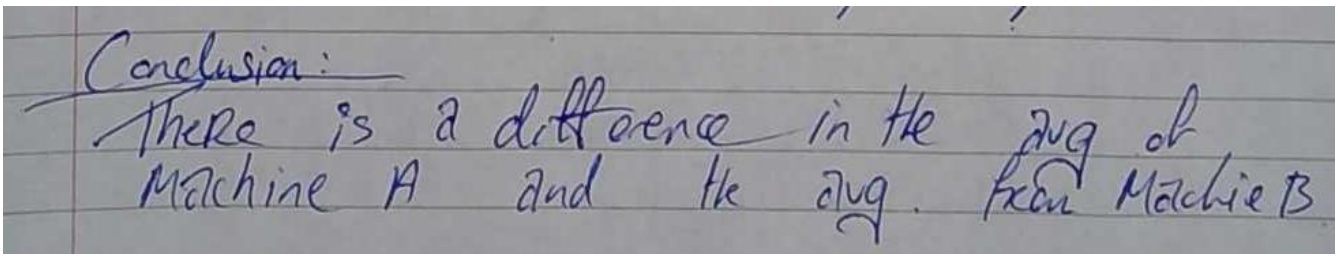


(d) **(4 Marks)**

What is the conclusion of the hypothesis test? = **Reject the Ho**







(e) **(3 Marks)**

Should the technician recommend that either Machine A or Machine B could be used to manufacture parts that are intended to have the same average length and why?

No, as the machines are producing parts that have statically different average lengths – give a little more information based on your own experience for full marks.

For info:

$$s_p = \sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1+n_2-2}}$$