ECON10005 Quantitative Methods 1

Tutorial in Week 9

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Introduction

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Don't be shy if you need help

- Visit Ed Discussion Board (read others' questions first)
- Lecturer's consultation sessions: see Canvas
- In case of special considerations, consult Stop 1
- For admin issues contact Chin via qm1-economics@unimelb.edu.au

But before asking any questions, make sure you have read the Ed discussion board, subject guide, announcements and etc on Canvas!!!

Assessments

MST-2 (10%):

- Additional consultation on Tuesday and Wednesday: see Canvas
- 4th May (Thursday in week 9)

Group (or individual) assignment: Final draft (7%):

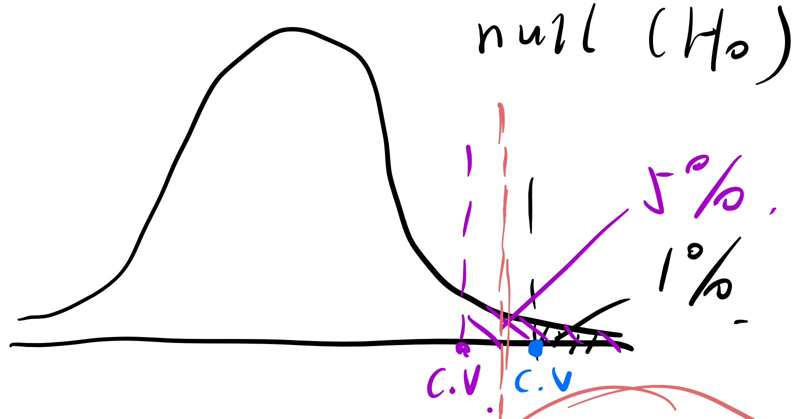
- Feedback for your first draft (3%) should be available on Canvas
- Group registration for Final task closes on 5th May at 5pm
- Read instruction carefully. Data is the same as the first draft.
- Due in week 11: 2pm on 18th May

Assessments

Some general feedback for your first draft

- Well done! Most of you scored 2 or 2.5.
- Please carefully revise all the in-text feedback on Canvas
- As a business report, a good title is required, and well organized sections such as Introduction, Data Descriptions, . . . , Conclusion.
- There is no unique way of writing a business report, so think about what are the key stories/insights you want to convey to readers.
- Readers are general audiences who barely know statistics or any terminologies, so you need to convey your ideas in a simple story.
- Please note that this is a business report, not just an assignment.

A. Hypothesis Testing



Revise the Pre-quiz question first

1. (a) A statistician randomly sampled 100 observations and found $\bar{X} = 106$ and $s = 35$. Calculate the t statistic and p value for testing. $H_0 : \mu = 100$ against $H_A : \mu > 100$. Carry out the test at the 1% level of significance.

$$t = \frac{\bar{X} - 100}{s/\sqrt{n}} = \frac{106 - 100}{35/\sqrt{100}} = 1.714 \; (< 2.365)$$

se($\bar{x}$) c.v(1%)

p-value =T.DIST.RT(1.714,99) = 0.0448 > 1%. Do not reject the null.

What if we change the level of significance to 5%

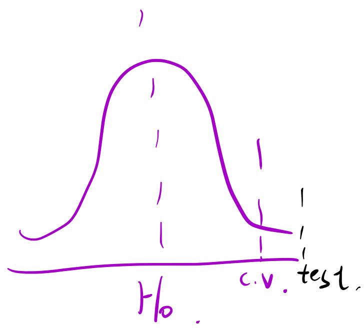
p-value = 0.0448 < 5%, reject the null. → Increase α, more likely to reject.

In-tute questions part A

α = type I error = Pr

1. How does the power of a test change with its level of significance?

α = type I error = Pr(reject H_0 | H_0 is true).



(β =) type II error = Pr(accept H_0 | H_A is true).

power = 1 - type II error

= Pr(reject H_0 | H_A is true).

$P(A) + P(\bar{A}) = 1$

$P(A | B) + P(\bar{A} | B) = 1$.

	H_0 is true	H_A true
accept H_0	✓	type II error.
reject H_0.	type I error	✓ power.

A. Hypothesis Testing

$H_0: \mu = \mu_0$.

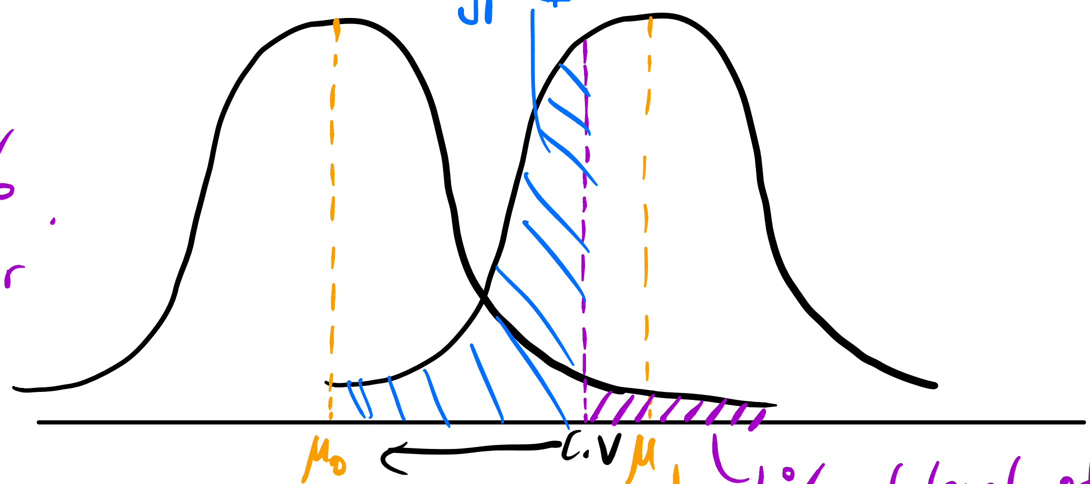
$H_A: \mu > \mu_0 \quad (\mu = \mu_1)$.

Holding all others constant, only consider change in the level of significance.

Type II error: → $Pr(\text{accept } H_0 \mid H_A \text{ true})$.

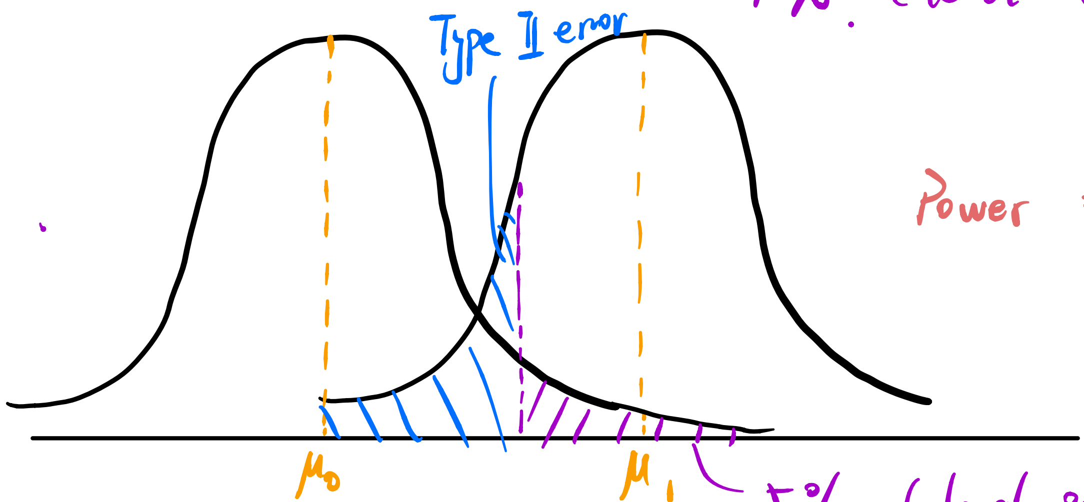
$\alpha = 1\%$.

Type I error



1% (level of significance).

$\alpha = 5\%$.



5% (level of significance).

Power = 1 − $\underbrace{\text{Type II error}}_{\downarrow}$ ↑

A. Hypothesis Testing

2. How does the power of the test depend on whether its alternative is one tail vs two tail? Why don't we just do two tail tests all the time?

A. Hypothesis Testing

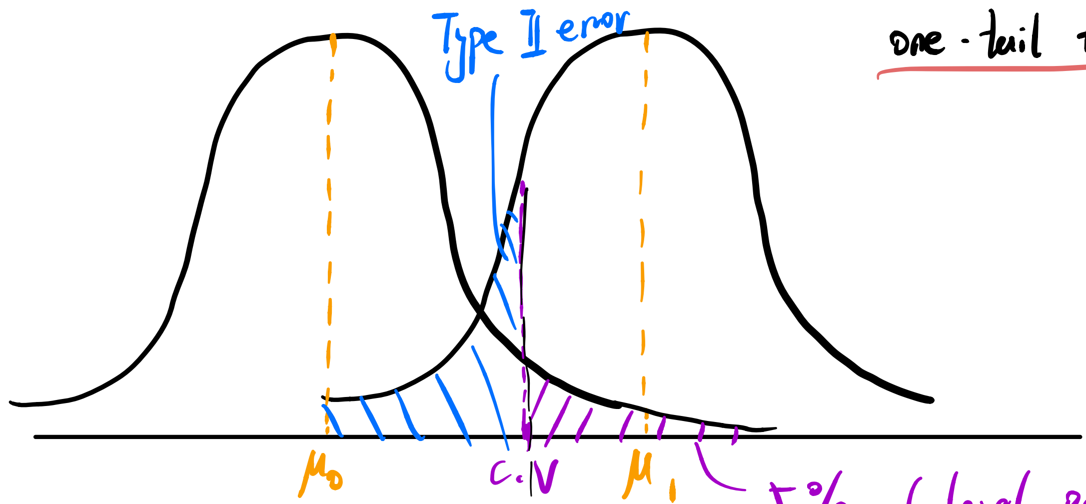
Given the same α, One-tail test has higher power than two-tail test.

$\alpha = 5\%$

one-tail test

$H_0: \mu = \mu_0$

$H_1: \mu > \mu_0$



5% (level of significance).

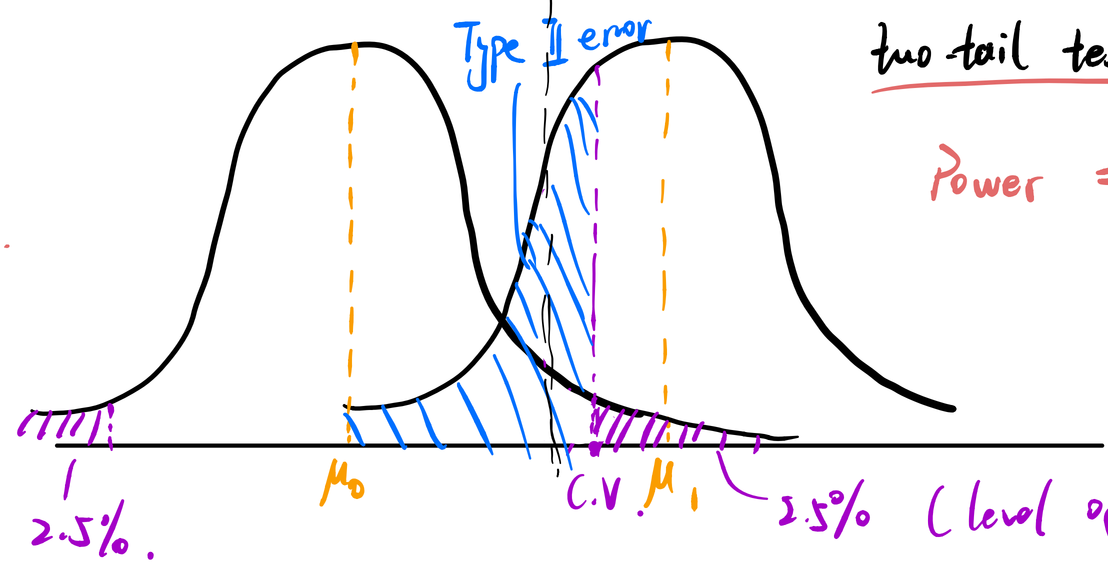
$\alpha = 5\%$

two-tail test

$H_0: \mu = \mu_0$

$H_1: \mu \neq \mu_0$

Power $= 1 -$ Type II error



2.5% (level of significance).

B. Hypothesis Testing

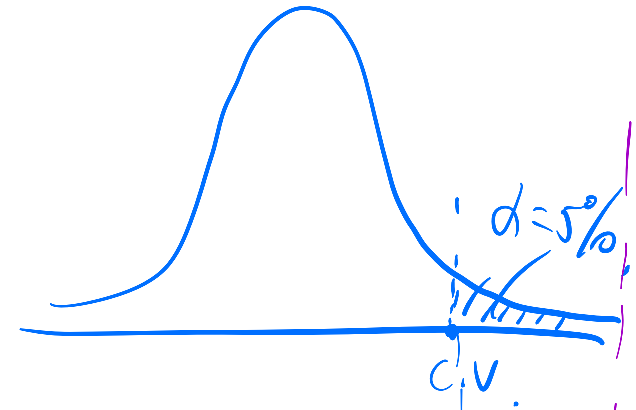
1. A diet doctor claims Australians are overweight by an average of 10kg. To test this claim, a random sample of 100 Australians were weighed and the difference between their actual weight and their ideal weight was calculated and recorded. Use these data to test the doctor's claim at the 5% level of significance.

The difference between here and pre-quiz is that:

- In pre-quiz we were asked "overweight by more than 10kg", which is a one-tail test. right tail
- Here, we are only interested whether it is 10kg, so a two-tail test.

B. Hypothesis Testing

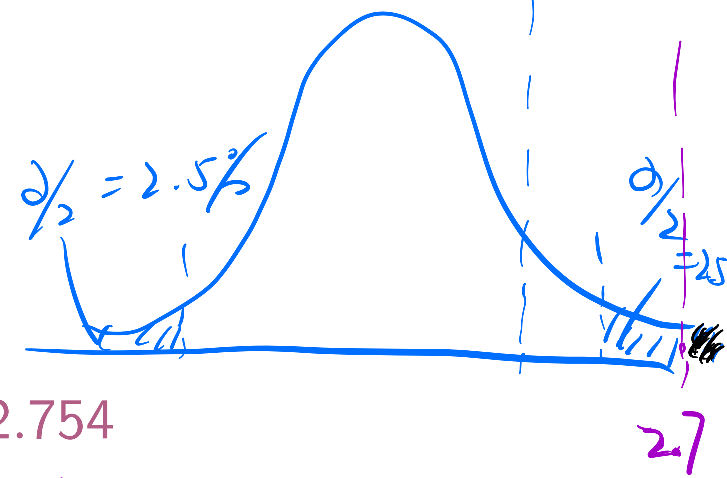
$H_0: \mu = 10 \quad H_A: \mu > 10$



Solution:

$[\bar{x} \pm t \cdot se(\bar{x})]$

$H_0 : \mu = 10, \quad H_A : \mu \neq 10$



The t-statistic is unchanged

$$t = \frac{\bar{X} - 10}{s/\sqrt{n}} = \frac{12.175 - 10}{7.898/\sqrt{100}} = 2.754$$

but the critical value is now $t_{0.025,99} = 1.984$.

$\frac{\alpha}{2} = 2.5\%$

p-value $= 2 \cdot P(t > 2.7)$
$= 2 \cdot P(t < -2.7)$

Therefore, H_0 is rejected in this case

$\boxed{t_{0.05,99}} \rightarrow$ c.v. for one-tail test

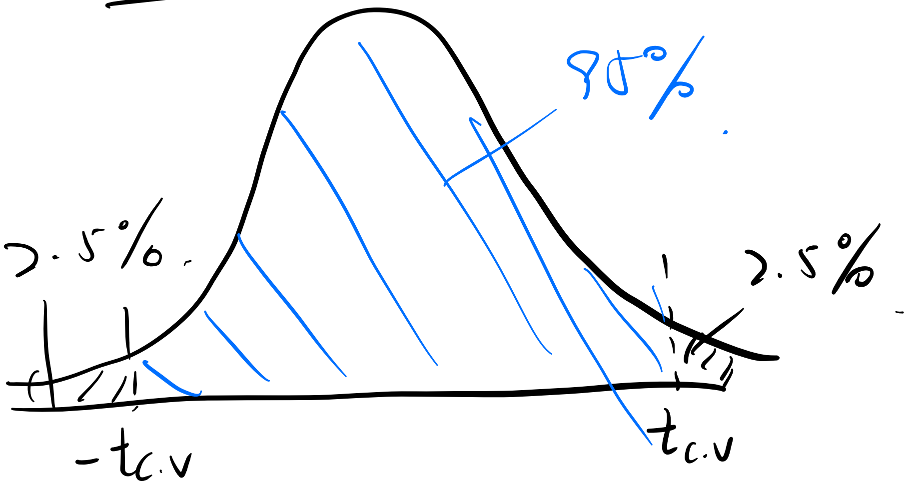
B. Hypothesis Testing

$$\left[\bar{x} \pm t \cdot se(\bar{x})\right]$$

2. Compute a $\boxed{\text{95\% confidence interval}}$ for the population mean of the weight deviations (actual from ideal). How does this interval relate to the findings of the hypothesis tests in question 1 here and Pre-Quiz Part B?

B. Hypothesis Testing

A 95% confidence interval is the range of null values that would NOT be rejected by a two tail test at the 5% level of significance.



$$Pr(-t_{c.v.} < t < t_{c.v}) = 95\%$$

$$\downarrow$$

$$-t_{c.v} < \frac{\bar{x}-\mu}{se(\bar{x})} < t_{c.v}$$

$$-t_{c.v} \cdot se < \bar{x}-\mu < t_{c.v} \cdot se$$

$$-\bar{x} - t_{c.v} \cdot se < -\mu < -\bar{x} + t_{c.v} \cdot se$$

$$(\bar{x} - t_{c.v} \cdot se < \mu < \bar{x} + t_{c.v} \cdot se)$$

$\mu \in CI \Rightarrow$ cannot reject

$\mu \notin CI \Rightarrow$ can reject

B. Hypothesis Testing

Solution:

The 95% confidence interval is

$$\left[\bar{X} \pm t_{0.025,99} \times \mathrm{s.e.}(\bar{X})\right]$$

where s.e.$(\bar{X}) = s/\sqrt{n}$. This gives

$$[12.175 \pm 1.984 \times 0.790] = [10.608, 13.742]$$

The two tail hypothesis test in question 1 rejected $H_0 : \mu = 10$, which is consistent with the value 10 being excluded from the 95% confidence interval in this question.

The end

Thanks for your attention! 😄

Feel free to leave and see you next week!

Good luck on your MST2!