Stat 101L: Lecture 36

Inference for $\mu_1 - \mu_2$

- Do males and females at I.S.U. spend the same amount of time, on average, at the Lied Recreation Athletic Center?
- Could the difference between the population mean times be zero?

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Test of Hypothesis for $\mu_1 - \mu_2$

- Step 1: Set up the null and alternative hypotheses.

$H_0 : \mu_1 = \mu_2$ or $H_0 : \mu_1 - \mu_2 = 0$

$H_A : \mu_1 \neq \mu_2$ or $H_A : \mu_1 - \mu_2 \neq 0$

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Test of Hypothesis for $\mu_1 - \mu_2$

- Step 2: Check Conditions.
  - Randomization Condition
    - Two Independent Random Samples
  - 10% Condition
  - Nearly Normal Condition

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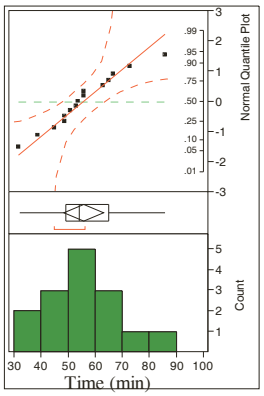
Females



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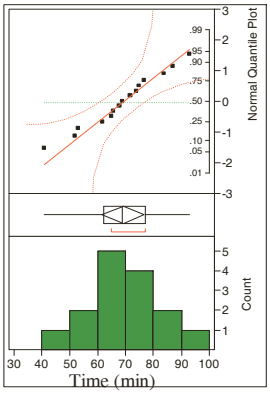
Males



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Nearly Normal Condition

- The female sample data could have come from a population with a normal model.
- The male sample data could have come from a population with a normal model.

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Test of Hypothesis for $\mu_1 - \mu_2$

- Step 3: Compute the value of the test statistic and find the P-value.

$$t = \frac{(\bar{y}_1 - \bar{y}_2) - 0}{\mathrm{SE}(\bar{y}_1 - \bar{y}_2)}$$

$$\mathrm{SE}(\bar{y}_1 - \bar{y}_2) = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

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Time (minutes)

Sex=F		Sex=M	
Mean	55.87	Mean	69.20
Std Dev	13.527	Std Dev	13.790
Std Err Mean	3.4927	Std Err Mean	3.5606
N	15	N	15

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$$\mathrm{SE}(\bar{y}_1 - \bar{y}_2) = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

$$= \sqrt{\frac{(13.527)^2}{15} + \frac{(13.792)^2}{15}}$$

$$= \sqrt{24.88} = 4.988$$

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Test of Hypothesis for $\mu_1 - \mu_2$

- Step 3: Compute the value of the test statistic and find the P-value.

$$t = \frac{(\bar{y}_1 - \bar{y}_2) - 0}{\mathrm{SE}(\bar{y}_1 - \bar{y}_2)} = \frac{(55.87 - 69.20)}{4.988} = -2.672$$

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Table T

Two tail probability	0.20	0.10	0.05	0.02	P-value	0.01
df						
1						
2						
3						
4						
⋮						
28	1.313	1.701	2.048	2.467	**2.672**	2.763

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Test of Hypothesis for $\mu_1 - \mu_2$

- Step 4: Use the P-value to make a decision.
  - Because the P-value is small (it is between 0.01 and 0.02), we should reject the null hypothesis.

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Test of Hypothesis for $\mu_1 - \mu_2$

- Step 5: State a conclusion within the context of the problem.
  - The difference in mean times is not zero. Therefore, on average, females and males at I.S.U. spend different amounts of time at the Lied Recreation Athletic Center.

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Comment

- This conclusion agrees with the results of the confidence interval.
- Zero is not contained in the 95% confidence interval (–23.55 mins to –3.11 mins), therefore the difference in population mean times is not zero.

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Alternatives

$H_0 : \mu_1 = \mu_2$

$H_A : \mu_1 < \mu_2$, One tail prob $(\Pr < t)$

$H_A : \mu_1 > \mu_2$, One tail prob $(\Pr > t)$

$H_A : \mu_1 \neq \mu_2$, Two tail prob $(\Pr > |t|)$

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JMP

- Data in two columns.
  - Response variable:
    - Numeric – Continuous
  - Explanatory variable:
    - Character – Nominal

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JMP Starter

- Basic – Two-Sample t-Test
  - Y, Response: Time
  - X, Grouping: Sex

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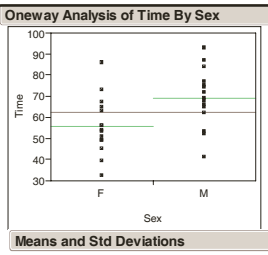
Oneway Analysis of Time By Sex



Means and Std Deviations

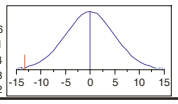
Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
F	15	55.8667	13.5270	3.4927	48.376	63.358
M	15	69.2000	13.7903	3.5606	61.563	76.837

t Test

F-M

Assuming unequal variances

Difference	-13.333	t Ratio	-2.67326
Std Err Dif	4.988	DF	27.98961
Upper CL Dif	-3.116	Prob > |t|	0.0124
Lower CL Dif	-23.550	Prob > t	0.9938
Confidence	0.95	Prob < t	0.0062



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