STATISTICS II

Bachelor's degrees in Economics, Finance and Management

2nd year/2nd Semester
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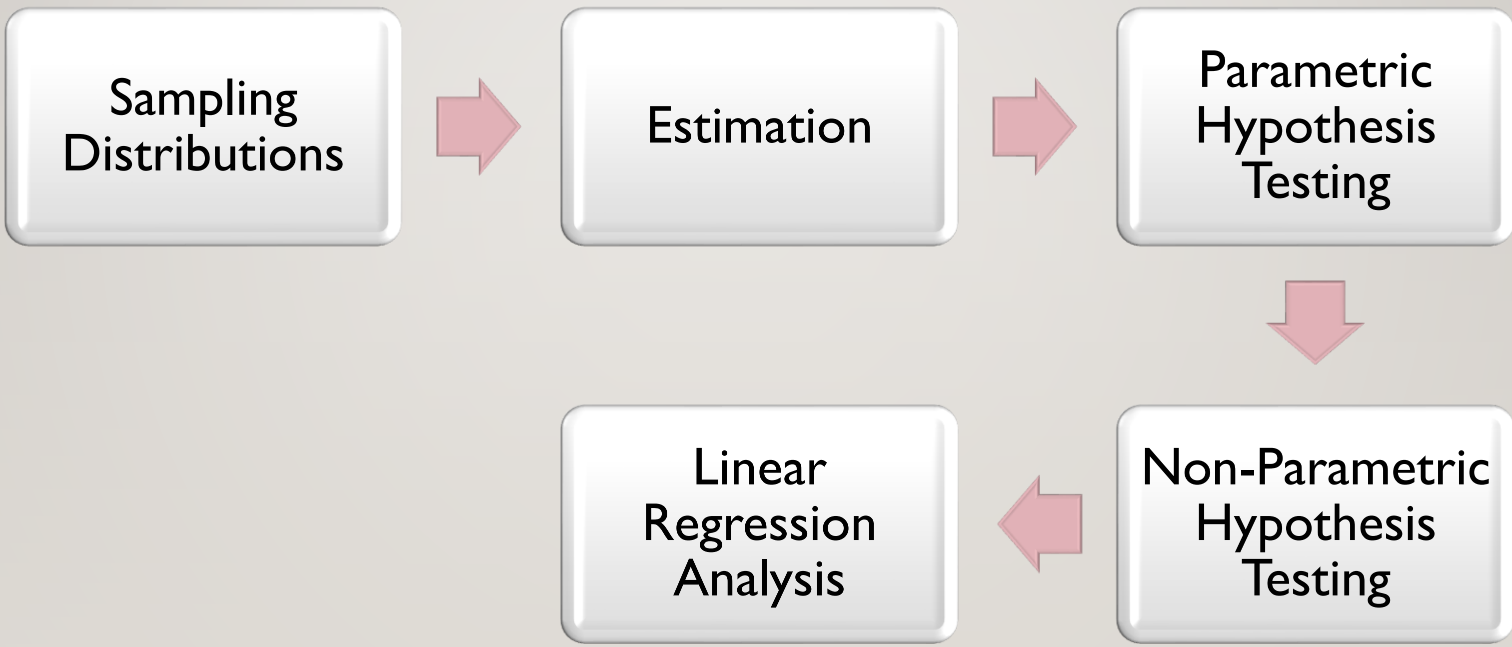
https://doity.com.br/estatistica-aplicada-a-nutricao

https://basiccode.com.br/produto/informatica-basica/

PROGRAM


Sampling Distributions
Estimation
Parametric Hypothesis Testing
Non-Parametric Hypothesis Testing
Linear Regression Analysis

PRATICAL CLASS 10

Exercises 10.6 D), 10.8, 10.11, 10.21,10.26

EXERCISE 10.6 D)

10.6 You have been asked to determine if two different production processes have different mean numbers of units produced per hour. Process 1 has a mean defined as μ_1 and process 2 has a mean defined as μ_2. The null and alternative hypotheses are as follows:

$$H_0: \mu_1 - \mu_2 = 0$$
$$H_1: \mu_1 - \mu_2 > 0$$

Use a random sample of 25 observations from process 1 and 28 observations from process 2 and the known variance for process 1 equal to 900 and the known variance for process 2 equal to 1,600. Can you reject the null hypothesis using a probability of Type I error $\alpha = 0.05$ in each case?

d. The difference in process means is 15.

Newbold et al (2013)

EXERCISE 10.6 D): SOLUTION

✅ Answer:

1. Hypotheses

$$H_0 : \mu_1 - \mu_2 \leq 0$$

$$H_1 : \mu_1 - \mu_2 > 0$$

2. Given Data

Process	n	σ^2 (known)
1	25	900
2	28	1,600

- Observed difference in sample means: $\bar{x}_1 - \bar{x}_2 = 15$
- Significance level: $\alpha = 0.05$

EXERCISE 10.6 D): SOLUTION

✅ Answer:

3. Standard Error

For known variances, the standard error of the difference in means is:

$$SE = \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$

$$SE = \sqrt{\frac{900}{25} + \frac{1,600}{28}} = \sqrt{36 + 57.14} = \sqrt{93.14} \approx 9.65$$

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4. Test Statistic

$$z = \frac{(\bar{x}_1 - \bar{x}_2) - 0}{SE} = \frac{15 - 0}{9.65} \approx 1.55$$

EXERCISE 10.6 D): SOLUTION

✅ Answer:

5. Critical Value

For a **right-tailed test** at $\alpha = 0.05$:

$$z_{0.95} \approx 1.645$$

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6. Decision

$$z = 1.55 < 1.645$$

We **fail to reject** H_0.

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7. Conclusion

At the 5% significance level, there is **insufficient evidence** to conclude that process 1 produces more units per hour than process 2.

Even though the observed difference in means is 15, the **difference is not statistically significant** given the variability of the processes.

EXERCISE 10.8

10.8 A screening procedure was designed to measure attitudes toward minorities as managers. High scores indicate negative attitudes and low scores indicate positive attitudes. Independent random samples were taken of 151 male financial analysts and 108 female financial analysts. For the former group the sample mean and standard deviation scores were 85.8 and 19.13, whereas the corresponding statistics for the latter group were 71.5 and 12.2. Test the null hypothesis that the two population means are equal against the alternative that the true mean score is higher for male than for female financial analysts.

Newbold et al (2013)

EXERCISE 10.8: SOLUTION

✅ Answer:

1. Hypotheses

$$H_0 : \mu_{\text{male}} = \mu_{\text{female}}$$

$$H_1 : \mu_{\text{male}} > \mu_{\text{female}}$$

2. Sample Data

Group	n	$\bar{x}$	s
Male	151	85.8	19.13
Female	108	71.5	12.2

EXERCISE 10.8: SOLUTION

Answer:

3. Test Statistic (Welch's *t*)

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Step 3a: Compute standard errors

$$\frac{s_1^2}{n_1} = \frac{19.13^2}{151} = \frac{366.0}{151} \approx 2.42$$

$$\frac{s_2^2}{n_2} = \frac{12.2^2}{108} = \frac{148.84}{108} \approx 1.38$$

$$SE = \sqrt{2.42 + 1.38} = \sqrt{3.80} \approx 1.95$$

Step 3b: Compute *t*

$$t = \frac{85.8 - 71.5}{1.95} = \frac{14.3}{1.95} \approx 7.33$$

EXERCISE 10.8: SOLUTION

6. Decision

$$t = 7.33 > 1.65$$

We **reject** H_0.

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7. *p*-Value

The *p*-value is extremely small (< 0.0001), indicating very strong evidence.

Conclusion

There is **strong statistical evidence** that male financial analysts have **higher scores** (more negative attitudes toward minorities as managers) than female financial analysts.

5. Critical Value

For a **right-tailed test** at $\alpha = 0.05$ and large df:

$$t_{0.95} \approx 1.65$$

EXERCISE 10.8: SOLUTION

✅ Answer:

6. Decision

$$t = 7.33 > 1.65$$

We **reject** H_0.

---

7. *p*-Value

The *p*-value is extremely small (< 0.0001), indicating very strong evidence.

Conclusion

There is **strong statistical evidence** that male financial analysts have **higher scores** (more negative attitudes toward minorities as managers) than female financial analysts.

EXERCISE 10.11

10.11 In light of a recent large corporation bankruptcy, auditors are becoming increasingly concerned about the possibility of fraud. Auditors might be helped in determining the chances of fraud if they carefully measure cash flow. To evaluate this possibility, samples of midlevel auditors from CPA firms were presented with cash-flow information from a fraud case, and they were asked to indicate the chance of material fraud on a scale from 0 to 100. A random sample of 36 auditors used the cash-flow information. Their mean assessment was 36.21, and the sample standard deviation was 22.93. For an independent random sample of 36 auditors not using the cash-flow information, the sample mean and standard deviation were, respectively, 47.56 and 27.56. Assuming that the two population distributions are normal with equal variances, test, against a two-sided alternative, the null hypothesis that the population means are equal.

Newbold et al (2013)

EXERCISE 10.11: SOLUTION

Answer:

1. Hypotheses

$$H_0 : \mu_1 = \mu_2 \quad \text{(auditors using cash-flow info vs not using)}$$

$$H_1 : \mu_1 \neq \mu_2$$

2. Sample Data

Group	n	$\bar{x}$	s
Using cash-flow info	36	36.21	22.93
Not using cash-flow info	36	47.56	27.56

EXERCISE 10.11: SOLUTION

✅ Answer:

3. Pooled Standard Deviation

The pooled variance formula is:

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

Compute each term:

$$(n_1 - 1)s_1^2 = 35 \cdot 22.93^2 = 35 \cdot 525.96 \approx 18,408.6$$

$$(n_2 - 1)s_2^2 = 35 \cdot 27.56^2 = 35 \cdot 759.4 \approx 26,579$$

$$s_p^2 = \frac{18,408.6 + 26,579}{36 + 36 - 2} = \frac{44,987.6}{70} \approx 642.68$$

$$s_p = \sqrt{642.68} \approx 25.36$$

EXERCISE 10.11: SOLUTION

Answer:

4. Test Statistic

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

$$SE = s_p\sqrt{\frac{1}{36} + \frac{1}{36}} = 25.36\sqrt{\frac{2}{36}} = 25.36\sqrt{0.05556} \approx 25.36 \cdot 0.2357 \approx 5.97$$

$$t = \frac{36.21 - 47.56}{5.97} = \frac{-11.35}{5.97} \approx -1.90$$

Degrees of freedom:

$$df = n_1 + n_2 - 2 = 70$$

EXERCISE 10.11: SOLUTION

Answer:

5. Critical Value

For a **two-sided test** at $\alpha = 0.05$ and $df = 70$:

$$t_{0.975,70} \approx 1.994$$

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6. Decision

$$|t| = 1.90 < 1.994$$

We **fail to reject** H_0.

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7. *p*-Value

$$p\text{-value} = 2P(T > 1.90) \approx 0.061$$

EXERCISE 10.11: SOLUTION

✅ Answer:

Conclusion

At the 5% significance level, there is **insufficient evidence** to conclude that the mean fraud assessment differs between auditors who **use** cash-flow information and those who **do not**.

The difference in sample means is suggestive ($p \approx 0.061$), but **not statistically significant** at $\alpha = 0.05$.

EXERCISE 10.21

10.21 Of a random sample of 1,200 people in Denmark, 480 had a positive attitude toward car salespeople. Of an independent random sample of 1,000 people in France, 790 had a positive attitude toward car salespeople. Test, at the 1% level the null hypothesis that the population proportions are equal, against the alternative that a higher proportion of French have a positive attitude toward car salespeople.

Newbold et al (2013)

EXERCISE 10.21: SOLUTION

Answer:

1. Hypotheses

Let p_{Denmark} = proportion of people with a positive attitude in Denmark,
and p_{France} = proportion in France.

$$H_0 : p_{\text{Denmark}} \geq p_{\text{France}} \quad \text{(France is not more positive)}$$

$$H_1 : p_{\text{Denmark}} < p_{\text{France}} \quad \text{(France has a higher proportion)}$$

This is a **left-tailed test**.

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2. Sample Data

Country	n	x	$\hat{p}$
Denmark	1,200	480	0.40
France	1,000	790	0.79

EXERCISE 10.21: SOLUTION

Answer:

3. Standard Error (Separate Variances)

$$SE = \sqrt{\frac{\hat{p}_{\text{Denmark}}(1-\hat{p}_{\text{Denmark}})}{n_{\text{Denmark}}} + \frac{\hat{p}_{\text{France}}(1-\hat{p}_{\text{France}})}{n_{\text{France}}}}$$

$$SE = \sqrt{\frac{0.40 \cdot 0.60}{1,200} + \frac{0.79 \cdot 0.21}{1,000}} = \sqrt{\frac{0.24}{1,200} + \frac{0.1659}{1,000}} = \sqrt{0.0002 + 0.0001659} = \sqrt{0.0003659} \approx 0.0191$$

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4. Test Statistic

$$z = \frac{\hat{p}_{\text{Denmark}} - \hat{p}_{\text{France}}}{SE} = \frac{0.40 - 0.79}{0.0191} = \frac{-0.39}{0.0191} \approx -20.42$$

EXERCISE 10.21: SOLUTION

Answer:

5. Critical Value

For a **left-tailed test** at $\alpha = 0.01$:

$$z_{0.01} \approx -2.33$$

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6. Decision

$$z = -20.42 < -2.33 \implies \text{reject } H_0$$

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7. Conclusion

At the **1% significance level**, there is **very strong evidence** that a **higher proportion of French people have a positive attitude toward car salespeople** compared to people in Denmark.

The difference is extremely significant due to the large sample sizes.

EXERCISE 10.26

10.26 A publisher is interested in the effects on sales of college texts that include more than 100 data files. The publisher plans to produce 20 texts in the business area and randomly chooses 10 to have more than 100 data files. The remaining 10 are produced with at most 100 data files. For those with more than 100, first-year sales averaged 9,254, and the sample standard deviation was 2,107. For the books with at most 100, average first-year sales were 8,167, and the sample standard deviation was 1,681. Assuming that the two population distributions are normal, test the null hypothesis that the population variances are equal against the alternative that the population variance is higher for books with more than 100 data files.

Newbold et al (2013)

EXERCISE 10.26: SOLUTION

✅ Answer:

1. Hypotheses

Let $\sigma^2_{>100}$ = population variance for books with **more than 100 data files**,
and $\sigma^2_{\leq 100}$ = population variance for books with **at most 100 data files**.

$$H_0 : \sigma^2_{>100} \leq \sigma^2_{\leq 100} \quad \text{(variances are equal or lower)}$$

$$H_1 : \sigma^2_{>100} > \sigma^2_{\leq 100} \quad \text{(variance is higher for books with >100 files)}$$

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2. Sample Data

Group	n	s
>100 data files	10	2,107
≤100 data files	10	1,681

EXERCISE 10.26: SOLUTION

✅ Answer:

3. Test Statistic

$$F = \frac{s^2_{>100}}{s^2_{\leq 100}} = \frac{2,107^2}{1,681^2} = \frac{4,437,649}{2,825,761} \approx 1.57$$

Degrees of freedom:

$$df_1 = n_1 - 1 = 9, \quad df_2 = n_2 - 1 = 9$$

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4. Critical Value

For a **right-tailed F-test** at $\alpha = 0.05$ with df1 = 9, df2 = 9:

$$F_{0.95,9,9} \approx 3.18$$

EXERCISE 10.26: SOLUTION

Answer:

5. Decision

$$F = 1.57 < 3.18 \implies \text{fail to reject } H_0$$

6. Conclusion

At the **5% significance level**, there is **insufficient evidence** to conclude that the population variance of first-year sales is higher for books with more than 100 data files.

Although the sample variance is higher for the books with more data files, the difference is **not statistically significant** given the small sample sizes.

THANKS!

Questions?