SESSIONS 4

Inferential Statistics: Hypothesis Testing Part 2

Data Science Program

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Hypothesis testing for mean

- T-test single population mean
- T-test independence double population mean
    - Equal variance
    - Non equal variance
- T-test paired
- Anova F-test for more than two population mean

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T-Test Single Population Mean

Assumption:

1. numerical value with population mean **μo**
2. Data collected using randomization
3. Population distribution approximately normal

Test Statistics *t* with degree of freedom n - 1:

$$t = \frac{(\bar{x} - \mu_0)}{se} = \frac{(\bar{x} - \mu_0)}{s/\sqrt{n}}$$

Hypothesis:

Ho : **μ** = **μo** (ex. **μ** = 40)

Ho : **μ** ≠ **μo** (two sided) or

μ < **μo** or **μ** > **μo** (one sided)

Rejection Criteria: P-value ≤ α

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Use Case: A/B Testing numerical measurements

A financial tech company want to test whether their new app design help people to increase the amount of many that they save (saving rate). Savings rate is the percentage of each user's monthly paycheck that he or she saves

1. Six months ago, our client randomly selected 1,000 newly signed up users and assigned 500 of them to the current design and 500 to the new design.
2. The control group went on to use the current app.
3. All users started with a 0% savings rate.
4. The 1,000 users represent just a small portion of the app's total users.

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T-Test Independence Double Population Mean

Assumption:

1. Numerical variable in each group
2. Data collected using randomization
3. Population distribution approximately normal for each group

Hypothesis:

Ho : **μ1** = **μ2** (ex. **μ1** - **μ2** = 0)

Ho : **μ1** ≠ **μ2** (two sided) or

μ1 < **μ2** or **μ1** > **μ2** (one sided)

Test Statistics *t*:

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - 0}{se} \text{ where } se = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

Rejection Criteria:

- P-value ≤ α
- in spicy, if you do one-sided hypothesis testing the p-value needed to be divided by two

T-Test Independence Double Population Mean Equal Variance

Assumption:

1. numerical variable in each group
2. Data collected using randomization
3. Population distribution approximately normal for each group
4. Equal variance in each group

Hypothesis:

Ho : **μ1** = **μ2** (ex. **μ1** - **μ2** = 0)

Ho : **μ1** ≠ **μ2** (two sided) or

μ1 < **μ2** or **μ1** > **μ2** (one sided)

Test Statistics *t*:

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - 0}{se}$$

$$se = \sqrt{\frac{s^2}{n_1} + \frac{s^2}{n_2}} = s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$$

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

Rejection Criteria (spicy) :

P-value ≤ α (two-sided)

P-value/2 ≤ α (one-sided)

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T-Test Paired

Assumption:

1. Numerical variable in each group
2. Data collected using randomization
3. Dependent sample (each sample has matched observation)
4. Population distribution approximately normal for each group

Hypothesis:

Ho : **D** = 0

Ho : **D ≠ 0** (two sided) or

D < **0** or **D** > **0** (one sided)

D is mean of difference between matched pair

Test Statistics *t* with df n - 1:

$$t = \frac{\bar{x}_d - 0}{se} \text{ with } se = s_d/\sqrt{n}$$

Rejection Criteria (spicy) :

P-value ≤ α (two-sided)

P-value/2 ≤ α (one-sided)

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Use Case: A/B Testing numerical measurements more than two groups

A financial tech company want to test whether their new two app design help people to increase the amount of money that they save (saving rate). Savings rate is the percentage of each user's monthly paycheck that he or she saves

1. Six months ago, our client randomly selected 1,500 newly signed up users and assigned 500 of them to the current design and each 500 to the new design (design 1 and design 2).
2. The control group went on to use the current app.
3. All users started with a 0% savings rate.
4. The 1,500 users represent just a small portion of the app's total users.

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Anova F-Test for More Than Two Population Mean

Assumption:

1. The population distribution of the numerical variable is assumed to be normal
2. Data collected using randomization
3. Each group has equal variance

Hypothesis:

Ho : **μ1** = **μ2** = … = **μk** (there are k groups)

Ho : at least one pair of the population are not equal (and we don’t know which)

Test Statistics *F* with df1 k - 1 and df2 n - k:

$$F = \frac{\text{Between-groups variability}}{\text{Within-groups variability}}$$

Rejection Criteria (spicy) :

P-value ≤ α

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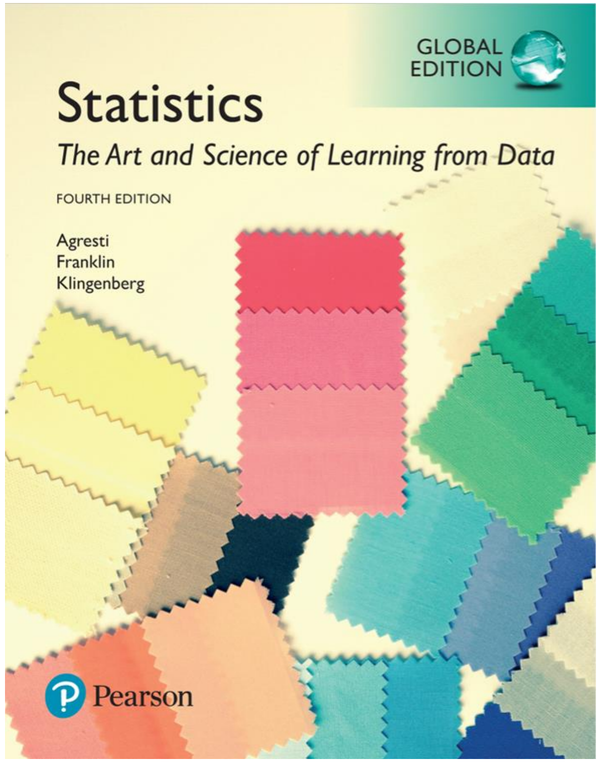
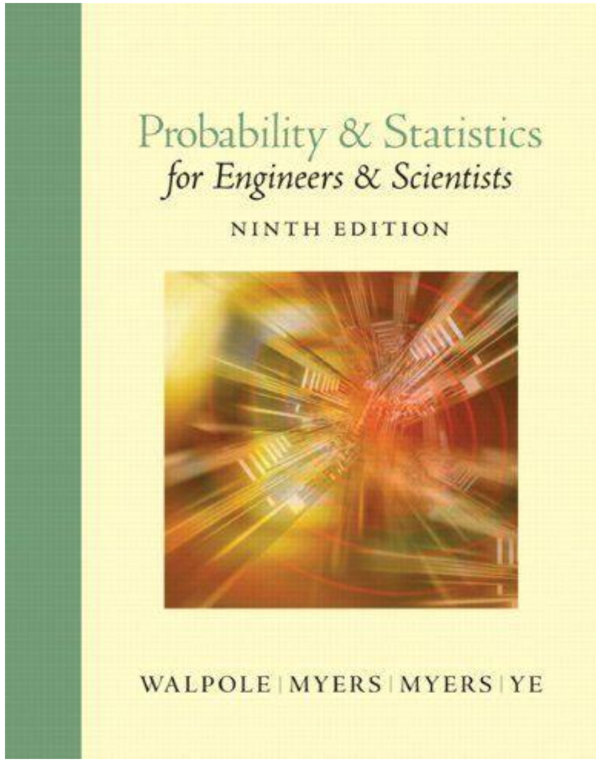
Reference





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Reference

https://towardsdatascience.com/data-science-you-need-to-know-a-b-testing-f2f12aff619a

https://towardsdatascience.com/data-science-fundamentals-a-b-testing-cb371ceecc27

https://www.niagahoster.co.id/blog/ab-testing-adalah/

https://vwo.com/blog/ab-testing-examples/

https://www.scribbr.com/methodology/sampling-methods/

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