مهم جدا

Chapter 13: Analysis of variance and Experimental Design (ANOVA)

13.1: An introduction to analysis of variance.

.. To measure how much employees at these plants know about total quality managment a Random sample of six employees was selected by each plant and gives a quality awareness examination. The examination scores obtained for these 18 employees are listed in table 13.1.

Sample عشوائي تكون Random

let μ_1 = mean examination score for population 1.

μ_2 = mean examination score for population 2.

μ_3 = mean examination score for population 3.

Although we will never know the actual values of μ_1, μ_2 and μ_3, we want to use the sample results to test the following hypotheses:

$H_0: \mu_1 = \mu_2 = \mu_3$

H_1: Not all population means are equal. يكفي 2 منهم غير متساويات بس

Table 13.1: Examination scores for 18 employees.

Factors — Treatments

observation	plant 1	plant 2	plant 3
1	85	71	59
2	75	75	64
3	82	73	62
4	76	74	69
5	71	69	75
6	85	82	67
sample mean $\bar{x}$	79	74	66
sample variance s^2	34	20	32
Sample standard deviation s	5.83	4.47	5.66

Response Variable

By calculator

variance

pop. = treatments

Continuous:

Response variable or dependent → score.

independent variable or factor → location.

Treatments or population → the values of a factor selected for investigation are referred to as levels of the factor.

↳ in table 13.1 the three treatments: Ayr, Dusseldorf and stockholm.

* Assumptions for analysis of variance:

Three assumptions are required to use analysis of variance.

1. For each population, the respons variable is normally distributed.

Implication: In the NCP example, the examination scores (response variable) must be Normally distributed at each plant.

2. The variance of the response variable (δ^2) is the same for all of the populations.

Implication: In the NCP example, the variance of examination scores must be the same for all three plants.

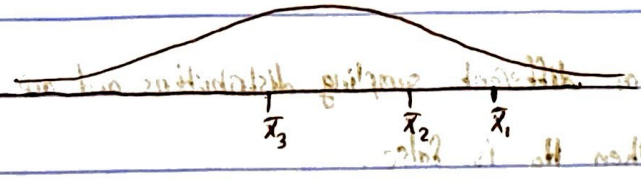
3. The observations must be independent.

Implication: In the NCP examples, the examination score for each employee must be independent of the examination score for any other employee.

→ A conceptual overview. Book.

→ sampling distribution of $\bar{X}$ given H_0 is true.

$$\sigma^2_{\bar{X}} = \frac{\sigma^2}{n}$$



$\bar{X}_1, \bar{X}_2, \bar{X}_3$: sample means are close together because there is only one sampling dis. when H_0 true.

overall mean 73
mean of means 79, 74, 66

بنا نقدر estimate $\sigma^2_{\bar{X}}$ بطريقتين : ① إذا كان n متساوي لكل treatments زي هيك :

$$S^2_{\bar{X}} = \frac{(79-73)^2 + (74-73)^2 + (66-73)^2}{3-1} = \frac{86}{2} = 43.$$

(3-1 ← treatments عدد)

$$\sigma^2_{\bar{X}} = \frac{\sigma^2}{n} \rightarrow \sigma^2 = n\,\sigma^2_{\bar{X}}$$

إعادة ترتيب القانون

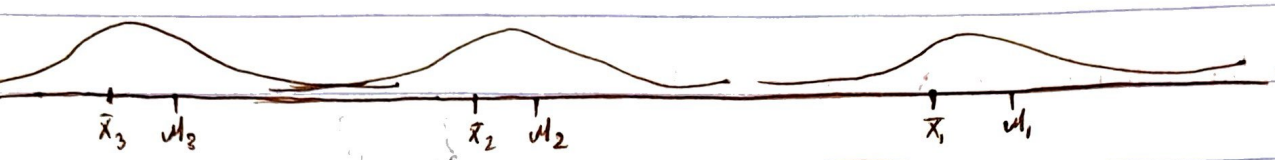
Hence, Estimate of σ^2 = n (estimate of $\sigma^2_{\bar{X}}$)

$= n \; S^2_{\bar{X}}$

$= 6\,(43) = 258$

The result, $nS^2_{\bar{X}} = 258$ is referred to as the between-treatments estimate of σ^2.

→ sampling distributions of $\bar{X}$ given H_0 is False.



$\bar{X}_1, \bar{X}_2, \bar{X}_3$: sample means come from different sampling distributions and are not as close togther when H_0 is false.

Within treatments estimate of $\delta^2 = \frac{34 + 20 + 32}{3} = 28.67$.

في الكتاب في تكملة شرح .

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