Hypothesis Testing

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Hypothesis Testing :

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Statement about population

To conduct Hypothesis Testing we have 4 steps:

① step 1: Define Hypothesis

① : Null Hypothesis (H_0) :

② Alternative Hypothesis (H_1/H_a) :

② Step 2 : - Define level of significance (α) (confidence about Null Hypothesis)

③ Step 3 :- Conduct the Test statistic

④ Step 4 :- Interpretations / Result

Example-1:

$\mu > 100$

A principal at a certain school claims that the students in his school are above average intelligence. A random sample of thirty students IQ scores have a mean score of 112.5. Is there sufficient evidence to support the principal's claim? The mean population IQ is 100 with a standard deviation of 15.

H_0 : $\mu \le 100$ The students are below average

H_1 : $\mu > 100$ The students

H_0 : $\mu = 100$

H_1 : $\mu \ne 100$

Two tailed test

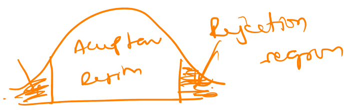
H_0 : $\mu \le 100$

H_1 : $\mu > 100$

H_0 : $\mu \ge 100$

H_1 : $\mu < 100$

one tailed test



Blood glucose levels for obese patients have a mean of 100 with a standard deviation of 15. A researcher thinks that a diet high in raw corn starch will have a positive or negative effect on blood glucose levels. A sample of 30 patients who have tried the raw corn starch diet have a mean glucose level of 140.
Test the hypothesis that the raw corn starch had an effect.

In [ ]:

We want to test if it takes fewer than 45 minutes to teach a lesson plan. State the null and alternative hypotheses. Fill in the correct symbol (=, ≠, ≥, <, ≤, >) for the null and alternative hypotheses.

- H0: μ __ 45
- Ha:μ __ 45

On a state driver's test, about 40% pass the test on the first try. We want to test if more than 40% pass on the first try. Fill in the correct symbol (=, ≠, ≥, <, ≤, >) for the null and alternative hypotheses.

- H0: p __ 0.40
- Ha: p __ 0.40

Step 2 :- Decide Significance level (α) (0.05 | 5%)

Errors in Hypothesis Testing :

	Accept H_0	Reject H_0
H_0 is True	✓	Type - I error
H_0 is False	Type - II	✓

Type-I : Rejecting the H_0 when it is true (α) = P (Rejecting H_0 | H_0 True)

Type-II : Accepting the H_0 when it is false (β) = P (Accepting H_0 | H_0 is False)

15-20 (2nd) P

Y

N

Y

Result

Predicted

Yes | No

Y
N
Y
N

Result, Predicted

Actual		Yes	No	
1	Yes	3000	1000	4000
0	No	0	4000	4000
		3000	5000	

Step 3: Test statistic

1. t-test
2. z-test } → Numerical
3. χ^2-test

1 Num → t-test, z-test

t-test:
1. $n \le 30$
2. Unknown population standard dev ($\sigma \ne$)

z-test
1. $n > 30$
2. σ known

$$t = \frac{\bar{x} - \mu}{S/\sqrt{n-1}} \sim \text{degrees of freedom}$$

$S/\sqrt{n-1}$ → Standard Error

$$z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$$

$\sigma/\sqrt{n}$ → Standard error

$P(X \le x)$

Step 4: Interpretations:

$\alpha = 0.05$

If P_value $\le \alpha$
Reject H_0

P_val = 1 − cdf(t_score)

$0.01 \le 0.05$
99%

P_value > α
Failed to Reject H_0

P_val = 2(1 − cdf(x))

$0.00000 \le 0.$

P_val = 0.09

0.09 > 0.05

$0.05 \le 0.1$

$0.15 \le 0.15$

$(a-b)^2 = a^2 + b^2 - 2ab$

two-sample test:

$$z = \frac{\bar{x}_1 - \bar{x}_2 - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

$H_0: \mu_1 = \mu_2$
$H_1: \mu_1 \ne \mu_2$

$$= \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

(0, 1)

Chi-square:

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

O E $(O-E)^2$ $(O-E)^2/E$

Chi-square:

$$\chi^2 = \sum \frac{(O-E)}{E}$$

sex	Male	Female	
time			
Lunch	33	35	68
Dinner	124	52	176
	157	87	244

$(2-1)\times(2-1)$

$= (1\times1)$

$= 1$

O	E	$(O-E)^2$	$(O-E)^2/E$
33	43.7	100	2.
35	24.24	1.21	.5.
124	115.2	121	1.
52	62.7	100	2
			9.0

$\frac{68 \times 157}{244}$ $\frac{87 \times 68}{244}$ $\frac{176 \times 157}{244}$ $\frac{176 \times 87}{244}$