Hypothesis testing:

Hypothesis is an assumption about a parameter (that indicates random quantity of distribution). This assumption may or may not be true. Hypothesis testing refers to the formal procedure used by the statisticians to accept or reject this hypothesis.

2 types

(I) H_0: Null Hypothesis

(II) H_1: Alternative "

H_1 হচ্ছে যা test করতে চায় / যে type assume করতেছে তা।

H_0 " উল্টো হিসেবে।

4 steps (For all)

Step1: H_0 & H_1 কে select করবো।

Step2: Test statistic value বের করবো। যা পরে Rejection region-এর সাথে compare করবো।

Step3: H_1 এর থেকে $\mu >/</\neq$ এর উপর depend করে rejection region select করবো।

Step4: Test statistic value rejection region-এর মধ্যে হলে H_0 rejected.

" " " rejection region " " না " H_0 cannot be rejected.

এভাবে লিখবো: [(Since the calculated value falls in the rejection region, so we ~~cannot~~ reject H_0 (null hypothesis)). The Assumption is ✓)

or, (Since the calculated value doesn't fall in the region, so we can not reject H_0 (null hypothesis). The Assumption is wrong.)]

Hypothesis test for the mean (μ)

[conditions $H_0: \mu = \mu_0$ (সবসময়) | $H_1: \mu > \mu_0$ → greater than
or $H_1: \mu < \mu_0$ → less/lower "
or $H_1: \mu \neq \mu_0$ → is not equal

3 type Situation-এ Q থাকতে পারে

Case 1

X has a normal distribution with $\boxed{\text{Known}}$ population variance (σ^2)

The statistic is $\dfrac{\overline{X} - \mu_0}{\frac{\sigma}{\sqrt{n}}} \sim N(0,1)$

when $H_1: \mu > \mu_0$

The rejection region $[z_\alpha, +\infty[$

$H_1: \mu < \mu_0$

The " " is $]-\infty, -z_\alpha]$

$H_1: \mu \neq \mu_0$

The " " "

$]-\infty, -z_\alpha] \cup [z_\alpha, +\infty[$

(Table 1; page 787)

* α-এর value দেয়া থাকবে।

Case 2

X has a normal distribution with $\boxed{\text{unknown}}$ population var (σ^2)

Test statistic is $\dfrac{\overline{X} - \mu_0}{\sqrt{\frac{s^2}{n}}} \sim t_{(n-1)}$

$s^2 = \dfrac{\sum_{i=1}^{n}(x_i - \overline{x})^2}{n-1}$

$\overline{x} = \dfrac{+ \ldots + \cdots + \cdots +}{n}$

$H_1: \mu > \mu_0$, the rejection region is $[t_\alpha, +\infty[$

$H_1: \mu < \mu_0$

the rejection region is $]-\infty, -t_\alpha]$

when $H_1: \mu \neq \mu_0$

the re... ... ...

$]-\infty, -t_{\frac{\alpha}{2}}] \cup [t_{\frac{\alpha}{2}}, +\infty[$

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t ...

Case 3

X has a general distribution but we have a $\boxed{\text{large sample size}}$ (≥ 30) ~~σ² is known~~

*1 Known σ^2

T.S: $\dfrac{\overline{x} - \mu_0}{\sqrt{\frac{\sigma^2}{n}}} \sim N(0,1)$

*2 Unknown σ^2

Test statistic is $\dfrac{\overline{x} - \mu_0}{\sqrt{\frac{s^2}{n}}} \sim N(0,1)$

when s^2 = sample variance $= \dfrac{\sum_{i=1}^{n}(x_i - \overline{x})^2}{n-1}$

$H_1: \mu > \mu_0$

The rejection region is $[z_\alpha, +\infty[$

$H_2: \mu < \mu_0$

... ... $]-\infty, -z_\alpha]$

$H_3: \mu \neq \mu_0$

re... ... ...

$]-\infty, -z_{\frac{\alpha}{2}}] \cup [z_{\frac{\alpha}{2}}, +\infty[$

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P.	A.
A	B
before	during
1 ✓	✓
2 ✓	✓
⋮	
10 ✓	✓

Matched pairs t test:

Matched-pairs t test is used to test whether there is a significant mean difference between two sets of paired data.

Step 1: $H_0 : \mu_D = 0$

$H_1 : \mu_D > 0$ or, $H_1 : \mu_D < 0$ or $H_1 : \mu_D \neq 0$

Step 2: Test statistics $= \dfrac{\overline{D}}{\sqrt{\frac{S_D^2}{n}}} \sim t_{n-1}$.

D is the difference between paired value from two data sets
$D = Y - X$
$\overline{D}$ is the sample mean difference between paired observation/data.
S_D^2 is the variance of the difference.
n is the number of paired data

Ex

ID	$D_i = Y_i - X_i$
1	$Y_1 - X_1$
2	$Y_2 - X_2$
⋮	
n	$Y_n - X_n$

$$\therefore \overline{D} = \frac{(Y_1-X_1)+(Y_2-X_2)+\dots+(Y_n-X_n)}{n} = \frac{D_1+D_2+\dots+D_n}{n}$$

$$S_D^2 = \frac{\sum_{i=1}^{n}(D_i - \overline{D})^2}{n-1}$$

Step 3: $H_1 : \mu_D > 0$
rejection region: $[t_{\alpha,n-1}, +\infty[$

$H_1 : \mu_D < 0$
rej... reg...: $]-\infty, -t_{\alpha,n-1}]$

$H_1 : \mu_D \neq 0$
$]-\infty, -t_{\frac{\alpha}{2},n-1}] \cup [t_{\frac{\alpha}{2},n-1}, +\infty[$

Step 4: comment.

Independent Sample t test:

also called unpaired sample t test helps us to compare means of two sets ~~(A & B)~~

M_1	M_2
R_A	R_B
A_1	B_1
A_2	B_2
⋮	⋮
A_{n_1}	B_{n_2}

Step 1: $H_0 : \mu_1 = \mu_2 \rightarrow H_0 : \mu_1 - \mu_2 = 0$
$H_1 : \mu_1 < \mu_2 \rightarrow H_1 : \mu_1 - \mu_2 < 0$
$H_1 : \mu_1 > \mu_2 \rightarrow H_1 : \mu_1 - \mu_2 > 0$
$H_1 : \mu_1 \neq \mu_2 \rightarrow H_1 : \mu_1 - \mu_2 \neq 0$

Step 2: Test statistics $= \dfrac{\overline{X} - \overline{Y}}{\sqrt{S_p^2\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}} \sim t_{n_1+n_2-2}$

$\overline{X} = \dfrac{A_1 + A_2 + \dots + A_{n_1}}{n_1}$
$\overline{Y} = \dfrac{B_1 + B_2 + \dots + B_{n_2}}{n_2}$.

where, $S_p^2 = \dfrac{\sum_{i=1}^{n_1}(x_i - \overline{X})^2 + \sum_{j=1}^{n_2}(Y_i - \overline{Y})^2}{n_1 + n_2 - 2}$

Step 3:
$H_1 : \mu_1 - \mu_2 < 0$
rejec. region: $]-\infty, -t_\alpha]$

$H_1 : \mu_1 - \mu_2 > 0$
rej... region..: $[t_\alpha, \infty[$

$H_1 : \mu_1 - \mu_2 \neq 0$
The rejec.. region: $]-\infty, -t_{\frac{\alpha}{2}}] \cup [t_{\frac{\alpha}{2}}, +\infty[$

Step 4: Comment.