The t- test (uji-t)

Uji beda Mean dua sampel kelompok I dan II

- ❑ require 2 samples which may be from the same population.(**berpasangan**)
- ❑ These samples need not be of equal #, nor are they paired.(**tidak berpasangan**)

H0: The 2 samples are from the same population (any differences are due to chance)

H1: The 2 samples come from different populations.

CATATAN : RISET GUNAKAN STATISTIK SEDERHANA (S1) Sesuai TUJUAN
RISET YANG HEBAT BUKAN STATISTIKNYA_ Tetapi SUBSTANSINYA

BUATLAH PEMASALAHAN PENELITIAN, TUJUAN , CARI DATA, ANALISIS, INTREPETASI, KESIMPULAN

CIRI- CIRI T TEST _ CONTOH:

- Menguji perbedaan rata-rata/mean :antara klmpk.I dan ke II
- Perlu diperhatikan : dua kelompok yang independen (tak berpasangan) atau dua kelompok yang dependen (berpasangan)

- A. Data independen : bila data kelompok yang satu tidak tergantung dari data kelompok kedua,

misal: 1.membandingkan mean tekanan darah sistolik orang desa dengan orang kota.

2.Produksi susu pada ketinggian tempat beda

- B. Data dependen/pasangan : bila kelompok data yang dibandingkan datanya saling mempunyai ketergantungan,

misal : 1.Data BB sebelum dan sesudah mengikuti program diet

2.Kualitas daging kaki kanan-kaki kiri

Pengujian t student

- Pengujian untuk perbedaan dua harga rataan perlakuan yang dicobakan
- Umumnya digunakan apabila sampel yang diamati jumlahnya sedikit
- Digunakan apabila pada sampel A dan B yang diamati berasal dari populasi yang sama dengan ragam yg tidak diketahui

Katagori Pengujian

1. Pengujian t berpasangan
2. Pengujian t tidak berpasangan

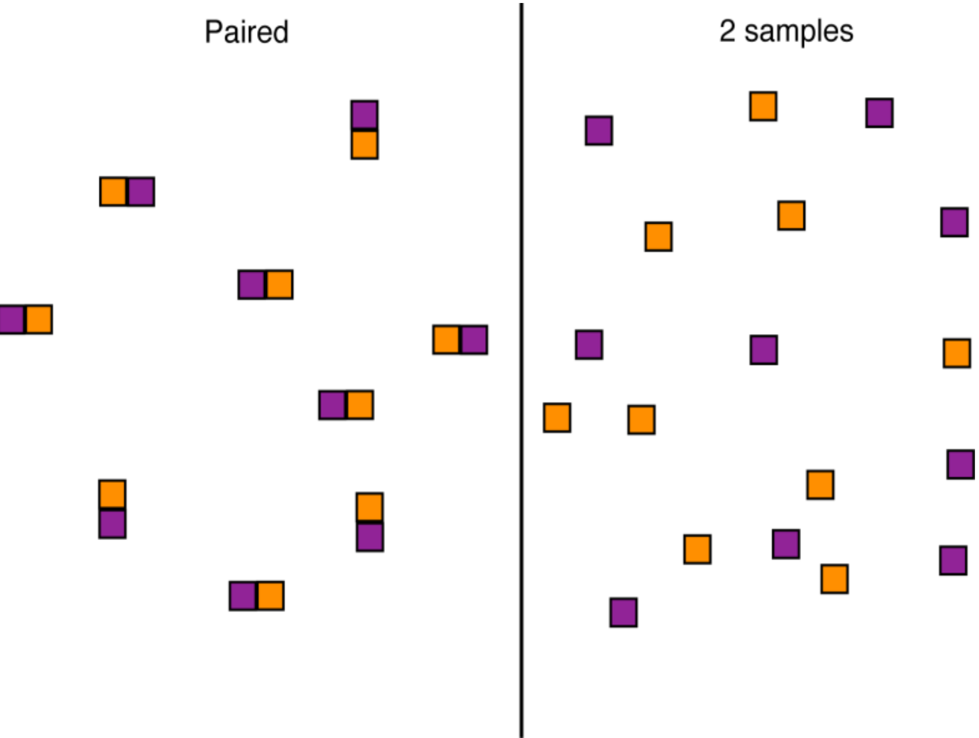
Pengujian tergantung pada bagaimana melakukan pengamatan dalam penelitian atau mendapatkan data dari penelitian.

T-Test :
Perbandingan dua nilai tengah (mean)

- Goal: to compare the mean of a numerical variable for different groups.
- Tests one categorical vs. one numerical variable

Example: gender (M, F) vs. height

Perbandingan :



Paired designs
(berpasangan)

- Data from the two groups are paired
- There is a one-to-one correspondence between the individuals in the two groups

Uji t dependen
(Paired Sampels T-Test)

- Untuk menguji perbedaan mean antara dua kelompok data yang dependen.
- Uji ini banyak digunakan untuk penelitian eksperimen.

Syarat/asumsi yang harus dipenuhi :

- Data berdistribusi normal/simetris
- Kedua kelompok data dependen
- Variabel yang dihubungkan berbentuk numerik untuk variabel dependen dan kategorik dengan hanya dua kelompok untuk variabel independen

Paired designs (Berpasangan)

- Each member of the pair shares much in common with the other, *except* for the tested categorical variable
- **Example: identical twins raised in different environments**
- Can use the same individual at different points in time
- Example sederhana: before, after medical treatment

Paired comparisons - setup

- We have many pairs
- In each pair, there is one member that has one treatment and another who has another treatment
- "Treatment" can mean "group"

- To compare two groups, we use the mean of the *difference* between the two members of each pair

STUDENT’S T TEST

•The student’s t test is used to see if to sets of data differ significantly.

•The method assumes that the results follow the normal distribution (also called student's t-distribution) if the null hypothesis is true.

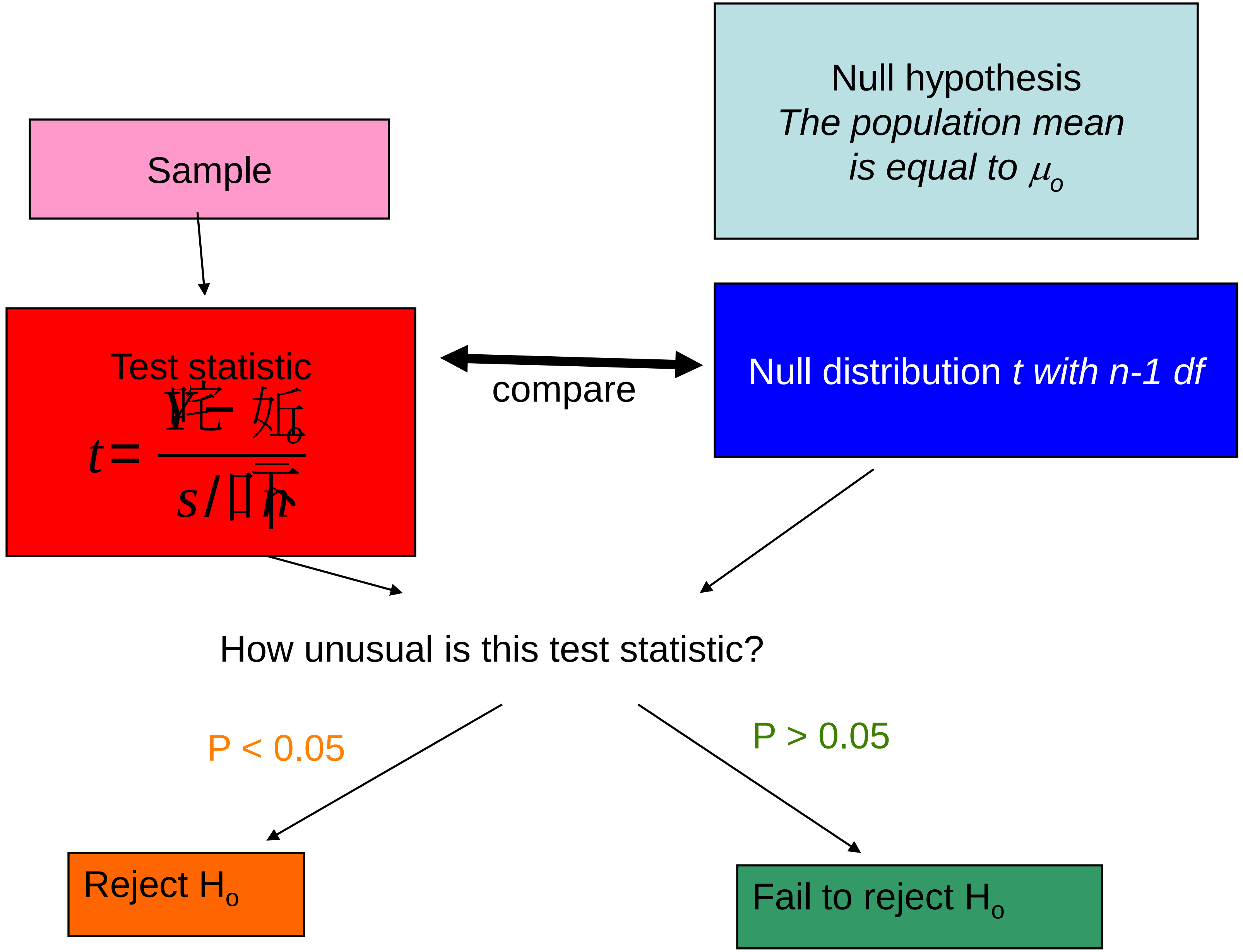
•This null hypothesis will usually stipulate that there is no significant difference between the means of the two data sets.

•It is best used to try and determine whether there is a difference between two independent sample groups. For the test to be applicable, the sample groups must be completely independent, and it is best used when the sample size is too small to use more advanced methods.

•Before using this type of test it is essential to plot the sample data from he two samples and make sure that it has a reasonably normal distribution, or the student’s t test will not be suitable.

• It is also desirable to randomly assign samples to the groups, wherever possible.

One-sample t-test



The Use of the Null Hypothesis

- Is the difference in two sample populations due to chance or a real statistical difference?
- The null hypothesis assumes that there will be no “difference” or no “change” or no “effect” of the experimental treatment.
- If treatment A is no better than treatment B then the null hypothesis is supported.
- If there is a significant difference between A and B then the null hypothesis is rejected...

- Test statistic > critical value
- P < alpha
- Reject the null hypothesis
- Statistically significant

Two Sample Difference of Means T-Test

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\left[\sqrt{\frac{(n_1 - 1)s_1^{\ 2} + (n_2 - 1)s_2^{\ 2}}{n_1 + n_2 - 2}} \left[\frac{n_1 + n_2}{n_1 n_2}\right]\right]}$$

Sp2 = $\frac{(n_1 - 1)s_1^{\ 2} + (n_2 - 1)s_2^{\ 2}}{n_1 + n_2 - 2}$ Pooled variance of the two groups

$$\left[\frac{n_1 + n_2}{n_1 n_2}\right]$$

= common standard deviation of two groups

The nominator of the equation captures difference in means,
while the denominator captures the variation within and between each group

Contoh

- Test on verbal test scores by gender:

Females: mean = 50.9, variance = 47.553,   n=6

Males: mean   =41.5, variance = 49.544,   n=10

$$t = \frac{50.9 - 41.5}{\left[\sqrt{\frac{(6-1)47.553 + (10-1)49.544}{6+10-2}}\left[\frac{6+10}{6(10)}\right]\right]}$$

$$t = \frac{9.4}{\left[\sqrt{48.826(.26667)}\right]} \qquad t = \frac{9.4}{\sqrt{13.02}} \qquad t = \frac{9.4}{3.608} = 2.605$$

Now what do we do with this obtained value?

Steps of Testing and Significance

1. Statement of null hypothesis: sesuai tujuan
2. Set Alpha Level of Risk: .10, .05, .01 (10 %, 5 %, 1 %) kepercayaan
3. Selection of appropriate test statistic: T-test. Lakukan perhitungan t test
4. Computation of statistical value: nilai t-test hitung.
5. Compare obtained value to critical value: bandingkan t hitung vs t tabel

Catatan:

6. Comparison of the obtained and critical values.
7. If obtained value is more extreme than critical value, you may reject the null hypothesis. In other words, you have significant results.
8. If point seven above is not true, obtained is lower than critical, then null is not rejected.

T table of values (5% = 0.05)

degrees of freedom	significance level 20%	10%	5%	2%	1%	0·1%
1	3·078	6·314	12·706	31·821	63·657	636·619
2	1·886	2·920	4·303	6·965	9·925	31·598
3	1·638	2·353	3·182	4·541	5·841	12·941
4	1·533	2·132	2·776	3·747	4·604	8·610
5	1·476	2·015	2·571	3·365	4·032	6·859
6	1·440	1·943	2·447	3·143	3·707	5·959
7	1·415	1·895	2·365	2·998	3·499	5·405
8	1·397	1·860	2·306	2·896	3·355	5·041
9	1·383	1·833	2·262	2·821	3·250	4·781
10	1·372	1·812	2·228	2·764	3·169	4·587
11	1·363	1·796	2·201	2·718	3·106	4·437
12	1·356	1·782	2·179	2·681	3·055	4·318
13	1·350	1·771	2·160	2·650	3·012	4·221
14	1·345	1·761	2·145	2·624	2·977	4·140
15	1·341	1·753	2·131	2·602	2·947	4·073
16	1·337	1·746	2·120	2·583	2·921	4·015
17	1·333	1·740	2·110	2·567	2·898	3·965
18	1·330	1·734	2·101	2·552	2·878	3·922
19	1·328	1·729	2·093	2·539	2·861	3·883
20	1·325	1·725	2·086	2·528	2·845	3·850
21	1·323	1·721	2·080	2·518	2·831	3·819
22	1·321	1·717	2·074	2·508	2·819	3·792
23	1·319	1·714	2·069	2·500	2·807	3·767
24	1·318	1·711	2·064	2·492	2·797	3·745
25	1·316	1·708	2·060	2·485	2·787	3·725
26	1·315	1·706	2·056	2·479	2·779	3·707
27	1·314	1·703	2·052	2·473	2·771	3·690
28	1·313	1·701	2·048	2·467	2·763	3·674
29	1·311	1·699	2·043	2·462	2·756	3·659
30	1·310	1·697	2·042	2·457	2·750	3·646
40	1·303	1·684	2·021	2·423	2·704	3·551
60	1·296	1·671	2·000	2·390	2·660	3·460
120	1·289	1·658	1·980	2·158	2·617	3·373
∞	1·282	1·645	1·960	2·326	2·576	3·291

For example:

For 10 degrees of freedom (2N-2)
The chart value to compare your t value to is 2.228

If your calculated t value is between +2.228 and -2.228
Then accept the null hypothesis the mean are similar

If your t value falls outside +2.228 and -2.228 (larger than 2.228 or smaller than -2.228)
Fail to reject the null hypothesis (accept the alternative hypothesis) there is a significant difference.

Contoh

- Pengamatan pada pemberian 2 macam ransum A dan B terhadap PBB anak kambing lepas sapih. Setiap pasang anak kambing dari satu induk diberi pakan yang berbeda yaitu RA dan RB, pada penelitian ini kemudian diulang pada pasangan anak kambing dari induk yang lain dan digunakan 10 pasang anak kambing lepas sapih.

Data PBB (gram/ekor/hari) selama penelitian sebagai berikut :

No	XA	XB	|XA - XB|
1	50	25	25
2	45	30	15
3	48	35	13
4	42	32	10
5	45	40	5
6	40	38	2
7	50	35	15
8	45	40	5
9	48	38	10
10	50	35	15

CARA HITUNG I:

t hitung dan t tabel

$$t_{hitung} = \frac{\left|\overline{D}\right|}{s/\sqrt{n}}$$

$$t_{tabel} = t_{(\alpha/2),(n-1)}$$

- Jika H_0 benar, maka kaidah keputusannya jika :
  - t hitung > t tabel maka H0 ditolak
  - T hitung < t tabel maka H0 diterima

$$\sum_{i=1}^{10} D_i = 25 + 15 + \ldots + 15 = 115$$

$$\overline{D} = 115/10 = 11{,}5$$

$$\sum_{i-1}^{10} D_i^2 = (25^2 + 15^2 + \ldots + 15^2) = 1723$$

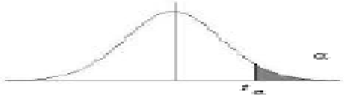
$$S^2 = \{1723 - (115)^2/10\}/10 - 1 = 44{,}5$$

$$S = \sqrt{44{,}5} = 6{,}6708$$

$$t_{hitung} = \frac{\overline{D}}{s/\sqrt{n}} = \frac{11{,}5}{6{,}6708/\sqrt{10}} = 5{,}4515$$

$$t_{tabel} : \alpha = 5\% \Leftrightarrow \alpha/2 = 2{,}5\% \rightarrow t$$

Table 4: Percentage Points of the t distribution



	α					
df	0.250	0.100	0.050	0.025	0.010	0.005
1	1.000	3.078	6.314	12.706	31.821	63.657
2	0.816	1.886	2.920	4.303	6.965	9.925
3	0.765	1.638	2.353	3.182	4.541	5.841
4	0.741	1.533	2.132	2.776	3.747	4.604
5	0.727	1.476	2.015	2.571	3.365	4.032
6	0.718	1.440	1.943	2.447	3.143	3.707
7	0.711	1.415	1.895	2.365	2.998	3.499
8	0.706	1.397	1.860	2.306	2.896	3.355
9	0.703	1.383	1.833	2.262	2.821	3.250
10	0.700	1.372	1.812	2.228	2.764	3.169
11	0.697	1.363	1.796	2.201	2.718	3.106
29	0.683	1.311	1.699	2.045	2.462	2.756
30	0.683	1.310	1.697	2.042	2.457	2.750
40	0.681	1.303	1.684	2.021	2.423	2.704
60	0.679	1.296	1.671	2.000	2.390	2.660
120	0.677	1.289	1.658	1.980	2.358	2.617
∞	0.674	1.282	1.645	1.960	2.326	2.576

- $H0 = \overline{XA} - \overline{XB} = 0$
- $H1 = \overline{XA} - \overline{XB} \neq 0$
- $\sum_{i=1}^{n} D_i = 115$
- $\bar{D} = (\sum_{i=1}^{n} D) / n = 115/10 = 11.5$
- $\sum_{i=1}^{n} D_i^2 = 1723$
- $s2 = \{ \sum_{i=1}^{n} Di\ 2 - (\sum_{i=1}^{n} Di)\ 2 / n \} / (n-1) = \{1723 - (1152 / 10)\} / (10-1) = 44.5$
- $s = \sqrt{s^2} = 6.6708$

CARA HITUNG II:

- t hitung $= \bar{D} / (s/\sqrt{n}) = 11.5 / (6.6708 / \sqrt{10}) = 5.4515$
- Alfa = 0,025→ t 0.975 (db=9) = 2.26
- Alfa = 0,005 → t 0.995 (db=9) = 3.25
- t hitung > t 0.01 (9) → Ho ditolak, H1 diterima
- Kesimpulan : pemberian 2 macam ransum pada anak kambing lepas sapih ternyata pengaruhnya berbeda yang sangat nyata terhadap PBB anak kambing.

CONTOH:

Rumus uji t

$$T = \frac{d}{Sd\_d \;/\; \sqrt{n}}$$

df = n - 1

d = rata-rata deviasi/selisih nilai sesudah dengan sebelum

SD_d = standar deviasi dari nilai d/selisih sampel 1 dan sampel 2

Contoh : Seorang peneliti ingin mengetahui pengaruh pemberian tablet Fe terhadap kadar Hb pada ibu hamil. Sebanyak 10 ibu hamil diberi tablet Fe dan diukur kadar Hb sebelum dan sesudah pemberian Fe. Hasil pengukuran sbb :

Sebelum : 12,2 11,3 14,7 11,4 11,5 12,7 11,2 12,1 13,3 10,8

Sesudah : 13,0 13,4 16,0 13,6 14,0 13,8 13,5 13,8 15,5 13,2

Buktikan apakah ada perbedaan kadar Hb antara sebelum dan sesudah pemberian tablet Fe, dengan alpha 5%

Jawab :

Hipotesis

Ho :δ=0 (tdk ada perbedaan kadar Hb sebelum dan sesudah pemberian Fe)

Ha : δ≠0 (ada perbedaan kadar Hb sebelum dan sesudah pemberian Fe)

Perhitungan uji t :

Sebelum : 12,2 11,3 14,7 11,4 11,5 12,7 11,2 12,1 13,3 10,8

Sesudah : 13,0 13,4 16,0 13,6 14,0 13,8 13,5 13,8 15,5 13,2

deviasi : 0,8 2,1 1,3 2,2 2,5 1,1 2,3 1,7 2,2 2,4

(jumlah deviasi = 18,6)

- rata-rata deviasi : 18,6/10 = 1,86
- Standar deviasi dari nilai deviasinya (SD_d)=0,60

$$t = \frac{d}{Sd\_d \,/\, \sqrt{n}} \qquad t = \frac{1,86}{0,60/\sqrt{10}}$$

t = 9,80

Kemudian dari nilai t tersebut dibandingkan dengan tabel t dengan df = n – 1 = 9

	.20	.10	.05	.01	-
1					
.					
9	1,383	1,833	2,262	3,250	

- Dari soal diatas didapat t=9,80, dan df=9 maka nilai t tabel adalah 2,26

- Keputusan uji statistik

  t hitung ≥ t tabel sehingga Ho ditolak

  t hitung < t tabel maka Ho diterima

  Jadi secara statistik ada perbedaan kadar Hb antara sebelum dan sesudah diberi tablet Fe