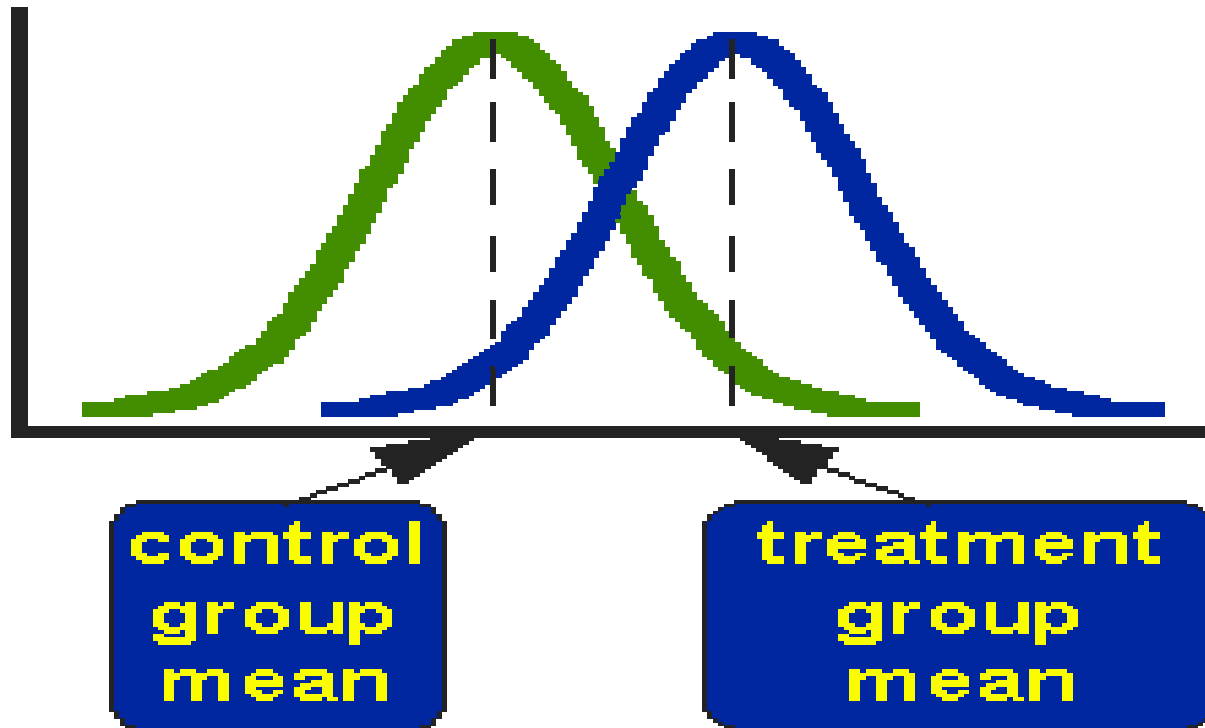
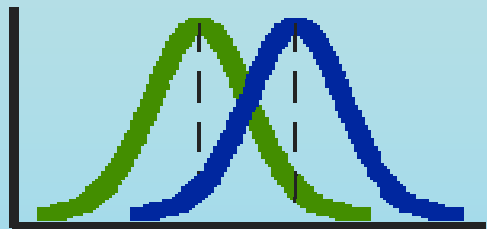


Comparing Means

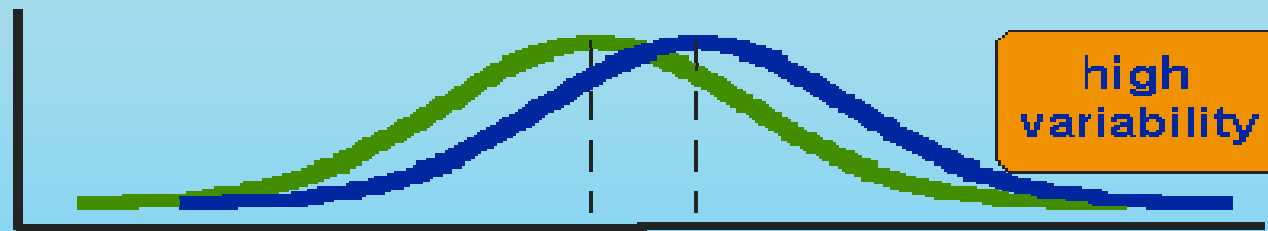


HERTANTO WAHYU SUBAGIO

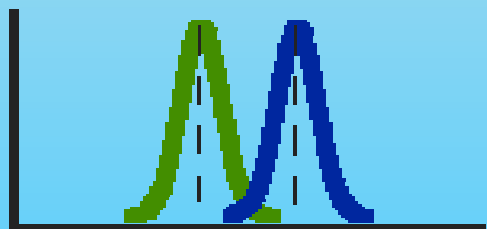
medium
variability



high
variability



low
variability



signal
noise

=

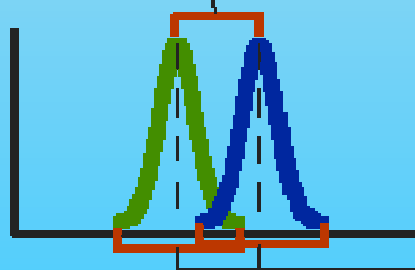
difference between group means
variability of groups

=

$$\frac{\bar{X}_T - \bar{X}_C}{SE(\bar{X}_T - \bar{X}_C)}$$

=

t-value



$$SE(\bar{X}_T - \bar{X}_C) = \sqrt{\frac{\text{var}_1}{(n_1 - 1)} + \frac{\text{var}_2}{(n_2 - 1)}}$$

$$t = \frac{\bar{X}_T - \bar{X}_C}{\sqrt{\frac{\text{var}_1}{(n_1 - 1)} + \frac{\text{var}_2}{(n_2 - 1)}}$$

Comparing means

- Significance test for a single means
 - paired t test
 - one sample t test
- Comparison of two means
 - independent t test
- Comparison of several means
 - analysis of variance (anova)

Paired t test

Is used to test whether the difference between a pair of variables measured on each individual is, on average, zero

Hours of sleep

Patient	Drug	Placebo	Difference
1	6.1	5.2	0.9
2	7.0	7.9	-0.9
3	8.2	3.9	4.3
4	7.6	4.7	2.9
5	6.5	5.3	1.2

etc.

Hypothesis :

There is no real difference in sleep time with the drug or the placebo.

(the true mean difference is zero)

Output paired t test SPSS

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	lama tidur dengan obat	7,0600	10	,8488	,2684
	lama tidur dengan plasebo	5,2800	10	1,2559	,3972

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	lama tidur dengan obat - lama tidur dengan plasebo	1,7800	1,7681	,5591	,5152	3,0448	3,184	9	,011

One sample t test

t test which tests whether a sample mean is different from some specified value, μ , which need not be zero

No. Height (cm)

1. 84,4
2. 80.6
3. 85.0
4. 89.9
5. 80.0
6. 82.5
7. 89.0
8. 81.3
9. etc.

Hypothesis :

The mean height of the samples is equal 86,5 cm (reference height) ?

Output one sample t test SPSS

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Tinggi badan (cm)	24	84,138	3,111	,635

One-Sample Test

	Test Value = 86.5					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Tinggi badan (cm)	-3,721	23	,001	-2,362	-3,676	-1,049

Independent t test

comparing two independent means

Birth weight

Non smokers	smokers
3.99	3.18
3.79	2.84
3.60	2.90
3.73	3.27
3.21	3.85
3.60	3.52
4.08	3.23
3.61	2.76
3.83	etc.
3.31	
etc.	

Hypothesis

There is no real difference in birth weight of the two groups (non smokers vs smokers)

Group Statistics

Ibu perokok ?	N	Mean	Std. Deviation	Std. Error Mean
BB lahir bayi (Kg) Bukan perokok	15	3,5933	,3707	9,573E-02
Perokok	14	3,2029	,4927	,1317

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means							
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
								Lower	Upper	
BB lahir bayi (Kg)	Equal variances assumed	2,009	,168	2,422	27	,022	,3905	,1612	974E-02	,7212
	Equal variances not assumed			2,399	24,117	,025	,3905	,1628	457E-02	,7264

analysis of variance

comparing several means

Haemoglobin level (g/dl)

Hb SS	Hb S	Hb SC
7.2	8.1	10.7
7.7	9.2	11.3
8.0	10.0	11.5
8.1	10.4	11.6
8.3	10.6	11.7
8.4	10.9	11.8
8.4	11.1	etc
etc	etc	

Hypothesis

There is no real difference in Hb level of the three groups

Output Anova SPSS

Descriptives

Kadar Hb

	N	Mean	Std. Deviation	Std. Error	% Confidence Interval		Minimum	Maximum
					Mean			
					Lower Bound	Upper Bound		
Hb SS	16	8,712	,844	,211	8,263	9,162	7,2	10,3
b thalaser	10	10,630	1,284	,406	9,711	11,549	8,1	12,1
Hb SC	15	12,300	,942	,243	11,778	12,822	10,7	13,9
Total	41	10,493	1,856	,290	9,907	11,079	7,2	13,9

Test of Homogeneity of Variances

Kadar Hb

Levene Statistic	df1	df2	Sig.
,902	2	38	,414

ANOVA

Kadar Hb

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	99,889	2	49,945	49,999	,000
Within Groups	37,959	38	,999		
Total	137,848	40			

Multiple Comparisons

Dependent Variable: Kadar Hb

Bonferroni

(I) tipe sickle cell diseas	(J) tipe sickle cell diseas	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Hb SS	b thalasemia	-1,918*	,403	,000	-2,927	-,908
	Hb SC	-3,588*	,359	,000	-4,487	-2,688
b thalasemia	Hb SS	1,918*	,403	,000	,908	2,927
	Hb SC	-1,670*	,408	,001	-2,692	-,648
Hb SC	Hb SS	3,588*	,359	,000	2,688	4,487
	b thalasemia	1,670*	,408	,001	,648	2,692

*. The mean difference is significant at the .05 level.