## Two sample T

1)

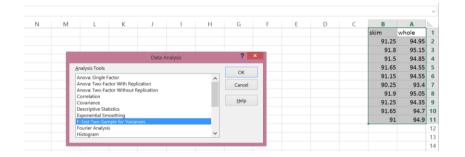
The phosphorus content was measured for independent samples of skim and whole

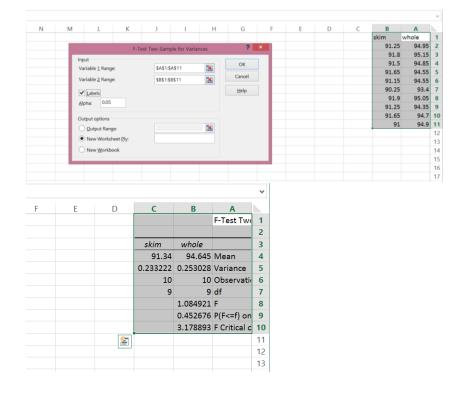
Whole: 94.95 95.15 94.85 94.55 94.55 93.40 95.05 94.35 94.70 94.90 Skim: 91.25 91.80 91.50 91.65 91.15 90.25 91.90 91.25 91.65 91.00 Assuming normal populations with equal variances

a) Test whether the average phosphorus content of skim milk is less than the average phosphorus content of whole milk. Use  $\alpha$ =0.01

1- Test for equality of variance

 $\begin{aligned} H_0: \sigma_{12} &= \sigma_{22} \\ H_1: \sigma_{12} \neq \sigma_{22} \end{aligned}$ 





**Conclusion:** As F  $\geq$  F Critical one-tail, we fail reject the null hypothesis. This is the case, 1.0849  $\geq$  3.1789. Therefore, we fail to reject the null hypothesis. The variances of the two populations are equal (p-value=0.4527  $\leq \alpha = 0.05$ )

(2- T test two samples for means assuming equal variance By Excel)

Data	Analysis <sub>Ran</sub>	– H Moving dom Number Ge	lysis Tools listogram Average	whole 94.95 95.15 94.85	skim 91.25 91.8	1 2 3
		– H Moving dom Number Ge	listogram Average	95.15	91.8	3
	Ran	– H Moving dom Number Ge	listogram Average			-
	Ran	Moving dom Number Ge	Average	94 85		
	Ran	dom Number Ge		01.00	91.5	4
				94.55	91.65	5
		Rank and F	Percentile	94.55	91.15	6
			Sampling	93.4	90.25	7
1.7				95.05	91.9	8
				94.35	91.25	9
*	z-Test	: Two Sample f	or Means	94.7	91.65	10
				94.9	91	11
						12
🎫 \$A\$1:\$A	\$11 \$11	: :Hypoth <u>e</u> sized C :Q :New V	In Variable <u>1</u> Ran Variable <u>2</u> Ran Mean Differer Labels 0.01 :Alp Output optio Output optio Output Range Vorksheet Ply	ge     ge     nce ()   ha     ha     ha       0     	Mean /ariance Dbservatio Pooled Var Hypothesiz df Stat P(T<=t) on Critical or P(T<=t) tw	ins riand red l ne-ta ne-ta
	t-Test: Tw est: Two-Sa \$4\$1:\$A \$5\$1:\$B 0	t-Test: Two-Sample Assu t-Test: Two-Sample Assu rest: Two-Sample Assu statistical statistical stati	t-Test: Paired Two Sample Assuming Lead   t-Test: Two-Sample Assuming Lead   t-Test: Two-Sample Assuming Lead   rest: Two-Sample Assuming Lead   fest: Sastisastin   fest: \$8\$\$1:\$8\$11   fest: \$8\$\$1:\$8\$\$11   fest: Hypothesized   fest: ::   fest: ::   fest: ::   fest: ::   fest: ::   fest: :   :: <td::< td="">   ::</td::<>	t-Test: Two-Sample Assuming Equal Variances t-Test: Two-Sample Assuming Unequal Variances t-Test: Two-Sample Assuming Unequal Variances z-Test: Two Sample for Means	t-Test: Paired Two Sample for Means t-Test: Two-Sample Assuming Couel Variances y4.35 94.35 94.7 94.9 est: Two-Sample Assuming Logual Variances y4.7 94.9 est: Two-Sample Assuming Equal Variances Input Sasti:Sasti Sasti:Sasti :Variable 1 Range Sasti:Sasti :Variable 2 Range 0 ::Hypothesized Mean Difference Labels 0 0.01 :Alpha Output options :Qutput Range :New Worksheet Ply 0 New Workbook 0	t-Test: Paired Two Sample for Means t-Test: Two-Sample Assuming Equal Variances z-Test: Two Sample Assuming Equal Variances yet. Test: Two Sample Assuming Equal Variances t-Test: Two Sample Assuming Equal Variances yet. Test: Two trest: Two-Sample Assuming Equal Variances yet. Test: Two trest: Two trest: Two-Sample Assuming Equal Variances yet. Test: Two trest: Trest: Two tr

	skim	whole
Mean	91.34	94.645
Variance	0.233222	0.253028
Observations	10	10
Pooled Variance	0.243125	
Hypothesized Mean Difference	0	
df	18	
t Stat	-14.9879	
P(T<=t) one-tail	6.53E-12	
t Critical one-tail	2.55238	
P(T<=t) two-tail	1.31E-11	
t Critical two-tail	2.87844	

- 1- Test hypothesis:
- $H_0: \mu_2 \ge \mu_1$
- $H_1: \mu_2 < \mu_1$
- 2- T stat = -14.9879
- 3- T critical one tail = 2.55238
- 4- **Conclusion:** We do a one-tail test . If t Stat < -t Critical one-tail, we reject the null hypothesis. As -14.9879 < -2.55238 (p-value=0.00000653< $\alpha$ =0.01). Therefore, we reject the null hypothesis

5- Independent random samples of 17 sophomores and 13 juniors attending a la university yield the following data on grade point averages:					
	Sophomores	Juniors			

Sophomores			Juniors			
3.04	2.92	2.86	2.56	3.47	2.65	
1.71	3.60	3.49	2.77	3.26	3.00	
3.30	2.28	3.11	2.70	3.20	3.39	
2.88	2.82	2.13	3.00	3.19	2.58	
2.11	3.03	3.27	2.98			
2.60	3.13					

Assuming normal population. At the 5% significance level, do the data provide sufficient evidence to conclude that the mean GPAs of sophomores and juniors at the university different ?

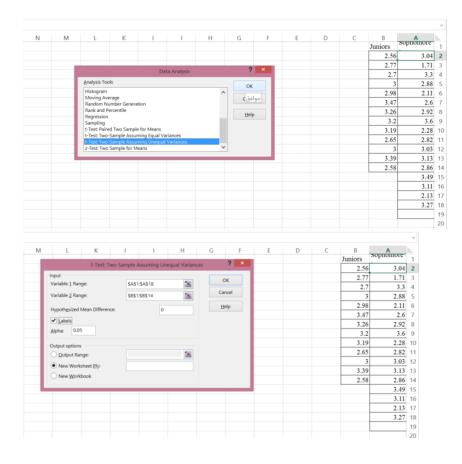
1- Test for equality of variance

$$H_0: \sigma_{12} = \sigma_{22}$$
$$H_1: \sigma_{12} \neq \sigma_{22}$$

F-Test Two-Sample for Variances

Juniors	Sophomores	
2.980769231	2.84	Mean
0.095641026	0.270225	Variance
13	17	Observations
12	16	df
	2.825408847	F
		P(F<=f) one-
	0.037332216	tail
		F Critical
	2.598881158	one-tail

**Conclusion:** As F > F Critical one-tail, we reject the null hypothesis. Therefore, reject the null hypothesis. The variances of the two populations are unequal (p-value= $0.03733 < \alpha = 0.05$ ) 2- T test two samples for means assuming unequal variance By Excel



t-Test: Two-Sample Assuming Unequal Variances

Juniors	Sophomores	
2.980769231	2.84	Mean
0.095641026	0.270225	Variance
13	17	Observations
	0	Hypothesized Mean Difference
	27	df
	<mark>-0.923149563</mark>	<mark>t Stat</mark>
	0.182052992	P(T<=t) one-tail
	1.703288446	t Critical one-tail
	<mark>0.364105983</mark>	P(T<=t) two-tail
	<mark>2.051830516</mark>	t Critical two-tail

## 1. Test hypothesis:

 $H_0 {:}\, \mu_2 = \mu_1$ 

 $H_1\!:\!\mu_2\neq\mu_1$ 

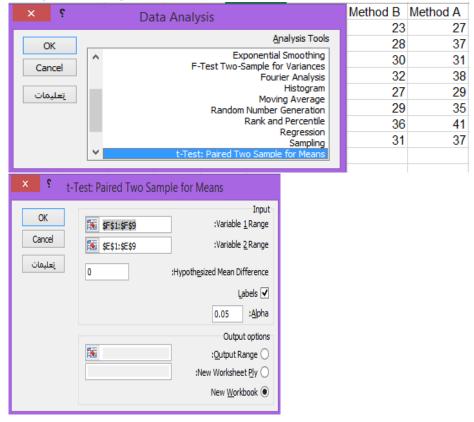
- 2. T stat = -0.9231
- 3. T critical two tail = 2.05183
- 4. **Conclusion:** We do a two-tail test (inequality). If t Stat < -t Critical two-tail or t Stat > t Critical two-tail, we reject the null hypothesis. This is not the case, 2.05183< -0.9231 < 2.05183. Therefore, we do not reject the null hypothesis (p-value=0.3641 $\lt \alpha = 0.05$ )

8- In an experiment comparing 2 feeding methods for caves, eight pairs of twins were used – one twin receiving Method A and other twin receiving Method B. At the end of a given time, the calves were slaughtered and cooked, and the meat was rated for its taste ( with a higher number indicating a better taste):

Twin pair	Method A	Method B
1	27	23
2	37	28
3	31	30
4	38	32
5	29	27
6	35	29
7	41	36
8	37	31

Assuming approximate normality, test if the average taste score for calves fed by Method B is less than the average taste foe calves fed by Method A. Use  $\alpha$ =0.05.

(T test parried two samples for means By Excel)



3-

method a	method b	
34.375	29.5	Mean
23.69642857	14.57142857	Variance
8	8	Observations
	0.857204246	Pearson Correlation
	0	Hypothesized Mean Difference
	7	df
	-5.445859126	t Stat
	0.000480113	P(T<=t) one-tail
	1.894578605	t Critical one-tail
	0.000960226	P(T<=t) two-tail
	2.364624252	t Critical two-tail

t-Test: Paired Two Sample for Means

1. Test hypothesis:

$$H_0: \mu_b \ge \mu_a$$
$$H_1: \mu_b < \mu_a$$

- 2. T stat = -5.44585
- 3. T critical one tail = 1.89457
- 4. **Conclusion:** We do a one-tail test . If t Stat < -t Critical one-tail, we reject the null hypothesis.As -5.44585< -1.89457 (p-value= $0.00048 < \alpha = 0.05$ ). Therefore, we reject the null hypothesis

## PEARSON CORRELATION COEFFICIENT

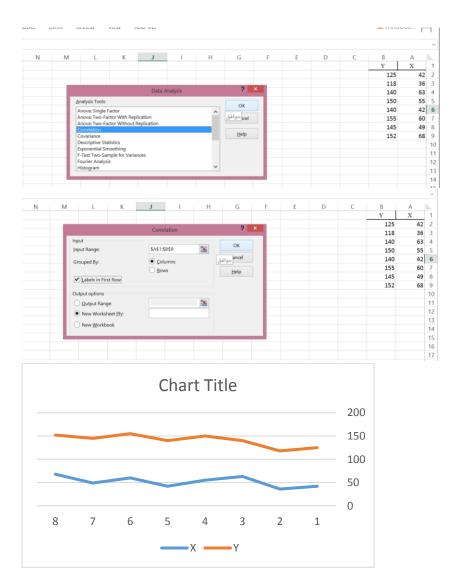
4) We have the table illustrates the age X and blood pressure Y for eight female.

68	49	60	42	55	63	36	42	Х
152	145	155	140	150	140	118	125	Y

Find:

	By Excel
	(using (fx) and (Data Analysis))
Correlation=0.791832	CORREL(M3:M10;N3:N10)

## Positive correlation between x and y



Ten Corvettes between 1 and 6 years old were randomly selected from last year's sales records in Virginia Beach, Virginia. The following data were obtained, where x denotes age, in years, and y denotes sales price, in hundreds of dollars.

x	6	6	6	4	2	5	4	5	1	2
у	125	115	130	160	219	150	190	163	260	260

a) Determine the regression equation for the data.

b) Compute and interpret the coefficient of determination,  $r^2$ .

c) Obtain a point estimate for the mean sales price of all 4-year-old Corvettes. (Linear regression by Excel)

Y		Х	W	V	U	Т	S	R	Q	<b>b</b> .
×	\$		Data /	alysis			у	х		1
			Data P	Marysis			125	6		2
O	<b>(</b>				<u>A</u> naly	sis Tools	115	6		3
	_	~		Exponential Smoothing			130	6		4
Can	cel			F-lest Iw	o-Sample for Va Fourier A		160	4		5
يمات	le:				His	togram	219	2		6
000	<u>inso</u>			Rand	Moving A om Number Gen		150	5		7
		_			Rank and Pe	rcentile	190	4		8
						ression ampling	163	5		9
		~		t-Test: Paired	Two Sample for		260	1		10
							260	2		11
										12

? ×	Regression	
OK Cancel تعليمات	\$\$\$\$1:\$\$\$11     \$\$\$\$\$1:\$\$\$\$11     \$	Input :Input <u>Y</u> Range :Input <u>X</u> Range Labels ✔ :Confidence Level □
		Output options :Output Range () :New Worksheet Ply () New Workbook () Residuals Residuals () Standardized Residuals () Normal Probability Normal Probability Plots ()

5)

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Г							
Statistics							
0.967871585							
0.936775406							
0.928872332							
14.24652913							
10							
df	SS	MS	F	Significance F			
1	24057.89126	24057.89	118.533	4.48427E-06			
8	1623.708738	202.9636					
9	25681.6						
Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
291.6019417	11.43289905	25.50551	5.98E-09	265.2376293	317.9662542	265.2376293	317.9662542
-27.90291262	2.562889198	-10.8873	4.48E-06	-33.81294571	-21.99287953	-33.81294571	-21,9928795
	Statistics     0.967871585     0.936775406     0.928872332     14.24652913     10     df     0     0f     1     8     9     Coefficients     291.6019417	Statistics     0.967871585     0.936775406     0.928872332     14.24652913     10     df     SS     1     24057.89126     8     1623.708738     9     25681.6     Coefficients     Standard Error     291.6019417	Image: Statistics   Image: Statistics     0.967871585   Image: Statistics     0.936775406   Image: Statistics     0.928872332   Image: Statistics     14.24652913   Image: Statistics     10   Image: Statistics     10   Image: Statistics     11   24057.89126   24057.89     12   24057.89126   24057.89     12   24057.89126   24057.89     9   25681.6   Image: Statistics     Coefficients   Standard Error   t Stat     291.6019417   11.43289905   25.50551	Image: Statistics   Image: Statistics     0.967871585   Image: Statistics     0.936775406   Image: Statistics     0.928872332   Image: Statistics     10   Image: Statistics     10   Image: Statistics     10   Image: Statistics     11   24057.89126     24057.89126   24057.89     11   24057.89126     202.9636   Image: Statistics     10   Image: Statistics     11   24057.89126     24057.89126   24057.89     11   24057.89126     202.9636   Image: Statistics     10   Image: Statistics     11   24057.89     12   24057.89     13   1623.708738     202.9636   Image: Statistics     14   11.43289905     25.50551   5.98E-09	Image: Statistics   Image: Statistics   Image: Statistics     0.967871585   Image: Statistics   Image: Statistics     0.936775406   Image: Statistics   Image: Statistics     0.928872332   Image: Statistics   Image: Statistics     10   Image: Statistics   Image: Statistics     10   Image: Statistics   Image: Statistics     10   Image: Statistics   Image: Statistics     11   24057.89126   24057.89     12   24057.89126   24057.89     13   24057.89126   24057.89     14   24057.89126   24057.89     15   1623.708738   202.9636     9   25681.6   Image: Statistics     10   Image: Statistics   Image: Statistics     11.43289905   25.50551   5.98E-09   265.2376293	Statistics   Image: Constraint of the system of	Image: Statistics   Image: Statistics

a)  $\hat{y} = 291.6019 - 27.9029x$ 

For every unit in x we expect that y to decrease by 27.9029

b) R<sup>2</sup>=0.9367

93.67% of the variation in y data is explained by x

c) c)  $\hat{y} = 291.6019 - 27.9029(4) = 180$