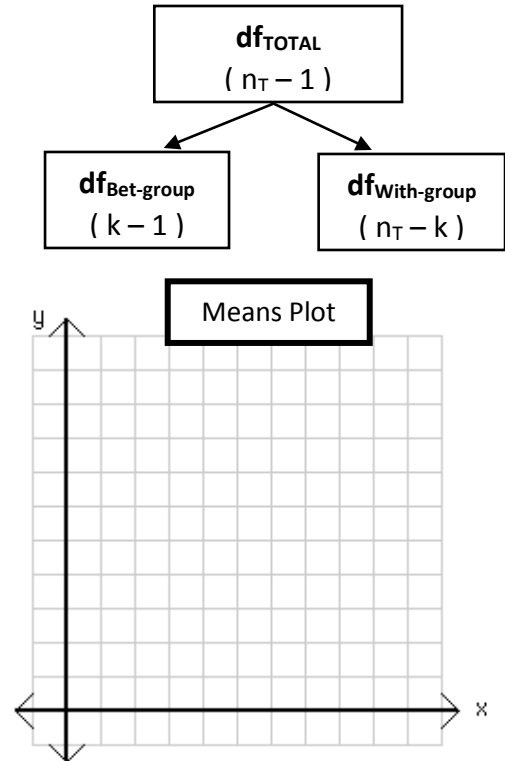
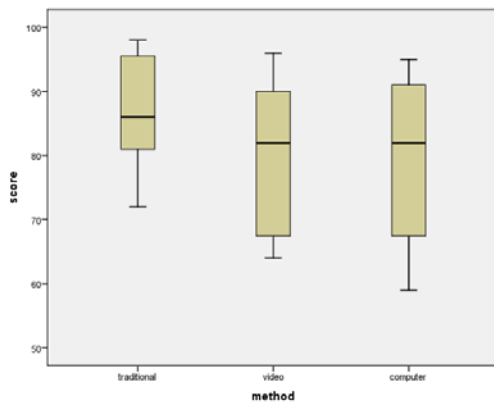


# 1-way Independent ANOVA

n = \_\_\_\_\_  
K = \_\_\_\_\_  
n<sub>T</sub> = \_\_\_\_\_

Setup: Started with 24 subjects, randomly divided them equally into three groups.  
Each group was taught with a different method.

Traditional	Video	Computer
72	69	63
83	66	72
96	78	78
79	64	59
83	96	89
95	87	93
89	93	86
98	86	95
M <sub>Trad</sub> = 86.875 S <sub>Trad</sub> = 9.1875	M <sub>Vid</sub> = 79.875 S <sub>Vid</sub> = 12.4607	M <sub>Comp</sub> = 79.375 S <sub>Comp</sub> = 13.6585



Source	SS	df	MS	F	p
Between-Groups					
Within-Groups ( <b>Residual</b> )					
Total					

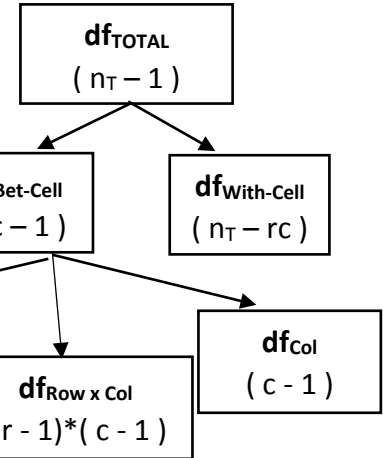
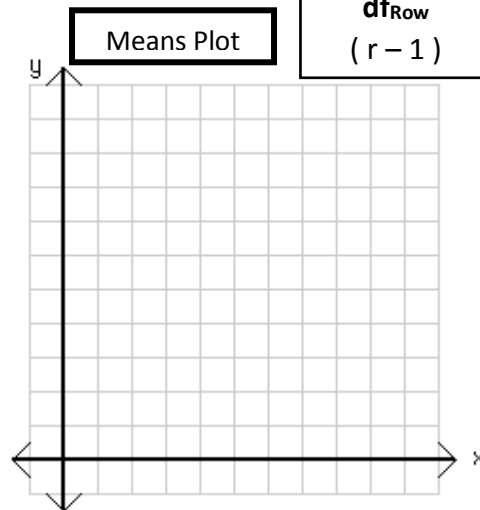
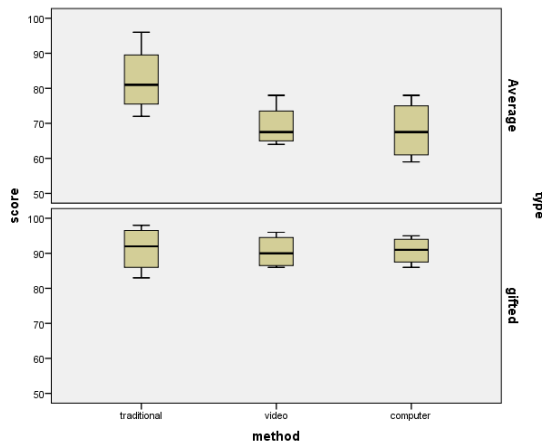
$F_{crit}(\_, \_) = \_$

## 2-way Independent ANOVA

Setup: Started with 24 subjects; half are gifted .  
Randomly divided each set of 12 them into three equal groups.  
Each group was taught with a different method.

n = \_\_\_\_  
c = \_\_\_\_  
r = \_\_\_\_  
n<sub>T</sub> = \_\_\_\_

	Traditional	Video	Computer	
Average	72	69	63	M <sub>Dep</sub> = 73.25
	83    M = 82.5	66    M = 69.25	72    M = 68	
	96    S = 10.083	78    S = 6.1847	78    S = 8.6023	
	79	64	59	
Gifted	83	96	89	M <sub>Not</sub> = 90.8333
	95    M = 91.25	87    M = 90.5	93    M = 90.75	
	89    S = 6.6521	93    S = 4.7958	86    S = 4.0311	
	98	86	95	
	M <sub>Trad</sub> = 86.875	M <sub>Vid</sub> = 79.875	M <sub>Comp</sub> = 79.375	M <sub>Grand</sub> = 82.0417



Source	SS	Df	MS	F	p
Between-Cells					
Row Groups					
Column Groups					
INTER (Row x Col)					
Within-Cells ( <b>Residual</b> )					
Total					

$F_{crit}(\_, \_) = \_$   
 $F_{crit}(\_, \_) = \_$

## **SPSS: 1-way independent ANOVA (just method type)**

ONEWAY score BY method.

### **ANOVA**

Score

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	281.333	2	140.667	.990	.388
Within Groups	2983.625	21	142.077		
Total	3264.958	23			

---

UNIANOVA score BY method.

### **Tests of Between-Subjects Effects**

Dependent Variable: score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	281.333 <sup>a</sup>	2	140.667	.990	.388
Intercept	161540.042	1	161540.042	1136.986	.000
method	281.333	2	140.667	.990	.388
Error	2983.625	21	142.077		
Total	164805.000	24			
Corrected Total	3264.958	23			

a. R Squared = .086 (Adjusted R Squared = -.001)

ONEWAY score BY method  
 /CONTRAST 1 -1 -1  
 /STATISTICS DESCRIPTIVES HOMOGENEITY  
 /PLOT MEANS  
 /MISSING ANALYSIS  
 /POSTHOC LSD BONFERRONI ALPHA(0.05).

#### Descriptives

score

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1 traditional	8	86.88	9.188	3.248	79.19	94.56	72	98
2 video	8	79.88	12.461	4.406	69.46	90.29	64	96
3 computer	8	79.38	13.658	4.829	67.96	90.79	59	95
Total	24	82.04	11.914	2.432	77.01	87.07	59	98

#### Test of Homogeneity of Variances

score

Levene Statistic	df1	df2	Sig.
1.140	2	21	.339

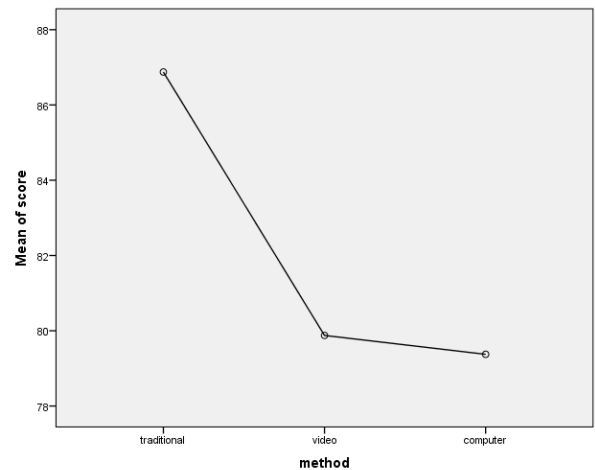
#### ANOVA

score

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	281.333	2	140.667	.990	.388
Within Groups	2983.625	21	142.077		
Total	3264.958	23			

#### Contrast Coefficients

Contrast	method		
	1 traditional	2 video	3 computer
1	1	-1	-1



#### Contrast Tests

		Contrast	Value of Contrast	Std. Error	t	df	Sig. (2-tailed)
score	Assume equal variances	1	-72.38 <sup>a</sup>	7.299	-9.915	21	.000
	Does not assume equal variances	1	-72.38 <sup>a</sup>	7.299	-9.915	19.258	.000

a. The sum of the contrast coefficients is not zero.

## Post Hoc Tests

#### Multiple Comparisons

Dependent Variable: score

	(I) method	(J) method	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
LSD	1 traditional	2 video	7.000	5.960	.253	-5.39	19.39
		3 computer	7.500	5.960	.222	-4.89	19.89
	2 video	1 traditional	-7.000	5.960	.253	-19.39	5.39
		3 computer	.500	5.960	.934	-11.89	12.89
	3 computer	1 traditional	-7.500	5.960	.222	-19.89	4.89
		2 video	-.500	5.960	.934	-12.89	11.89
Bonferroni	1 traditional	2 video	7.000	5.960	.760	-8.50	22.50
		3 computer	7.500	5.960	.666	-8.00	23.00
	2 video	1 traditional	-7.000	5.960	.760	-22.50	8.50
		3 computer	.500	5.960	1.000	-15.00	16.00
	3 computer	1 traditional	-7.500	5.960	.666	-23.00	8.00
		2 video	-.500	5.960	1.000	-16.00	15.00

## **SPSS: 2-way independent ANOVA (avg/gifted & mehtod type)**

UNIANOVA score BY type method.

### **Tests of Between-Subjects Effects**

Dependent Variable: score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2372.708 <sup>a</sup>	5	474.542	9.573	.000
Intercept	161540.042	1	161540.042	3258.863	.000
type	1855.042	1	1855.042	37.423	.000
method	281.333	2	140.667	2.838	.085
type * method	236.333	2	118.167	2.384	.121
Error	892.250	18	49.569		
Total	164805.000	24			
Corrected Total	3264.958	23			

a. R Squared = .727 (Adjusted R Squared = .651)

# UNIANOVA score BY type method

/POSTHOC method(LSD)

/POSTHOC type

/PLOT PROFILE(method\*type)

/EMMEANS TABLES(type) COMPARE

/EMMEANS TABLES(method) COMPARE

/EMMEANS TABLES(type\*method) COMPARE (method)

/PRINT OPOWER ETASQ HOMOGENEITY DESCRIPTIVE

/CRITERIA=ALPHA(.05)

/DESIGN type method type\*method.

## Descriptive Statistics

Dependent Variable: score

type	method	Mean	Std. Deviation	N
1 Average	1 traditional	82.50	10.083	4
	2 video	69.25	6.185	4
	3 computer	68.00	8.602	4
	Total	73.25	10.261	12
2 gifted	1 traditional	91.25	6.652	4
	2 video	90.50	4.796	4
	3 computer	90.75	4.031	4
	Total	90.83	4.783	12
Total	1 traditional	86.88	9.188	8
	2 video	79.87	12.461	8
	3 computer	79.38	13.658	8
	Total	82.04	11.914	24

## Levene's Test of Equality of Error Variances<sup>a</sup>

Dependent Variable: score

F	df1	df2	Sig.
.861	5	18	.526

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + type + method + type \* method

## Tests of Between-Subjects Effects

Dependent Variable: score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power <sup>b</sup>
Corrected Model	2372.708 <sup>a</sup>	5	474.542	9.573	.000	.727	47.866	.999
Intercept	161540.042	1	161540.042	3258.863	.000	.995	3258.863	1.000
type	1855.042	1	1855.042	37.423	.000	.675	37.423	1.000
method	281.333	2	140.667	2.838	.085	.240	5.676	.486
type * method	236.333	2	118.167	2.384	.121	.209	4.768	.418
Error	892.250	18	49.569					
Total	164805.000	24						
Corrected Total	3264.958	23						

a. R Squared = .727 (Adjusted R Squared = .651)

b. Computed using alpha = .05

## Estimated Marginal Means

### 1. type

#### Estimates

Dependent Variable: score

type	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1 Average	73.250	2.032	68.980	77.520
2 gifted	90.833	2.032	86.563	95.103

#### Pairwise Comparisons

Dependent Variable: score

(I) type	(J) type	Mean Difference (I-J)	Std. Error	Sig. <sup>b</sup>	95% Confidence Interval for Difference <sup>b</sup>	
					Lower Bound	Upper Bound
1 Average	2 gifted	-17.583 <sup>*</sup>	2.874	.000	-23.622	-11.545
2 gifted	1 Average	17.583 <sup>*</sup>	2.874	.000	11.545	23.622

Based on estimated marginal means

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

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

#### Univariate Tests

Dependent Variable: score

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power <sup>a</sup>
Contrast	1855.042	1	1855.042	37.423	.000	.675	37.423	1.000
Error	892.250	18	49.569					

The F tests the effect of type. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

## 2. method

### Estimates

Dependent Variable: score

method	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1 traditional	86.875	2.489	81.645	92.105
2 video	79.875	2.489	74.645	85.105
3 computer	79.375	2.489	74.145	84.605

### Pairwise Comparisons

Dependent Variable: score

(I) method	(J) method	Mean Difference (I-J)	Std. Error	Sig. <sup>b</sup>	95% Confidence Interval for Difference <sup>b</sup>	
					Lower Bound	Upper Bound
1 traditional	2 video	7.000	3.520	.062	-.396	14.396
	3 computer	7.500*	3.520	.047	.104	14.896
2 video	1 traditional	-7.000	3.520	.062	-14.396	.396
	3 computer	.500	3.520	.889	-6.896	7.896
3 computer	1 traditional	-7.500*	3.520	.047	-14.896	-.104
	2 video	-.500	3.520	.889	-7.896	6.896

Based on estimated marginal means

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

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

### Univariate Tests

Dependent Variable: score

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power <sup>a</sup>
Contrast	281.333	2	140.667	2.838	.085	.240	5.676	.486
Error	892.250	18	49.569					

The F tests the effect of method. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05



### 3. type \* method

#### Estimates

Dependent Variable: score

type	method	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
1 Average	1 traditional	82.500	3.520	75.104	89.896
	2 video	69.250	3.520	61.854	76.646
	3 computer	68.000	3.520	60.604	75.396
2 gifted	1 traditional	91.250	3.520	83.854	98.646
	2 video	90.500	3.520	83.104	97.896
	3 computer	90.750	3.520	83.354	98.146

#### Pairwise Comparisons

Dependent Variable: score

type	(I) method	(J) method	Mean Difference (I-J)	Std. Error	Sig. <sup>b</sup>	95% Confidence Interval for Difference <sup>b</sup>	
						Lower Bound	Upper Bound
1 Average	1 traditional	2 video	13.250 <sup>*</sup>	4.978	.016	2.791	23.709
		3 computer	14.500 <sup>*</sup>	4.978	.009	4.041	24.959
	2 video	1 traditional	-13.250 <sup>*</sup>	4.978	.016	-23.709	-2.791
		3 computer	1.250	4.978	.805	-9.209	11.709
	3 computer	1 traditional	-14.500 <sup>*</sup>	4.978	.009	-24.959	-4.041
		2 video	-1.250	4.978	.805	-11.709	9.209
2 gifted	1 traditional	2 video	.750	4.978	.882	-9.709	11.209
		3 computer	.500	4.978	.921	-9.959	10.959
	2 video	1 traditional	-.750	4.978	.882	-11.209	9.709
		3 computer	-.250	4.978	.961	-10.709	10.209
	3 computer	1 traditional	-.500	4.978	.921	-10.959	9.959
		2 video	.250	4.978	.961	-10.209	10.709

Based on estimated marginal means

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

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

#### Univariate Tests

Dependent Variable: score

type		Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power <sup>a</sup>
1 Average	Contrast	516.500	2	258.250	5.210	.016	.367	10.420	.760
	Error	892.250	18	49.569					
2 gifted	Contrast	1.167	2	.583	.012	.988	.001	.024	.052
	Error	892.250	18	49.569					

Each F tests the simple effects of method within each level combination of the other effects shown. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

Post Hoc Tests

method

Multiple Comparisons

Dependent Variable: score  
LSD

(I) method	(J) method	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1 traditional	2 video	7.00	3.520	.062	-.40	14.40
	3 computer	7.50*	3.520	.047	.10	14.90
2 video	1 traditional	-7.00	3.520	.062	-14.40	.40
	3 computer	.50	3.520	.889	-6.90	7.90
3 computer	1 traditional	-7.50*	3.520	.047	-14.90	-.10
	2 video	-.50	3.520	.889	-7.90	6.90

Based on observed means.  
The error term is Mean Square(Error) = 49.569.  
\*. The mean difference is significant at the .05 level.

Profile Plots

