

Análisis estadístico con Jamovi

Parte III: Pruebas de Hipótesis

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Población

Pregunta
Científica

Pregunta
Estadística

Muestreo

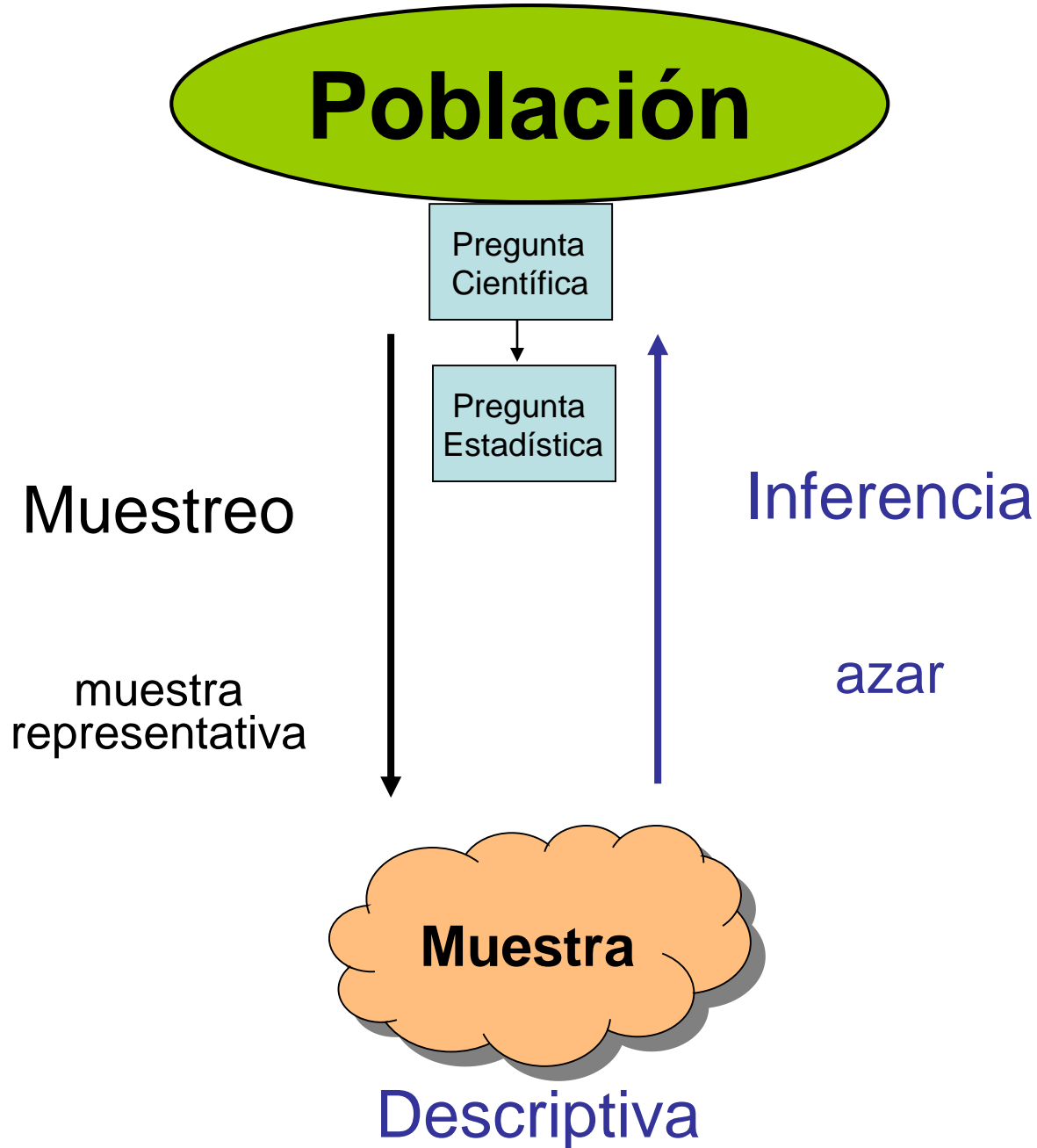
muestra
representativa

Inferencia

azar

Muestra

Descriptiva



Tests para datos categóricos (Chi-cuadrado)

Pulso, ejercicio físico y fármaco

Factores que se asocian al aumento de la frecuencia cardiaca (pulso.txt)

- IB: Número de identificación
- Sexo: 1=Hombre; 2=Mujer
- Fumador: 1=sí; 2=no
- Edad: Edad en años
- FC1: Frecuencia cardiaca antes del ejercicio
- FC2: Frecuencia cardiaca después del ejercicio
- FC2FC1 : Incremento de la frecuencia cardiaca
- Status : Nivel de entrenamiento físico 1, 2 ó 3
- Farmaco : 1=Fármaco1; 2=Fármaco2

Pulso, ejercicio físico y fármaco

- HIPÓTESIS: Sospecho que en mi población la prevalencia de fumadores es menor que en la población general ($\pi=0.3$)
- PREGUNTA CIENTÍFICA: ¿La prevalencia de fumadores es de 0.3?
- PREGUNTA ESTADÍSTICA:
 - $H_0: \pi=0.3$
- MUESTRA: la que hay en 'pulso.txt'

Estadístico: Una proporción

Contraste de hipótesis (1 proporción)

- Un 30% de la muestra es fumador:

$$H_0: \pi = 0,3$$

- Veamos cómo obtener el p-valor del test

Cálculo del P-valor

The screenshot shows a statistical software interface with a blue header bar. The 'Analyses' tab is selected, displaying icons for Exploration, T-Tests, ANOVA, Regression, Frequencies, and Factor. A red arrow points from the 'Regression' icon to a dropdown menu. The menu lists several test categories: 'One Sample Proportion Tests' (with sub-items '2 Outcomes' and 'N Outcomes'), 'Contingency Tables', 'Independent Samples', 'Paired Samples', and 'Log-Linear Regression'. The background data table has columns 'EDAD', 'FC1', 'FC2', and 'FARMACO'.

	EDAD	FC1	FC2	FARMACO
1	22.6	96	155	1
2	20.0	78	154	2
3	21.6	76	148	1
4	21.4	62	132	2
5	24.5	80	126	1
6	22.1	66	132	2
7	22.5	88	156	1
8	24.4	90	138	2
9	19.5	76	158	1
10	23.0	90	144	1
11	22.8	86	144	2
12	23.3	80	136	1
13	25.4	92	134	1

Cálculo del P-valor

Proportion Test (2 Outcomes)

IB

SEXO

EDAD

FC1

FC2

FC2FC1

STATUS

FARMACO

→

FUMADOR

☐ Values are counts

Test value

Hypothesis

☒ \neq Test value

☐ $>$ Test value

☐ $<$ Test value

Additional Statistics

☐ Confidence intervals

Interval %

Cálculo del P-valor

Proportion Test (2 Outcomes)

Binomial Test

	Level	Count	Total	Proportion	p
FUMADOR	1	16	40	0.400	0.268
	2	24	40	0.600	0.268

Note. H_a is proportion $\neq 0.5$



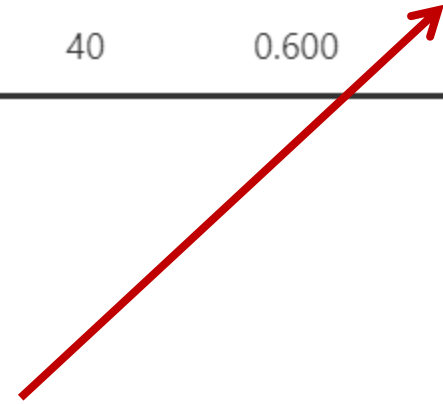
Cálculo del P-valor

Proportion Test (2 Outcomes)

Binomial Test

	Level	Count	Total	Proportion	p
FUMADOR	1	16	40	0.400	0.170
	2	24	40	0.600	< .001

Note. H_a is proportion $\neq 0.3$



Dos variables categóricas

- ¿La proporción de fumadores es igual en hombres que en mujeres?
- Dos variables categóricas:
 - Fumadores ('Si' y 'No')
 - Sexo (Hombre y Mujer)

Cálculo del P-valor

Software interface showing data analysis options. The 'Analyses' tab is selected, and the 'Frequencies' icon is highlighted. A dropdown menu is open, showing various statistical tests. A red arrow points to the 'Independent Samples' option, which includes the χ^2 test of association.


Data Table:








	EDAD	FC1	FC2	FARMACO
1	22.6	96	155	1
2	20.0	78	154	2
3	21.6	76	148	1
4	21.4	62	132	2
5	24.5	80	126	1
6	22.1	66	132	2
7	22.5	88	156	1
8	24.4	90	138	2
9	19.5	76	158	1
10	23.0	90	144	1
11	22.8	86	144	2
12	23.3	80	136	1
13	25.4	92	134	1

Statistical Tests Menu:



- One Sample Proportion Tests
 - 2 Outcomes
 - Binomial test
 - N Outcomes
 - χ^2 Goodness of fit
- Contingency Tables
- Independent Samples
 - χ^2 test of association
- Paired Samples
 - McNemar test
- Log-Linear Regression

Cálculo del P-valor



Contingency Tables 

 IB
 EDAD
 FC1
 FC2
 FC2FC1
 STATUS
 FARMACO


→

Rows
 SEXO 

→

Columns
 FUMADOR 

→

Counts (optional)


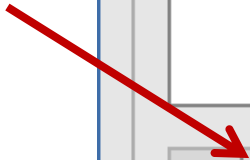
→

Layers

> | Statistics

> | Cells

OR, RR



Cálculo del P-valor

Contingency Tables

Contingency Tables

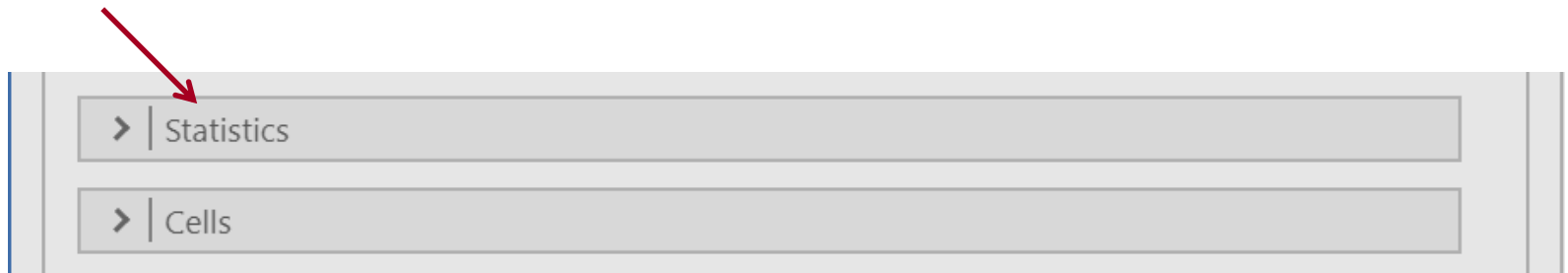
SEXO	FUMADOR		Total
	1	2	
1	10	12	22
2	6	12	18
Total	16	24	40

χ^2 Tests

	Value	df	p
χ^2	0.606	1	0.436
N	40		

Test exacto de Fisher

- Cuando en alguna casilla la frecuencia esperada es < 5 , se usa este test y no el de χ^2
- Con Jamovi:
Statistics -> Fisher's exact test



Cálculo del P-valor (Jamovi)

Contingency Tables

Contingency Tables

SEXO	FUMADOR		Total
	1	2	
1	10	12	22
2	6	12	18
Total	16	24	40

χ^2 Tests

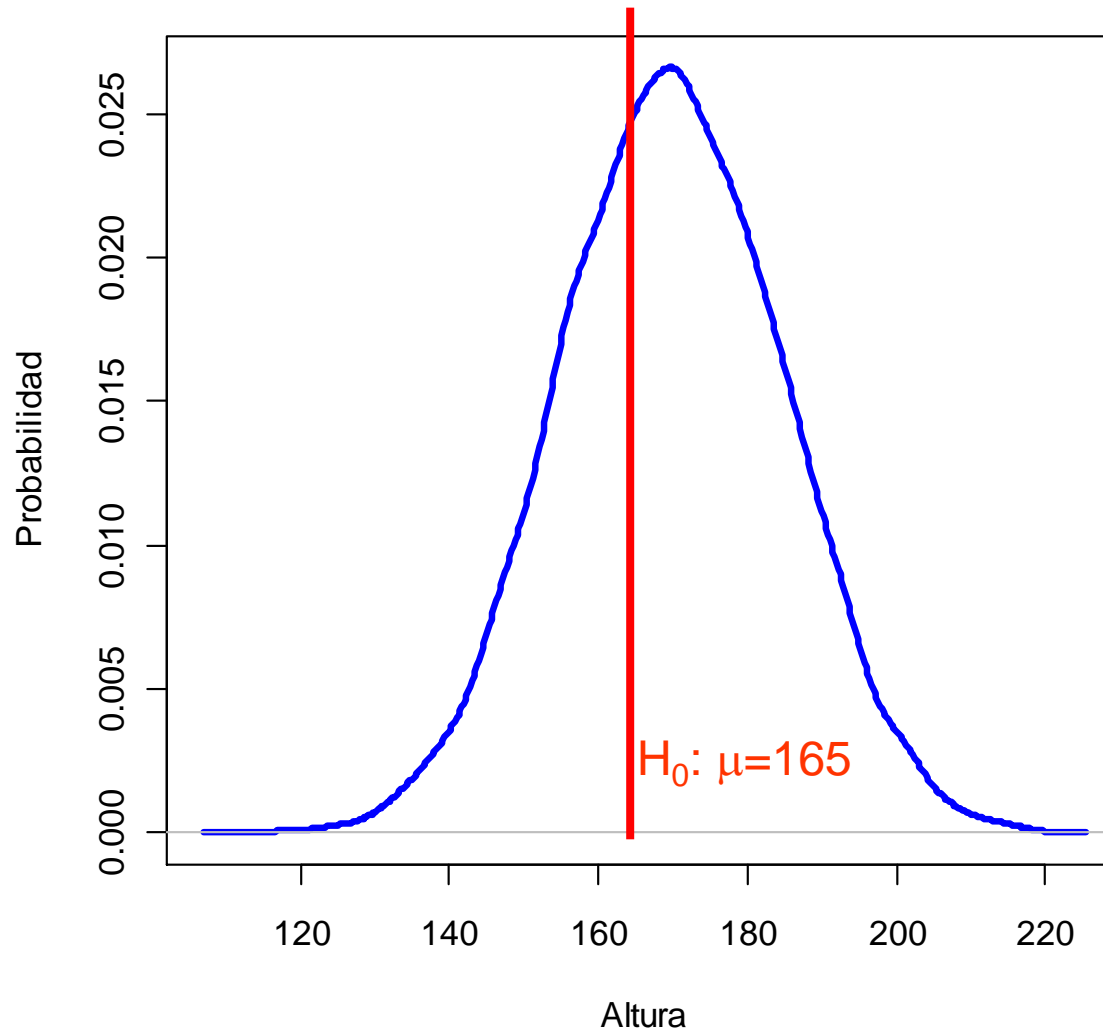
	Value	df	p
χ^2	0.606	1	0.436
Fisher's exact test	1.65		0.526
N	40		

Tests para datos continuos (t-Student)

Objetivos: Preguntas

- Pregunta científica:
 - 1 muestra
 - ¿La altura de la población española es 1,65?
 - ¿El nivel de colesterol en España es 200?
 - 2 muestras
 - ¿La altura en España es igual que en Italia?
 - ¿El nivel de colesterol es igual en los individuos que hacen deporte que en los sedentarios?

Pregunta: ¿La altura media es 165 cm?



¿Altura = 165?

The screenshot shows a software interface with a top navigation bar containing 'Data' and 'Analyses' tabs. Below these are icons for 'Exploration', 'T-Tests', 'ANOVA', 'Regression', 'Frequencies', and 'Factor'. The 'T-Tests' icon is selected, opening a dropdown menu with three options: 'Independent Samples T-Test', 'Paired Samples T-Test', and 'One Sample T-Test'. A red arrow points to the 'One Sample T-Test' option. Below the menu is a data table with a column labeled 'Altura' containing numerical values.

	Altura
1	
2	
3	
4	149
5	155
6	182
7	176
8	157
9	189
10	178
11	
12	
13	
14	

¿Altura = 165?

jamovi

Data Analyses

Exploration T-Tests ANOVA Regression Frequencies Factor

One Sample T-Test

Dependent Variables

Altura

Tests

☒ Student's
☐ Bayes factor
Prior 0.707
☐ Mann-Whitney U

Hypothesis

Test value 0
☒ ≠ Test value
☐ > Test value
☐ < Test value

Additional Statistics

☐ Mean difference
☐ Effect size
☐ Confidence interval
Interval 95 %
☐ Descriptives
☐ Descriptives plots

Assumption Checks

☐ Normality

One Sample T-Test

One Sample T-Test

		statistic	df	p
Altura	Student's t	41.6	9.00	< .001

OJO !!!!

¿Altura = 165?

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Data Analyses

Exploration T-Tests ANOVA Regression Frequencies Factor

One Sample T-Test

Dependent Variables

Altura

Tests

☒ Student's

☐ Bayes factor

Prior

☐ Mann-Whitney U

Hypothesis

Test value

☒ ≠ Test value

☐ > Test value

☐ < Test value

Additional Statistics

☐ Mean difference

☐ Effect size

☐ Confidence interval

Interval %

☐ Descriptives

☐ Descriptives plots

Assumption Checks

☐ Normality

One Sample T-Test

One Sample T-Test

		statistic	df	p
Altura	Student's t	1.15	9.00	0.279

Note. H_a population mean \neq 165

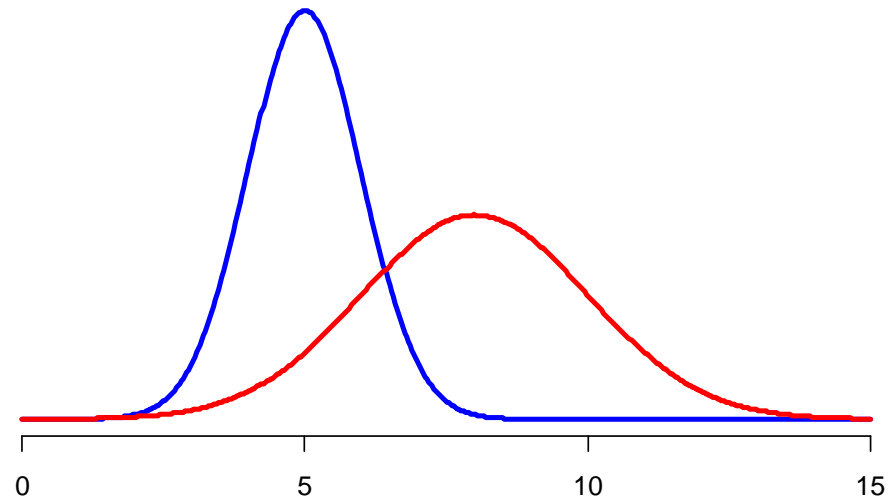
One Sample T-Test

One Sample T-Test

		statistic	df	p
Altura	Student's t	1.15	9.00	0.279

Note. H_a population mean \neq 165

Comparación de grupos



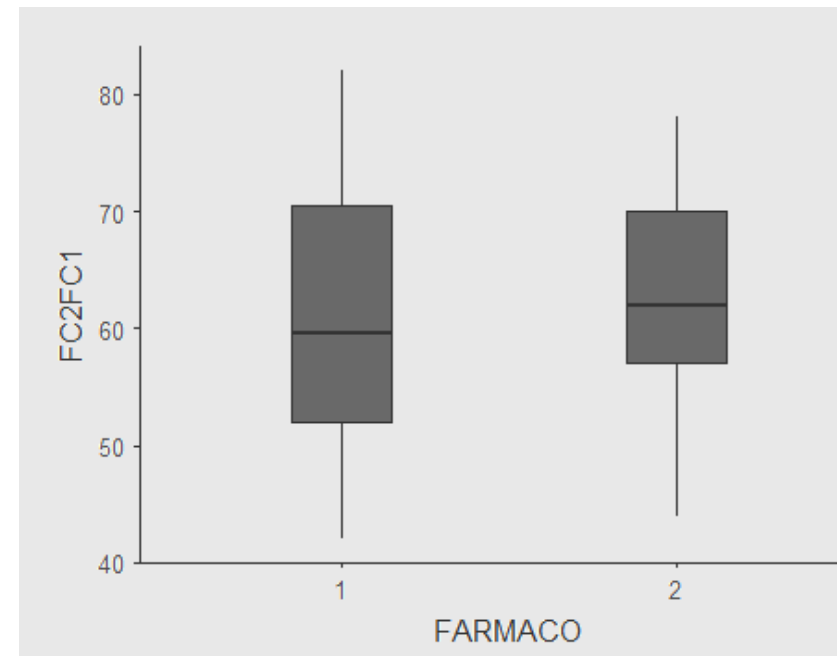
Comparación de grupos independientes

- ¿La diferencia de FC antes y despues se asocia al consumo de cierto fármaco?

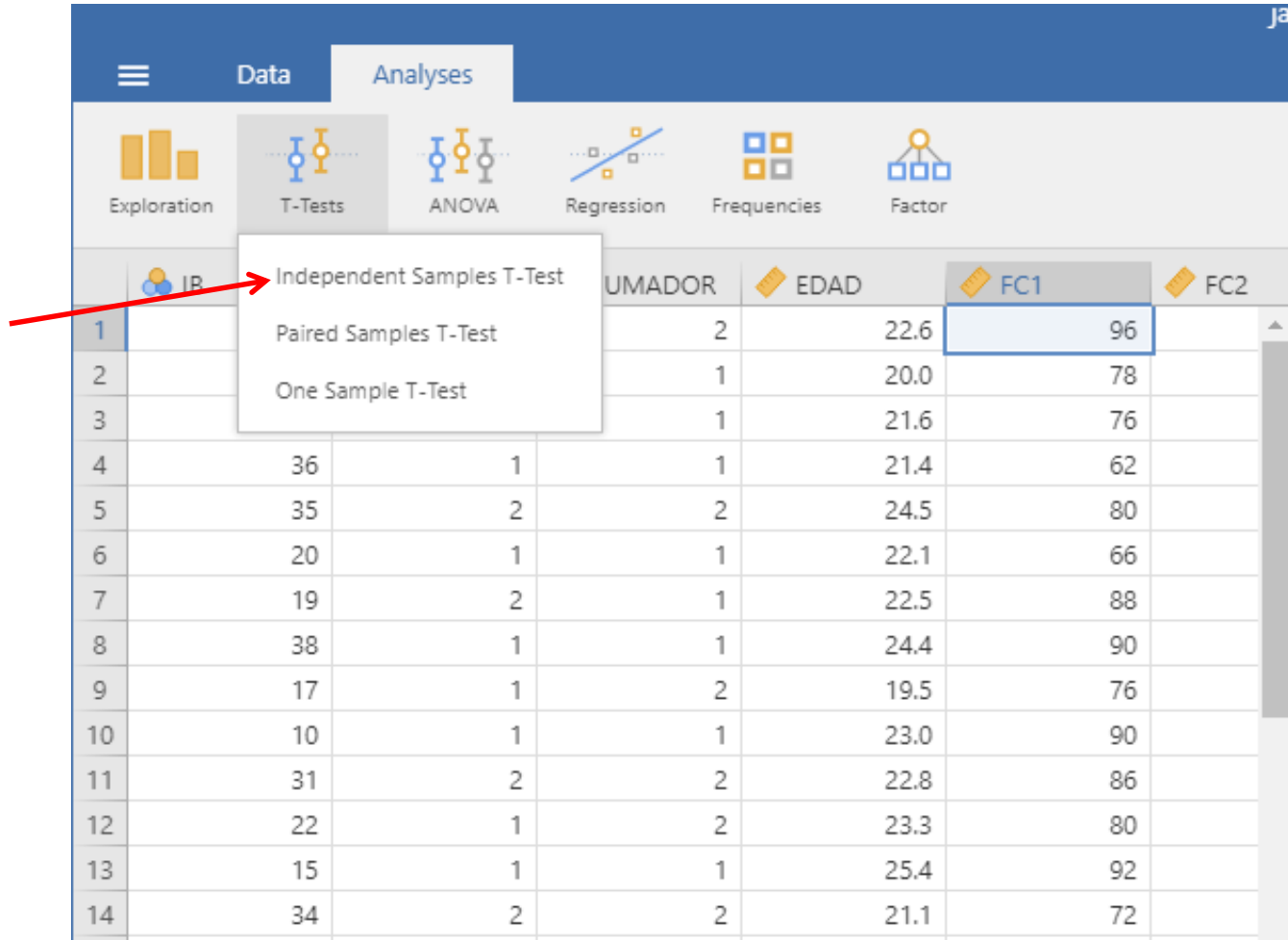
Descriptives

Descriptives

	FARMACO	FC2FC1
N	1	20
	2	20
Missing	1	0
	2	0
Mean	1	61.1
	2	62.4
Median	1	59.5
	2	62.0



Datos independientes



The screenshot displays the SPSS software interface. The 'Data' tab is active, and the 'Analyses' menu is open. The 'Independent Samples T-Test' option is highlighted in the dropdown menu, indicated by a red arrow. The background shows a data table with the following columns: ID, EDAD, FC1, and FC2. The data is as follows:

ID	EDAD	FC1	FC2	
1	2	22.6	96	
2	1	20.0	78	
3	1	21.6	76	
4	36	1	21.4	62
5	35	2	24.5	80
6	20	1	22.1	66
7	19	2	22.5	88
8	38	1	24.4	90
9	17	1	19.5	76
10	10	1	23.0	90
11	31	2	22.8	86
12	22	1	23.3	80
13	15	1	25.4	92
14	34	2	21.1	72

Datos independientes

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Data Analyses

Exploration T-Tests ANOVA Regression Frequencies Factor

Independent Samples T-Test

Dependent Variables

FC2FC1

Grouping Variable

FARMACO

Tests

☒ Student's
☐ Bayes factor
Prior 0.707
☐ Welch's
☐ Mann-Whitney U

Hypothesis

☒ Group 1 ≠ Group 2
☐ Group 1 > Group 2
☐ Group 1 < Group 2

Additional Statistics

☐ Mean difference
☐ Effect size
☐ Confidence interval
Interval 95 %
☐ Descriptives
☐ Descriptives plots

Assumption Checks

☐ Normality
☐ Equality of variances

40 1 FARMACO

Descriptives

Descriptives

	FARMACO	FC2FC1
N	1 2	20 20
Missing	1 2	0 0
Mean	1 2	61.1 62.4
Median	1 2	59.5 62.0

Independent Samples T-Test

Independent Samples T-Test

		statistic	df	p
FC2FC1	Student's t	-0.342	38.0	0.734

Datos apareados: FC2 vs FC1

- En el estudio hemos recogido sobre los mismos individuos la FC antes y después de tomar el fármaco (o hacer ejercicio, o tomar un recuperador, ...)
- Estamos ante un **diseño apareado**
- Se calculan las diferencias entre mediciones y se compara la media de la diferencia con la diferencia teórica esperada (generalmente $\delta=0$)
- Desde el punto de vista de análisis estadístico es idéntico el análisis de 1 población

Datos apareados

The screenshot displays the SPSS 'Analyses' menu. The 'T-Tests' option is selected, and its dropdown menu is open, showing 'Independent Samples T-Test', 'Paired Samples T-Test' (highlighted by a red arrow), and 'One Sample T-Test'. The background data table is as follows:

	IB	UMADOR	EDAD	FC1	FC2
1		2	22.6	96	
2		1	20.0	78	
3		1	21.6	76	
4	36	1	21.4	62	
5	35	2	24.5	80	
6	20	1	22.1	66	
7	19	2	22.5	88	
8	38	1	24.4	90	
9	17	2	19.5	76	
10	10	1	23.0	90	
11	31	2	22.8	86	
12	22	1	23.3	80	
13	15	1	25.4	92	
14	34	2	21.1	72	


Datos apareados


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≡


Data


Analyses


 Exploration

 T-Tests

 ANOVA

 Regression

 Frequencies

 Factor

Paired Samples T-Test

EDAD

FC1

FC2

FC2FC1

IB

SEXO

FUMADOR

STATUS

→

FC2

FC1

☒ Student's

☐ Bayes factor

Prior

☐ Wilcoxon rank

☐ Mean difference

☐ Effect size

☐ Confidence interval

Interval %

☐ Descriptives

☐ Descriptives plots

☒ Measure 1 ≠ Measure 2

☐ Measure 1 > Measure 2

☐ Measure 1 < Measure 2

Missing values

Additional Statistics

Assumption Checks

Test of Normality (Shapiro-Wilk)

	W	p
FC2FC1	0.975	0.521

Note. A low p-value suggests a violation of the assumption of normality

Test of Equality of Variances (Levene's)

	F	df	p
FC2FC1	1.91	1	0.175

Note. A low p-value suggests a violation of the assumption of equal variances

Paired Samples T-Test

Paired Samples T-Test

		statistic	df	p	
FC2	FC1	Student's t	35.6	39.0	< .001

Test of Normality (Shapiro-Wilk)

	W	p
FC2 - FC1	0.975	0.521

Note. A low p-value suggests a violation of the assumption of normality

Condiciones

- Normalidad de la variable numérica
 - Si el tamaño de muestra no es muy pequeño, esta condición no es muy importante
 - Se pueden transformar los datos
- Homogeneidad de varianzas (homocedasticidad)
 - Esta condición sí afecta cuando los tamaños de grupo son diferentes
 - No es muy importante con grupos del mismo tamaño


Asunciones


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≡


Data


Analyses


 Exploration

 T-Tests

 ANOVA

 Regression

 Frequencies

 Factor

Independent Samples T-Test

IB

SEXO

FUMADOR

EDAD

FC1

FC2

STATUS

→

Dependent Variables

FC2FC1

→

Grouping Variable

FARMACO

Tests

☒ Student's

☐ Bayes factor

Prior

☐ Welch's

☐ Mann-Whitney U

Hypothesis

☒ Group 1 ≠ Group 2

☐ Group 1 > Group 2

☐ Group 1 < Group 2

Additional Statistics

☐ Mean difference

☐ Effect size

☐ Confidence interval

Interval %

☐ Descriptives

☐ Descriptives plots

Assumption Checks

☒ Normality

☒ Equality of variances

2

62.4

Median

1

59.5

2

62.0

Independent Samples T-Test

Independent Samples T-Test

	statistic	df	p	
FC2FC1	Student's t	-0.342	38.0	0.734

Assumptions

Test of Normality (Shapiro-Wilk)

	W	p
FC2FC1	0.975	0.521

Note. A low p-value suggests a violation of the assumption of normality

Test of Equality of Variances (Levene's)

	F	df	p
FC2FC1	1.91	1	0.175

Note. A low p-value suggests a violation of the assumption of equal variances

No se cumplen las condiciones

- ¿Qué podemos hacer cuando nuestra variable de interés no cumple las condiciones de la t-Student?
 - No normalidad
 - No homocedasticidad

Transformaciones (logaritmo) / Welch's
Métodos no paramétricos

Test con Jamovi

The screenshot shows the Jamovi software interface. The 'Analyses' tab is selected, and the 'Independent Samples T-Test' analysis is configured. The dependent variable is 'FC2FC1' and the grouping variable is 'SEXO'. The 'Tests' section has 'Student's', 'Welch's', and 'Mann-Whitney U' checked. The 'Hypothesis' section has 'Group 1 ≠ Group 2' selected. The 'Assumption Checks' section has 'Normality' and 'Equality of variances' unchecked. The results panel on the right shows the 'Paired Samples T-Test' and 'Independent Samples T-Test' results.

Independent Samples T-Test

Dependent Variables: FC2FC1

Grouping Variable: SEXO

Tests

- ☒ Student's
- ☐ Bayes factor
- Prior: 0.707
- ☒ Welch's
- ☒ Mann-Whitney U

Hypothesis

- ☒ Group 1 ≠ Group 2
- ☐ Group 1 > Group 2
- ☐ Group 1 < Group 2

Assumption Checks

- ☐ Normality
- ☐ Equality of variances

Paired Samples T-Test

	statistic	df	p		
FC2	FC1	Student's t	35.6	39.0	< .001

Test of Normality (Shapiro-Wilk)

	W	p	
FC2	- FC1	0.975	0.521

Independent Samples T-Test

	statistic	df	p	
FC2FC1	Student's t	-2.41	38.0	0.021
	Welch's t	-2.45	37.9	0.019
	Mann-Whitney U	115		0.025

No
homogeneidad
de varianzas

No normalidad

