

Análisis estadístico con Jamovi aplicado a Enfermería y CAFE

Parte III: Pruebas de Hipótesis

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Población

Pregunta
Científica

Pregunta
Estadística

Muestreo

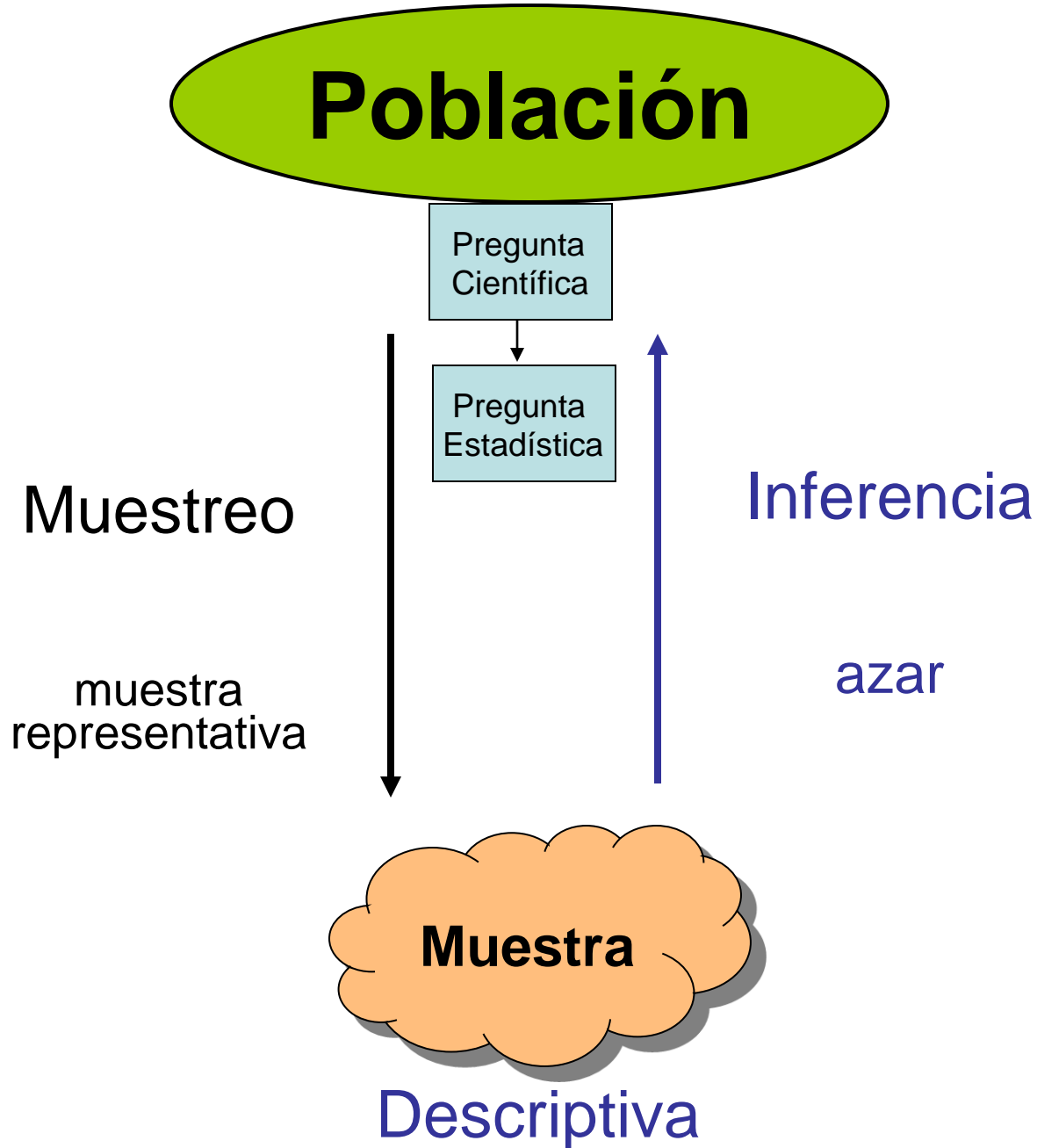
muestra
representativa

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

Software interface showing data analysis options. The 'Analyses' tab is selected, and the 'Frequencies' icon is highlighted with a red arrow. A dropdown menu is open, listing various statistical tests.

Analyses Tab Options:

- Exploration
- T-Tests
- ANOVA
- Regression
- Frequencies**
- Factor

Dropdown Menu Options:

- 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

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

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 $\neq 0.5$



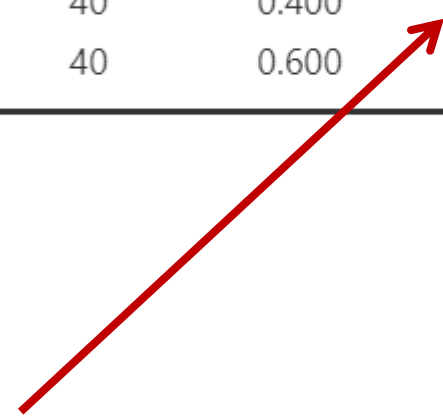
Cálculo del P-valor

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, displaying various statistical tests. A red arrow points to the 'Independent Samples' option under the 'Contingency Tables' section.

Analyses Menu:

- Exploration
- T-Tests
- ANOVA
- Regression
- Frequencies**
- Factor


Contingency Tables Section:


- 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


Data Table:


	EDAD	FC1	FC2	FARMACO
1	22.6	96	155	1
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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


Contingency Tables 


 IB


 EDAD

 FC1

 FC2



 FC2FC1

 STATUS

 FARMACO



→

Rows

 SEXO 


→

Columns

 FUMADOR 

→

Counts (optional)



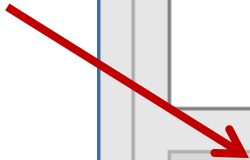
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Layers

> | 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

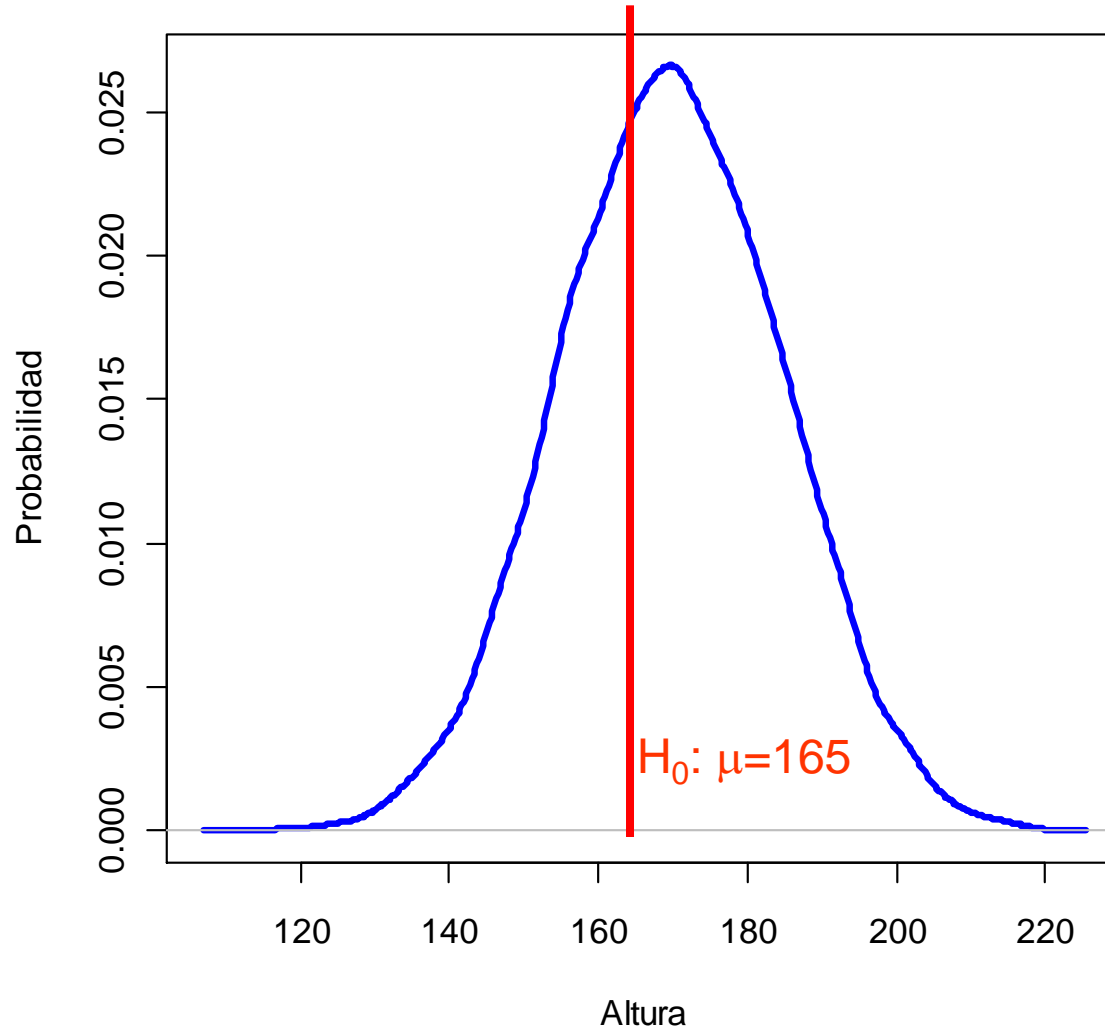
	Value	df	p
χ^2	0.606	1	0.436
Fisher's exact test	1.65		0.526
N	40		

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 blue header bar containing a menu icon, a 'Data' tab, and an 'Analyses' tab. Below the header, there is a row of icons for different analysis types: Exploration, T-Tests, ANOVA, Regression, Frequencies, and Factor. The 'T-Tests' icon is highlighted. A dropdown menu is open, showing 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, a data table is visible with a column labeled 'Altura' and rows numbered 1 to 14. The 'Altura' column contains the following values: 149, 155, 182, 176, 157, 189, 178. Row 11 is highlighted with a blue border.

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

¿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	41.6	9.00	< .001

OJO !!!!

¿Altura = 165?

The screenshot shows the Jamovi software interface for a One Sample T-Test analysis. The dependent variable is 'Altura'. The test value in the hypothesis section is circled in red and set to 165. The results panel on the right shows a t-statistic of 1.15, df of 9.00, and a p-value of 0.279.

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

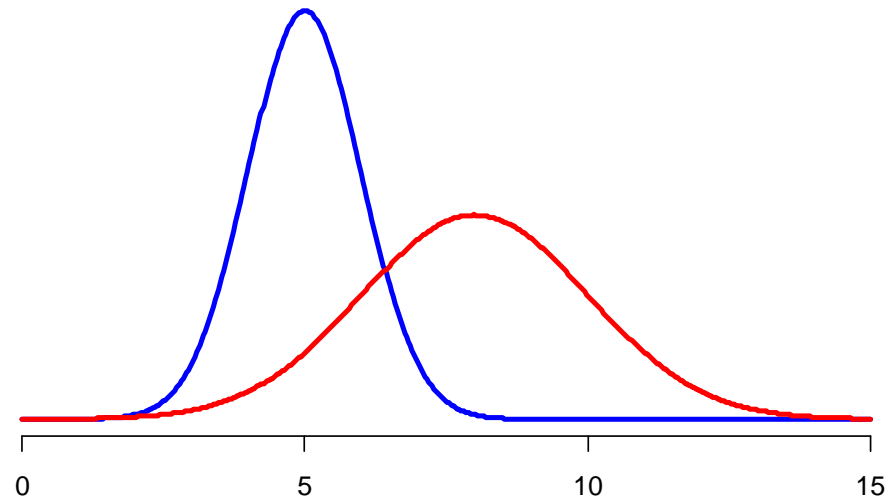
One Sample T-Test

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



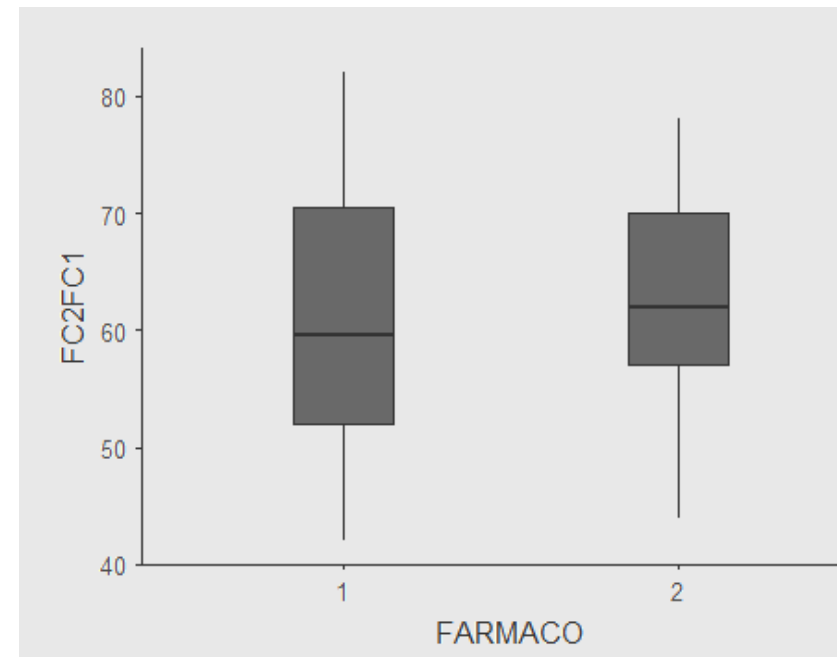
Comparación de grupos independientes

- ¿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 'Analyses' menu. The 'T-Tests' option is selected, and a dropdown menu is open, showing 'Independent Samples T-Test', 'Paired Samples T-Test', and 'One Sample T-Test'. A red arrow points to 'Independent Samples T-Test'. The background shows a data table with the following columns: IB, UMADOR, EDAD, FC1, and FC2.

	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	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

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', and 'One Sample T-Test'. A red arrow points to 'Paired Samples 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	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 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

Tests

☒ Student's

☐ Bayes factor

Prior

☐ Wilcoxon rank

Hypothesis

☒ Measure 1 ≠ Measure 2

☐ Measure 1 > Measure 2

☐ Measure 1 < Measure 2

Missing values

Additional Statistics

☐ Mean difference

☐ Effect size

☐ Confidence interval

Interval %

☐ Descriptives

☐ Descriptives plots

Assumption Checks

☒ Normality

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

The screenshot shows the Jamovi software interface. The top navigation bar has 'Data' and 'Analyses' tabs. Below the navigation bar are icons for various statistical tests: Exploration, T-Tests, ANOVA, Regression, Frequencies, and Factor. The main panel is titled 'Independent Samples T-Test'. On the left, a list of variables includes IB, SEXO, FUMADOR, EDAD, FC1, FC2, and STATUS. STATUS is selected. In the center, 'FC2FC1' is listed as the 'Dependent Variable' and 'FARMACO' is listed as the 'Grouping Variable'. On the right, there are sections for 'Tests' (Student's, Bayes factor, Welch's, Mann-Whitney U), 'Additional Statistics' (Mean difference, Effect size, Confidence interval, Descriptives, Descriptives plots), and 'Assumption Checks' (Normality, Equality of variances). The 'Assumption Checks' section is circled in red. On the far right, there are two summary tables: one for the Independent Samples T-Test results and another for the Assumptions (Shapiro-Wilk and Levene's tests).

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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

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 top navigation bar includes 'Data' and 'Analyses' tabs. Below the navigation bar are icons for various statistical tests: Exploration, T-Tests, ANOVA, Regression, Frequencies, and Factor.

The main panel is titled 'Independent Samples T-Test'. It features a list of variables on the left: IB, FUMADOR, EDAD, FC1, FC2, STATUS, and FARMACO. The 'Dependent Variables' box contains 'FC2FC1'. The 'Grouping Variable' box contains 'SEXO'. The 'Tests' section has checkboxes for 'Student's', 'Bayes factor', 'Welch's', and 'Mann-Whitney U'. The 'Prior' value is set to 0.707. The 'Hypothesis' section has radio buttons for 'Group 1 ≠ Group 2', 'Group 1 > Group 2', and 'Group 1 < Group 2'. The 'Additional Statistics' section has checkboxes for 'Mean difference', 'Effect size', 'Confidence interval', 'Descriptives', and 'Descriptives plots'. The 'Assumption Checks' section has checkboxes for 'Normality' and 'Equality of variances'.

On the right side, there are three result panels:

- Paired Samples T-Test**: Shows a table with columns 'statistic', 'df', and 'p'. The row for 'FC2' and 'FC1' shows a Student's t statistic of 35.6, df of 39.0, and a p-value of < .001. Below this is a 'Test of Normality (Shapiro-Wilk)' table with columns 'W' and 'p'. The row for 'FC2' and 'FC1' shows a W value of 0.975 and a p-value of 0.521. A note states: 'Note. A low p-value suggests a violation of the assumption of equal variances' and 'Note. A low p-value suggests a violation of the assumption of normality'.
- Independent Samples T-Test**: Shows a table with columns 'statistic', 'df', and 'p'. The row for 'FC2FC1' shows a Student's t statistic of -2.41, df of 38.0, and a p-value of 0.021. The row for 'Welch's t' shows a statistic of -2.45, df of 37.9, and a p-value of 0.019. The row for 'Mann-Whitney U' shows a statistic of 115 and a p-value of 0.025.

Annotations on the left side of the image point to specific settings:

- 'No homogeneidad de varianzas' points to the 'Welch's' checkbox in the 'Tests' section.
- 'No normalidad' points to the 'Mann-Whitney U' checkbox in the 'Tests' section.

