

Comparing 2 independent groups' quantitative data

Independent samples t-test & Mann-Whitney test

Prepared by Dr. Hesham Mousli

MHA 613
Statistics in Healthcare

Lecture 7



Intended Objectives

1. Understand the Purpose and Importance of Comparing Two Independent Samples.
2. Identify Appropriate Statistical Tests for Two Independent Samples.
3. Interpret Results of Statistical Tests.
4. Evaluate the Assumptions and Limitations of Comparative Tests and their practical applications.

Vs.



Indication of Use

- We have samples from **two independent (unrelated) groups** of individuals and one **Numerical (Quantitative) variable** of interest.
- We are interested in whether the **Mean or distribution (Median)** of the variable is the same in the two groups.

Explaining Example

- For example, we may wish to **compare the weights in two groups of babies**, each group being randomly allocated to be either born **via normal labor or through a C-section labor**.



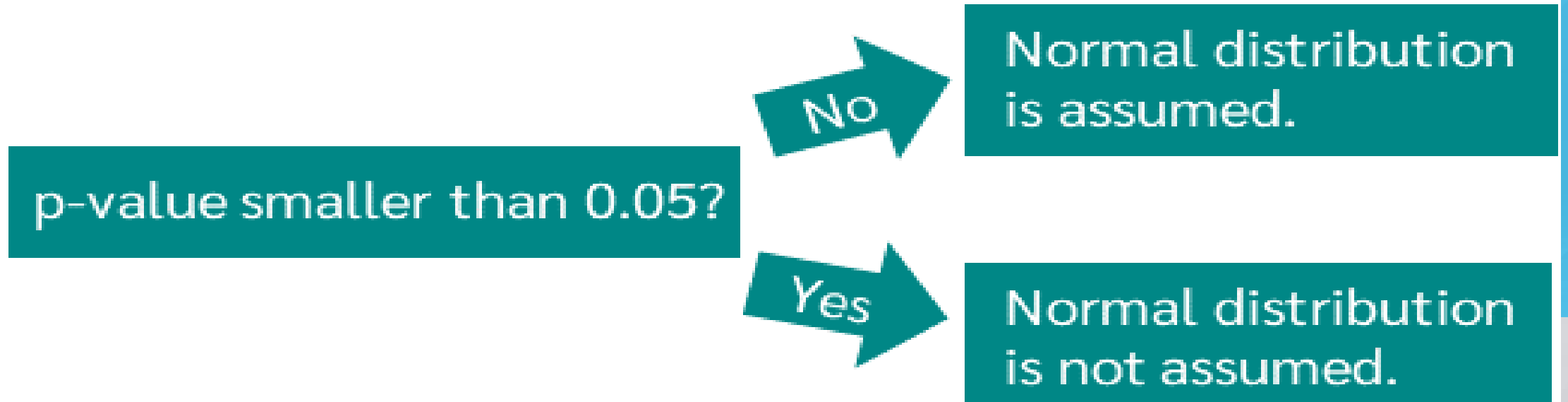
- The **Hypothesis test** that can solve this problem is either **(Independent samples) *t*-test** **OR** Mann-Whitney test.
- I can select **either of them** based on the **Normality status** of **each group's data**.



- So, I must first *check the Normality of data for each group* using the *Shapiro-Wilk test* and *interpret its resulting P-value*.



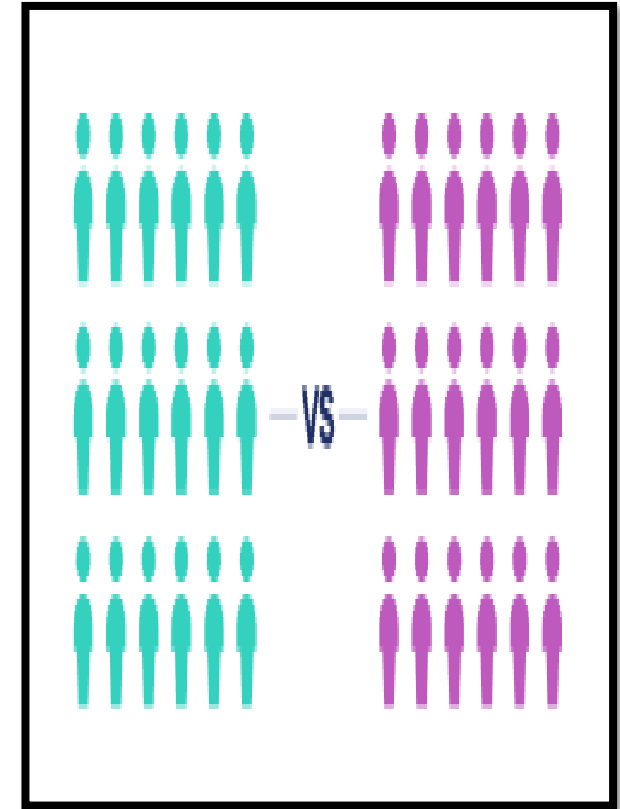
	Statistics	p-Value
Kolmogorov-Smirnov	0.09	0.892
Shapiro-Wilk	0.98	0.862
Anderson-Darling	0.24	0.772



1. The (Independent samples) t -test

➤ Assumptions:

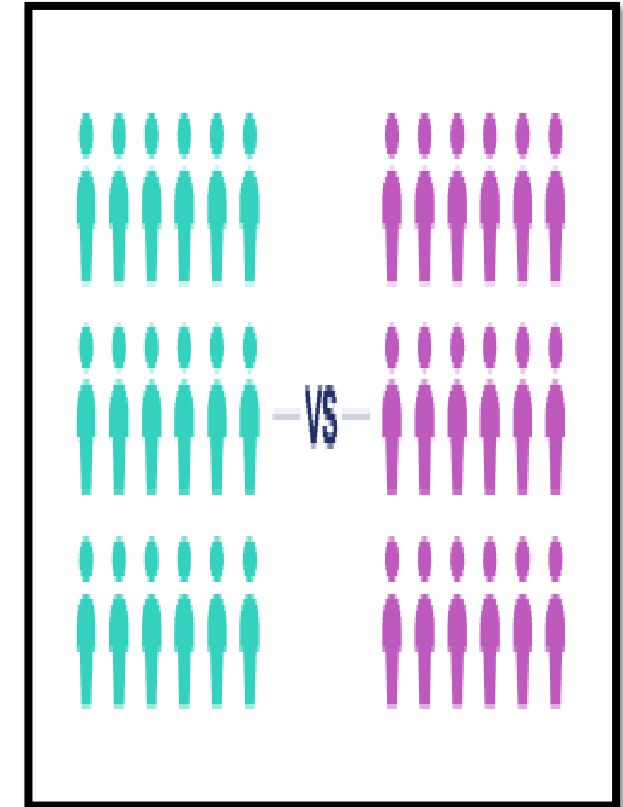
- In the population, the variable is Normally distributed in each group. In addition, we have reasonable sample sizes so that we can check the assumptions of Normality.



1. The (Independent samples) t -test

➤ Rationale:

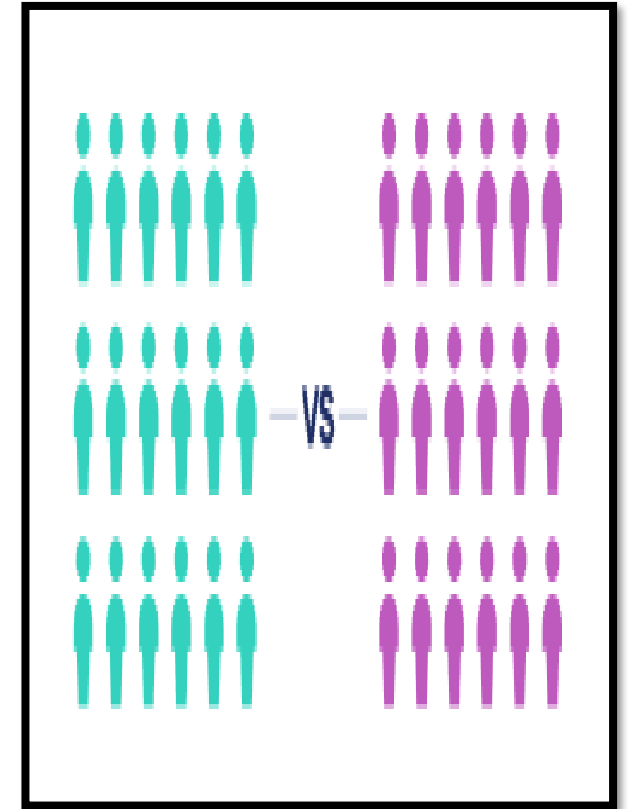
- We consider the **difference in the means** of the two groups.
- Under the **Null hypothesis** that the population **means in the two groups are the same**, this **difference will equal zero**.



1. The (Independent samples) t -test

➤ Rationale:

- Under the **Alternate hypothesis** that the population means in the two groups are **significantly different**, this difference will be **significantly more than zero**.



$p < 0.05 \rightarrow$ statistically
significant

Difference between the two
compared groups.

$p > 0.05 \rightarrow$ no statistically
significant

Difference between the two
compared groups.

Conclusion

- It will be in terms of Mean & SD reporting for each group.
- If **P-value < 0.05** so, there is **a** statistically significant difference between the **weights** of normal labor babies (Mean=, SD=) and the **weights** of C-section labor babies (Mean=, SD=), (P-value =).

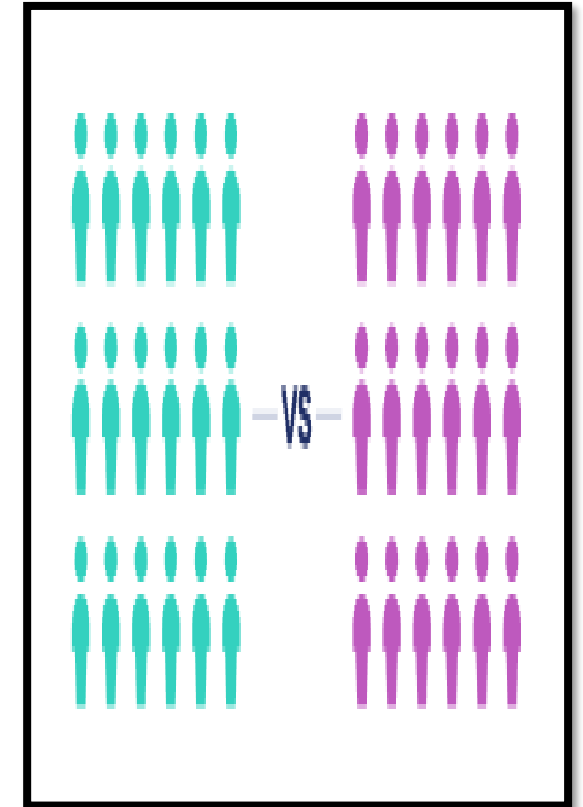
Conclusion

- If **P-value > 0.05** so, there is **No** statistically significant difference between the **weights** of **normal labor babies** (Mean=, SD=) and the **weights** of **C-section labor babies** (Mean=, SD=), (P-value =).

2. The Mann-Whitney test

➤ Rationale:

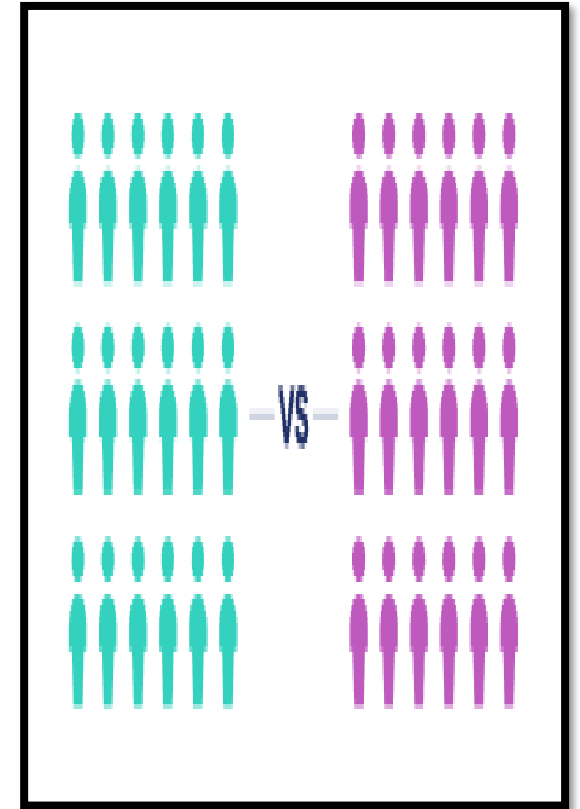
- The **Mann-Whitney test** is used when data is **(not normally distributed)** and is the **non-parametric equivalent** of the **independent samples t-test**.



2. The Mann-Whitney test

➤ Rationale:

- It is used when **one or both group's data are not normally distributed.**
- It relies on comparing non-parametric measures such as **Median & Range/IQR.**



$p < 0.05 \rightarrow$ statistically
significant

Difference between the two
compared groups.

$p > 0.05 \rightarrow$ no statistically
significant

Difference between the two
compared groups.

Conclusion

- It will be in terms of Median & Range/IQR reporting for each group.
- If $P\text{-value} < 0.05$ so, there is a statistically significant difference between the weights of normal labor babies (Median=, Range=) and the weights of C-section labor babies (Median=, Range=), ($P\text{-value} = \dots\dots\dots$).

Conclusion

- If **P-value > 0.05** so, there is **No** statistically significant difference between the **weights** of **normal labor babies** (Median=, Range=) and **weights** of **C-section labor babies** (Median=, Range=), (P-value =).



Please don't forget: Before
dealing with any
Quantitative data, first,
test for its normality.

Case Scenario (1)

- A healthcare system assesses if there's a difference in **response time to critical cases** between **two emergency departments (EDs)** in separate locations.
- **Purpose:** Identifying significant differences in response times may reveal best practices or areas for improvement in emergency care.

Case Scenario (1)

- **Null Hypothesis (H_0):** There is **no significant difference** in the **response times** to critical cases between the two emergency departments (EDs).
- **Alternative Hypothesis (H_1):** There is a **significant difference** in the **response times** to critical cases between the two emergency departments (EDs).

Case Scenario (1)

- **Test Selection:** An **independent samples t-test** would be applied if response times are normally distributed; otherwise, the **Mann-Whitney test** would be used.



	 Time of response (min.)	 ED (a or b)
1	2	a
2	3	b
3	4	a
4	3	a
5	5	b
6	4	b
7	6	a
8	2	b
9	3	a

Results

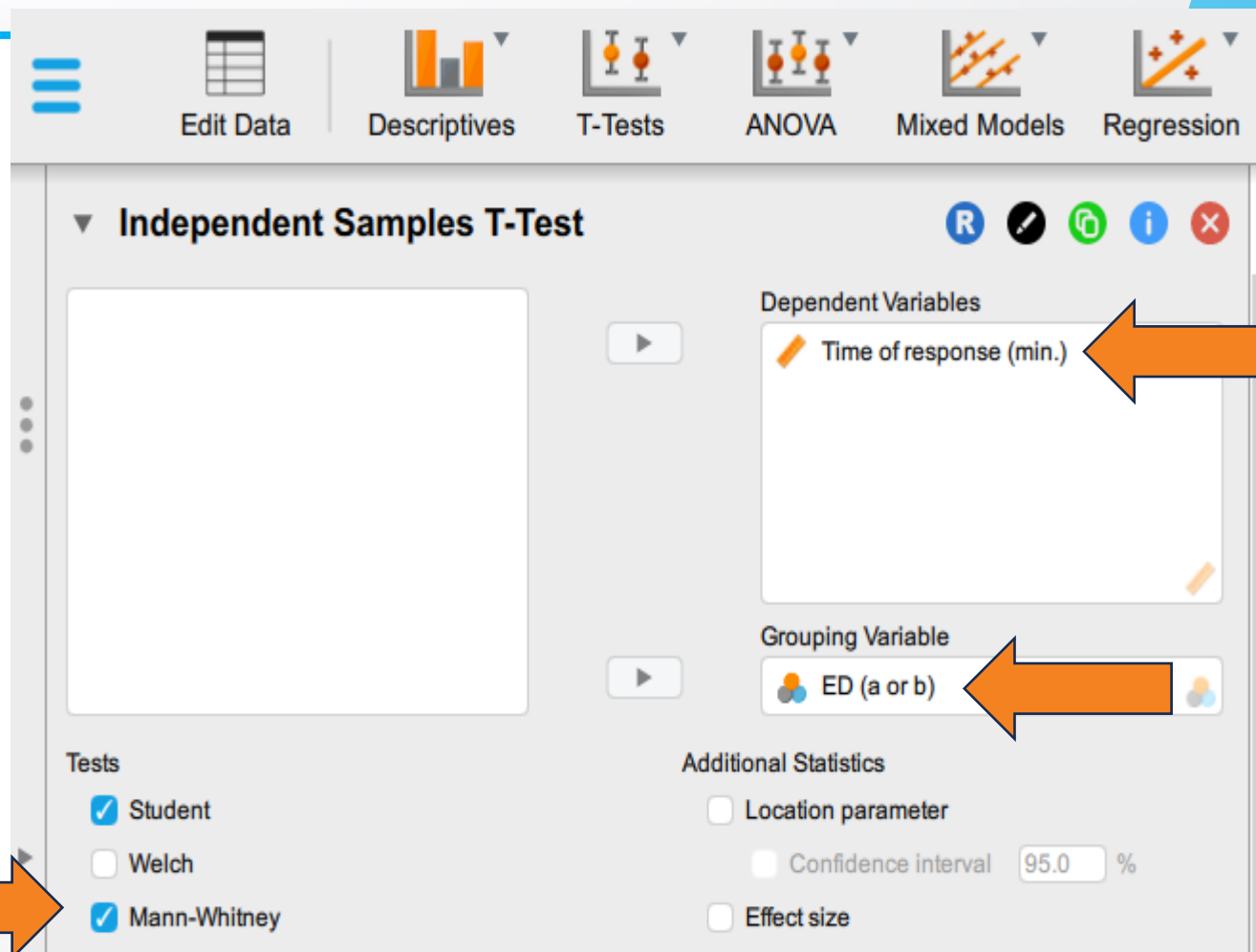
Descriptive Statistics

Descriptive Statistics

	ED (b)	ED (a)
Valid	30	30
Missing	0	0
Shapiro-Wilk	0.963	0.882
P-value of Shapiro-Wilk	0.375	0.003

The screenshot displays the SPSS software interface. The top menu bar includes options: Edit Data, Descriptives, T-Tests, ANOVA, Mixed Models, Regression, Frequencies, and Factor. The T-Tests menu is open, showing two sections: Classical and Bayesian. The Classical section lists Independent Samples T-Test, Paired Samples T-Test, and One Sample T-Test. The Bayesian section lists Independent Samples T-Test, Paired Samples T-Test, and One Sample T-Test. An orange arrow points to the T-Tests menu, and another orange arrow points to the Independent Samples T-Test option in the Classical section.

	ED (a)	ED (b)
1	2	7
2	3	8
3	4	5
4	3	6
5	5	4
6	4	3
7	6	5
8	2	6
9	3	9
10	4	4
11	2	6
12	3	5
13	2	3



The image shows the SPSS 'Independent Samples T-Test' dialog box. A blue line with an arrow points from the left to the 'Tests' section. Two orange arrows point to the 'Dependent Variables' and 'Grouping Variable' fields. The 'Tests' section has checkboxes for 'Student' (checked), 'Welch' (unchecked), and 'Mann-Whitney' (checked). The 'Additional Statistics' section has checkboxes for 'Location parameter' (unchecked), 'Confidence interval' (unchecked, with a value of 95.0 %), and 'Effect size' (unchecked).

Independent Samples T-Test

Dependent Variables
Time of response (min.)

Grouping Variable
ED (a or b)

Tests

- ☒ Student
- ☐ Welch
- ☒ Mann-Whitney

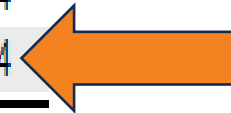
Additional Statistics

- ☐ Location parameter
- ☐ Confidence interval 95.0 %
- ☐ Effect size

Independent Samples T-Test

Independent Samples T-Test

	Test	Statistic	df	p
Time of response (min.)	Student	0.581	58	0.564
	Mann-Whitney	480.500		0.654



Case Scenario (1)

- The lack of a significant difference in response times between the two EDs (**p-value > 0.05**) suggests **comparable performance** in managing critical cases, so no immediate changes are needed based on response time.
- This finding highlights **an opportunity to explore other factors**, such as resource allocation, staff training, and procedural efficiency, to further enhance overall performance and patient outcomes.



**Now, let's go to the 2nd
Case Scenario**

Case Scenario (2)

- To reduce readmissions, a hospital compares the **readmission rates** of patients given two different discharge planning approaches: **a standard approach** versus **a comprehensive planning program**.
- **Purpose:** The analysis helps evaluate if a particular discharge approach is more effective, informing policy changes to improve patient outcomes and reduce readmission rates.

Case Scenario (2)

- **Null Hypothesis (H_0):** There is **no significant difference** in readmission rates between patients receiving **the standard discharge approach** and those receiving **the comprehensive discharge planning program**.
- **Alternative Hypothesis (H_1):** There is a **significant difference** in readmission rates between patients receiving **the standard discharge approach** and those receiving **the comprehensive discharge planning program**.

Case Scenario (2)

- **Test Selection:** If the readmission rate data is normally distributed, the **independent samples t-test** would be appropriate. Otherwise, the **Mann-Whitney test** would be applied.



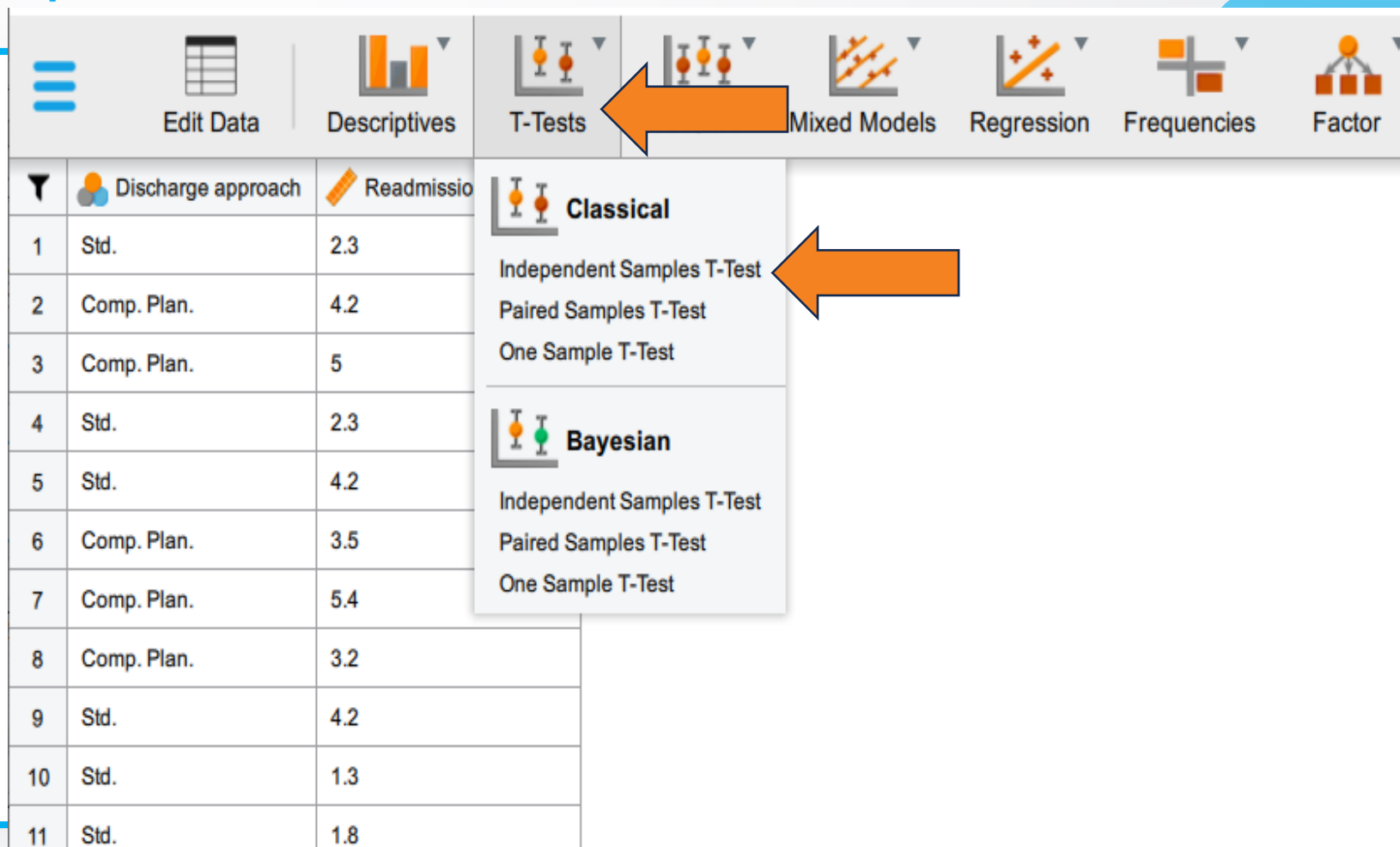
	 Discharge approach	 Readmission rate (%)
1	Std.	2.3
2	Comp. Plan.	4.2
3	Comp. Plan.	5
4	Std.	2.3
5	Std.	4.2
6	Comp. Plan.	3.5
7	Comp. Plan.	5.4
8	Comp. Plan.	3.2
9	Std.	4.2

Results

Descriptive Statistics

Descriptive Statistics

	Readmission rate (%)	
	Std.	Comp. Plan.
Valid	30	30
Missing	0	0
Shapiro-Wilk	0.935	0.935
P-value of Shapiro-Wilk	0.069	0.068



The screenshot shows the SPSS software interface. The top toolbar contains icons for 'Edit Data', 'Descriptives', 'T-Tests', 'Mixed Models', 'Regression', 'Frequencies', and 'Factor'. The 'T-Tests' icon is highlighted with an orange arrow. Below the toolbar, a dropdown menu is open, showing two sections: 'Classical' and 'Bayesian'. Under the 'Classical' section, the 'Independent Samples T-Test' option is highlighted with an orange arrow. The main data window shows a table with 11 rows and 3 columns: 'Discharge approach', 'Readmission', and a numerical value.

	Discharge approach	Readmission
1	Std.	2.3
2	Comp. Plan.	4.2
3	Comp. Plan.	5
4	Std.	2.3
5	Std.	4.2
6	Comp. Plan.	3.5
7	Comp. Plan.	5.4
8	Comp. Plan.	3.2
9	Std.	4.2
10	Std.	1.3
11	Std.	1.8

Independent Samples T-Test

Dependent Variables

Readmission rate (%)

Grouping Variable

Discharge approach

Tests

- ☒ Student
- ☐ Welch
- ☒ Mann-Whitney

Additional Statistics

- ☐ Location parameter
- ☐ Confidence interval 95.0 %
- ☐ Effect size

Results

Independent Samples T-Test

Independent Samples T-Test

	Test	Statistic	df	p
Readmission rate (%)	Student	-1.439	58	0.155
	Mann-Whitney	369.500		0.232



Case Scenario (2)

- With no significant difference in readmission rates between the standard and comprehensive discharge approaches (**P-value > 0.05**), **neither approach shows a clear advantage**, so no immediate policy changes are necessary.
- Management may consider **evaluating additional factors**, like patient satisfaction and follow-up care quality, to identify other ways to improve discharge planning and reduce readmissions.

Intended Objectives

1. Comparing quantitative data from two independent groups helps healthcare managers assess differences in areas like treatment effectiveness and operational efficiency.
2. Choosing the correct statistical test such as the Mann-Whitney test for non-normal data, and the independent samples t-test for normally distributed data.
3. Interpreting results from these tests, focusing on p-values is crucial for translating data analysis into actionable insights.
4. Practical applications, such as comparing patient outcomes or departmental performance, can guide improvements in healthcare quality, efficiency, and patient satisfaction.



Thank You