Univariate Hypothesis Testing

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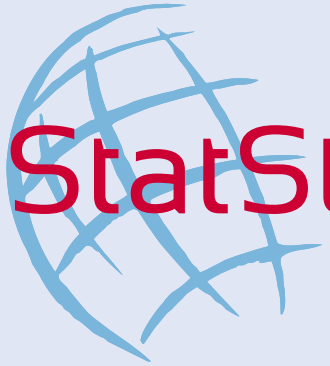


MedStatStudio

Objectives

- Understand the steps for statistical hypothesis testing
- Choose an appropriate statistical tests for various univariate statistical problems

Quiz

Part I. Below are the steps for statistical hypothesis testing. Place them in the correct order (1 through 7)

___Define the test statistic

___Calculate the test statistic

___State the rejection region

___State conclusion in context

___Identify the parameter of interest

___Decide if H_0 will be rejected

___Determine the null and alternative hypothesis

Quiz

Part II. For the following scenarios, indicate which would be the best test statistic.

A. Proportion Test

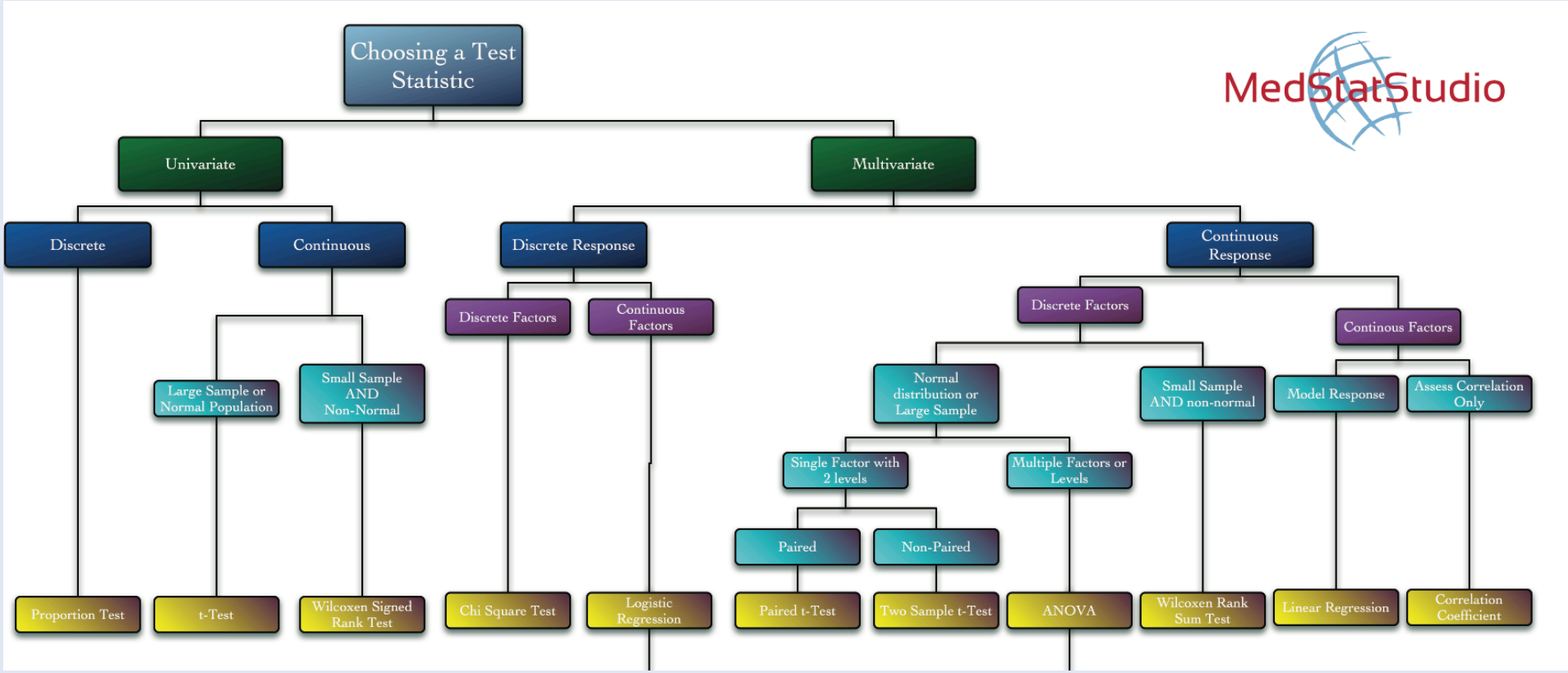
B. T-test

C. Wilcoxen Signed Rank Test

Hypothesis Testing

1. Identify parameter of interest
2. Determine null and alternative hypothesis
3. Define the test statistic***
4. State rejection region
5. Calculate test statistic
6. Decide if H_0 will be rejected
7. State conclusion in context

Choosing a Test Statistic



Procedure Success

A researcher has tabulated the success rate of a series of procedures in the emergency department and ICU. She wishes to show that the true success rate is greater than 90%.

She found 211 successful procedures, and 4 unsuccessful.

Procedure Success

1. Identify parameter of interest

P=proportion of successful procedures

Procedure Success

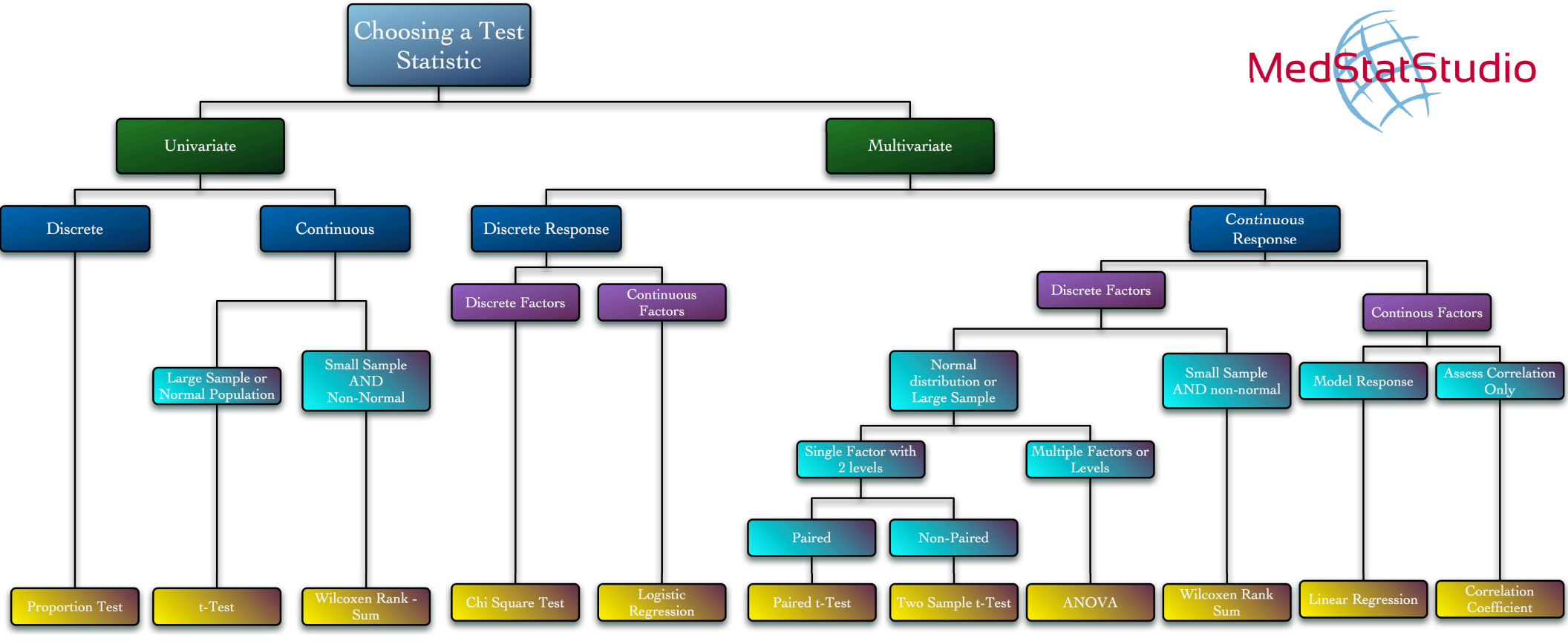
2. Hypotheses

H_0: $p=0.1$

H_A: $p\neq 0.1$

Procedure Success

3. Define the Test Statistic



Procedure Success

3. Define the Test Statistic

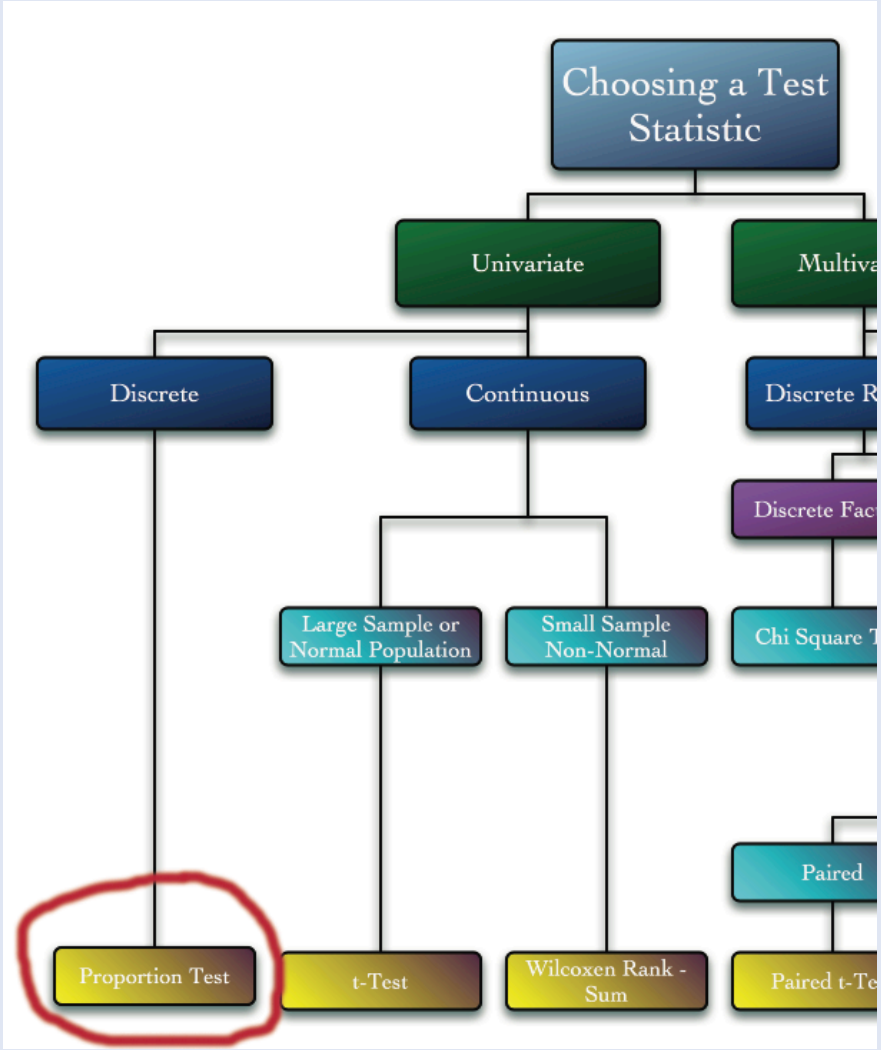
Univariate

⬇

Discrete

⬇

Proportion Test



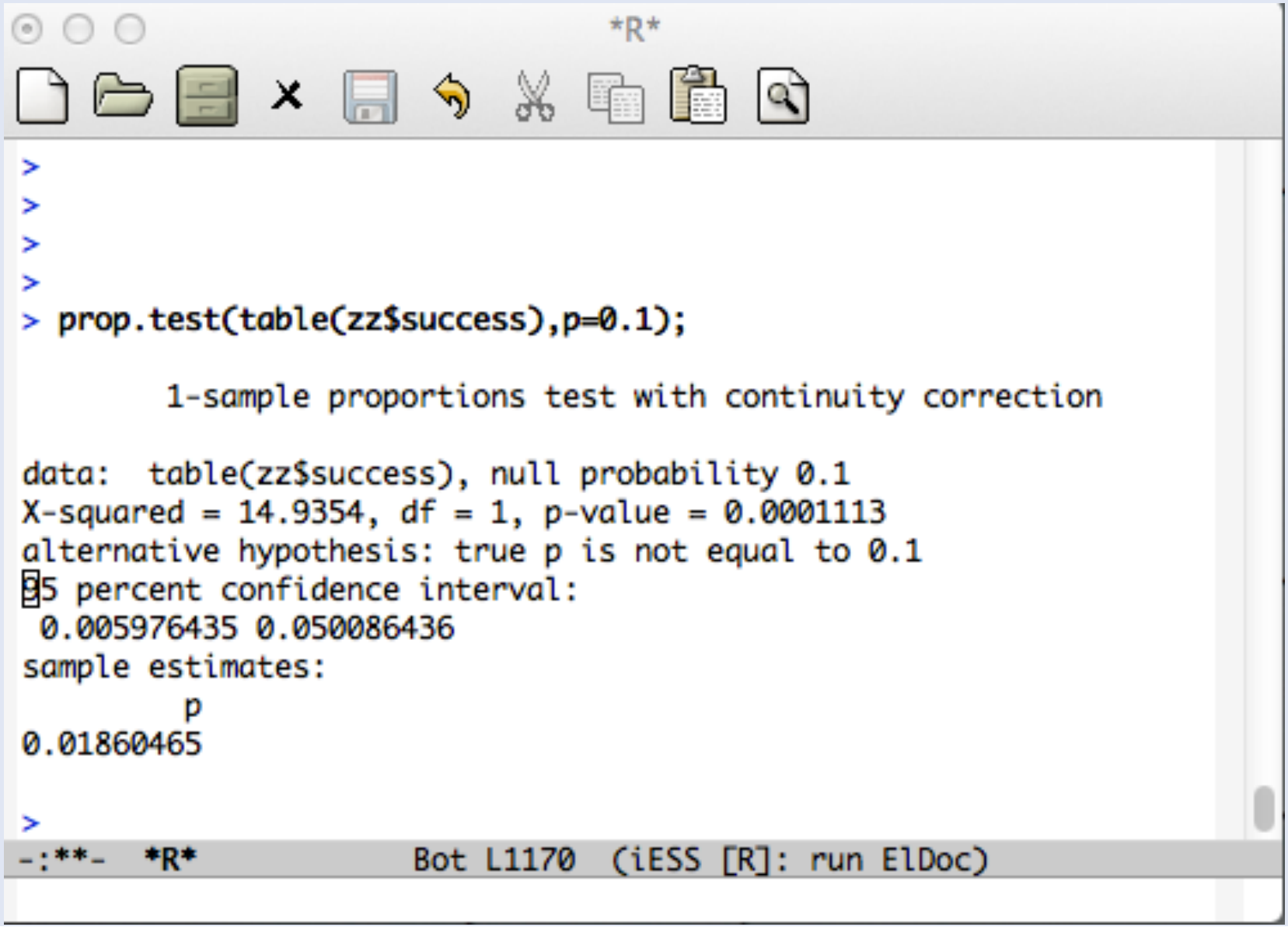
Procedure Success

4. Rejection Region

- Using $\alpha=0.05$
- Reject if $p<0.05$

Procedure Success

5. Calculate Test Statistic



Procedure Success

6. Decide if Null Hypothesis Rejected

Reject

Procedure Success

7. State conclusion in context

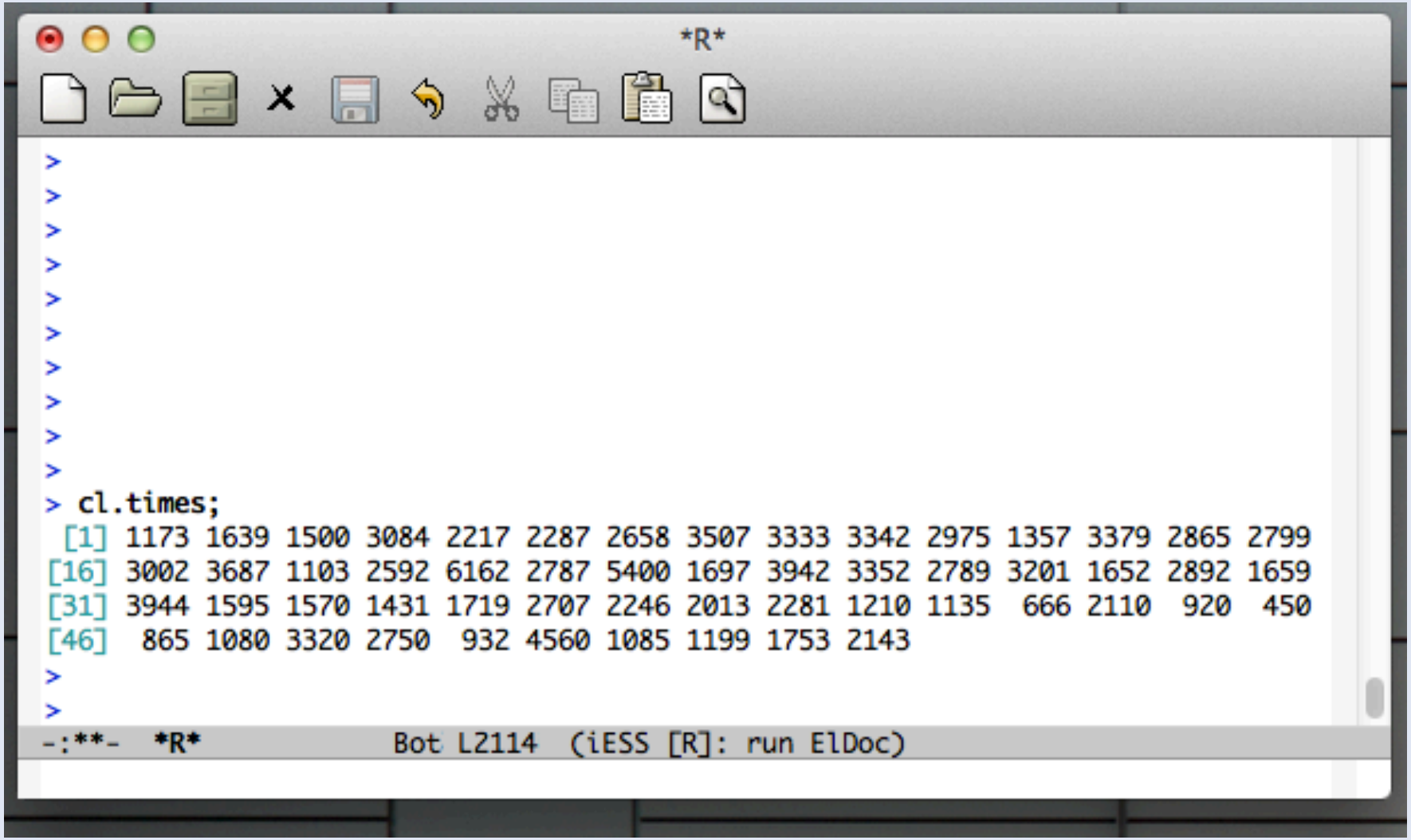
The observed procedure failure rate was 1.8% (95% confidence interval 0.6% to 5.0%). Thus, we are able to reject the null hypothesis of failure rate being 10% ($p<0.0002$)

Central Line Times

At present, a simulation software uses an average time of 8 minutes for placement of a central line. A researcher feels that true central line placement is much longer.

The researcher measured time in seconds to place central line in 55 cases

Central Line Times



Central Line Times

1. Parameter of interest

   μ_1 (Mean time for line placement)

Central Line Times

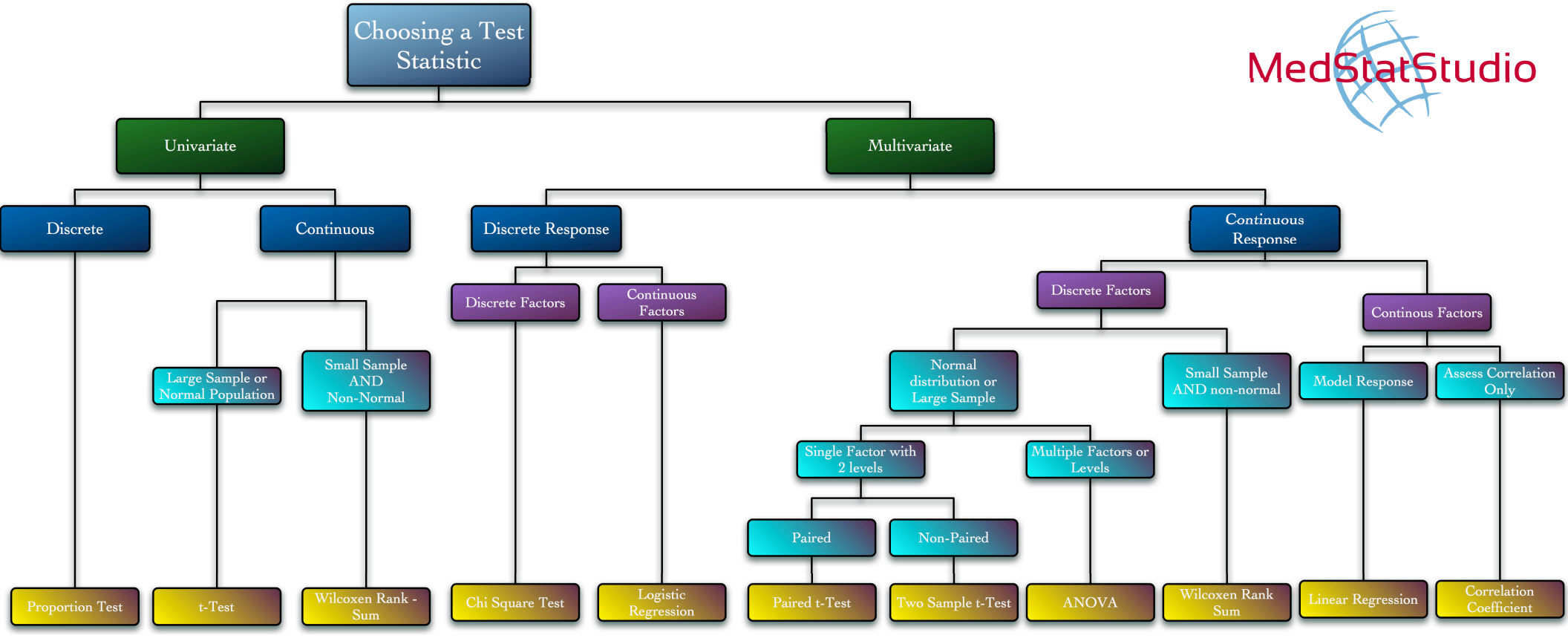
2. Determine null and alternative hypothesis

H_0: μ_1=480 seconds

H_A: $\mu_1 \neq 480$ seconds

Central Line Times

3. Define the test statistic



Central Line Times

3. Define the test statistic

Univariate

↓

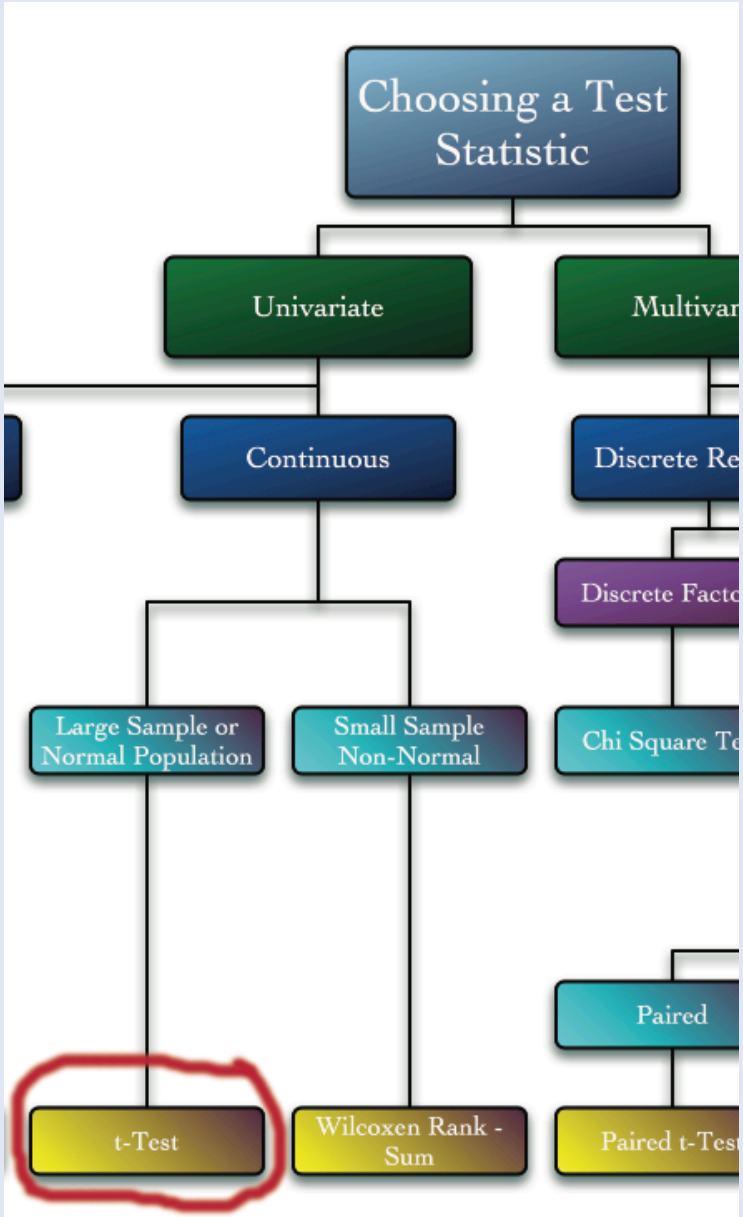
Continuous

↓

Large Sample

↓

t-Test



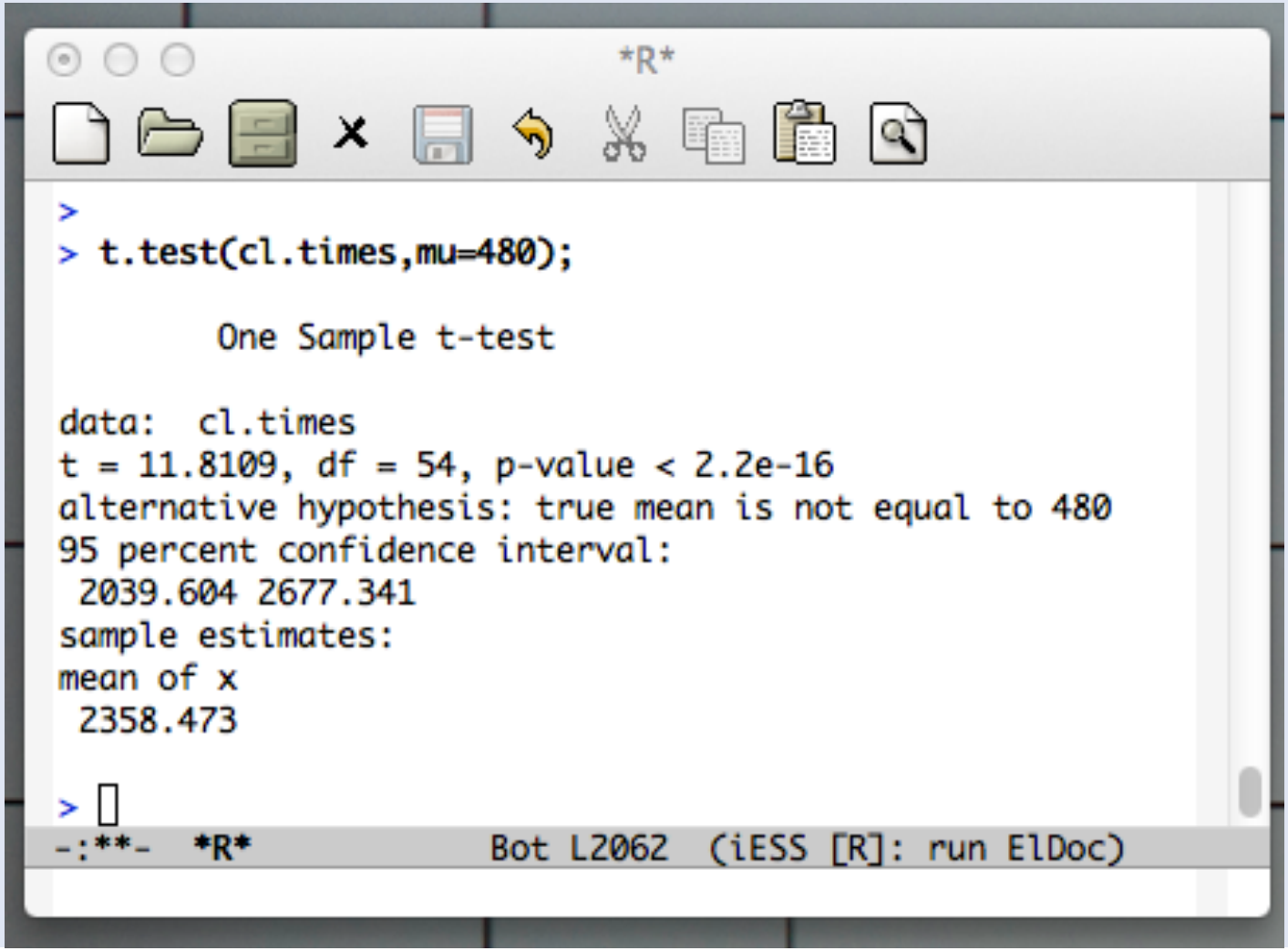
Central Line Times

4. State Rejection Region

- $\alpha=0.05$
- Reject if $p<0.05$

Central Line Times

5. Calculate Test Statistic



Central Line Times

6. Decide if H_0 will be rejected

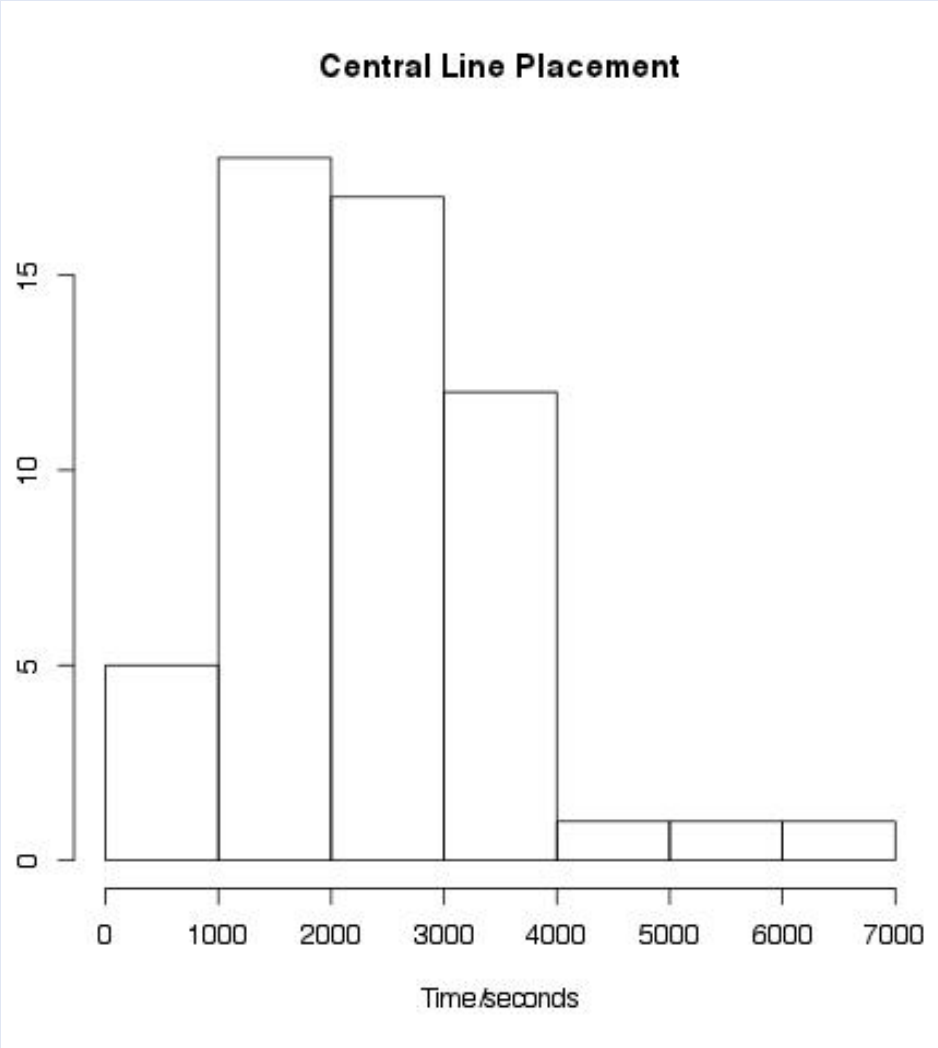
- Reject

Central Line Times

7. State conclusion in context

The mean time for central line placement was 2358 seconds (95% confidence interval 2039 to 2677 seconds). Thus, the null hypothesis of mean time being 480 seconds was rejected ($p<0.0001$).

Central Line Times



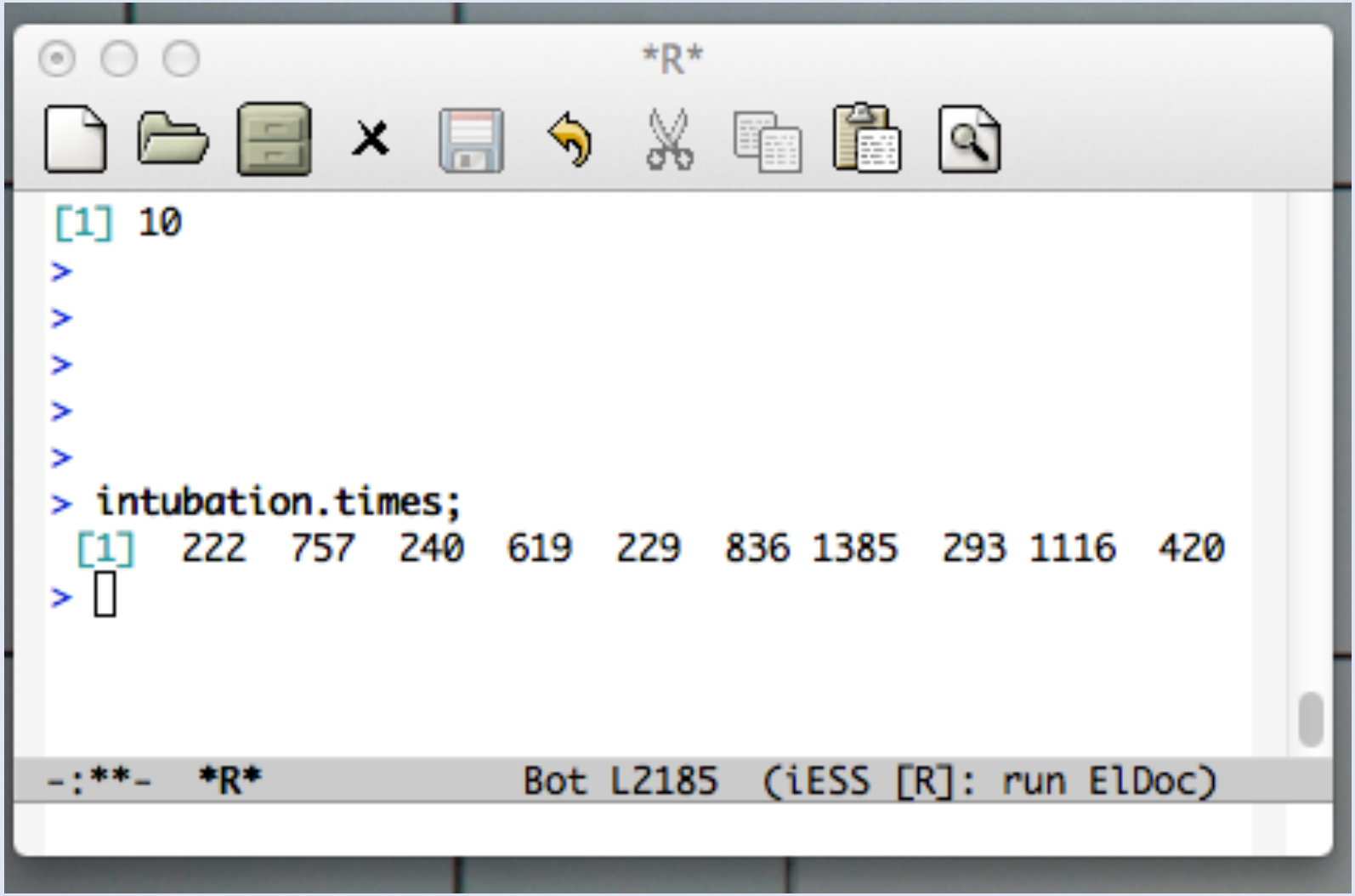
Sometimes Graphical methods are far superior!!

Intubation Times

The researcher is also investigating intubation time for the same study. The simulation software has been using 10 minutes as the estimated time for intubation. She believes that the true time is much shorter at her institution.

She has intubation times for 10 intubations

Intubation Times



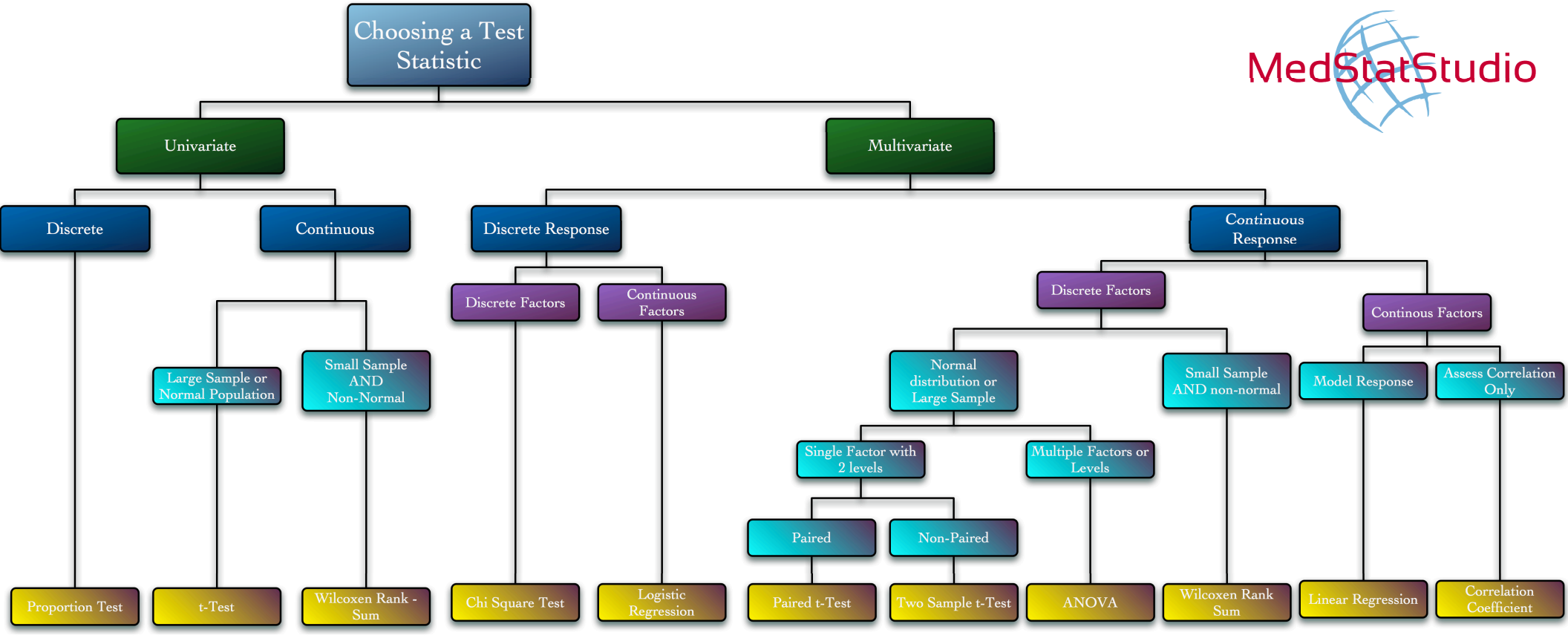
Intubation Times

1. Parameter of interest
   - μ_1 (Mean Intubation Time)
2. Null and Alternative Hypothesis
   - H_0: μ_1=600 seconds
   - H_A: $\mu_1 \neq 600$ seconds

4. State Rejection Region
   - α=0.05
   - Reject if p<0.05

Intubation Times

3. Define Test Statistic



Intubation Times

3. Define test statistic

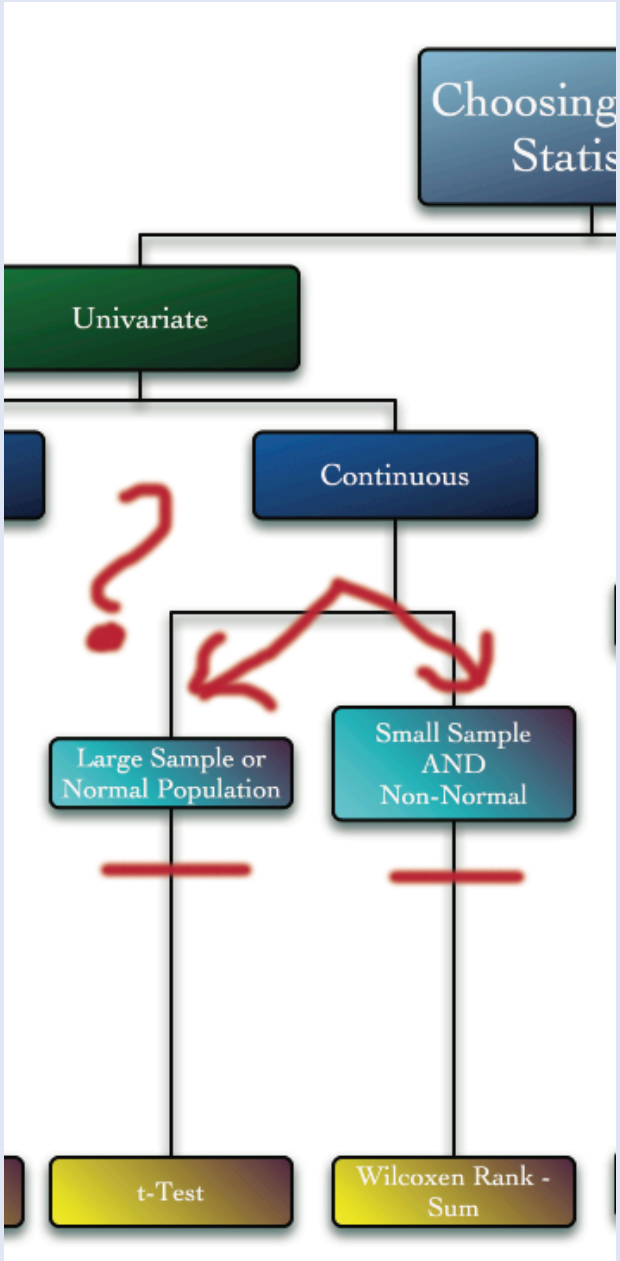
Univariate

⬇

Continuous

⬇

????

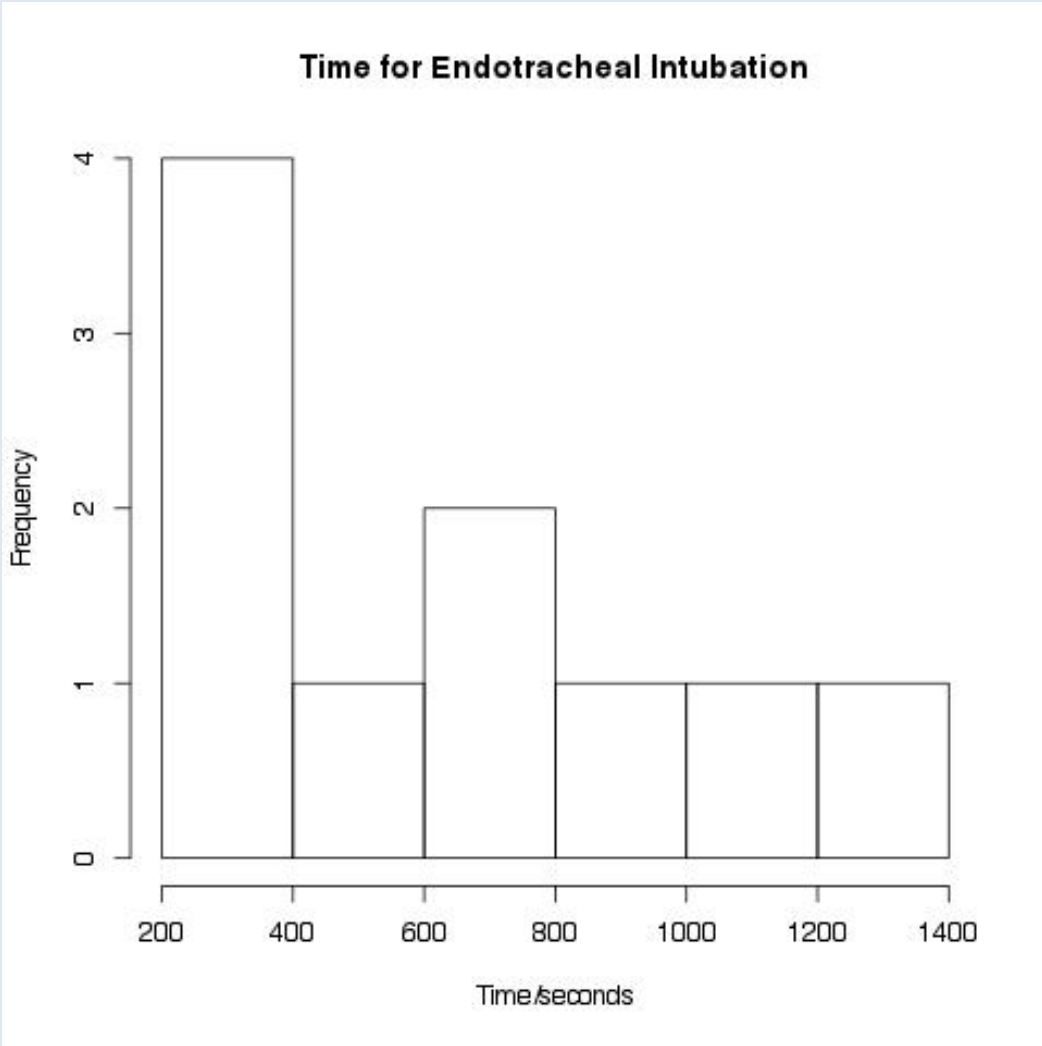


Intubation Times

3. Define test statistic

- How do we know if the population is normal or not?

PLOT!!



Intubation Times

3. Define test statistic

Univariate

⬇

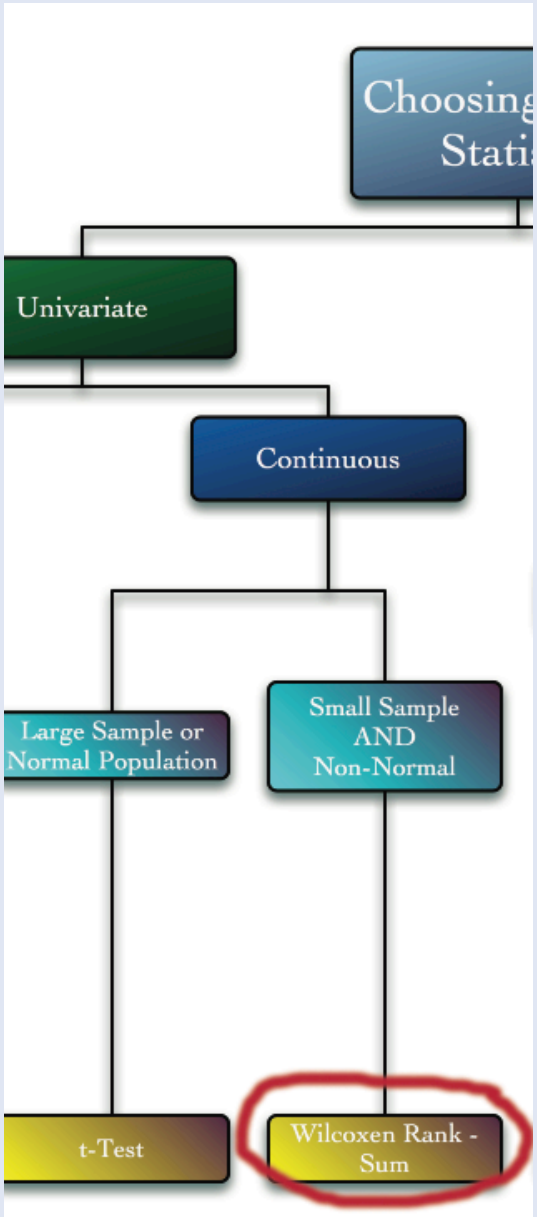
Continuous

⬇

Small and non-normal

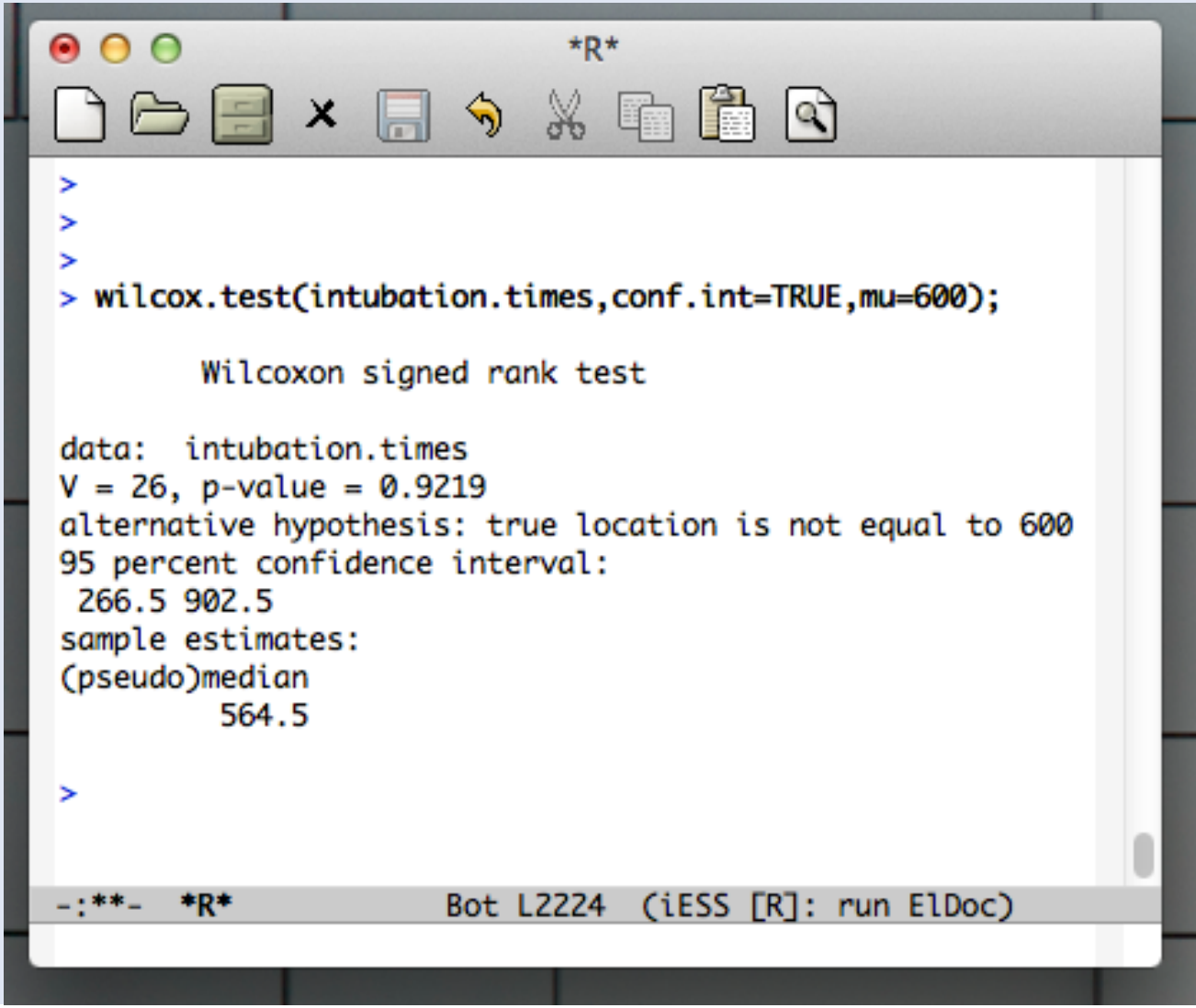
⬇

Wilcoxen Signed Rank



Intubation Times

5. Calculate Test Statistic



Intubation Times

6. State if H_0 will be rejected
   - Unable to reject

Intubation Times

7. State Conclusions in context

The median time for intubation was 564 seconds (95% CI: 266-902 seconds). There is no evidence to suggest that the median time for intubation is different from the current standard of 10 minutes.

Univariate Hypothesis Testing

Questions

Objectives

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Quiz Answers

Quiz Answer: Part I

1. Identify parameter of interest
2. Determine null and alternative hypothesis
3. Define the test statistic***
4. State rejection region
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7. State conclusion in context

Quiz Answer Part II

___1. A researcher is investigating the number of patients who are successfully evacuated from a disaster scene in comparison to the number of patients who were not successfully evacuated. Of 342 victims, 121 were successfully evacuated while 221 were not.

Quiz Answer Part II

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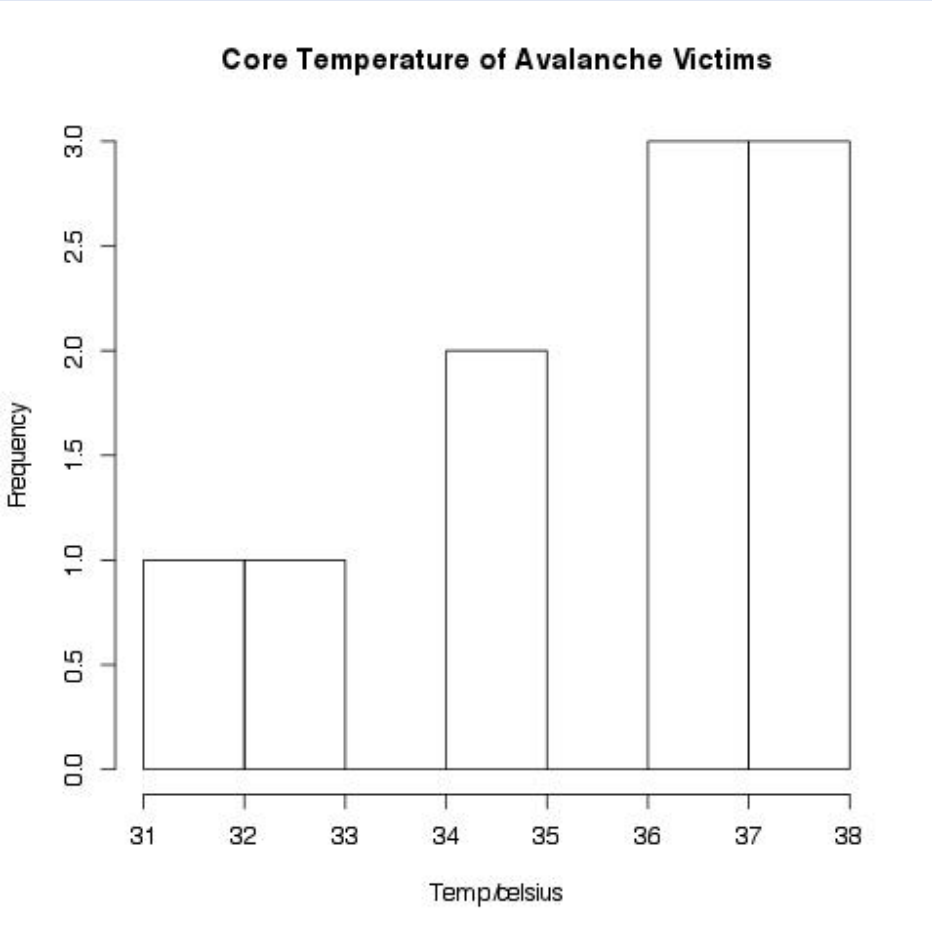
Proportion Test

Quiz Part II

___2. A researcher is investigating the effect of hypothermia on victims of an avalanche. He believes that the true average temperature of these victims is lower than 37.5 celsius. He has data from 10 victims.



Quiz Part II

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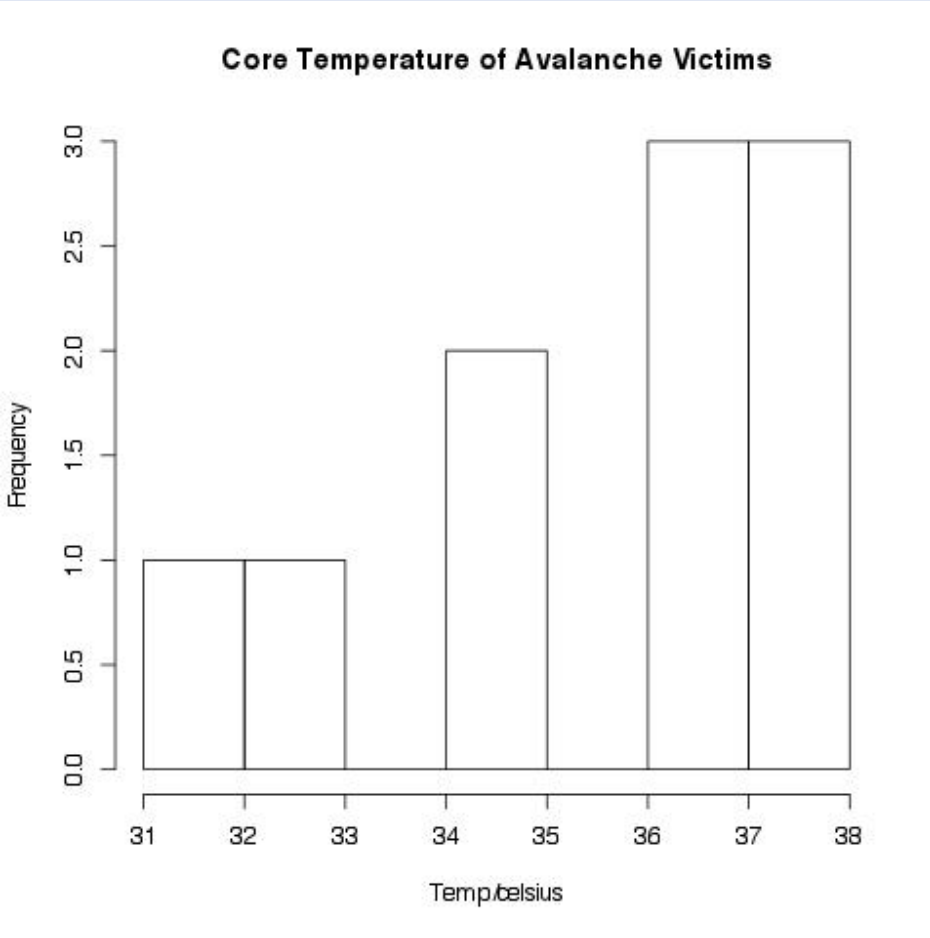
Wilcoxen Signed Rank



Quiz Part II

___3. A researcher wishes to describe the time it takes to complete successful triage among disaster victims of a simulation exercise. She has the time in seconds for successful triage for 35 victims.

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t-Test

Math Lesson

How does the signed rank test work?

➢ 30.4 31.5 30.5 37.3 37.6 37.2 37.1

1. Identify parameter of interest
2. Determine null and alternative hypothesis
3. Define the test statistic***
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