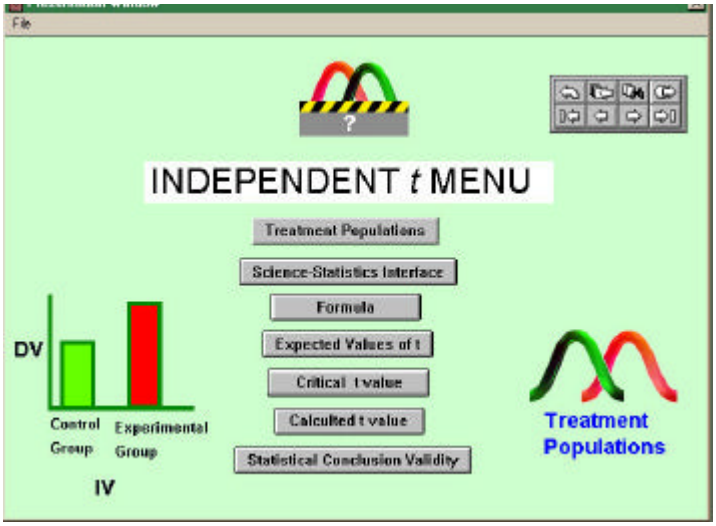
t test for independent means

Tom Malloy



TREATMENT POPULATIONS

Elite Skiers Example

A high performance psychologist has developed Imagery Techniques for improving the performance of world-class elite skiers

DV =

Modeled as...

IV =

Control Population

General population of skiers...

Imagery Treatment Population

2 Populations (Which has lower ET?)

Treatment effects

Treatment effect size =

Large versus small treatment effects

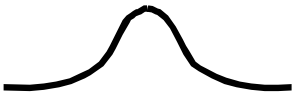
Scientist versus Sceptic

H_0

H_1

How do we decide between H_0 and H_1?

OR



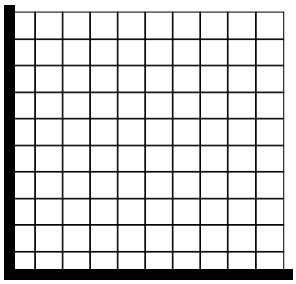
SCIENCE-STATISTICS INTERFACE

Experimental situation: Psychotherapy outcome study...

Therapy group vs. Waiting list control

Scientific hypothesis:

Skeptical scientific hypothesis:



In the experimental design
the scientific hypothesis means that

1)

2)

Do the data pattern fit the Scientific Hypothesis?

Skeptic says that the two groups differ only by chance

CHANCE is a plausible competing hypothesis

Example of dividing class into two parts:

Measure anything...

By chance alone...

In terms of treatment populations

The skeptic says IV is not effective

Therefore...

The Scientist says IV is effective

Therefore...

Abduction from science to statistics

Science	Statistics
	$\mathbf{H_0}$
	$\mathbf{H_1}$

Skeptical Hypothesis

Expects

OR

Expects

Another way to express this:

$\mu_1 - \mu_2 =$

OR

Expect

Therefore

H_o:

OR

H_o:

The Scientific Hypothesis

Expects

Is the Scientific Hypothesis directional?

Therefore

H_1

One- or two-tailed?

FORMULA

A Test Statistic to decide between statistical hypotheses:

Formula for the calculated value of *t*

We will calculate a value of *t* from the experimental data

t=

M_1=

M_2=

$E(M_1 - M_2)$ =

= 0, usually

n_1

n_2

$(S_1)^2$ =

$(S_2)^2$ =

df =

EXPECTED VALUES OF t

Expected Value of **t given H_0** is true

Expected Value of **t given H_1** is true

Critical Values of t

Overview: 1 vs 2 tailed tests

Two-tailed:

Either

One-tailed

Or

One-tailed (upper) example:

The psychotherapy outcome study is a one-tailed upper example because...

Directional Scientific Hypothesis

One tailed alternative Hypothesis ($\mathbf{H_1}$)

(upper) rejection region

Find the critical values of t:

(We will compare the calculated value of *t* with a critical value of *t* found in tables)

First, find **df =**

Second, decide: **One- or two-tailed?**

Third, what is alpha?

To find the critical value of ***t:***

Q = 1 tailed

2Q = 2 tailed

df = degrees of freedom

t-Table

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	one-tailed	0.05	0.025	0.01	0.005	0.001
	two-tailed	0.1	0.05	0.02	0.01	0.002
df						
1		6.314	12.706	31.821	63.657	318.310
2		2.920	4.303	6.965	9.925	22.326
3		2.353	3.182	4.541	5.841	10.213
4		2.132	2.776	3.747	4.604	7.173
5		2.015	2.571	3.365	4.032	5.893
6		1.943	2.447	3.143	3.707	5.208
7		1.895	2.365	2.998	3.499	4.785
8		1.86	2.306	2.896	3.355	4.501
9		1.833	2.262	2.821	3.250	4.297
10		1.812	2.228	2.764	3.169	4.144
11		1.796	2.201	2.718	3.106	4.025
12		1.782	2.179	2.681	3.055	3.930

Put the critical t on a number line

Use Critical values to divide the range of the test statistic (***t***) into...

We assume H_o is true!!!

0

Values of ***t***

CALCULATED VALUE OF t

REVIEW EXAMPLE

CALCULATE THE VALUE OF ***t***

***t* =**

Calculated value of *t* =

df =

STATISTICAL CONCLUSION VALIDITY

SCV SUMMARY

SAMPLING DISTRIBUTION OVERVIEW

[ ] Sample Statistic

Compare the critical value of ***t*** with the calculated value of ***t:***

Delineate Regions:

0

E(*t* given H_o) =

Values of ***t***

[Put critical value on the number line]
[Label Rejection region(s)]

If H_0 is true...

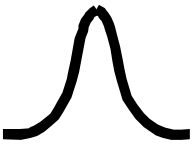
If H_1 is true...

The calculated value of t is...

So...

Reject or not?

Back to Sampling Distribution Overview:

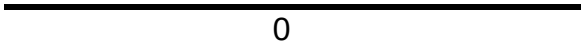


[ ] Sample Statistic

Compare the critical value of ***t*** with the calculated value of ***t***

Reconnecting to Science

H_o expects the value of ***t*** to be.....



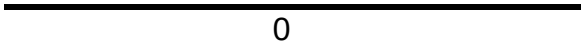
E(*t* given H_o) =

Values of ***t***

A calculated ***t*** in the rejection region is...

So..

H_1 expects the value to ***t*** to be....



E(*t* given H_1) =

Values of ***t***

So if H_1 is true a value of ***t*** above the critical value is....

Translate back from statistics to science

Science	Statistics

So at the level of science...

If Chance is no longer plausible...

Skeptic may have other PCH's

E.g., Placebo

Statistically significant means...

Other PCH's not eliminated by statistics