Hypothesis testing

Is something (statistically) different from something else?

experiment vs accepted
experiment 1 vs experiment 2

Did a treatment have an effect? (change)

Two types of quesitons about means:

1. Is my sample mean different than the true population mean?

2-sided test

2. Is my sample mean greater than the true populaiton mean?
(less than)

1 sided test

Quesiton about a treatment:

Did a treatment have an effect?

(often 1 sided test)

ski → faster fertilizer → bigger

Propose a null hypothesis and an alternate hypothesis.

my mean μ — 1. different — 2. $>$ or $<$ — binomial usually

H_0: $\mu = 0$ ⇒ not different — $\mu \leq 0$

every possibility

H_A: $\mu \neq 0$ — $\mu > 0$

If $P_{data} < P_{significant}$ reject H_0, assume H_A true — sig difference

$P_{data} > P_{significant}$ assume H_0 true — not sig diff.

P_{data} depends on the type of question

$t = \frac{\bar{x} - \text{accept}}{\sigma}$

1. Is my sample mean <u>different</u> than the true population mean?

2-sided — higher or lower ⇒ 2 sided

sig dif — not sig diff

cuties: $P_{\bar{x}+t} > P_{sig}$ $P_{\bar{x}-t} > P_{sig}$

2. Is my sample mean <u>greater than</u> the true populaiton mean?

(less than)

1 sided — $P_{\bar{x}-t} > P_{sig}$ — sig. diff — not sig larger

<u>Quesiton about a treatment:</u>

Did a treatment have an effect?

one-sided

N — $\Sigma \geq$

$P_{x-t} \geq P_{significant}$ *or* $P_{x+t} \geq P_{significant}$

$P_{N \geq result}$ *or* $P_{N \geq result}$

After several trials, a student finds the concentration of a sample of acetic acid to be 5.6 M.

The data from the entire class show a normal distribution with an average of 5 M and a standard deviation of 0.25 M.

Is the student's result statistcally different than the class data?

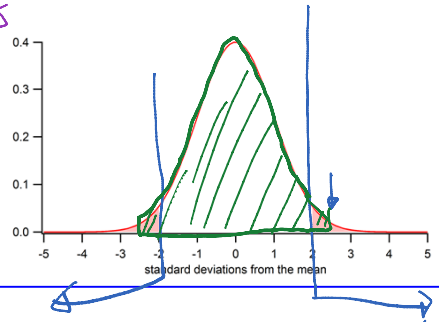
Is this
A) a 1-sided test
B) a 2-sided test

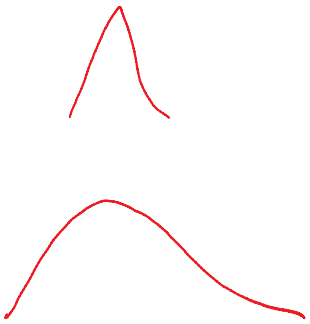
After several trials, a student finds the concentration of a sample of acetic acid to be 5.6 M.

The data from the entire class show a normal distribution with an average of 5 M and a standard deviation of 0.25 M.

Is the student's result statistcally different than the class data at the 5% level? At the 1 % level?

A) 1%, but not 5%
B) 5%, but not 1%
C) 5% and 1%
D) Neither 5% nor 1%
E) No idea





After several trials, a student finds the concentration of a sample of acetic acid to be 5.6 M.

The data from the entire class show a normal distribution with an average of 5 M and a standard deviation of 0.25 M.

Is the student's result statistcally higher than the class average?

Which is the appropriate null hypothesis?

no, it's not higher

A) $\mu = 5$ X
B) $\mu \neq 5$ X
C) $\mu \geq 5$
D) $\mu \leq 5$

avg group = 5 σ 0.25 $t = 2.4$

Is the student's result statistcally higher than the class average at the 5% level?

$P_{2.40}$ = 50.00 − 49.18 = 0.82 (%)

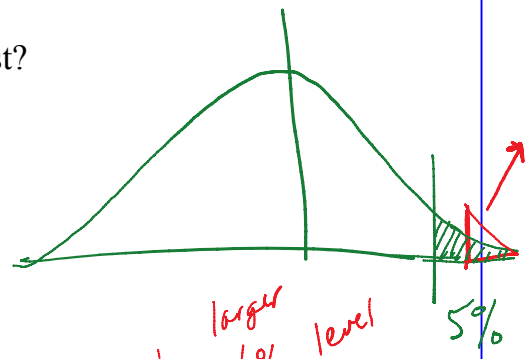
Is this a 1-sided test or a 2-sided test?

(A) ✓ higher @ is if 5% level

yes ✓ (A)

no (B)

(B)



$P_{2.40} < 5\%$

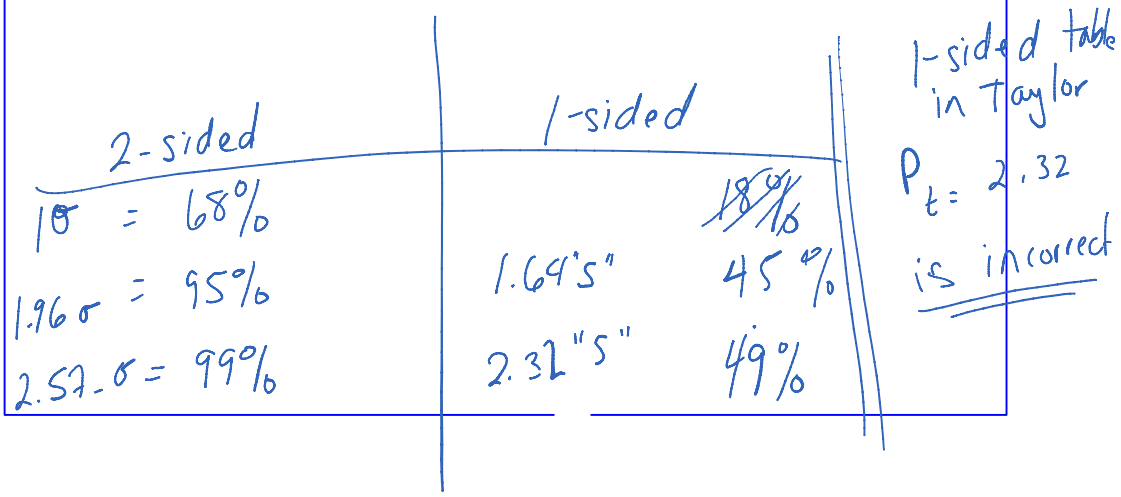
reject H_0 (is not large)

it is larger than chance would predict

Choices: Prob or t

Is the student's result statistcally higher than the class average at the 5% level?

What is the equivalent t for the 5% level for a 1-sided test?



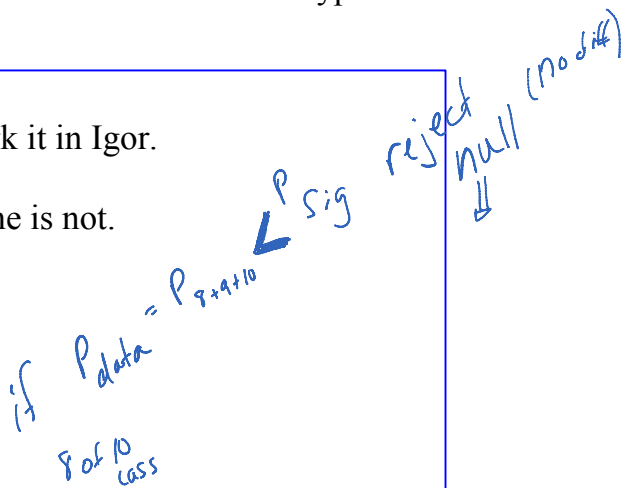
-- Did my "treatment" have an effect?

Easiest statistical hypothesis you can test is:

I assume my test had no influence --> null hypothesis

Taylor's Ski wax example -- Let's work it in Igor.

- Two skis "race" -- one is treated, one is not.
- Number of races = 10
- ***I assume my test had no influence***
  - Null hypothesis:
    $P_{"better"} = 1/2$



Calculate the probability distribution for the number of times the treated ski will win the race. Be sure to label your axes.

You may use `statsbinomialPDF`.

What is the probability that the treated ski will win 10 races?

If the ski wins 8 races, did the wax have a significant effect?
Or could that be random chance?

$P_{N \geq result}$ vs. $P_{significant}$

What is the probability of winning 8 or more times?