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Stat 202 2015S W13-Wed

§6.3 Use and Abuse of Tests.

Carrying out test is simple
Using tests wisely is not.

* Tests designed to give a clear statement of the degree of evidence provided by sample against the null hypothesis

P-value does this

• Reporting "significant" ~~and~~ or "not significant" does not

No clear boundary between two
Only increasingly strong evidence as p decreases.

* When a null hypothesis is rejected at ~~[illegible]~~ $\alpha = 0.05$ there is good evidence that an effect is there

However the effect can be very small (e.g. very small difference in means)

OTOH * If the null hypothesis is not rejected at the level $\alpha = 0.05$ it does not mean that there is no effect, It could mean there is not enough data to see it.

"Absence of Evidence is not evidence of absence

* Statistical inference is not valid for all data sets

Eg if sampling is not random,

* Beware of searching for Significance

You cannot legitimately test a hypothesis on the same data that first suggested that hypothesis,

Multiple comparisons in genomics have 1000s genes ~~How many correlated with~~
If you did a significance test on all, 5% would be significant assuming there was no effect at all,

Standard deviation estimated from data $s = \frac{1}{n-1}\sum(x_i - \bar{x})^2$

Estimate $\bar{X}$

what is the standard deviation of $\bar{x}$ estimated from data

$$\sigma_{\bar{X}} = s/\sqrt{n}$$

When the standard deviation of a statistic is estimated from data the result is called the standard error of the statistic.

The Standard error of the sample mean is $SE_{\bar{X}} = \frac{s}{\sqrt{n}}$

The t statistic is

$$t = \frac{\bar{X} - \mu}{s/\sqrt{n}} = \frac{\bar{X} - \mu}{SE_{\bar{X}}}$$

When an SRS of size n is drawn from a $N(\mu, \sigma)$ population the t statistic has the t distribution with $n-1$ degrees of freedom.

$\boxed{\text{Show book figure}}$ P94

Comparison of z-test and t-test

We used: $z = \dfrac{\bar{X} - \mu}{\sigma/\sqrt{n}}$

as the test statistic for z-test

· But we needed to know σ.

Here we will use

$$t = \frac{\bar{X} - \mu}{s/\sqrt{n}}$$

And s will be computed from data

$z \sim N(0, 1)$

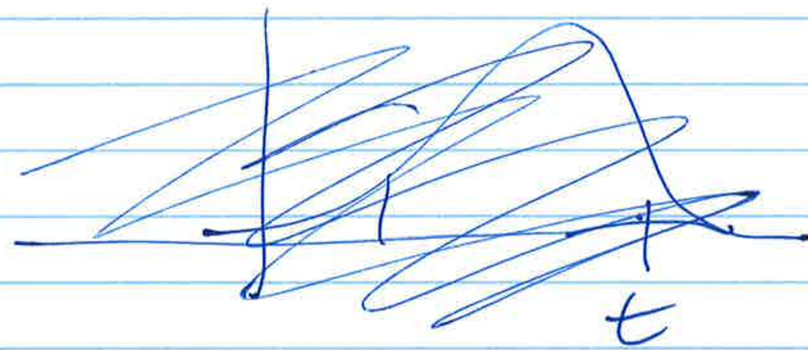
$t \sim t(n-1)$

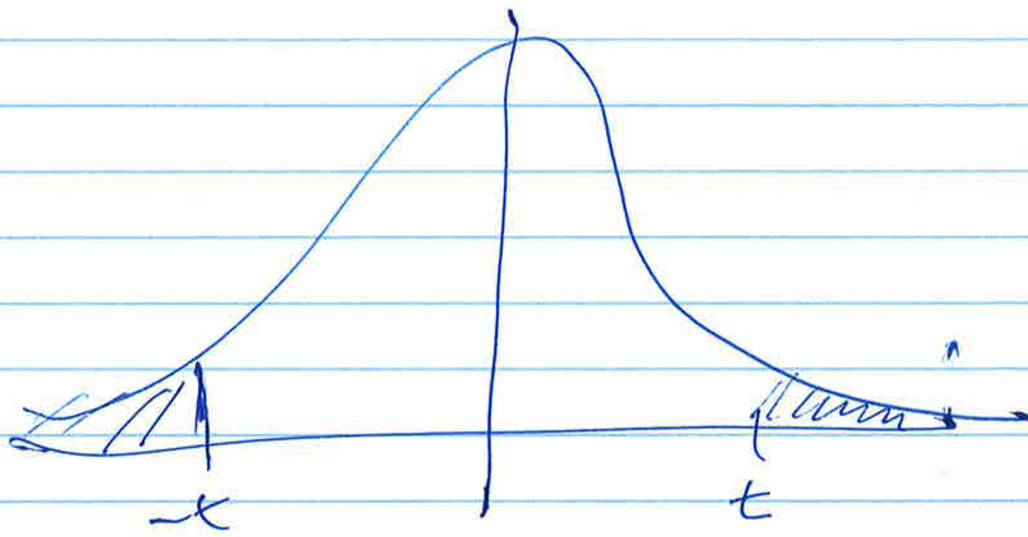
The next step involves the density curves.

For the z-stat the density curve is a bell curve.

For the t-stat the density curve is a modified bell curve (heavier tails)

The next Step is to locate the test Statistic on the density curve (software does this For you)





Compute area represented by more extreme values.

Thats your p value

Reject H_0 if $p < \alpha$

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Only differences between t and z stats

z stats : need to know σ
t stats : use s instead of σ

Density curve is $t(n-1)$ instead of $N(0,1)$

Everything else is same.

Phillip asked a question last class
Do the data have to be Normal

My answer was technically yes but in practice $\bar{X}$ is approximately Normal for large n by the ~~CLT~~ Central limit theorem. How large does n need to be? Depends on how skewed data are.

The book gives these guidelines

- Sample sizes less than 15 — use t procedures (tests, confidence intervals) if data are close to Normal. If data are clearly not normal don't use t.
- Sample size at least 15 — t procedures can be used except in presence of outliers or strong skewness
- Large samples — t procedure can be used for clearly skewed distributions when roughly $n \geq 40$