Stat 202 9.05XP-WS-Wed

The first test we will study is the Z-test (under Data → Z-Stats in stat crunch)

The test statistic is the Z-score

If you are trying to figure out if your cupcakes have mean fat content 30g. You measure the fat content in 10 out of the 500 cupcakes in the store (random sample)

30, 31, 35, 29, 37,
42, 36, 27, 32, 31

You right down your hypotheses

H_0 (null hypothesis, no difference, no effect): $\mu = 30$

↑ want population parameter for all 500 cupcakes to be 30

Versus alternative

H_a: $\mu \neq 30$

Now plug it in to Stat crunch

Data → Z-Stats → One sample
→ with data

* Use "one sample" if you are comparing mean to some specified value
* Use "two samples" if you have two samples and you are comparing the means of the two samples

For example

You have 500 birthday surprise cupcakes and 500 salted caramel cupcakes

You take samples of 10 each and measure the fat content of each of the cupcakes in the sample

The sampling is random so you wouldn't expect the sample mean for the birthday surprise would be equal to the sample mean for the salted caramel EVEN IF the population parameters are the same. With a two sample test you try to weigh the evidence for and/or against the null hypothesis that the population means are the same.

See how this is different from one sample.

For now we are doing one sample. You also have a chance to choose between

With data
With summary
Power / sample size.

With data means you use a column of numbers — the grams of fat of a cupcake.

30, 31, 35, 29, 37, etc

With summary you don't enter in the specific observations. Instead you plug in the summary statistics

- mean of numbers
- standard deviation
- Sample size

this is all you need to know to do the test

if you put in a column of numbers Stat Crunch will just derive these three statistics from the column and use that.

pg 4

We have a column of numbers
lets put that in

Now you need to put in ~~four~~ three
pieces of information

the standard deviation
the null hypothesis
Whether it is a one sided test
or two sided test.

the null hypothesis is $\mu = 30$

the standard deviation

Statcrunch say it is optional

If you don't think! Bullshit! You must put in the std dev

Stat crunch will use the Standard deviation of the sample as the standard deviation of the population

You can do that. But if you do that and you use a normal distribution for your test statistic (z-test) you will get the wrong answer. You must use a t-test if you do that Data → t stats →

Show t-stat with stat crunch (You don't enter in standard deviation) When would you know the standard deviation?

Only if it is given to you in the problem OR if experima show previous studies show etc,

Z-stats are rarely used in practice

Because you usually don't assume you know the standard deviation

Almost always you use T-stats.

The reason the book spends a whole chapter on Z-stats is if you happen to know the standard deviation (rather than use the sample standard deviation) then the test statistic has a Normal distribution (if you use the sample standard deviation it has a T-distribution).

Now about the test statistic

$\bar{X}$ has Normal Distribution with mean, std dev

$\left(\mu, \frac{\sigma}{\sqrt{n}}\right)$

this is the known standard deviation

this is the sample size

this is the μ from the null hypothesis

approximately for large n

To use Z-stats we must be given the ~~sample size~~ (standard dev) in the problem.

For the cupcake example let's say $\sigma = 5$

then $\bar{X}$ ~~[illegible]~~ under our hypotheses $\mu = 30$ $\sigma = 5$

has distribution $N\left(30, \frac{5}{\sqrt{10}}\right)$

The next step is ~~to~~ to standardize $\bar{x}$ and convert to a z-score

$$Z = \frac{\bar{X} - \mu}{\sigma/\sqrt{n}}$$ ← use σ for sample mean not population

$\bar{X}$ was normal with mean 30 std dev. $5/\sqrt{10}$

Z is normal with mean 0 std dev 1

Using standardized test statistic is important if you are looking up p values in a table otherwise you'd need a different table for each mean and each std deviation

We can use software so we can skip the ~~normalization~~ standardization step without changing p-value.

P98

I am going to use a one sided alternative. StatCrunch gives p value

0.0289

Now mean 30

Std dev $\frac{5}{\sqrt{10}} = 1.581138$

The test statistic we are using is

$\bar{X} = 33$ that's our sample mean

Check

P value is $P(\bar{X} \geq 33)$

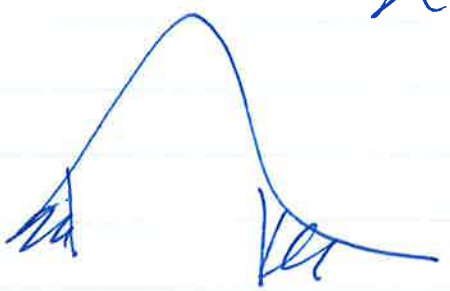
where mean = 30 std dev $= \frac{5}{\sqrt{10}}$

Put into normal calculator

get same thing

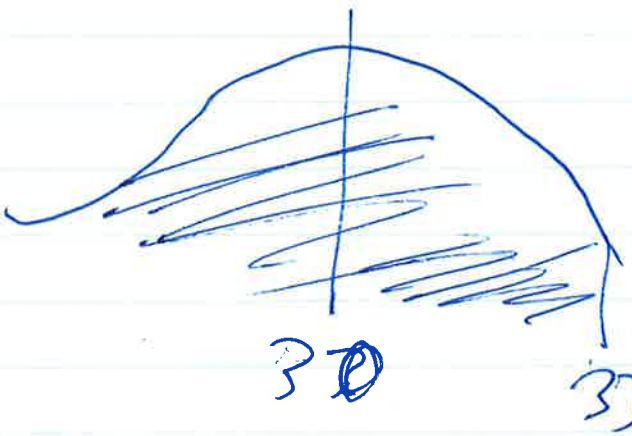
Pg 9

The p value for a two sided alternative is the probability that $X \geq 33$ OR $X \leq 27$



because of symmetry, in bell curve each pica has same area. p value double check

If alternative hypothesis is $X < 33$ we would take the area here



$= 1 - 0.0287$

Should you use a one-sided or two sided alternative.

You can use a one sided alternative when you know in advance that the ~~results will be bigger or~~ mean can only be bigger or can only be smaller than the mean of the null hypothesis

It is cheating (and considered very bad statistical practice) to frame the hypotheses after you have seen the data.

The short answer is always use a two sided alternative.

Some statisticians insist that this is the only answer to the question.

You should use two sided alternatives for all tests I give you, but know about one sided tests.

Pg 1/p

Statistical Significance

If the P value is a small or smaller than a number α then we say that the data are **Statistically significant at level α**

The traditional level is 0.05
But statisticians are less stringent about the traditional level than they used to

In other words it is now considered more useful to report the p-value than it is to say it is significant (at the 0.05 level) without reporting p-value.