SAMPLE SIZE CALCULATIONS

FOR HYPOTHESIS TESTS:

The following five things affect the sample size you need:

1. Which hypothesis test you plan to use

Hypothesis test based on categorical outcomes (as opposed to numerical outcomes)	→	BIGGER sample size
Hypothesis test uses independent groups (as opposed to repeated measures)	→	BIGGER sample size

2. Size of the difference you are looking for

Most hypothesis tests concern the differences between means or percentages.
The difference you would like to see is often called:

- Clinically significant difference
- Practically significant difference

Choosing how big this difference is requires KNOWLEDGE OF YOUR AREA OF RESEARCH.

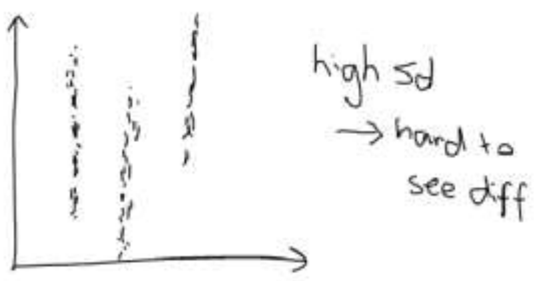
Looking for a SMALL DIFFERENCE	→	BIGGER sample size

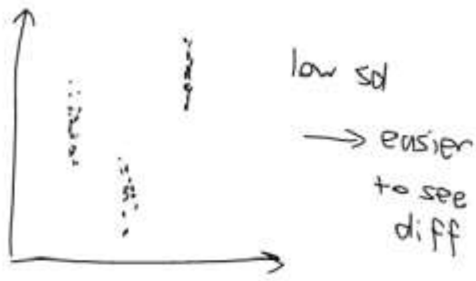
3. Variability of the results

HIGH VARIABILITY means many options for what could happen in a sample of a particular size

eg: for the CHI-SQUARED TEST
very high or very low expected percentage → low variability
medium expected percentage → high variability

eg: for t-tests or ANOVA
large standard deviation → high variability



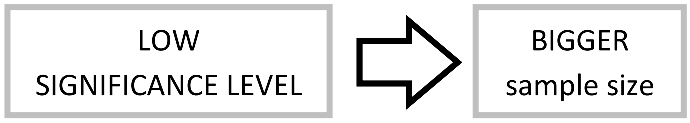


You usually get this information from previous research or a pilot study.

HIGH VARIABILITY	→	BIGGER sample size

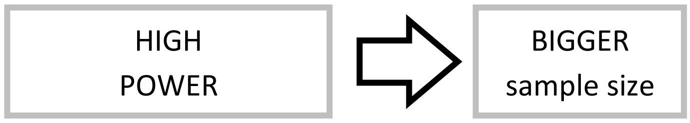
4. <u>Significance level</u>

The cut-off for saying when a p-value is significant. Usually 5%.
Also known as α (alpha) or the "Type I Error rate".



5. <u>Power</u>

The probability of getting a significant result if in fact there IS a difference in the population.
Usually you set this at 80%.
The opposite of Type II Error rate (also known as β (beta)).



[Note that a high dropout rate also increases sample size]

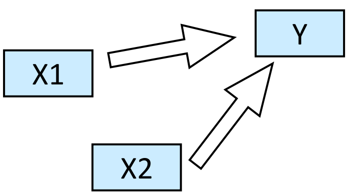
<u>FOR CONFIDENCE INTERVALS:</u>

Confidence intervals are related to hypothesis tests, so the considerations above are used for confidence intervals too.

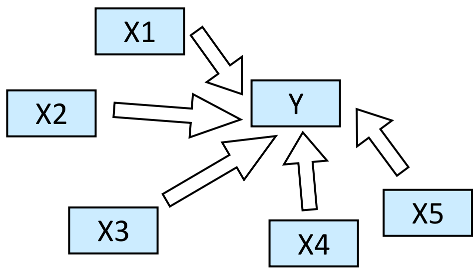
NOTE: Significance level = 100% - Confidence Level
(so for a 95% confidence interval, the significance level is 5%)
NOTE: The "difference you are looking for" is half the width of the confidence interval. Also known as the "margin of error".

<u>FOR REGRESSION:</u>

Rule of thumb: at least 10 times as many subjects as there are explanatory variables.
Proper calculations are based on the t-tests involved to see if slope is significant.

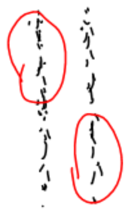


At least 2×10 = 20



At least 5×10 = 50

SOME TERMINOLOGY:



Type I Error:

NO difference in the population

BUT there IS a difference in the sample

(also known as significance level or alpha α or the false positive rate)

Type II Error:

There IS a difference in the population

BUT there is NO difference in the sample

(also known as beta β or the opposite of power or the false negative rate)

PERFORMING THE CALCULATIONS :

Russ Lenth's has created a comprehensive suite of online calculators:
http://homepage.stat.uiowa.edu/~rlenth/Power
You need all the information mentioned above in order to use the calculators.

There is also a simple rough formula for the t-tests and chi-squared tests in Chapter 36 of "*Medical Statistics at a Glance" by Aviva Petrie and Caroline Sabin*

Lehr's Formula

For 80% power at the 5% significance level:

$$\text{Sample size needed per group} = \frac{16}{(D)^2}$$

Here "D" is the "standardised difference" which is calculated like this for three common tests:

Unpaired t-test	Paired t-test	Chi-squared test
$D = \frac{d}{\sigma}$ d = difference in means you want to find σ= standard deviation	$D = \frac{2d}{\sigma}$ d = mean of the difference you want to find σ= standard deviation of the difference	$D = \frac{d}{\sqrt{p(1-p)}}$ d = difference in proportions you want to find p = estimated average proportion

Examples of Calculations With Lehr's Formula

Unpaired t-test

Suppose the difference we are looking for is d = 1°C and the standard deviation is $\sigma = 1$°C.

Std diff: $D = \frac{d}{\sigma} = \frac{1}{1} = 1$

Sample size $= \frac{16}{D^2} = \frac{16}{1^2} = 16$ per group

Suppose the difference we are looking for is d = 1°C and the standard deviation is $\sigma = 0.5$°C.

Std diff: $D = \frac{d}{\sigma} = \frac{1}{0.5} = 2$

Sample size $= \frac{16}{D^2} = \frac{16}{2^2} = 4$ per group

Suppose the difference we are looking for is d = 1°C and the standard deviation is $\sigma = 2$°C.

Std diff: $D = \frac{d}{\sigma} = \frac{1}{2} = 0.5$

Sample size $= \frac{16}{D^2} = \frac{16}{(0.5)^2} = 64$ per group

Chi-squared test

Suppose the difference we are looking for is d = 3% = 0.03 and the average percentage is p = 20% = 0.20.

$\sqrt{p(1-p)} = \sqrt{0.2 \times 0.8} = 0.4$

Std diff $D = \frac{d}{\sqrt{p(1-p)}} = \frac{0.03}{0.4} = 0.075$

Sample size $= \frac{16}{D^2} = \frac{16}{(0.075)^2} = 2843$ per group