British Standards Institution Study Day

Detecting a single event

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Detecting a single event

The problem is this. If we have a series of cases where no event has taken place, what is the estimated event rate?

Our best estimate of the proportion of cases which have an event is zero.

We need a small sample confidence interval for the estimate, based on the Binomial distribution.

The Binomial distribution has two parameters, p, the proportion of observations which are an event, and n, the number of observations.

We find p which would give a probability 0.025 of having zero events. This is the upper limit of the 95% confidence interval.

Detecting a single event

For example, suppose we observe n = 40 cases with no events. What is the estimated proportion in the population who would experience the event?

95% confidence interval = 0 to 0.088.

Upper limit = 8.8%.

Suppose we observe n = 100 cases with no events.

95% confidence interval = 0 to 0.036,
upper limit = 3.6%.

Suppose we observe n = 1000 cases with no events.

95% confidence interval = 0 to 0.0037,
upper limit = 0.37%.

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It is easy to tabulate this for selected sample sizes.

Follow link: http://martinbland.co.uk/ and follow menu to "Detecting a single event".

Number	Proportion	Number	Proportion	Number	Proportion
10	0.31	41	0.086	140	0.026
11	0.28	42	0.084	150	0.024
12	0.26	43	0.082	160	0.023
13	0.25	44	0.080	170	0.021
14	0.23	45	0.079	180	0.020
15	0.22	46	0.077	190	0.019
16	0.21	47	0.075	200	0.018
17	0.20	48	0.074	250	0.015
18	0.19	49	0.073	300	0.012
19	0.18	50	0.071	350	0.010
20	0.17	51	0.070	400	0.0092
21	0.16	52	0.068	450	0.0082
22	0.15	53	0.067	500	0.0074
23	0.15	54	0.066	600	0.0061
24	0.14	55	0.065	700	0.0053
25	0.14	56	0.064	800	0.0046
26	0.13	57	0.063	900	0.0041
27	0.13	58	0.062	1000	0.0037
28	0.12	59	0.061	1100	0.0034
29	0.12	60	0.060	1200	0.0031
30	0.12	65	0.055	1300	0.0028
31	0.11	70	0.051	1400	0.0026
32	0.11	75	0.048	1500	0.0025

Detecting a single event

There is a program, biconf.exe, but it is a bit difficult to use as Microsoft have dropped MS-DOS from Windows 7.

Go to http://martinbland.co.uk/

and follow the link to Simple statistical software on the menu.

Can be used when there are events, too.

Detecting a single event

How does it work?

Binomial distribution formula, probability of *r* events out of *n*:

$$\mathrm{Pr}(r) = \frac{n!}{r!\,(n-r)!} p^r (1-p)^{n-r}$$

(but we only do that to make ourselves look clever).

Then to find the probability of being less or equal to than some number of events, we sum all the probabilities for *r* up to that number.

We find *p* so that this is 0.025.

Detecting a single event

How does it work?

We find p so that this is 0.025.

It is all built into the program.

A power calculation

How big a sample do we need to have a 90% chance of finding an event?

We postulate an event probability for the population, p.

What is the probability (proportion of possible samples) of no events in a sample of size n?

Probability that a given observation has no adverse event $= 1 - p$.

Probability of no observations in n observations $= (1 - p)^n$.

We set this equal to 1 − power = 1 − 0.90 = 0.1.

A power calculation

Probability of no observations in n observations $= (1 - p)^n$.

We set this equal to 1 − power = 1 − 0.90 = 0.1.

For example, suppose adverse events happen once in 100 trials, p = 0.01. What sample to we need to have 90% chance of seeing an event?

$$(1 - 0.01)^n = 0.1$$

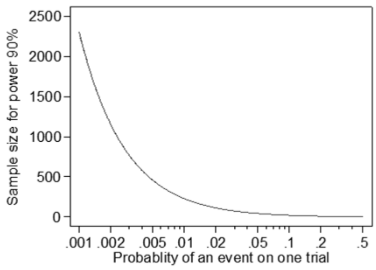
$$n\log(0.99) = \log(0.1)$$

$$n = \log(0.1)/\log(0.99) = 229.1$$

We need 229 observations to have a 90% chance of an adverse event.

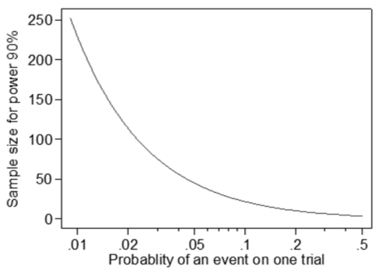
A power calculation

We can do this for any value of p.



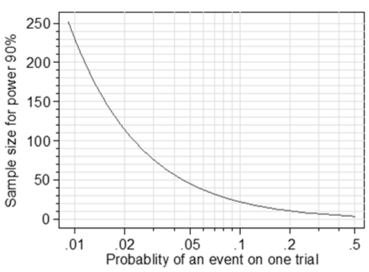
A power calculation

For more practical sample sizes:



A power calculation

For more practical sample sizes, with grid lines:



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