Suppose that we calculated a fault rate ('number not OK'/'number insp.') from a process. (A calculated fault rate often is designated $\hat{p}$ and is read *p-hat*.) We want to estimate the true fault rate *p* of the process using the calculated result which is based on data containing randomness. Thus our estimation will not be *p* exactly.

If we let the (green) dot in every diagram be our calculated $\hat{p}$, we find that there are many values of *p* that might give the $\hat{p}$ that we did get from our data.

The eight distributions symbolize only few of all possible distributions. The two (red) distributions (upper left and lower right) can however be regarded as some kind of extreme possibilities.

If the green dot lies in right '2.5%'-tail of the left distribution and in the left '2.5%'-tail of the right distribution respectively, we state that the difference between the two 'p'-values of the distributions forms a '95%' *confidence interval* for the theoretical fault rate (*p*) of the process.

Such an interval covers the true value of the parameter being studied with 95% probability. If we want a more secure interval, e.g. 99%, we must let the green dot enter the '0.5%'-tails of the distributions. In other words we must pull the left distribution further to the left and the right distribution further to the right. In this way we get an interval that with a higher probability cover the true value of the process; although to the price of a longer interval.

Calculating and reporting a confidence interval is an honest way to exhibit the available data and shows what conclusions can be (or can not be) drawn.
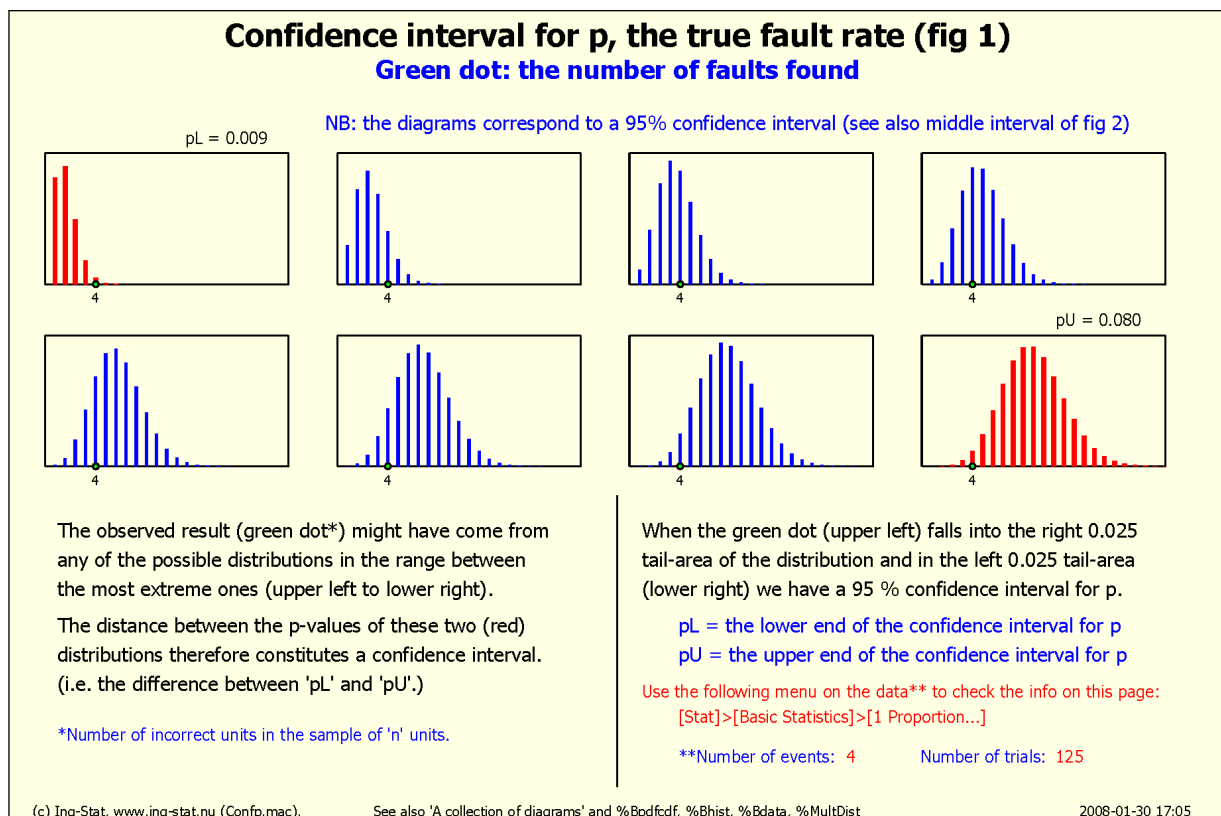
Macros and menus
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[Stat]>[Basic Statistics]>[1 Proportion…]

Data on the printout
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Confidence interval for p, the true fault rate (fig 1)
Green dot: the number of faults found

NB: the diagrams correspond to a 95% confidence interval (see also middle interval of fig 2)

pL = 0.009

pU = 0.080

The observed result (green dot*) might have come from any of the possible distributions in the range between the most extreme ones (upper left to lower right).

The distance between the p-values of these two (red) distributions therefore constitutes a confidence interval. (i.e. the difference between 'pL' and 'pU'.)

*Number of incorrect units in the sample of 'n' units.

When the green dot (upper left) falls into the right 0.025 tail-area of the distribution and in the left 0.025 tail-area (lower right) we have a 95 % confidence interval for p.

pL = the lower end of the confidence interval for p
pU = the upper end of the confidence interval for p

Use the following menu on the data** to check the info on this page:
[Stat]>[Basic Statistics]>[1 Proportion…]

**Number of events: 4   Number of trials: 125

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An estimate of the true fault rate p ($0 \leq p \leq 1$) is calculated using the relation between 'number of incorrect products' and 'number of inspected products' (perhaps multiplied by 100 in order to get the result expressed in percent). Statistical theory shows however that this estimate includes some uncertainty. An honest and complete report should indicate the size of this uncertainty.

A common way to do this is to calculate a so-called *confidence interval*. It is an interval which with a rather large probability includes the true value of the fault rate.

The diagram shows the calculated estimate (called *p*-hat) and three intervals with 90, 95 and 99 percents confidence. The 'alpha'-risk is the risk that the interval, by random causes, misses the true *p*-value. When 'alpha' = 0.10, on the average 1 interval of 10 will miss the true value, with 'alpha' = 0.05 1 interval of 20 and with 'alpha' = 0.01 1 interval of 100 will miss the true *p*-value. Of course, we can not determine whether a just calculated interval is missing the true value.

The calculation is also based on the number of data points and the wanted confidence where higher confidence leads to a longer interval.

The printout describes 'number of products' but the theory is valid for every situation when there is a number with a certain feature: number of orders in time amongst *n* orders, number of women amongst *n* human beings, etc.

Data on the printout

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[Stat]>[Basic Statistics]>[1 Proportion…]		

Number of events = e.g. number of incorrect details
Number of trials   = e.g. number of inspected details

Confidence interval for p, the true fault rate (fig 2)
Red dots: the interval. Green dot: the point estimate (p-hat)

Number of events (e.g. number of faulty items):   4
Number of trials (e.g. number of inspected items):   125

0.011	0.032	0.072	
			(alpha-risk 0.10)

0.009	0.032	0.080	
			(alpha-risk 0.05)

0.005	0.032	0.097	
			(alpha-risk 0.01)

The alpha-risk expresses the probability that the interval misses the true value of the parameter.

See also the menu [Stat]>[Basic Statistics]>[1 Proportion...]

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