

Re: Chi squared -> p-value - Any formula??

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- *From:* "Dave (from the UK)" <see-my-signature@xxxxxxxxxxxxxx>
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Ray Koopman wrote:

My favorite simple approximation for the standard normal cdf is

$$1/(1 + \text{Exp}[-.496937z*\text{Sqrt}[z^2 + 10.28]]),$$

for which the absolute error is $< 1.58*10^{-4}$.

The corresponding approximation for the complementary cdf (i.e.,

the upper tail area) of a chi-square variable with 1 d.f. is

$$2/(1 + \text{Exp} [.496937*\text{Sqrt}[x(x + 10.28)]]).$$

Thanks for that Ray - it was most helpful.

The claimed accuracy of the approximation for the standard normal cdf ($< 1.58*10^{-4}$) is somewhat better than that of the approximation Ken gave, and is also simpler to type, so I decided to try your approximation.

I did some checks of your formula in Mathematica and found largest *absolute* error of the p-value is 0.0003147. (I tested that for chi-squared values in the range 0 to 40 in steps of 0.00001)

For chi-squared in the range 0 to 6.63489 (p-values 1.0 down to 0.01), the maximum fractional error in the p-values was 2.91%.

Extending its range somewhat more, with chi-squared to 10.827566 (p-values of 1.0 down to 0.001) gave an error in the p-values of $\leq 9.18\%$, which is good enough for me.

Just for completeness, I tested it to p-values down to 0.0001 (chi-squared up to 15.136705) at which point the error in p-values is quite large (16.9%), but realistically for me, I'm only really interested in p-values down to 0.005 or so, where the error is 4.56% or less.

So far I've only tested a Mathematica approximation, but assuming Tcl's maths functions are not broken, it should give similar results in Tcl.

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BTW, the reason for using Tcl is that I have a program that was originally written in that. Its not an ideal language for maths stuff, but the main program is a chess database, not a maths package.

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Dave (from the UK)

Please note my email address changes periodically to avoid spam.

It is always of the form: month-year@xxxxxxxxxxxxx

Hitting reply will work for a few months only - later set it manually.

<http://chessdb.sourceforge.net/> - a Free open-source Chess Database

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