Why the dimensionless mathematical ratio Pi occurs in the Gauss distribution law

Nigel B. Cook, 27 March 2014 www.quantumfieldtheory.org

The occurrence of pi in formulae apparently unrelated to geometry was used by Eugene Wigner in his 1960 paper *The unreasonable effectiveness of mathematics in the natural sciences.* Wigner's example is the Gaussian/normal distribution law, which is an example of obfuscation. Laplace (1782), Gauss (1809), Maxwell (1860) and Fisher (1915) wrote the normal exponential distribution with the square root of pi in the normalization outside the integral. But Stigler in 1982 rewrote the equation with pi in the exponent, making the formula look less mysterious because the exponent is then the area of a circle (in other words, Poisson's exponential distribution, adapted to circular areas, with areas expressed in dimensionless form); if you think of the use of the normal distribution to model CEP error probabilities for missiles landing around a target point (H. Kahn, *On Thermonuclear War,* 1960, appendix):

Gaussian (normal) distribution, Wigner and Stigler

Laplace (1782): $\int_{-\infty}^{\infty} e^{-t^2}\, dt = \sqrt{\pi}$

Gauss (1809): $\frac{1}{\sqrt{\pi}} \int_{-\infty}^{\infty} e^{-t^2}\, dt = 1$

Maxwell (1860): $\int_{-\infty}^{\infty} \frac{1}{\alpha\sqrt{\pi}} e^{-\frac{x^2}{\alpha^2}}\, dx = 1$

Fisher (1915): $\frac{1}{\sigma\sqrt{2\pi}} \int_{-\infty}^{\infty} e^{-\frac{(x-m)^2}{2\sigma^2}}\, dx = 1$ **or** $\int_{-\infty}^{\infty} \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}\, dx = 1$

Stigler (1982): $\int_{-\infty}^{\infty} e^{-\pi x^2}\, dx = 1$ **Pi is just due to circular area!**

Regular exponential coin-tossing in a circular area

Wigner (1960): "There is a story about two friends … One of them became a statistician … He showed a reprint to his former classmate. The reprint started, as usual, with the Gaussian distribution … 'And what is this symbol here?' 'Oh,' said the statistician, 'this is pi.' 'What is that?' 'The ratio of the circumference of the circle to its diameter.' 'Well, now you are pushing your joke too far,' said the classmate, 'surely the population has nothing to do with the circumference of the circle.' Naturally, we are inclined to smile about the simplicity of the classmate's approach. Nevertheless, when I heard this story, I had to admit to an eerie feeling because, surely, the reaction of the classmate betrayed only plain common sense."

Pope Benedict XVI (2009): "Yet the human mind invented mathematics in order to understand creation; but if nature is really structured with a mathematical language and mathematics invented by man can manage to understand it, this demonstrates something extraordinary. The objective structure of the universe and the intellectual structure of the human being, coincide; the subjective reason and the objectified reason in nature are identical. In the end it is 'one' reason that links both and invites us to look to a unique creative Intelligence."

Mathematics is a human tool; not a replacement for God.

So there's really no mystery at all. It's a terrific example of how thinking about military applications of mathematics undermines the dogmatic prejudices that reside at the heart of so-called "pure mathematic", which is sheer ignorance, enforced by censorship and coercion from on-high.