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Added in proof. A later literature search uncovered the following paper in which the result given here is noted: W. Feit, R. Lyndon, and L. Scott, A remark about permutations, *J. Combinatorial Theory* (A) 18 (1975), 234–235. The following paper explores generalizations of our result: M. Herzog and K. B. Reed, Representation of permutations as products of cycles of fixed length, *J. Austral. Math. Soc.* 22(Series A) (1976), 321–331.

A Note on the Gaussian Integral

CONSTANTINE GEORGAKIS
DePaul University
Chicago, IL 60614

The elementary derivation given below for the Gaussian integral

$$I=\int_0^{\infty} e^{-x^2}\,dx=\frac{\sqrt{\pi}}{2}$$

uses integration in Cartesian coordinates and a dilation kind of change of variable. It is a better alternative to the usual method of reduction to polar coordinates that is found in texts on advanced calculus or probability and statistics.

Let $y=xs$, $dy=xds$, then

$$\begin{aligned}I^2&=\int_0^{\infty}\left(\int_0^{\infty} e^{-(x^2+y^2)}\,dy\right)dx=\int_0^{\infty}\left(\int_0^{\infty} e^{-x^2(1+s^2)}x\,ds\right)dx\\&=\int_0^{\infty}\left(\int_0^{\infty} e^{-x^2(1+s^2)}x\,dx\right)ds\\&=\int_0^{\infty}\left[\frac{1}{-2(1+s^2)}e^{-x^2(1+s^2)}\Big|_0^{\infty}\right]ds=\frac{1}{2}\int_0^{\infty}\frac{ds}{(1+s^2)}\\&=\frac{1}{2}\arctan s\Big|_0^{\infty}=\frac{\pi}{4}.\end{aligned}$$

The idea utilized in this derivation is implicit in a similar method used for establishing the functional equation: $\Gamma(a)\Gamma(b)=\Gamma(a+b)\mathrm{B}(a,b)$ for the gamma and beta function, in the special case where $a=b=\frac{1}{2}$.