

Example: $\int_{-\infty}^{\infty} e^{-x^2} dx$

Another famous improper integral is:

$$\int_{-\infty}^{\infty} e^{-x^2} dx = \sqrt{\pi}.$$

This is a key number in probability. It is used to understand standard deviation, predict outcomes of elections, calculate insurance rates, and estimate income from lotteries.

This number was first calculated numerically around the end of the the seventeenth century by de Moivre, who was selling his services to various royalty who were running lotteries. Although he didn't know the exact value of $\sqrt{\pi}$, he approximated the integral well enough to predict how much money their lotteries would make.

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