

**ABRAHAM DE MOIVRE** (May 26, 1667 – November 27, 1754)

by HEINZ KLAUS STRICK, Germany

The French-English mathematician ABRAHAM DE MOIVRE shares the fate of many personalities who had to flee their homeland: in their new homeland they do not get recognition for their outstanding scientific achievements, and ultimately they will not be considered as belonging to either country. In the past, neither the French nor the British postal administration were prompted to commemorate ABRAHAM DE MOIVRE.



In 1598, KING HENRI IV issued the *Edict of Nantes*, thereby granting the Calvinist Protestants (called Huguenots) of his country certain rights to practice their religion. In the decades that followed, however, these freedoms were gradually restricted until KING LOUIS XIV finally revoked the edict in 1685, which led to the Huguenots fleeing France from the mobs who had attacked them.

ABRAHAM MOIVRE, son of a Protestant doctor, first attended the tolerant Catholic school of the Christian Brothers in Vitry (Champagne), and then at the age of 11, the Protestant Academy in Sedan. After this school was closed in 1682, he moved to Saumur (Loire) and finally to a college in Paris. His interest in mathematical questions is not quenched at school.

He read the works of CHRISTIAAN HUYGENS, in particular his investigations on the calculation of probability, *De ratiociniis in ludo aleae*, and took private lessons from JACQUES OZANAM, a respected author of numerous mathematics books, including the 5-volume work *Cours des mathématiques*, which even appeared in English, as well as the *Récréations mathématiques et physiques*.



After the *Edict of Nantes* was revoked, ABRAHAM MOIVRE and other Huguenots were held in a monastery for over two years to try to convert them to the Catholic faith. In 1688 he managed to flee to England.

When he arrived in London, he added the DE to his name. He earned his living as a private teacher, taught mathematics to children from wealthy families and offered his services in coffee houses. With a letter of recommendation, he applied to the Earl of Devonshire, who did not offer him a job, but this led to an encounter that was important for his future life: The Earl showed him a copy of the freshly printed *Principia Mathematica*. DE MOIVRE realized that this is a work that surpassed any other book he had ever had in his hands. He bought a copy and cut it up; so he could read it anywhere page by page, even between and during his lessons.



In 1692 he met EDMOND HALLEY, who was secretary of the *Royal Society* at the time, and shortly thereafter ISAAC NEWTON himself, with whom he had long discussions about the differential calculus he had developed.

In 1695 DE MOIVRE submitted a first contribution of *The Method of Fluxions* to the Royal Society, which accepted him as a member two years later. He was also able to generalize NEWTON'S (general) binomial theorem to the multinomial theorem.



He became friends with NEWTON and there was a close collaboration between the two; NEWTON was very impressed by DE MOIVRE's skill; for example, he left the publication of the Latin version of his *Optics* to him. NEWTON even answered questions about the *Principia* with "Go to Mr DE MOIVRE; he knows these things better than I do".

However, membership in the *Royal Society*, friendship with NEWTON and the large number of publications did not help DE MOIVRE find a suitable position at a university – as a foreigner, he had no chance with his applications.

Efforts by LEIBNIZ and JOHANN BERNOULLI on the continent were also unsuccessful. And so DE MOIVRE spent his days frugally, wandering back and forth between the houses of wealthy families and waiting in coffee houses for people who wanted to know what opportunities they had with certain games of chance or whether pension insurance schemes were recommended. In the evening he met regularly with NEWTON for philosophical discussion.

After a few short contributions on the calculation of probabilities, *The Doctrine of Chance: A method of calculating the probabilities of events in play* appeared in 1711, with a dedication to NEWTON. In 1718 it was published in Latin and then in 1738 and posthumously in 1756 in an extended version.

The 1738 edition contained the definition of probability, now known as "classic", which was later taken over verbatim by PIERRE SIMON DE LAPLACE.

It can be phrased: probability of an event =  $\frac{\text{number of favorable cases}}{\text{number of possible cases}}$ .



Priority disputes between DE MOIVRE and PIERRE RÉMONDE DE MONTMORT, who published a collection of combinatorial problems under the title *Essay d'analysis sur les jeux de hazard* in 1708, regarding the solution of the so-called *Rencontre problem* did not become serious, since both conceded that the other had played a key role in it.

HALLEY was the first to use mortality tables around 1693 to calculate reasonable rates for life insurance. From this data, DE MOIVRE developed formulas that could be used to calculate the annual rates. His work *Annuities on lives* appeared in 1724 and was reprinted several times.

In *Miscellanea Analytica* (Articles in analysis) from 1730, DE MOIVRE gave a formula for calculating the FIBONACCI numbers (this calculation was rediscovered in 1843 by JACQUES PHILIPPE MARIE BINET):

$$f_n = \frac{1}{\sqrt{5}} \cdot \left( \left( \frac{1+\sqrt{5}}{2} \right)^n - \left( \frac{1-\sqrt{5}}{2} \right)^n \right).$$

DE MOIVRE then dealt with the factorisation of polynomials of the type  $x^{2n+1}$ . ROGER COTES, astronomy professor in Cambridge and editor of the second edition of the *Principia*, had previously found that factorisation was possible:

$$x^{2n} + 1 = \left[ x^2 - 2x \cdot \cos\left(\frac{\pi}{2n}\right) + 1 \right] \cdot \left[ x^2 - 2x \cdot \cos\left(\frac{3\pi}{2n}\right) + 1 \right] \cdot \dots \cdot \left[ x^2 - 2x \cdot \cos\left(\frac{(2n-1)\pi}{2n}\right) + 1 \right]$$

DE MOIVRE was enthusiastic about this wonderful connection with geometry and derived the formula named after him today:

$$(\cos \alpha + i \cdot \sin \alpha)^n = \cos(n\alpha) + i \cdot \sin(n\alpha) \quad \text{for } n \in \mathbb{N}$$

In 1745 LEONHARD EULER generalized this formula for any exponent.

In 1733 he developed an approximation formula for factorials:

$$n! \approx c \cdot \sqrt{n} \cdot n^{n+1} \cdot e^{-n} \quad \text{with } c \approx 2.5.$$

It annoyed him when a short time later the Scot JAMES STIRLING identified the unknown factor  $c$  as  $\sqrt{2\pi}$ .

He examined BERNOULLI's *law of large numbers* and discovered the approximation of the *binomial distribution* by a distribution that is now called the *normal distribution*.

Starting from the probability  $p_k = \binom{n}{k} \cdot \frac{1}{2^n}$

for  $k$  heads out of  $n$  tosses of the coin and the symmetry regarding  $k = \frac{1}{2} \cdot n$  he notes that the distribution can be standardized using  $\sqrt{n}$ .

Except for the factor  $\frac{1}{2}$  this is just what is now called the standard deviation  $\sigma$ .

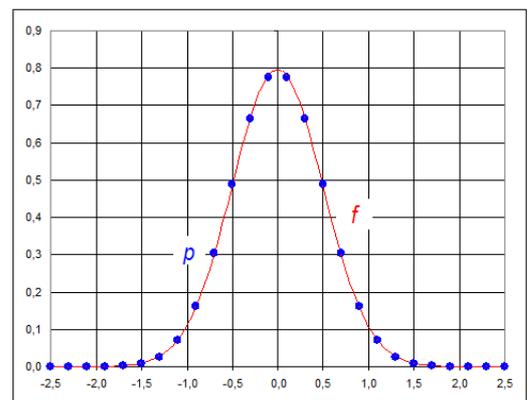
This means that a continuous function  $f$  is given by:

$$f(x) = \sqrt{\frac{2}{\pi}} \cdot e^{-2x^2} \approx \frac{\sqrt{n}}{2^n} \cdot \binom{n}{k}$$

This approximation is later generalized by LAPLACE (*MOIVRE-LAPLACIAN approximation formulas*).

Until his death, DE MOIVRE lived alone, in modest circumstances. Even the earnings from his publications did not amount to an adequate income. He complacently accepted his fate and endured it with unwavering piety.

There was a final ray of hope: A few months before his death he received the news that the *Prussian Academy of Sciences* and the *French Academy of Sciences* had now both recognized his achievements and had elected him a member.



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<https://www.spektrum.de/wissen/abraham-de-moivre-1667-1754/1148560>

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Here an important hint for philatelists who also like individual (not officially issued) stamps. Enquiries at [europablocks@web.de](mailto:europablocks@web.de) with the note: "Mathstamps".

