

# The roots of industrial engineering: Girolamo Cardano – the gambling physician

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Girolamo Cardano was a real rogue. He lived a somewhat less than charming (certainly not conservative), but nevertheless very colourful and interesting life. He had an unhappy childhood, but was gifted. He was a physician, a philosopher, an engineer, a theoretical and applied mathematician, an astrologer, an eccentric and a liar, but above all, he was a gambler. It was with this passion for gambling that Cardano converted experimentation into theory, making a lasting contribution to the early basis of modern probability theory.

The ancient Britons, Greeks, Romans and Egyptians, as well as the inhabitants of South America, the Middle East and the Far East, used *astragali* (knuckle bones, or 'dolosse' in a South African context) as a means of introducing unpredictability into games of chance (gambling) long before the birth of Christ. It was the Romans who imitated the *astragalus* by carving a rough cube from stone, wood or ivory and inscribing the sides with lewd figures and differing numbers of dots, thus creating the present-day dice.

These 'random generators' are still used widely in a variety of games of chance, but they were also used extensively in all kinds of religious ceremonies, specifically as a mechanism for soliciting the wishes of the gods (divination). The involvement of religion, and even magic, may be the restraining reason why no known attempt was made to mathematically analyse the stochastic process of throwing a die until the 16th century.

A mid-13th-century Latin poem, *De Vetula (On the old woman)*, attempted to evaluate the number of ways of obtaining a given total from the throw of three dice, but it was left to the Italian from Pavia, Girolamo Cardano, to show the audacity of suggesting that there

may be some kind of logical structure in the seemingly unpredictable magic of a die.

Girolamo Cardano (or Hieronymus Cardanus or Jerome Cardan, 1501–1576) was the illegitimate son of Fazio Cardano. Fazio was a lawyer in Milan, but his expertise in mathematics was so extraordinary that he was consulted by Leonardo da Vinci on questions of geometry.

He also lectured on geometry, both at the University of Pavia and at the Piatti Foundation in Milan. He eventually married the mother of Girolamo, but only when the boy was already seven years old.

Girolamo Cardano seemingly inherited this intellectual gift from his father, but he was a troubled man. Quite a lot is known about Cardano, as he wrote a lengthy autobiography, *De propria vita (The book of my life)*. However, some historians are of the opinion that the content of *De propria vita* is a complete hoax, or at best a figment of Cardano's overactive imagination. Cardano was a skinny man, with a long neck, heavy lower lip, wart over one eye, and a voice so loud that even his friends complained about it.

He was appointed Professor of Medicine at Pavia in 1543 and at Bologna in 1562. In 1551, he treated the Archbishop of St Andrews in Scotland for an asthmatic complaint and in London cast the horoscope of King Edward VI.

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Cardano wrote 131 printed works on many subjects, including mathematics, astronomy, physics, urine, teeth, the life of the Virgin Mary, morality and immortality.

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He claimed to have burned 170 other manuscripts before publication and left behind another 111 manuscripts when he died. Some of his most popular and best-selling works include *De sibtilitate rerum (On the subtlety of things)*, *Ars magna (The great art)* and *Liber de ludo aleae (Book on games of chance)*.

However, it was probably his passion for gambling that motivated

Cardano to apply his considerable mathematical skills to the analysis of dice throwing. He converted experimentation into theory, defined 'an honest die', used the concept of mathematical combinations to calculate 'chance' (he never used the Latin word *probabilitas*; this honour belongs to Galileo Galilei), defined equally probable events and the concept of expressing probability as a fraction. The very early basis of modern probability theory should be seen as his lasting contribution to mathematical science. Once Cardano had broken the (d)ice, further development of the mathematics of chance followed relatively quickly, with significant contributions made by most of the great mathematical minds of the time, placing probability theory on a firm mathematical foundation.

Cardano unfortunately had a tragic and troubled personal and family life. His eldest son was executed for the murder of his wife, his other son was constantly jailed for various crimes and his daughter was a prostitute. The Inquisition arrested him for heresy at the age of 69, since he dared to cast a horoscope of Jesus Christ (contained in *De astrorum iudiciis*). He immediately recanted and was subsequently hired by Pope Pius V as an astrologer and later granted a pension by Pope Gregory XIII.

He did not escape the consequences of his lifestyle. In his own words: "I suffer from diarrhoea, ruptures, kidney trouble, palpitations and even an infection of a nipple." He was also fully aware of his own peculiar personality traits: "I am hot-tempered, single-minded, given to women, cunning, crafty, sarcastic, diligent, impertinent, sad, treacherous, a magician and a sorcerer, miserable, hateful, lascivious, obscene, lying, obsequious and fond of the prattle of old men."

Cardano was strongly disliked by some of his contemporaries and



→ *Girolamo Cardano's lasting contribution to mathematics was by providing the early basis of probability theory.*

despised by some of his successors, while his biographers alternately described him as a charlatan and a persecuted savant. He was a brilliant academic, physician and mathematician, widely respected, but rather outspoken.

For example: "The things which give most reputation to a physician nowadays are his manners, servants, carriage, clothes, smartness and caginess, all displayed in a sort of artificial and insipid way..." During his stay in

Bologna, he made many enemies. He humiliated a fellow medical professor in front of his students by pointing out errors in his lectures and his colleagues tried to get the Senate to dismiss him by spreading rumours that his lectures were practically unattended.

It has been claimed that Cardano predicted the date of his own death by casting his own horoscope. However, since he was healthy at the end of the specified day, he poisoned himself! 📍