

# Bernoulli, Nikolaus I | Encyclopedia.com

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(b. Basel, Switzerland, 21 October 1687; d. Basel, 29 November 1759)

*mathematics.*

The son of Nikolaus Bernoulli, a Basel alderman and painter, Nikolaus I studied with his two uncles, Jakob I and Johann I, and made rapid progress in mathematics. As early as 1704, studying under Jakob I, he obtained his master's degree by defending Jakob's last thesis on infinite series (1), in which quadratures and rectifications are determined by means of series expansions, arrived at by the method of undetermined coefficients or by interpolation, after Wallis, for binomial expansions. In 1709 he obtained the degree of doctor of jurisprudence (2) with a dissertation on the application of the calculus of probability to questions of law. In 1712 Nikolaus undertook a journey to Holland, England, and France, where he met Montmort, later his friend and collaborator. He became a member of the Berlin Academy in 1713, of the [Royal Society](#) in 1714, and of the Academy of Bologna in 1724. In 1716 he succeeded Hermann as professor of mathematics in Padua, but in 1722 he returned to Basel in order to accept the chair of logic, which he exchanged in 1731 for a professorship in law. He served four times as rector of the University of Basel.

Nikolaus was a gifted but not very productive mathematician. As a result, his most important achievements are hidden throughout his correspondence, which comprises about 560 items. The most important part of his correspondence with Montmort (1710–1712) was published in the latter's *Essai d'analyse sur les jeux de hazard* (2nd ed., Paris, 1713). Here Nikolaus formulated for the first time the problem of probability theory, later known as the [St. Petersburg](#) problem.

In his correspondence with Leibniz (1712–1716), Nikolaus discussed questions of convergence and found that the binomial expansion  $(1 + x)^n$  diverges for  $x > 1$ . In his letters to Euler (1742–1743) he criticized Euler's indiscriminate use of divergent series. In this correspondence he also solved the problem of the sum of reciprocal squares which had confounded Leibniz and Jakob I. His personal copy of the *Opera omnia* of his uncle Jakob, which he had published, contains the proof, which does not require the help of analytical methods.

To his edition of his uncle's *Opera*, he added as an appendix thirty-two articles from Jakob I's diary ("Annotationes et meditationes"). His concern with editing his uncle's works went back to at least 1713, when he published the *Ars conjectandi*.

In the priority quarrel with Newton, Nikolaus sided with his uncle Johann in defending the interests of Leibniz. It was he who pointed out Newton's misunderstanding of the higher-order derivatives (3), which had caused Newton's errors with the inverse problem of central force in a resisting medium (5). He also considered the problem of orthogonal trajectories (6) and Riccati's differential equation (6, 8, 10–12).

## BIBLIOGRAPHY

Jakob I's last thesis on infinite series is (1) *De seriebus infinitis earumque usu in quadraturis spatiorum et rectificationibus curvarum* (Basel, 1704), Nikolaus' writings include (2) *De usu artis conjectandi in jure* (Basel, 1709); (3) "Addition au Mém. de Mr. Jean Bernoulli touchant la manière de trouver les forces centrales dans les milieux résistans..." in *Mémoires de l'Académie des Sciences* (1711), pp. 53–56; (4) "Solutio generalis problematis 15 propositi a D. de Moivre in Transactiones de mensurasortis," in *Philosophical Transactions of the Royal Society*, **29** (1714), 133–144; (5) "Calculus pro invenienda lineacurva, quam describit projectile in medio resistente," in *Acta eruditorum* (1719), 224–226; (6) "Modus inveniendi aequationem differentialem completam ex data aequatione differentiali incompleta..." *ibid.*, supp. 7 (1719), pp. 310–859; (7) "Tentamen solutionis generalis problematis de construenda curva, quae alias ordinatim positione datas ad angulos rectos secat," *ibid.*, (1719), pp. 295–304; (8) "Novum theorema pro integratione aequationum differentialium secundi gradus, quae" *ibid.*, supp. 9 (1720); (9) *Theses logicae de methodo analytica et synthetica* (Basel, 1722); (10) "Annotazioni sopra lo schediasma del Conte Jacopo Riccati etc. coll'annessa soluzione propria del problema, inverso delle forze centrali..." in *Giornale de' Letterati d'Italia*, **20**, 316–351; (11) "Dimostrazione analitica di un teorema, il qual serve per la soluzione del problema proposto nel T. XX, del Giorn. Lett. Ital.," *ibid.*, 29, 163–171; and (12) "Osservazione intorno al teorema propostodal Conte Jacopo de Fagnano," *ibid.*, pp. 150–163. See also *Athenae Rauricae* (Basel, 1778), pp. 148–151.

