

Three Bernoullis

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The Bernoulli family was originally from Antwerp, settled in Basel in Switzerland, and produced at least eight persons who made significant contributions to math and/or natural science. We'll look at the brothers Jacob & Johann, and Johann's son Daniel, among them.

Jacob [James, Jacques] Bernoulli (1654-1705)

- studied theology in university and became a minister (per his parents' request), but his real interest was in mathematics & astronomy
- travelled in Western Europe (1676-1682) learning math from various scholars [eg corresponded with Leibniz]
- settled in Basel in 1683, began teaching at the University of Basel, submitted a doctoral thesis in 1684, and became a professor of mathematics there in 1687, retaining it until his death.

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- worked in various areas related to calculus

- eg he devised the first general method for handling separable differential equations.

$$\frac{dy}{dx} = g(x)h(y) \quad \& \text{ treat } \frac{dy}{dx} \text{ as a fraction}$$

$$\Rightarrow \frac{dy}{h(y)} = g(x)dx$$

$$\Rightarrow \int \frac{dy}{h(y)} = \int g(x)dx \quad \& \text{ solve for } y \dots$$

- worked on various optimization problems, and was one of the early developers of the "calculus of variations"

- worked on probability and discrete mathematics ("Bernoulli numbers" are named after him)

- mostly published posthumously in 1713 by his ~~Nicholas~~ nephew Nicolaus (not sure which one)

- He supported Leibniz in the priority dispute with Newton, but had a lot of respect for Newton's abilities.

Johann [Jean, John] Bernoulli (1667-1748)

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- Jacob's younger brother
- His father wanted him to take over the family business, but was persuaded to let him study medicine instead. He studied medicine, but also studied math & physics with his brother Jacob, with whom he collaborated in this period.
- Johann then took a professorship in Gröningen, but then took over Jacob's professorship upon his death.
- He various areas of calculus and was an excellent teacher (taught Euler!), but a difficult person in some ways.
 - he ended up being very jealous & competitive his brother Jacob; ditto for his son Daniel.
 - he plagiarized Daniel's work ^{on hydrodynamics} and backdated his own notes on it to establish priority
 - kicked Daniel out when Daniel won a prize that Johann wanted.

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- he was probably the most bitter and fanatical supporter of Leibniz in the priority dispute
 - hated Newton so much that he tried to promote Descartes' failed theory of vortices as an alternative to Newton's theory of gravitation.

Daniel Bernoulli (1700-1782)

- son of Johann (one of several)
- poor relationship with his father
- became Professor of Mathematics at the Univ. of St. Petersburg (1724-1733) and then returned to Basel and took on a series of professorships at the Univ. of Basel
- did a lot of applied mathematics
 - fluid mechanics ("Bernoulli's principle" is named after him)

- mechanics

- probability and statistics

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He analyzed the St. Petersburg Paradox:

A casino game pays off 2^n units
for tossing a coin n times until a tail.

What is a fair price to enter this game?

Classic answer: the fair price is ^{the} expected value

Problem: Expected value of this game

$$\begin{aligned} & \frac{1}{2} \cdot 2^1 + \frac{1}{4} \cdot 2^2 + \dots + \frac{1}{2^n} \cdot 2^n + \dots \\ & = 1 + 1 + 1 + \dots = \infty \end{aligned}$$

However, very few people would pay even
a few units to play.

His solution introduced the notion of "expected utility"
which became significant in economic theory.

- He was also a close friend of Euler's and corresponded with him after they were not both in St. Petersburg.

Bernoulli Family Tree (very partial...)

