From John Graunt to Adolphe Quetelet:
On the Origins of Demography

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- Demography: statistical study of (human) populations
- Origins of demography $\longleftrightarrow$ origins of statistics
- Serving the society and the whole humankind
- Only Quetelet is fully acknowledged

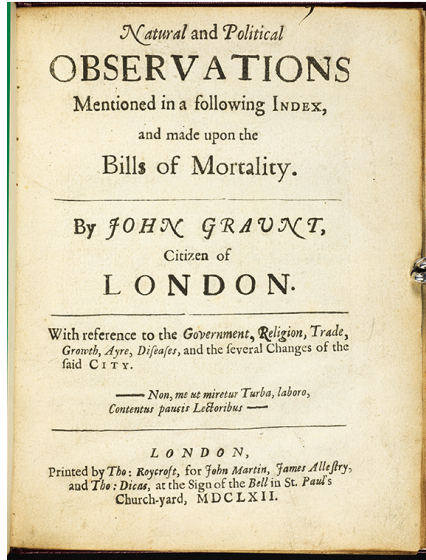John Graunt (1620–1674)   Adolphe Quetelet (1796–1874)

1. Kalina J. (2023): From John Graunt to Adolphe Quetelet: On the origins of demography. Proceedings RELIK 2023, in press.

Empiricism

- Rationalism was based purely on deduction, abstract thinking
- Francis Bacon (1561–1626)
- Thomas Hobbes (1588–1679)
- John Locke, David Hume, George Berkeley, ...
- A need for a new science
- Experimental science based on measured data (and their analysis)
- Methodical principles of performing scientific experiments
- Theoretical foundation for the origin of demography
- Strong influence on modern science

Francis Bacon

- Founder of demography
- Self-educated tradesman in London
- Under strong influence of Baconian empiricism
- Mortality tables, small dataset from a single parish in London
- Later representative data from the whole London
  - Bills of Mortality
  - Access to data with the help of William Petty (1623–1687), founder of political arithmetic
- 1661 talk, 1662 book
- After that: more detailed statistics during the 'Great Plague' (1665)
- Statistical approach (without any probabilistic thinking)

Natural and *Political*

OBSERVATIONS

Mentioned in a following INDEX,

and made upon the

Bills of Mortality.

By *JOHN GRAUNT*,

Citizen of

LONDON.

With reference to the *Government*, *Religion*, *Trade*, *Growth*, *Ayre*, *Diseases*, and the several Changes of the said CITY.

—— *Non, me ut miretur Turba, laboro,*
Contentus paucis Lectoribus ——

LONDON,
Printed by *Tho: Roycroft*, for *John Martin*, *James Allestry*,
and *Tho: Dicas*, at the Sign of the *Bell* in St. *Paul's*
Church-yard, MDCLXII.

John Graunt (1620–1674)

- 1662 book *Natural and Political Observations Made Upon the Bills of Mortality*
- Description of the Bills of Mortality
- Tables of death according to different causalities (chronic vs. acute diseases)
- Detailed discussion for severe diseases
- Dying of a disease vs. dying with the disease
- Mortality in infancy and childhood
- Seasonal effects
- Causes of death, mortality in infancy and childhood, percentage of women, migration trends to cities, statistics of marriages, spread of syphilis, ...
- Modern census techniques: he estimated the number of inhabitants in London to be 384 000
- Number of men vs. number of women
- Growth of London & its population
- Popularization of demography

1654	Pierre Fermat, Blaise Pascal
1657	Christian Huygens
1662	John Graunt
1671	John de Witt
1678	Gottfried Wilhelm Leibniz
1713	Jacob Bernoulli

John de Witt   Gottfried Wilhelm Leibniz   Jacob Bernoulli

- 1667–1754
- Left from France to London
- Excellent education, still no appointment at the university
- Mathematical analysis, Stirling formula, combinatorics
- Tutor of healthy children & consultant for insurance brokers
    - Hazard games (cards, dice, lotteries, coins)
    - Life insurance
- First textbook on probability theory "Doctrine of Chances" (1718)
    - Very systematic
    - Central limit theorem
    - The first who used normal distribution
    - Density of normal distribution
- After that: applications to demographic data
- Died in poverty

Picture from the title page of the Doctrine of Chances.

Abraham de Moivre

- "Annuities upon Lives" (1725)
- The only two sets of life tables: Graunt, Halley
- Birth and death records from Breslau, life tables, life annuities
    - Data studied by Edmond Halley in 1693 (under Leopold I. Habsburg)
- Mortality rate, mortality tables (London)
- Examples using simple probabilistic calculus
- Annuity pricing, life premiums for life insurance
- de Moivre's Law: uniform distribution of the occurrence of deaths across age (used until now in survival models)
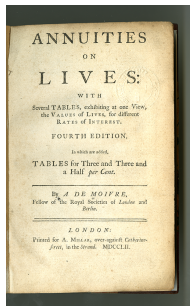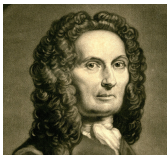
1763	Thomas Bayes
1809	Carl Friedrich Gauss
1812	Pierre-Simon de Laplace
1835	Adolphe Quetelet (1796–1874)

Thomas Bayes   Carl Friedrich Gauss   Pierre-Simon de Laplace

- 1796–1874
- Professor of astronomy and mathematics, polymath
- Attempted to use statistics in sociology, demography, criminalistics etc.
- Social physics (social mechanics)
    - By methods of physics, he meant mainly statistics
- Belgian Statistical Office (state-wide data), gifted organizer
- Censuses (population data) every 10 years from 1846, modern questionnaires
- International cooperation of statisticians, statistical societies abroad

- Mortality data (mortality tables), applications in insurance, infant mortality
- Economic statistics
- Sociology
    - Moral statistics (against crime, pathologies of the society)
    - Individual disposition to crime, suicide
    - No practical influence on the society
    - Undervalued, controversial
    - Against the definition of sociology; statistics is sufficient
    - Repeated experiments or measurements bring evidence but not proof

Anthropometric measurements and their analysis

- Belgian men
- Height is normally distributed
- 5738 Scottish soldiers
- The first to apply normal distribution to humans
- Normal distribution as a universal principle
- Individuals compared with the mean, without considering variability

Body Mass Index (BMI) defined in 1835

- Quetelet's Index (QI)
- Weight divided by the square of height
- Normal distribution
- Homogeneous population
- Average man, ideal properties
- Subjectively formulated the limits of the "normal"
- Normal individuals vs. abnormal (outliers, pathological)
- Narrow-minded
- The mean is "center of gravity" as in astronomy

What Quetelet Thought

"If an individual at any given epoch of society
possessed all the qualities of the average
man, he would represent all that is great,
good, or beautiful."

Francis Galton

- 1822–1911
- Professor of eugenics in London
- Anthropometric measurements of 9000 individuals
- Also hearing and vision acuity, reaction times
- Focus on intelligence
- Fingerprints of 8000 individuals, recognition
- Laws of papillary ridges on hands
- Registration systems for fingerprint databases
- Practical applications
- Significantly surpassed Alphonse Bertillon (1853–1914)
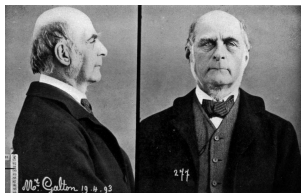
- Natural selection
- Evolution
- Principles of heredity (esp. for intelligence)
- Rigorous intelligence tests
- No practical influence on the policy
- Psychology, facial image analysis
- Contribution to statistics

Conclusion

- John Graunt, Abraham de Moivre, Adolphe Quetelet: study of mortality
- Origins of statistics $\longleftrightarrow$ origins of demography
  $\longleftrightarrow$ methodology of science
- Rely on the normal distribution?
- Obtaining knowledge from the information
- Quetelet
  - Attempted to contribute to social sciences by statistics
  - Contributed mainly to statistics
- The quality of demographic data