IN·NOMINE·PATRIS

Radboud University Nijmegen

The Law of Large Numbers (Bernouiili, 1713) +
The Central Limit Theorem (de Moivre, 1733) +
The Gauss-Markov Theorem (Gauss, 1809) +
Statistics by Intercomparison *(Galton, 1875)* =
Social Physics *(Quetelet, 1840)*

Collectively known as:
The Classical Ergodic Theorems

Molenaar, P.C.M. (2008). On the implications of the classical ergodic theorems: Analysis of developmental processes has to focus on intra individual variation. *Developmental Psychobiology, 50*, 60-69

component dominant dynamics

interaction dominant dynamics

Deterministic chaos (Lorenz, 1972)
(complexity, nonlinear dynamics, predictability)

Takens' Theorem (1981)
(phase space reconstruction)

Systems far from thermodynamic equilibrium
(Prigogine, & Stengers, 1984)

SOC / $\frac{1}{f^{\alpha}}$ **noise** (Bak, 1987)
(self-organized criticality, interdependent measurements)

Fractal geometry (Mandelbrot, 1988)
(self-similarity, scale free behaviour, infinite variance)

Aczel's Anti-Foundation Axiom (1988)
(hyperset theory, circular causality, complexity analysis)

Two types of mathematical formalism:

Random events / processes

Linear

Efficient causes

Random events / processes
Deterministic events / processes
Linear / Nonlinear
Efficient causes / Circular causality

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Two types of mathematical formalism for two types of systems

component dominant dynamics

Jakob Bernouiili (1654-1704): [The application of the Law of large numbers in chance theory] *to predict the weather next month or year, predicting the winner of a game which depends partly on psychological and or physical factors or to the investigation of matters which depend on hidden causes, which can interact in a multitude of ways is* ***completely futile!****"* Vervaet (2004)

A system is ***ergodic*** *iff:*

The averaged behaviour of an observed variable in a substantial ensemble of individuals (space-average) is expected to be equivalent to the average behaviour of an individual observed over a substantial amount of time (time average)

f.i. Throw 100 dice at once, and then throw 1 die 100 times in a row… The expected value will be similar for both measurements

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