A random walk through the history of random terms

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- 1654: widely considered to be the birth year of probability theory. Why?
- Influential correspondence between Pierre de Fermat and Blaise Pascal who were motivated by understanding games of chance or gambling.
- 1713: Jakob Bernoulli's influential *Ars Conjectandi* (The Conjecturing art)
- Number of renown mathematicians worked on probability including Laplace, Gauss, Poisson, de Moivre over the years
- 1800s: birth of statistical mechanics due to work by physicists such as Ludwig Boltzmann, James Clerk Maxwell, and Josiah Willard Gibbs.
- But by 1900, probability was still not accepted as part of mathematics by the broader mathematical community (a notable exception: Chebyshev's St Petersburg school).
- David Hilbert's sixth problem on an axiomatic framework for physics mentions probability explicitly:

    The investigations on the foundations of geometry suggest the problem: to treat in the same manner, by means of axioms, those physical sciences in which mathematics plays an important part; in the first rank are the theory of probabilities and mechanics.

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- Andrey Kolmogorov used measure theory and presented an axiomatic framework of probability *Grundbegriffe der Wahrscheinlichkeitsrechnung* (published in English as *Foundations of the Theory of Probability*)

- Early important contributions by Russian school (eg Kolmogorov, Aleksandr Khinchin), French school (eg Paul Lévy, Maurice Fréchet, Wolfgang Doeblin), in Sweden (eg Harald Cramér, William Feller (trained in Germany, then moved to Sweden, then the US) and in America (Norbert Wiener, Joseph Doob, then joined by Feller and others).

- There are other schools, for example, Italian school of Paolo Cantelli and Bruno de Finetti, the Polish school between WWI and WWII, and the British school, though more focused on statistics or philosophy (Karl Pearson, John Maynard Keynes, and Alan Turing 1934, proved central limit theorem, but Jarl Lindeberg beat him in 1922).

- Many of these new probabilists were trained in analysis eg Fréchet, Feller, Cramér

- Cramér called the 1930s the "heroic period" of probability theory.

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- Stems from a Greek word meaning "to aim at a mark, guess"
- 1917: "stochastik" firsts appear in German with the meaning *random* in the book "Die Iterationen " by economist and statistician Ladislaus Bortkiewicz.
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- In Bernoulli in 1713 used the phrase "Ars Conjectandi sive Stochastice" or "the stochastic or art of conjecturing". Part of the quote:

    To conjecture about something is to measure its probability. The Art of Conjecturing or the Stochastic Art is therefore defined as the art of measuring as exactly as possible the probabilities of things...

- Who first used the term "stochastic process" (in German, again, as "stochastischer Prozeß") and defined it (on the real line) in 1934? And then who first used it in English in the same year?

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- 1934: Khintchin, colleague of Kolmogorov (both worked under Luzin), defined a stochastic process in 1934 on the real line. Doob citing Khintchin, used the term in English in the same year.

- Early occurrences of the word "random" with its current meaning, relating to chance or luck, date back to the 16th century, where the "m" becomes a "n" (also happened with the English word "ransom").
- Used to be a noun meaning "impetuosity, great speed, force, or violence (in riding, running, striking, etc.)" , with early uses in 14th century
- Comes from Middle French meaning "speed, haste", is probably derived from a French verb "randir" meaning to "to run" or "to gallop", compare this with the modern French word "randonnée" meaning an excursion.
- 1888: first recorded use of "random process" by Francis Edgeworth in a statistics paper (on school testing methods)

- *random variable*: Doob and others used to call a random variable a *chance variable*, while his friend Feller called it a "random variable".
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- Through flipping a coin of course! Our use of "random variable" is due to randomness.
- *probability* $\sim$ probable, late Middle English (in the sense worthy of belief): via Old French from Latin probabilis, from probare "to test, demonstrate".
- Probable and provable related – "b" and "v", one often becomes the other in European languages.

- Luck: 1400-50; late Middle English *luk* < Middle Dutch *luc*, cognate with German *Glüch*
- Happiness and luck. In German: Sie hat Glüch. $\sim$ She is lucky. She ist glüchlich $\sim$ She is happy.
- In English: *happy* $\sim$ favoured by good fortune; lucky, fortunate; successful, early recorded uses late 14 th century
- *happenstance* $\sim$ a chance happening or event $\sim$ coincidence
- *perchance* $\sim$ (Literary) perhaps; maybe; possibly. (Archaic) by chance.
- *hapless* $\sim$ unlucky; luckless; unfortunate.

- *haphazard* $\sim$ characterized by lack of order or planning, by irregularity, or by randomness
- *hazard* is generally a bad thing in English now (starting from middle 16 th century eg risk of loss or harm, but used to be a dice game.
- "hazard" used to be spelt (or spelled) "hasard" in French. English (spoken in Britain) used to have many words with Z.
- Small digression: *Characterization* spelt (or spelled) with Z in English for centuries. First appeared like that in 1570, and it's in a mathematical context. But where?

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- "The Symmetrie..Characterization..of any parcell of the sayd body." – ...Euclid Elements

- In French a random variable is a "variable aléatoire". In English the word *aleatory* also exists.
- Latin *aleatorius* of a gambler, from *aleator* gambler, from *alea* a dice game
- Caesar's famous quote: "Alea iacta est." usually translated in English as "The die is cast". (Easiest verb to conjugate. I cast, I cast yesterday. I have cast.)
- Der Würfel ist gefallen. Les dés sont jetés. A sorte está lançad. De teerling is geworpen
- *chance*: Middle English *chea(u)nce* , < Old French *cheance* (= Provençal *cazensa* , Italian *cadenza*) < late Latin *cadentia* falling, < *cadent* - falling, present participle of *caděre* to fall: compare to the word *cadence*

- French often changes words starting with "ca" into "cha" or "che" eg chat, cheval/chevalier. chateau, chemise, chemin etc
- (Brothers) Grimm laws: letters or sounds in non-Germanic (usually Latin) languages make transitions into Germanic languages. $P \rightarrow F$, $C \rightarrow H$
- fish/Fisch VS poisson, pescado, pisces,
- foot/Fuß VS pie, piede, pede
- father, Vater, vader VS padre, pere, pater
- heart, Herz versus cœr, cardio,
- Words starting with "wh" (eg question words, whole, wheel) all related to words in other languages starting with *c* or *q*

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- 1920: "central limit theorem" in German as "zentraler Grenzwertsatz" by George Pólya. By why call it central?
- Pólya referred to the theorem as "central" due to its central importance in probability theory.
- According to Lucien Le Cam, the French school of probability interprets the word central in the sense that "it describes the behaviour of the centre of the distribution as opposed to its tails".

Thank you.