**THE CONCEPT OF RANDOMNESS IN STATISTICS**

**Randomness**

Several Authors define Randomness as follows:

Dembski,William A in Thematic randomness defines Randomness as; The the output of

a chance process. Thus an event is random if it is the output of a chance process.

Moreover, a sequence of events constitutes a random sample if all events in the

sequence derive from a single chance process and no event in the sequence is

influenced by the others.

Randomness is one of the five Big Ideas that form the foundation for Statistics

including Informal inference, Distribution, Variation and Expectation.(*Watson,*

*Fitzallen, Fielding-Wells, & Madden, 2018). The Top Drawer Teachers: Statisticsweb*

*site (<topdrawer.aamt.edu.au/Statistics>)* is built around these Big Ideas.

Top drawer statistics gives the following description of Randomness:

Randomness describes a phenomenon in which the outcome of a single repetition is

uncertain,but there is a nonetheless a regular distribution of relative frequencies in a

large number of repetitions.

The main focus here is on Randomness and its relationship to Variation and

Expectation. The “uncertain” part of Randomness is the Variation that occurs over

repetitions of an event andthe final Expectation arises from the “regular distribution of relative frequencies” from

the repetitions. Experience from research has shown that students readily pick up the

Variation component of Randomness while carrying out trials when learning about

probability but often do not realize that there is also a specific Expectation component,

which is the goal at the end of the process *(Moore, 1990)*. In the classroom, the concepts of Variation and Expectation need to be reinforced before they can be linked

to form the foundation for Randomness. Carrying out familiar activities based on trials

related to probability can be used to reinforce the relationship between these big ideas.

One often quoted defination1 of Randomness is that given by venon Mises(II):(a)"the

relative frequencies of particular attribute of single elements of the collective tends to

fixed limits.(b) The fixed limits are not affected by any place of selection.

**Measure of Randomness**

Before we begin, we will clarify the idea of randomness. There are three main

approaches to classifying the randomness of a binary sequence. Here we list

these in the words of *Downey and Hirschfeldt [3]. Algorithmic Randomness and*

*Complexity*

1. Statistician’s approach: random sequences should not have statistically

rare properties. In the language of measure theory, the set of sequences

satisfying any sort of statistical regularity should belong to an effectively

null set.

2. Gambler’s approach: random sequences should be unpredictable. Namely,

a gambler betting double-or-nothing on successive bits of a sequence should

not be able to get unboundedly rich.

3. Coder’s approach: we should not be able to compress random sequences

while retaining all its information.

We will be focusing on the first approach on the statistical approach.A numeric

sequence is said to be statistically random when it contains no recognizable patterns or

regularities; sequences such as the results of an ideal dice roll or the digits of π exhibit

statistical randomness.[1]

Statistical randomness does not necessarily imply "true" randomness, i.e., objective

unpredictability. Pseudorandomness is sufficient for many uses, such as statistics,

hence the name statistical randomness.(*https://en.mwikipedia.org)*

The statistical approach to randomness is useful for many applications, such as

cryptography, simulation, gambling, and data analysis. However, it is important to note

that statistical randomness is not the same as true randomness, and that a sequence

exhibiting a pattern is not thereby proved not statistically random. According to

principles of Ramsey theory, sufficiently large objects must necessarily contain a given

substructure (“complete disorder is impossible”)[1]*(statistical randomness -Wikipedia)*

***Ra*ndom process**

A random process is a mathematical model of a system or phenomenon that appears to vary in a random manner. ¹ A random process consists of an infinite collection of

random variables, one for each value of time or space. ²

One example of a random process is the \*\*Bernoulli process\*\*, which models random phenomena with binary outcomes, such as flipping a coin, transmitting bits over a noisy channel, or detecting events in discrete time. ² A Bernoulli process is a sequence of

independent and identically distributed (i.i.d.) Bernoulli random variables, each taking

the value 1 with probability p and 0 with probability 1-p, where 0 < p < 1. ²

Another example of a random process is the \*\*Poisson process\*\*, which models

the occurrence of events in continuous time, such as the arrival of customers at a

bank, the emission of radioactive particles, or the number of failures in a computer

network. ² A Poisson process is a counting process that records the number of

events that occur in a given time interval. The number of events in any interval of

length t follows a Poisson distribution with parameter λt, where λ is the average

rate of events per unit time. The interarrival times between consecutive i.i.d.

exponential random variables with parameter λ.

**Reference**

1).Watson, Fitzallen, Fielding-Wells, & Madden, 2018). The Top Drawer Teachers: Statistics web site (<topdrawer.aamt.edu.au/Statistics>)

2).Moore, 1990

3).venon Mises(II):

4).Downey and Hirschfeldt [3]. Algorithmic Randomness and Complexity

5).statistical randomness -Wikipedia

6).(https://en.mwikipedia.org)

7) Worked examples | Random Processes - HKUST. https://www.math.hkust.edu.hk/~maykwok/courses/ma246/04\_05/04MA246EX\_Ran.pdf.

8) Lecture Notes 7 Random Processes - Stanford University. https://isl.stanford.edu/~abbas/ee178/lect07-2.pdf.