Random Sampling

Young W. Lim

2020-04-06 Mon

Outline

Based on

"Understanding Statistics in the Behavioral Sciences" R. R. Pagano

Random Sample

- a sample selected from the population
  by a process that ensures
  - each possible sample of a given size has
    an equal chance of being selected
  - all the members of the population have
    an equal chance of being selected into the sample

Replacement

- Sampling with replacement
  each member of the sample
  is returned to the population
  before the next member is selected

- Sampling without replacement
  the members of the sample
  are not returned to the population
  before subsequent members are selected

A priori and a posterior Probabilities

- a priori probability

$$P(A) = \frac{Number\ of\ events\ classifiable\ as\ A}{Total\ number\ of\ possible\ events}$$

- a posteriori probability

$$P(A) = \frac{Number\ of\ times\ A\ occurred}{Total\ number\ of\ occurrences}$$

A priori probability

- a probability that is derived purely by deductive reasoning
- One way of deriving a priori probabilities is
  the principle of indifference
  - if there are N mutually exclusive and
    collectively exhaustive events and
    if they are equally likely,
    then the probability of a given event occurring is 1/N.
  - Similarly the probability of one of a given collection of K events
    is K / N.

A posteriori probability

- the conditional probability that is assigned
  after the relevant evidence or background is taken into account
- the posterior probability distribution is
  the probability distribution of an unknown quantity,
  treated as a random variable,
  conditional on the evidence obtained from an experiment
- "Posterior", in this context, means
  after taking into account the relevant evidence
  related to the particular case being examined.

Probability of occurrence of A or B

- the probability of occurrence of A plus
  the probability of occurrence of B
  minus the probability of occurrence of both A and B
- addition rule for two events - general equation
  $p(A \ or \ B) = p(A) + p(B) - p(A \ and \ B)$

Mutually exclusive events

- if both cannot occur together
- if the occurrence of one percludes the occurrence of the other
- addition rule when A and B are mutually exclusive
  $p(A \ or \ B) = p(A) + p(B)$

Exhaustive

- a set of events is exclusive
  if the set includes all of the possible events
- when events are exhaustive and mutually exclusive
  $p(A) + p(B) + ... + p(Z) = 1.00$

Exhaustive Events

- When a sample space is distributed down into some mutually exclusive events such that their union forms the sample space itself, then such events are called exhaustive events.
- When two or more events form the sample space collectively then it is known as collectively exhaustive events.
- When at least one of the events occur compulsorily from the list of events, then it is also known as exhaustive events.

https://www.engineeringintro.com/statistics/what-is-probability/exhaustive-events/

Exhaustive Event Examples

- Sample Space $S = 1, 2, 3, 4, 5$
  - event $X = 1, 2$
  - event $Y = 3, 4$
  - event $Z = 5$
  - events X, Y, Z are mutually exclusive events
- Sample Space $S = 1, 2, 3, 4, 5$
  - event $X = 1, 2, 3$
  - event $Y = 1, 3, 4$
  - event $Z = 5$
  - events X, Y, Z are collectively exhaustive events

https://www.engineeringintro.com/statistics/what-is-probability/exhaustive-events,

Multiplication rule

- the probability of occurrence of both A and B is equal to the probability of occurrence of A times the probability of occurrence of B given A has occurred
- multiplication rule with two events - general case
  $p(A\ and\ B) = p(A)p(B|A)$
- multiplication rule with two events - mutually exclusive events
  $p(A\ and\ B) = 0$
- multiplication rule with two events - independent events
  $p(A\ and\ B) = p(A)p(B|A) = p(A)p(B)$

Independent

- two events are independent if the occurrence of one has no effect on the probability of occurrence of the other

Probability and continuous variables

- probability of A with a continuous variable

$$p(A) = \frac{Area\ under\ the\ curve\ corresponding\ to\ A}{Total\ area\ under\ the\ curve}$$

OOO

OOO