# Random Sampling 

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## Outline

(1) Based on
(2) Random Sampling

- Data Vectors


## Based on

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

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## 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

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

- a posteriori probability

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

## 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 $1 / \mathrm{N}$.
- Similarly the probability of one of a given collection of K events is $\mathrm{K} / \mathrm{N}$.


## 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 $p(A)+p(B)+\ldots+p(Z)=1.00$


## 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 $Y=1,3,4$
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## 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 $B)=p(A) p(B \mid A)$
- multiplication rule with two events - mutually exclusive events $p(A$ and $B)=0$
- multiplication rule with two events - independent events $p(A$ and $B)=p(A) p(B \mid A)=p(A) p(B)$


## 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

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

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