not order conscious: $a_1b_1 = b_1a_1$

6 Probability and Statistics

(arrangements) $a_1b_1 \neq b_1a_1$

Order conscious

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COMBINATIONS AND PERMUTATIONS

There are a finite number of ways in which n elements can be combined into distinctly different groups of r items. For example, suppose a farmer has a chicken, a rooster, a duck, and a cage that holds only two birds. The possible combinations of three birds taken two at a time are (chicken, rooster), (chicken, duck), and (rooster, duck). The birds in the cage will not remain stationary, so the combination (rooster, chicken) is not distinctly different from (chicken, rooster). That is, combinations are *not* order conscious.

The number of combinations of n items taken r at a time is written $C(n,r)$, C_r^n, ${}_nC_r$, or $\binom{n}{r}$ (pronounced "n choose r"). It is sometimes referred to as the binomial coefficient and is given by Eq. 6.1.

combinations

$$\binom{n}{r} = C(n,r) = \frac{n!}{r!(n-r)!} \qquad [r \leq n] \qquad 6.1$$

An order-conscious subset of r items taken from a set of n items is the permutation $P(n,r)$, also written P_r^n and ${}_nP_r$. The permutation is order conscious because the arrangement of two items (e.g., a_1 and b_1) as a_1b_1 is different from the arrangement b_1a_1. The number of permutations is

$$P(n,r) = \frac{n!}{(n-r)!} \qquad [r \leq n] \qquad 6.2$$

Permutations

LAWS OF PROBABILITY

Probability theory determines the relative likelihood that a particular event will occur. An event, E, is one of the possible outcomes of a *trial*. The *probability* of E occurring is denoted as $P(E)$.

Property 1 — General Character of Probability

Probabilities are real numbers in the range of zero to one. If an event A is certain to occur, then the probability $P(A)$ of the event is equal to one. If the event is certain not to occur, then the probability $P(A)$ of the event is equal to zero. The probability of any other event is between zero and one.

$P(A)=1$ $P(A)=0$ $0 \leq P(E) \leq 1$

The probability of an event occurring is equal to one minus the probability of the event not occurring. This is known as a complementary probability.

$$P(E) = 1 - P(\text{not } E) \qquad 6.3$$

Complementary Prob.

Property 2 — Law of Total Probability

Equation 6.4 gives the probability that either event A or B, or both, will occur. $P(A,B)$ is the probability that both A and B occur.

$$P(A+B) = P(A) + P(B) - P(A,B) \qquad 6.4$$

Total Prob. (either A or B, or both)

Property 3 — Law of Compound or Joint Probability

Equation 6.5 gives the probability that both events A and B will occur. $P(B|A)$ is the conditional probability that B occurs given that A has already occurred. Likewise, $P(A|B)$ is the conditional probability that A occurs given that B has already occurred. If the events are independent, then $P(B|A) = P(B)$ and $P(A|B) = P(A)$. Examples of dependent events for which the probability is conditional include drawing objects from a container or cards from a deck, without replacement.

Elements Of Probability And Mathematical Statistics

H. Cramer

Elements Of Probability And Mathematical Statistics:

The Elements of Probability Theory and Some of Its Applications Harald Cramér,1958 **Elements of Probability and Mathematical Statistics** Frederick Henry Steen,1982 The Elements of Probability Theory and Some of Its Applications H. Cramer,1955 *Elements of Probability and Statistics* Francesca Biagini,Massimo Campanino,2016-01-22 This book provides an introduction to elementary probability and to Bayesian statistics using de Finetti s subjectivist approach One of the features of this approach is that it does not require the introduction of sample space a non intrinsic concept that makes the treatment of elementary probability unnecessarily complicate but introduces as fundamental the concept of random numbers directly related to their interpretation in applications Events become a particular case of random numbers and probability a particular case of expectation when it is applied to events The subjective evaluation of expectation and of conditional expectation is based on an economic choice of an acceptable bet or penalty The properties of expectation and conditional expectation are derived by applying a coherence criterion that the evaluation has to follow The book is suitable for all introductory courses in probability and statistics for students in Mathematics Informatics Engineering and Physics *Probability Theory and Elements of Measure Theory* Heinz Bauer,1981

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