

| Probability and its notations             |                                                                                           | Probability and its notations (cont)                                            |                                                                                               | Probability and its notations (cont)                               |                                                                                       |
|-------------------------------------------|-------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Deterministic processes                   | outcome can be predicted exactly in advance                                               | Probability events A and B both occur                                           | $P(A \cap B)$                                                                                 | Continuous random variable                                         | range of X is uncountably infinite (that makes a physical measurement)                |
| Random processes                          | outcome is not known exactly (can desc the probability distribution of possible outcomes) | Events A and B are mutually exclusive or disjoint cannot occur at the same time | $P\{A B\}=0, P\{A \cap B\}=0$                                                                 | <b>Bayes' Theorem</b>                                              |                                                                                       |
| Probability of event A                    | $0 \leq P(A) \leq 1$                                                                      | Probability events A or B occur                                                 | $P(A \cup B)$                                                                                 | Mutually exclusive/disjoint (if both events cannot occur together) | $P(A \cup B) = P(A) + P(B)$                                                           |
| Probability of whole sample space         | $P(S)=1, P(A)+P(B)+P(C) = 1$                                                              | Conditional probability (event A occurs, given that event B has occurred)       | $P(A B)$                                                                                      | Collectively exhaustive (if at least one of the events must occur) | $A \cup B = S$                                                                        |
| Event A will almost definitely not occur  | $P(A)=0$                                                                                  | Independent (event A does not change the probability of event B)                | $P\{A B\} = P(A)$                                                                             | Events A and B are independent                                     | $P(A \cap B) = P(A) \times P(B)$                                                      |
| Only small chance that event A will occur | $P(A)=0.1$                                                                                | Complement (event that not occurring)                                           | $P(A')$                                                                                       | Events A and B are not independent                                 | $P(A \cap B) = P(A) \times P(B A)$                                                    |
| 50-50 chance that event A will occur      | $P(A)=0.5$                                                                                | Rule of subtraction (event A will occur)                                        | $P(A) = 1 - P(A')$                                                                            | Conditional probability of A given B                               | $P(A B) = P(A, B) / P(B)$                                                             |
| Strong chance that event A will occur     | $P(A)=0.9$                                                                                | Rule of multiplication (probability of the intersection of two events)          | $P(A \cap B) = P(A) \times P(B A)$                                                            | If A and B are statistically independent                           | $P(A B) = (P(A) \times P(B)) / P(B) = P(A)$                                           |
| Event A will almost definitely occur      | $P(A)=1$                                                                                  | Rule of addition (either event occurs, not mutually exclusive)                  | $P(A \cup B) = P(A) + P(B) - P(A \cap B)$                                                     | if A and B are statistically dependent                             | $P(A B) \neq P(A)$                                                                    |
| Probability successful outcome (S)        | $P(S) = r/n$ ; r: num of successful outcomes, n: total num of equally likely outcomes     |                                                                                 | $P(A \cup B) = P(A) + P(B) - (P(A) \times P(B A))$                                            | Multiplication rule for conditional probabilities                  | $P(A \cap B) = P(B) \times P(A B)$ or $P(A \cap B) = P(A) \times P(B A)$              |
| Permutations                              | Order is taken into account                                                               | Random variable                                                                 | determined by a chance event, outcome of a random experiment, measurable real-valued          | Bayes Theorem                                                      | $P(A B) = (P(B A) \times P(A)) / P(B)$                                                |
| Combinations                              | Order is not important                                                                    |                                                                                 |                                                                                               |                                                                    | $P(S F) = (P(F S) \times P(S)) / (P(F S) \times P(S)) + (P(F S') \times P(S'))$       |
| Permutation with repetition               | $n^r$                                                                                     | Discrete random variable                                                        | range of X is finite or countably infinite (values X can take on, not the size of the values) | Prior probability                                                  | <b>originally</b> obtained <b>before</b> any additional information is obtained       |
| Permutation without repetition            | $n!/(n-r)!$                                                                               |                                                                                 |                                                                                               | Posterior probability                                              | has been <b>revised</b> by using additional information that is <b>later</b> obtained |

Combination with repetition

$$(r+n-1)!/r!(n-1)!$$

Combination without repetition

$$n!/(n-r)!$$

n: number of things to choose from ; r: them are chosen



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