Biostatistics

Boolean Algebra

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Introduction :

Boolean Algebra is used to analyze and simplify the digital (logic) circuits. It uses only the binary numbers i.e. 0 and 1. It is also called as **Binary Algebra** or **logical Algebra**. Boolean algebra was invented by **George Boole** in 1854.

Rule in Boolean Algebra:

Following are the important rules used in Boolean algebra.

- Variable used can have only two values. Binary 1 for HIGH and Binary 0 for LOW.
- Complement of a variable is represented by an overbar (-). Thus, complement of variable B is represented as $\overline{B}$. Thus if B = 0 then $\overline{B}$ = 1 and B = 1 then $\overline{B}$ = 0.
- ORing of the variables is represented by a plus (+) sign between them. For example ORing of A, B, C is represented as A + B + C.
- Logical ANDing of the two or more variable is represented by writing a dot between them such as A.B.C. Sometime the dot may be omitted like ABC.

Boolean Laws:

There are six types of Boolean Laws.

1.Commutative law:

Any binary operation which satisfies the following expression is referred to as commutative operation.

$$(i)\ A.B = B.A \qquad (ii)\ A + B = B + A$$

Commutative law states that changing the sequence of the variables does not have any effect on the output of a logic circuit.

2.Associative law:

This law states that the order in which the logic operations are performed is irrelevant as their effect is the same.

$$(i)\ (A.B).C = A.(B.C) \qquad (ii)\ (A + B) + C = A + (B + C)$$

3.Distributive law

Distributive law states the following condition.

$$A.(B + C) = A.B + A.C$$

4.AND law

These laws use the AND operation. Therefore they are called as **AND** laws.

$$\text{(i) } A.0 = 0 \qquad \text{(ii) } A.1 = A$$

$$\text{(iii) } A.A = A \qquad \text{(iv) } A.\overline{A} = 0$$

5.OR law

These laws use the OR operation. Therefore they are called as **OR** laws.

$$\text{(i) } A + 0 = A \qquad \text{(ii) } A + 1 = 1$$

$$\text{(iii) } A + A = A \qquad \text{(iv) } A + \overline{A} = 1$$

6.INVERSION law

This law uses the NOT operation. The inversion law states that double inversion of a variable results in the original variable itself.

$$\overline{\overline{A}} = A$$