A Review of Some Statistical Concepts

Summation and Product Operators

The Greek capital letter ∑ (sigma) is used to indicate summation. Thus,

$$\sum_{i=1}^{n} x_i = x_1 + x_2 + ... + x_n$$

Some of the important properties of the summation operator ∑ are

1. $\sum_{i=1}^{n} k = nk$, where k is constant.

2. $\sum_{i=1}^{n} kx_i = k\sum_{i=1}^{n} x_i$, where k is constant.

3. $\sum_{i=1}^{n}(a + bx_i) = na + b\sum_{i=1}^{n} x_i$, where a and b are constants and where use is made of properties 1 and 2 above.

4. $\sum_{i=1}^{n}(x_i + y_i) = \sum_{i=1}^{n} x_i + \sum_{i=1}^{n} y_i$

The summation operator can also be extended to multiple sums. This, $\sum\sum$, The double summation operator, is defined as

$$\sum_{i=1}^{n}\sum_{j=1}^{m} x_{ij} = \sum_{i=1}^{n}(x_{i1} + x_{i2} + \cdots + x_{im})$$

$$=(x_{11} + x_{21} + \cdots + x_{n1}) + (x_{12} + x_{22} + \cdots + x_{n2}) + \cdots + (x_{1m} + x_{2m} + \cdots + x_{nm})$$

Some of the properties of $\sum\sum$ are

1. $\sum_{i=1}^{n}\sum_{j=1}^{m} x_{ij} = \sum_{j=1}^{m}\sum_{i=1}^{n} x_{ij}$; that is, the order in which the double summation is performed is interchangeable.

2. $\sum_{i=1}^{n}\sum_{j=1}^{m} x_i\, y_j = \sum_{i=1}^{n} x_i + \sum_{j=1}^{m} y_j$.

3. $\sum_{i=1}^{n}\sum_{j=1}^{m}(x_{ij}+y_{ij})=\sum_{i=1}^{n}\sum_{j=1}^{m}x_{ij}+\sum_{i=1}^{n}\sum_{j=1}^{m}y_{ij}$