Certainty, Coverage, Strength calculations

An example of a simple decision table is shown in Table 1. In the table, *age*, *sex*, and *professior* condition attributes, whereas *disease* is the decision attribute.

Table 1: Decision table

Decision Rule	Age	Sex	Profession	Disease
1	Old	Male	Yes	No
2	Med.	Female	No	Yes
3	Med	Male	Yes	No
4	Old	Male	Yes	Yes
5	Young	Male	No	No
6	Med.	Female	No	No

Another decision table is shown in Table 2. This decision table can be understood as an abbreviation of bigger decision table containing 1100 rows. **Support of the decision rule means the number of identic decision rules in the original decision table.**

Table 2: Support and Strength

Decision Rule	Age	Sex	Profession	Disease	Support	Strength
1	Old	Male	Yes	No	200	0.18
2	Med.	Female	No	Yes	70	0.06
3	Med	Male	Yes	No	250	0.23
4	Old	Male	Yes	Yes	450	0.41
5	Young	Male	No	No	30	0.03
6	Med.	Female	No	No	100	0.09

A decision rule is an expression of the form C(x) → D(x), read " *if C(x) then D(x)*" where C(x) and D(x) are the condition and decision of the rule respectively.

- **Support**

If, C(x) → D(x) is a decision rule then, *supp$_x$(C,D)* will be called Support of the decision Rule.

$$supp_x(C,D) = |C(x) \cap D(x)|$$

Support of the decision rule means the number of identical decision rules in the original decision table with respect same conditions.
In Table 2. for Rule 1, if Age=Old, Sex=Male. Profession=Yes and the decision disease is No then total number of similar rule is 200 that is Support=200.

- **Strength**

Strength is

$$\sigma_x(C,D) = \frac{supp_x(C.D)}{|U|}$$

where, U is the set of all objects from the Universe.

Strength of a rule means strength (weightage) of a particular rule among total set of Objects.

In Table 2, for Rule1, there are 200 rules similar to Rule1 that is called Support and total number of Objects in Universe (U) is 1100 (already given).

So, Strength = $\dfrac{\text{Support for a particular Rule}}{\text{Total Number of Objects in Universe}}$

For Example, in Table 2, for Rule1, Strength = 200/1100 = 0.18
Similarly for Rule2, Strength=70/1100=0.06

Table 3: Certainty and Coverage

CONDITION Decision

Decision Rule	Age	Sex	Profession	Disease	Support	Strength	Certainty	Coverage
1	Old	Male	Yes	No	200	0.18	0.31	0.34
2	Med.	Female	No	Yes	70	0.06	0.40	0.13
3	Med	Male	Yes	No	250	0.23	1.00	0.43
4	Old	Male	Yes	Yes	450	0.41	0.69	0.87
5	Young	Male	No	No	30	0.03	1.00	0.06
6	Med.	Female	No	No	100	0.09	0.60	0.17

- **Certainty:**

It is a degree of membership x to the decision class D*(x)*, given *C*.

$$cer_x(C.D) = \frac{|C(x) \cap D(x)|}{|C(x)|}$$

The Certainty factor can be interpreted as the frequency of objects having same decision D(x) in the set of objects with the conditional property C(x).

$$\textbf{Certainty} = \frac{\textbf{Number of rules satisfies particular condition with respect to same decision}}{\textbf{Total Number of rules satisfies that particular condition irrespective of decisi}}$$

Condition fixed decision variable

For example, in Table 3, For Rule1, Certainty = 200/(200+450) = 200/650 = 0.31
Similarly, For Rule4, Certainty = 450/(200+450) = 450/650 = 0.69

f $cer_x(C, D) = 1$, then the rule will be called a *certain decision* rule; if $0 < cer_x(C, D) < 1$ the decisior ule will be referred to as an *uncertain decision rule*

- **Coverage:**

It is the degree of membership of x to condition class $C(x)$, given D.

$$cov_x(C,D) = \frac{|C(x) \cap D(x)|}{|D(x)|}$$

The Coverage factor can be interpreted as the frequency of objects having same conditional property C(x) in the set of objects with the decision property D(x).

$$\textbf{Coverage} = \frac{\textbf{Number of rules satisfies particular condition with respect to same decision}}{\textbf{Total Number of rules satisfies that particular decision irrespective of condition}}$$

Decision fixed condition variable

For example, in Table 3, For Rule1, Coverage = 200/(200+250+30+100) = 200/580 = 0.34
Similarly, For Rule4, Coverage = 450/(70+450) = 450/520 = 0.87