

Methods of Assigning Probability

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The probability of an event of interest in statistical analysis is a numerical measure of the chance that this event will occur.

Assigning probabilities to events of interests, is often a challenge for novice statistics students.

The following concepts should be helpful to clarify the problem:

- A given statistical experiment has at least two experimental outcomes. Depending on the problem being analyzed, either some of the outcomes, or even all of them could be events of statistic interest.
- The probability of any event e_i (we denote it $P(e_i)$) must lie in the range between 0 and 1:

$$0 \leq P(e_i) \leq 1$$

- The sum of the probabilities of all n experimental outcomes equals 1:

$$P(e_1) + P(e_2) + \dots + P(e_n) = 1.$$

There are several approaches to assigning probability. Those approaches depend on the nature of the information that is available.

1. The classical method for assigning probability

If probabilities of the experimental outcomes satisfy the following assumptions:

- a) the probabilities of all of the outcomes are known in advance, and
- b) the outcomes are equiprobable (all the outcomes are equally likely). Then the probability of each of the n outcomes is $1/n$.

... then we can deal with so called **classical method** of assigning probabilities.

Example: A die game.

When throwing a die there are six possible outcomes: 1, 2, 3, 4, 5, and 6.

We expect that all of these six outcomes are equiprobable and equal to $1/6$. Therefore the sum of all six probabilities is:

$$1/6 + 1/6 + 1/6 + 1/6 + 1/6 + 1/6 = 1.$$

The classical method for assigning probability, even though being convenient and having well-developed mathematical ground, cannot be applied to many real-life statistical problems because the above conditions cannot be satisfied.

2. Relative frequency method of assigning probabilities

When the assumption that the outcomes of a statistical experiment are known in advance and are equally likely is not satisfied, the estimation of probability for events of interest can be done by using past statistics.

Example: Consider a manager of a computer hardware retail company who is looking for an inventory count estimate. Such an estimate can be made based on probability that a given product will be sold.

If the total number of monitors that were sold last year was 260 and the number of sold 19" Samsung monitors was 52, and the number of 21" Samsung monitors was 39, then probability of their sale for this year can be estimated as relative frequency of selling of these types of monitors:

$$P(19") = 52 / 260 = 0.2,$$

$$P(21") = 39 / 260 = 0.15.$$

Therefore the manager can estimate that 20% of the Samsung monitors in stock are 19", and 15% of the monitors in stock are 21" monitors.

3. Subjective method

This method is used when the assumptions used in the classical method are not applicable and the past statistics that can be used for the relative frequency method are unavailable. In such a situation, the basis for assigning probability to experimental outcomes is previous business experience, belief, and even feeling.

Since this method relies on individual judgmental, it is highly subjective. Nonetheless, the method is quite common in the absence of any information. Later, when the information becomes available, the assigned probability can be revised.