A **discrete probability distribution** is the probability distribution of a random variable that can take on only a countable number of values[15] (almost surely)[16] which means that the probability of any event

$$E$$

can be expressed as a (finite or countably infinite) sum:

$$P(X\in E)=\sum _{\omega \in A\cap E}P(X=\omega),$$

where

$$A$$

is a countable set with

$$P(X\in A)=1$$

. Thus the discrete random variables (i.e. random variables whose probability distribution is discrete) are exactly those with a probability mass function

$$p(x)=P(X=x)$$

. In the case where the range of values is countably infinite, these values have to decline to zero fast enough for the probabilities to add up to 1. For example, if

$p($

n
)
=
1
2
n
{\displaystyle p(n)={\tfrac {1}{2^{n}}}}
 for

n
=
1
,
2
,
.
.
.
{\displaystyle n=1,2,...}
, the sum of probabilities would be

1
/
2
+
1
/
4
+
1
/
8

$+$
$\dots$
$=$
1
$${\displaystyle 1/2+1/4+1/8+\dots =1}$$
$1/2+1/4+1/8+\cdots=1$.

Well-known discrete probability distributions used in statistical modeling include the Poisson distribution, the Bernoulli distribution, the binomial distribution, the geometric distribution, the negative binomial distribution and categorical distribution.[3] When a sample (a set of observations) is drawn from a larger population, the sample points have an empirical distribution that is discrete, and which provides information about the population distribution. Additionally, the discrete uniform distribution is commonly used in computer programs that make equal-probability random selections between a number of choices.