What is the method for calculating the variance of a probability distribution?

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The method for calculating the variance of a probability distribution involves finding the difference between each data point and the mean of the distribution, squaring those differences, and then taking the average of those squared differences. This value represents the spread or variability of the data points from the mean and is used to measure the overall uncertainty or risk associated with the distribution. The variance is a fundamental statistical tool that helps analyze and interpret data, and is essential in many fields such as finance, economics, and science. It allows for a more comprehensive understanding of the probability distribution and can aid in making informed decisions.

Calculate the Variance of a Probability Distribution

A probability distribution tells us the probability that a takes on certain values.

For example, the following probability distribution tells us the probability that a certain soccer team scores a certain number of goals in a given game:

Goals (X)	Probability P(X)
0	0.18
1	0.34
2	0.35
3	0.11
4	0.02

To find the variance of a probability distribution, we can use the following formula:

$\sigma 2 = \Sigma(xi-\mu)2 * P(xi)$

where:

xi: The ith valueμ: The mean of the distributionP(xi): The probability of the ith value

For example, consider our probability distribution for the soccer team:

Goals (X)	Probability P(X)
0	0.18
1	0.34
2	0.35
3	0.11
4	0.02

The mean number of goals for the soccer team would be calculated as:

μ = 0*0.18 + 1*0.34 + 2*0.35 + 3*0.11 + 4*0.02 = 1.45 goals.

We could then calculate the variance as:

Goals (X)	Probability P(X)	$(x_i-\mu)^2 * P(x_i)$
0	0.18	$(0-1.45)^2*0.18 = .3785$
1	0.34	$(1-1.45)^2*0.34 = .0689$
2	0.35	$(2-1.45)^2*0.35 = .1059$
3	0.11	$(3-1.45)^2*0.11 = .2643$
4	0.02	$(4-1.45)^2*0.02 = .1301$

The variance is simply the sum of the values in the third column. Thus, we would calculate it as:

$\sigma 2 = .3785 + .0689 + .1059 + .2643 + .1301 = 0.9475$

The following examples show how to calculate the variance of a probability distribution in a few other scenarios.

Example 1: Variance of Vehicle Failures

Failures (X)	Probability P(X)
0	0.24
1	0.57
2	0.16
3	0.03

To find the variance of this probability distribution, we need to first calculate the mean number of expected

failures:

$\mu = 0*0.24 + 1*0.57 + 2*0.16 + 3*0.03 = 0.98$ failures.

We could then calculate the variance as:

Failures (X)	Probability P(X)	$(x_i-\mu)^2 * P(x_i)$
0	0.24	$(0-.98)^2*0.24 = .2305$
1	0.57	$(1-.98)^2*0.57 = .0002$
2	0.16	$(2-.98)^2*0.16 = .1665$
3	0.03	$(3-.98)^2*0.03 = .1224$

The variance is the sum of the values in the third column. Thus, we would calculate it as:

$\sigma 2 = .2305 + .0002 + .1665 + .1224 = 0.5196$

Example 2: Variance of Sales

The following probability distribution tells us the probability that a given salesman will make a certain number of sales in the upcoming month:

Sales (X)	Probability P(X)
10	0.24
20	0.31
30	0.39
40	0.06

To find the variance of this probability distribution, we need to first calculate the mean number of expected sales:

μ = 10*.24 + 20*.31 + 30*0.39 + 40*0.06 = 22.7 sales.

We could then calculate the variance as:

Sales (X)	Probability P(X)	$(x_i-\mu)^2 * P(x_i)$
10	0.24	$(10-22.7)^2*0.24 = 38.7096$
20	0.31	$(20-22.7)^2*0.31 = 2.2599$
30	0.39	$(30-22.7)^2*0.39 = 20.7831$
40	0.06	$(40-22.7)^2*.06 = 17.9574$

The variance is the sum of the values in the third column. Thus, we would calculate it as:

$\sigma 2$ = 38.7096 + 2.2599 + 20.7831 + 17.9574 = 79.71

Note that we could also use the to automatically

calculate the variance of this distribution:

Outcome	Probability	Value
Outcome 1	.24	10
Outcome 2	.31	20
Outcome 3	.39	30
Outcome 4	.06	40
Outcome 5		
Outcome 6		
Outcome 7		
Outcome 8		
Outcome 9		
Outcome 10		

CALCULATE

Mean (μ) = **22.7000**

Standard Deviation (σ) = **8.9280**

Variance (σ^2) = **79.7100**

The variance is 79.71. This matches the value that we calculated by hand.