Expected value of a discrete random variable

Two ways to sum the terms to get the expected value of a random variable. Only differ by how we group the values. These are completely equivalent ways.

1. Sum over all possible outcomes in the sample space.

$$E(X) = \sum_{\omega \in S} X(\omega) P(\{\omega\})$$

2. Sum over all possible values of the random variable. Say that X takes on possible values $x_1, x_2, \ldots$, then

$$E(X) = \sum_j x_j P(X = x_j) = \sum_j x_j P(\{\omega \mid X(\omega) = x_j\})$$