DEFINITION: A random variable is a mapping from a sample space (the S of <S,S*,P>) to the real numbers. You have seen many random variables. For example, from various childhood board games, the number of dots on a die is a number between 1 and 6, and the sum of the dots on two dice is a number between 2 and 12. The numbers of dots on a die or on two dice are random variables.

Random variables come in two kinds – discrete and continuous. For example, the number of dots on two dice is a discrete random variable, whereas the height of humans is a continuous random variable. The difference is this – a discrete random variable can have at most a countable (including countably infinite) number of values; a continuous random variable has an uncountably infinite number of values.

QUESTION: Is everyone aware of the difference between countably infinite and uncountably infinite? These two infinities have a special relationship: \( c = 2^{\aleph_0} \) where \( c \) is the size of the real numbers (i.e., uncountable infinity) and \( \aleph_0 \) (pronounced “aleph-null”) is the size of the integers (i.e., countable infinity).

Every random variable has a probability distribution, i.e., a probability measure over the sample space of the random variable, \( S_{rv} \), composed of the possible values of the random variable together with the probabilities of those values.

EXAMPLE
For one fair die, we have the following probability distribution:

<table>
<thead>
<tr>
<th>X</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>P(X)</td>
<td>( \frac{1}{6} )</td>
<td>( \frac{1}{6} )</td>
<td>( \frac{1}{6} )</td>
<td>( \frac{1}{6} )</td>
<td>( \frac{1}{6} )</td>
<td>( \frac{1}{6} )</td>
</tr>
</tbody>
</table>

Here, \( S_{rv} = \{1, 2, 3, 4, 5, 6\} \).

PROBLEM:
Ch. 3, #1 (This problem asks you to find the probability distribution for the sum of two fair dice.)