Example 1:
We are flipping 3 loaded coins. With these coins, the probability of getting tail is 0.3. Let $X$ be the number of heads we get.

$$E(X) = 2.1$$

$$Var(X) = 0.63$$

$$S = \{ TTT, TTH, THT, THH, HTT, HTH, HHT, HHH \}$$

<table>
<thead>
<tr>
<th>$x$</th>
<th>$f(x)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.027</td>
</tr>
<tr>
<td>1</td>
<td>0.189</td>
</tr>
<tr>
<td>2</td>
<td>0.441</td>
</tr>
<tr>
<td>3</td>
<td>0.343</td>
</tr>
</tbody>
</table>

Binomial Distribution
1. The number of trials, $n$, is fixed.
2. Each trial has two possible outcomes: “success” and “failure.”
3. The probability of “success”, $p$, is the same from trial to trial.
4. The trials are independent.
5. $X$ = the number of “successes” in $n$ independent trials.

Then,

$$P(X = k) = \binom{n}{k} \cdot p^k \cdot (1 - p)^{n-k}$$

where $k = 0, 1, \cdots, n$

with

$$\binom{n}{k} = \frac{n!}{k!(n-k)!}$$

$$E(X) = n \cdot p.$$  \hspace{1cm}$$Var(X) = n \cdot p \cdot (1 - p)$$

Example 1:
We are flipping 3 loaded coins. With these coins, the probability of getting tail is 0.3. Let $X$ be the number of heads we get.

a) What is the probability of getting 2 heads?

b) On average, how many heads will we get each time?

c) Find the variance and the standard deviation of $X$?
Example 2:
An automobile salesman thinks that the probability of making a sale is 0.30. If he talks to five customers on a particular day, what is the probability that he will make exactly 2 sales? (Assume independence.)

Example 3:
*Often On-time Parcel Service (OOPS)* delivers a package to the wrong address with probability 0.05 on any delivery. Suppose that each delivery is independent of all the others. There were 7 packages delivered on a particular day.

a) What is the probability that at least 1 of them was delivered to the wrong address?

b) What is the probability that exactly 2 of them were delivered to the wrong address?

c) What is the probability that at most 2 of them were delivered to the wrong address?

d) What is the probability that at least 2 of them were delivered to the wrong address?

Computing Binomial Distribution Probabilities using scipy.stats in Python

```python
from scipy.stats import binom

binom.pmf(k=0, n=7, p=0.05)  # P(X=0) when X ~ Binom(n=7, p=0.05)
binom.cdf(k=2, n=7, p=0.05)  # P(X<=2)
binom.mean(n=7, p=0.05)  # E(X)
binom.var(n=7, p=0.05)  # Var(X)
```