Probability Theory Graded Assignment Week 2
Problem 1

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Let X be the random variable that denotes launches without insurance.
If the launch succeeds, $X = 100$ and $P(X) = 0.9$, else, $X = -200$ and $P(X) = 0.1$

$$E(X) = 0.9 * 100 + 0.1 * (-200) \tag{1}$$
$$= 70 \tag{2}$$

$$E(X^2) = 0.9 * 100^2 + 0.1 * (-200)^2 \tag{3}$$
$$= 13000 \tag{4}$$

$$Var(X) = E(X^2) - E^2(X) \tag{5}$$
$$= 13000 - 70^2 \tag{6}$$
$$= 8100 \tag{7}$$

Let Y be the random variable that denotes launches with insurance. Regardless the launch result, we pay for the insurance.

If the launch succeeds, $= 100 - 30 = 70$ and $P(Y) = 0.9$, else, $= -200 + 200 - 30 = -30$ and $P() = 0.1$

$$E(Y) = 0.9 * 70 + 0.1 * (-30) \tag{8}$$
$$= 60 \tag{9}$$

$$E(Y^2) = 0.9 * 70^2 + 0.1 * (-30)^2 \tag{10}$$
$$= 4500 \tag{11}$$

$$Var(Y) = E(Y^2) - E^2(Y) \tag{12}$$
$$= 4500 - 60^2 \tag{13}$$
$$= 900 \tag{14}$$

To summarise, we have

Stats	X	Y
E	70	60
Var	8100	900

This means that buying insurance lowers the expectation of profit and **does not make sense in the long run**. But if the company just started, it would be devastating to suffer successive losses without insurance. The low variance provided by the insurance could make the company cashflow **more stable**.