

Task 4

Space Company is preparing to launch a spaceship. If the launch is successful, the company earns \$100 million in profit. In case of failure, the company loses \$200 million (i.e. negative profit). Probability of failure is 1/10. The company can buy insurance for this launch. Cost of insurance is \$30 million (paid before the launch). In case of failure the insurer will pay Space Company \$200 million (thus compensating all the damages). Consider two cases: 1. Space Company decided not to buy insurance. 2. Space Company decided to buy insurance. Denote its profit in the first case by X and in the second case by Y . (In the second case profit includes payments to/from the insurer taken with appropriate sign.) Find expected values and variances of X and Y . Describe how buying of insurance affects the profit, its expected value and variance? Does buying insurance is cost-efficient in the long run? In which case Space Company can decide to buy insurance and why?

P	0.9	0.1
X	100	-200
$X - EX$	30	-270
$(X - EX)^2$	900	72900

$$EX = \sum_{i=1}^n p_i x_i = 0.9 \cdot 100 + 0.1 \cdot (-200) = 90 - 20 = \mathbf{70}$$

$$Var X = E(X - EX)^2 = \sum_{i=1}^n p_i (x_i - EX)^2$$

$$= 0.9 \cdot 900 + 0.1 \cdot 72900 = \mathbf{8100}$$

P	0.9	0.1
Y	70	-30
$Y - EY$	10	-90
$(Y - EY)^2$	100	8100

$$EY = \sum_{i=1}^n p_i y_i = 0.9 \cdot 70 + 0.1 \cdot (-30) = 63 - 3 = \mathbf{60}$$

$$Var Y = E(Y - EY)^2 = \sum_{i=1}^n p_i (y_i - EY)^2$$

$$= 0.9 \cdot 100 + 0.1 \cdot 8100 = \mathbf{900}$$

As we can see from the calculations, buying insurance decreases expected value of profit and its variance. It means that in long run, if no accidents occur, Space Company will get less profit from every launch of a spaceship. So the 1st strategy (without insurance) seems to be more profitable.

At the same time in the long run, the 2nd strategy (with insurance) is safer. It's fine if Company has a lot of money, then it can cover the cost of a failed launch. But if several launches fail in a row, then there is a high chance that Company will go bankrupt. But if Company has insurance, then failed launches won't cost as much.

So basically, if the Company is rich enough it might ignore dangers of failed launches and not buy insurance to get more profit. Otherwise, buying insurance can save the company a lot of trouble, especially in case of continuous failures.