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# Project Management for Managers

## Lec – 24 Hillier Model

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A project with the initial investment of 100 lacs with a lifespan of four years has the following probabilistic outcomes in different years.

| Year 1     |       | Year 2     |       | Year 3     |       | Year 4     |       |
|------------|-------|------------|-------|------------|-------|------------|-------|
| NCF (lacs) | Prob. | NCF (lacs) | Prob. | NCF (lacs) | Prob. | NCF (lacs) | Prob. |
| 50         | 20%   | 60         | 25%   | 70         | 40%   | 60         | 30%   |
| 30         | 50%   | 40         | 50%   | 40         | 50%   | 40         | 55%   |
| 10         | 30%   | 10         | 25%   | -10        | 10%   | 20         | 15%   |

Determine the expected net present value of the project and its standard deviation.

Also, determine the probability of (i) positive NPV of 30 lacs and (ii) loss. Assume 10% as discounting factor.



## Solution:

| Year 1     |       | Year 2     |       | Year 3     |       | Year 4     |       |
|------------|-------|------------|-------|------------|-------|------------|-------|
| NCF (lacs) | Prob. | NCF (lacs) | Prob. | NCF (lacs) | Prob. | NCF (lacs) | Prob. |
| 50         | 20%   | 60         | 25%   | 70         | 40%   | 60         | 30%   |
| 30         | 50%   | 40         | 50%   | 40         | 50%   | 40         | 55%   |
| 10         | 30%   | 10         | 25%   | -10        | 10%   | 20         | 15%   |

Projected cash flow of first year =  $50 * 20\% + 30 * 50\% + 10 * 30\% = 28 \text{ lacs}$

Projected cash flow of second year =  $60 * 25\% + 40 * 50\% + 10 * 25\% = 37.5 \text{ lacs}$

Projected cash flow of third year =  $70 * 40\% + 40 * 50\% - 10 * 10\% = 47 \text{ lacs}$

Projected cash flow of fourth year =  $60 * 30\% + 40 * 55\% + 20 * 15\% = 43 \text{ lacs}$

NPV =  $(28/1.1) + (37.5/ \{1.1\}^2) + (47/ \{1.1\}^3) + (43/ \{1.1\}^4) - 100 = 21.13$

$\sigma_1^2 = 0.2(50 - 28)^2 + 0.5(30 - 28)^2 + 0.3(10 - 28)^2 = 196$



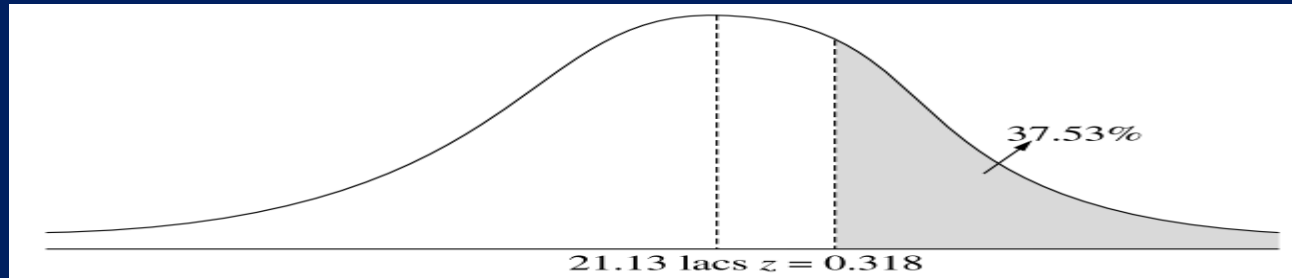
Similarly,  $\sigma_2^2 = 318$ ,  $\sigma_3^2 = 561$ ,  $\sigma_4^2 = 171$

$$\sigma(\text{NPV}) = \left[ \sum \frac{\sigma_t^2}{(1+i)^{2t}} \right]^{1/2}$$

$$\sigma(\text{NPV}) = (196/\{1.1\}^2) + (318/\{1.1\}^4) + (561/\{1.1\}^6) + (171/\{1.1\}^8) = \mathbf{27.86}$$

(i) Prob of positive NPV of 30 lacs and more

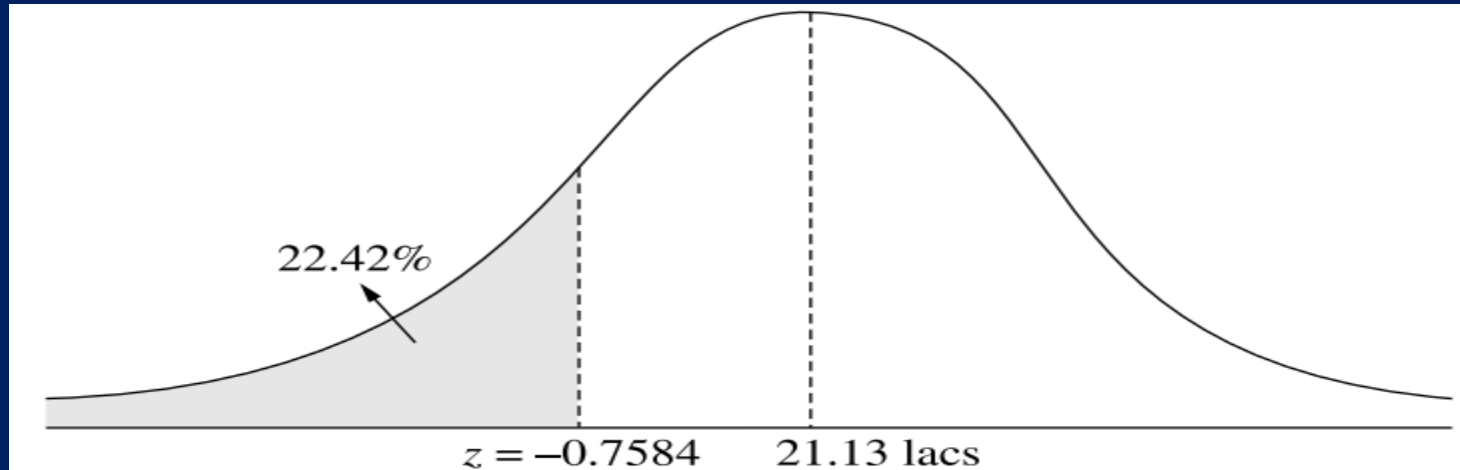
$$Z = (30 - 21.13) / 27.86 = 0.318, \text{ area under curve is } 0.12$$



37.53%

## (ii) probability of loss

$$Z = (0 - 21.13) / 27.86 = -0.75 \text{ (area under curve .2734)}$$



Determine the expected NPV and the probability of earning at least ₹ 50 lacs and the probability of making at least no loss with the following information. Initial investment is ₹ 150 lacs and discounting factor is 12%.

| Year                        | 1  | 2  | 3  | 4  | 5  |
|-----------------------------|----|----|----|----|----|
| Expected cash flow(in lacs) | 40 | 60 | 80 | 70 | 50 |
| Standard deviation(in lacs) | 6  | 8  | 10 | 9  | 7  |

Determine the expected NPV and the probability of earning at least ₹ 50 lacs and the probability of making at least no loss with the following information. Initial investment is ₹ 150 lacs and discounting factor is 12%.

| Year                        | 1  | 2  | 3  | 4  | 5  |
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| Expected cash flow(in lacs) | 40 | 60 | 80 | 70 | 50 |
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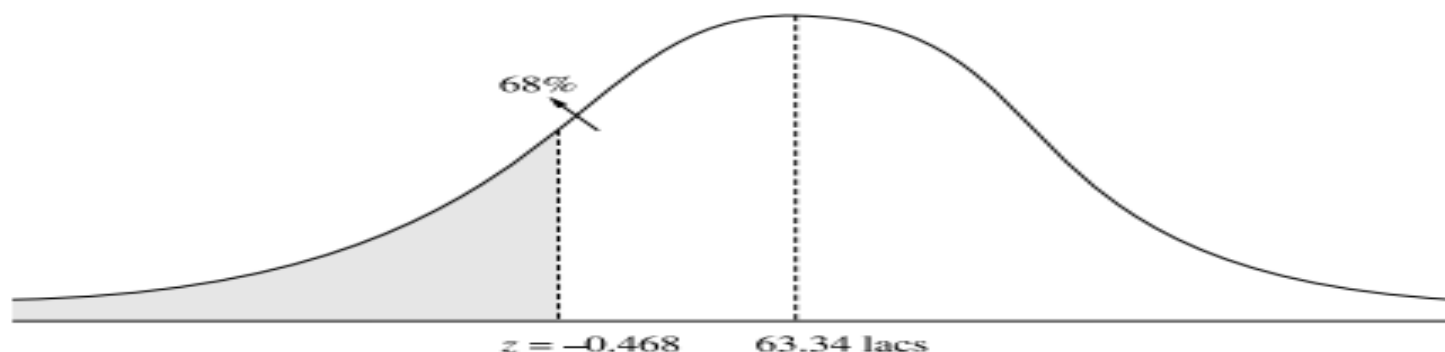
**Solution**

$$NPV = \frac{40}{1.12} + \frac{60}{(1.12)^2} + \frac{80}{(1.12)^3} + \frac{70}{(1.12)^4} + \frac{50}{(1.12)^5} - 150 = ₹ 63.34 \text{ lacs}$$

$$\sigma (NPV) = \left[ \frac{6}{(1.12)} + \frac{8}{(1.12)^2} + \frac{10}{(1.12)^3} + \frac{9}{(1.12)^4} + \frac{7}{(1.12)^5} \right] = ₹ 28.40 \text{ lacs}$$

Probability of earning at least 50 lacs

$$z = \frac{(50 - 63.34)}{28.4} = -0.468$$

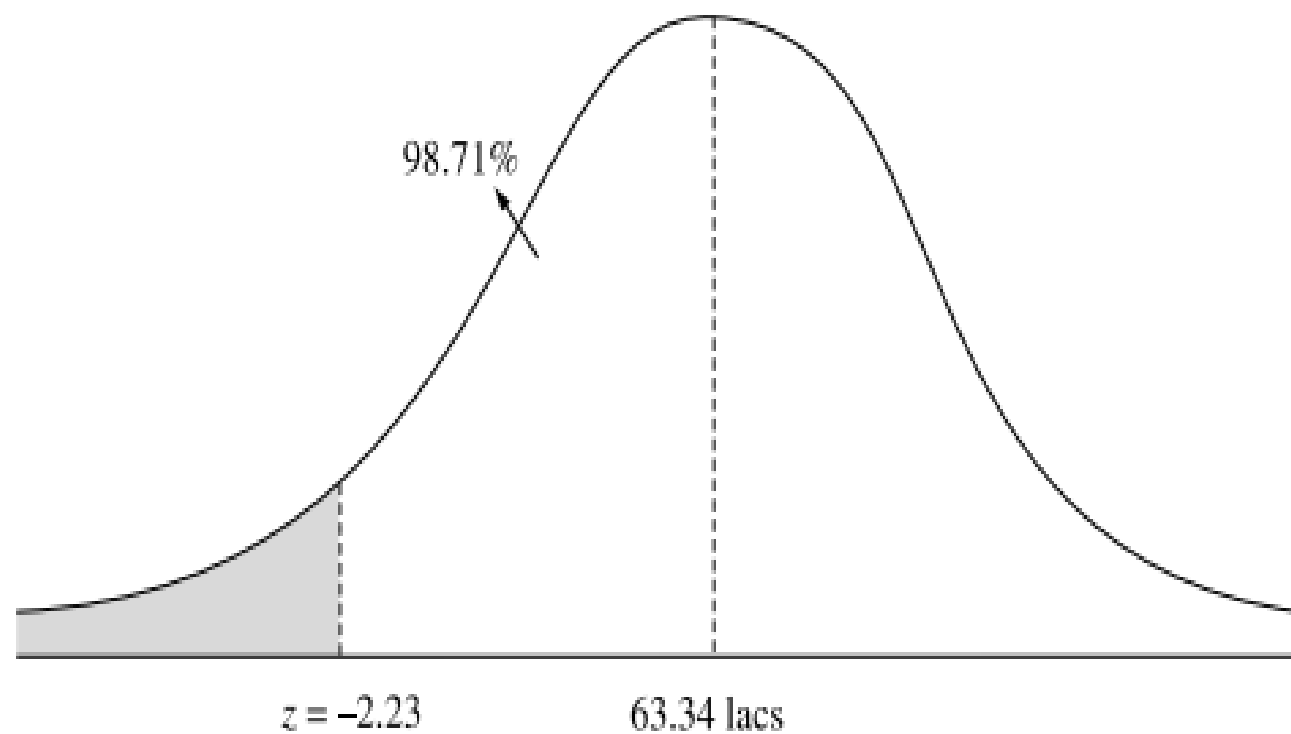


**Figure 9.3(a)** Solution to Example 9.2(a).

Corresponding probability of earning ₹ 50 lacs is .68 or 68%.

Probability that the project will not suffer a loss.

$$z = \frac{(0 - 63.34)}{28.4} = -2.23$$



**Figure 9.3(b)** Solution to Example 9.2(b).

Corresponding probability of at least making no loss is 98.71%.