Que 1:-

Ans 1:-

$B(0) = ₹100$ → current bond price

$B(1) = ₹110$ → bond price after 1 period.

$S(0) = ₹80$ → current stock period.

$V(t) = x S(t) + y B(t)$ → total wealth of an investor holding x stock shares and y bonds at time t

$V(0) = ₹10000$

Let the investors hold x stock shares and y bond shares at time instant $t = 0, 1$

$x = 10000 \times \left(\frac{3}{5}\right) \times \left(\frac{1}{80}\right) = 75$

$y = 10000 \times \left(\frac{2}{5}\right)\left(\frac{1}{100}\right) = 40$

$(75, 40)$ → portfolio.

$(₹10000)$ → value of portfolio at $t = 0$

$$S(1) = \begin{cases} ₹100 & \text{with } p = 0.8 \\ ₹60 & \text{with } p = 0.2 \end{cases}$$

$$V(1) = \begin{cases} ₹11900 & p = 0.8 \\ ₹8900 & p = 0.2 \end{cases}$$

$$R_V = \frac{V(1) - V(0)}{V(0)}$$ = return on the portfolio

$$R_V = \begin{cases} 0.19 & p = 0.8 \\ -0.11 & p = 0.2 \end{cases}$$

$$E(R_V) = 0.19 \times 0.8 - 0.11 \times 0.2$$
$$= 0.152 - 0.022$$
$$= 0.16$$ → expected return

Risk $(\sigma_V) = \sqrt{(0.19 - 0.16)^2 \times 0.8 + (-0.11 - 0.16)^2 \times 0.2}$
$$= 0.123$$

Ans 2:- $B(0) = ₹90$ $S(0) = ₹25$

$B(1) = ₹100$

$S(1) = \begin{cases} ₹30 & \text{with probability } p \\ ₹20 & \text{with probability } (1-p) \end{cases}$

portfolio : $(10, 15)$ value of portfolio at $t=0$

$V(0) = ₹10 \times 25 + 15 \times 90$

$= ₹(250 + 1350)$

$= ₹1600$

$V(1) = \begin{cases} ₹(10 \times 30 + 15 \times 100) & = ₹1800 \\ ₹(10 \times 20 + 15 \times 100) & = ₹1700 \end{cases}$

$K_V = \begin{cases} 0.125 \\ 0.0625 \end{cases}$

Expected return $= 0.125p + 0.0625q$

Ans 3 :-

$B(0) = ₹100$

$B(1) = ₹110$

$S(0) = ₹80$

$S(1) = \begin{cases} ₹100 & p = 0.8 \\ ₹60 & p = 0.2 \end{cases}$

$V(0) = ₹10000$

$x = \frac{5000}{80} = 62.5$

$y = \frac{5000}{100} = 50$

$V(1) = \begin{cases} 62.5 \times 100 + 50 \times 110 & = ₹11750 \\ 62.5 \times 60 + 50 \times 110 & = ₹9250 \end{cases}$

$K(V) = \begin{cases} 0.175 \\ -0.075 \end{cases}$

$E(K_V) = 0.175 \times 0.8 - 0.075 \times 0.2$
$= 0.14 - 0.015$
$= 0.125$ (Expected return)

Risk $(\sigma_V) = \sqrt{(0.175 - 0.125)^2 \times 0.8 + (-0.075 - 0.125)^2 \times 0.2}$
$= 0.084$

~~Ans~~

Ans 4:-

$B(0) = ₹90$ $\qquad S(0) = ₹25$

$B(1) = ₹100$

$S(1) = \begin{cases} ₹30 & \text{with probability } p \\ ₹20 & \text{" " } 1-p \end{cases}$

$U(1) = \begin{cases} ₹1160 & \text{" " } p \\ ₹1040 & \text{" " } 1-p \end{cases}$

portfolio = (x, y)

x → no. of shares

y → no. of bonds.

$x \times 30 + y \times 100 = 1160$

$x \times 20 + y \times 100 = 1040$

$10x = 120$

$x = 12$ — (1)

$y = \frac{1160 - 360}{100} = 8$ — (2)

from (1) & (2)

$U(0) = ₹(12 \times 25 + 8 \times 90)$

$= ₹1020$

Ans 7:-

No Arbitrage principle :-

There is no admissible portfolio with initial value $V(0) = 0$ such that $V(1) > 0$ with non-zero probability

let's suppose $V(0) = 0$;

₹10000 is borrowed from bank.

① we will buy pounds from dealer B we get,

$$\frac{10000}{80} = 125 \text{ pound.}$$

② Investing it in bank for 1 year we get;

$$(125 + 125 \times 0.06) \text{ pound} = 132.5 \text{ pound.}$$

③ we sell the pound for rupee to dealer A we get :-

$$₹(132.5 \times 79) = ₹10467.5$$

④ we returned the borrowed amount with interest to the bank i.e. ₹10000 + ₹400 → interest

= ₹10400

⑤ profit :- ₹10467.5 - ₹10400

= ₹67.5 > 0 (Arbitrage exist!!)

Ans 8:- $B(0) = ₹100$
$B(1) = ₹110$
$S(0) = ₹50$

Let the forward price be F :-

// Case 1:- Short forward contract

If we sell at a fixed price F
- Borrow \$50 (we start from $V(0) = 0$)
- Buy asset for $S(0) = \$50$

portfolio :- $(1, -1/2, -1)$

Now, we will sell the asset at F and return the amount \$ 55 to the borrower
the profit $= \$(F - 55)$

Now for no arbitrage condition.

$$F - 55 <= 0$$

$$\Rightarrow F <= 55 \quad -(1)$$

// Case 2:- Long forward contract

If we buy at F ~~[illegible]~~. at $t = 1$ then,

- Sell short the asset at \$ 50
  - Investing at risk free

we get \$ 55 from investment, we get the asset at F, we will return the asset to the owner

profit = \$55 - F

for no arbitrage :-

$$55 - F <= 0$$

$$\Rightarrow 55 <= F \quad - (2)$$

from (1) & (2)

$$F = \$ 55$$

Ans 9:- Strike price = ₹ 30
price of option = ₹ 4

Investor is able to make a gain if the price of the commodity (P) becomes less than ₹ 34 in future.

as if $P < 34$
then he/she can ~~sell~~ sell the commodity at ₹ 30 and buying it again at cheaper price making a profit of $(30+4) - P$
$= ₹ (34 - P)$

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