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Question 1: a) Paying executives with RSUs can align the executives' goals with the board and other shareholders. This is because, under this situation the uprising of stock price, represents not only company's interests but executives' payoff through their efforts. Besides, the set of a vesting period helps prolonging this process into a long-term goal.

b) Yes. Paying non-exautive employees with RSUS would motivate them to enhance work performance and reduce slacking off. They are more likely to focus on the whole benefits of companys rather than just their own interests.

However, it might not be so powerful or effective as paying them to executives. Since these employees, in most companies, have less influence on the company's decisions. Though being encourged and hard-working, the economical benefits for the company might not be enough obvious.

Question 2: a) $\text{price}_1 = \frac{100}{1+\text{Rate}_1} = \frac{100}{1+5.498\%} = 94.79$

b) $\text{Price}_2 = \frac{100}{(1+\text{Rate}_2)^2} = \frac{100}{(1+5.150\%)^2} = 90.44$

c) $\text{Price}_5 = \frac{100}{(1+\text{Rate}_5)^5} = \frac{100}{(1+4.794\%)^5} = 79.12$

d) $F = 100$, Annual Coupon : $C = 5\% \times 100 = 5$

$$\text{Price}_5' = \frac{C}{1+\text{Rate}_1} + \frac{C}{(1+\text{Rate}_2)^2} + \dots + \frac{C}{(1+\text{Rate}_5)^5} + \frac{F}{(1+\text{Rate}_5)^5}$$

$$= \frac{5}{1+5.498\%} + \frac{5}{(1+5.15\%)^2} + \frac{5}{(1+4.95\%)^3} + \frac{5}{(1+4.832\%)^4} + \frac{5+100}{(1+4.794\%)^5}$$

$$= 4.74 + 4.522 + 4.325 + 3.986 + 83.082$$

$$= 100.655$$

e) $p = \sum_{t=1}^{n} \frac{c}{(1+YTM)^t} + \frac{F}{(1+YTM)^n}$

For a zero-coupon, $c=0$, therefore:

1 year: $YTM_1 = \frac{F}{P} - 1 = \frac{100}{94.79} - 1 = 5.498\%$

2 year: $YTM_2 = \sqrt{\frac{F}{P}} - 1 = \sqrt{\frac{100}{90.48}} - 1 = 5.130\%$

5 year:

$YTM_5 = \left(\frac{F}{P}\right)^{\frac{1}{5}} - 1 = \sqrt{\frac{100}{\cancel{100.655}\ 79.12}} - 1 = 4.795\%$

For a 5-year coupon with 5% annual payments

$$p = \sum_{t=1}^{5} \frac{5}{(1+YTM)^t} + \frac{100}{(1+YTM)^5} = 100.655$$

$YTM = 0.48493 = 4.849\%$ (By drawing its picture)

Question 3: a) $p = \cancel{\frac{F}{1+}}\ Fe^{-rt}$, $r = \frac{\ln\left(\frac{F}{P}\right)}{t} = \frac{\ln\left(\frac{100}{98.88}\right)}{\cancel{182}\left(\frac{182}{365}\right)} = 2.259\%$

b) $r = \frac{F-P}{P} \times \frac{360}{T} = \frac{100 - 98.88}{98.88} \times \frac{360}{182} = 2.238\%$

Question 4: a) To ensure the $\sqrt{}$ abitrage opportunity, we must consider the investment between year 2 to year 5. Because we need to re-invest the payoff from 2-year strips to cover the 5-year strips. So this needs a further distcussion.

b) $F_0(2,5) = \left[\frac{(1+Y_5/2)^{5\times2}}{(1+Y_2/2)^{2\times2}}\right]^{\frac{1}{3}} - 1 = \left[\frac{(1+0.0371/2)^{10}}{(1+0.04011/2)^{4}}\right]^{\frac{1}{3}} - 1 \approx 3.540\%$

c) $F_0(2,5) < Y_5 = 3.71\%$, therefore, this chance doesn't exist. Because during year 2 to year 5, the returns from re-investing can't cover your payment on yields of the 5-year strip.

Question 5:

a)

Maturity	Start/Value Date	End/Maturity Date	Days from Value Date
1M	2024-08-22	2024-09-23	~~31~~ 32
3M	2024-08-22	2024-11-~~20~~ 21	~~92~~ 91
6M	2024-08-22	2025-2-20	~~184~~ 182
12M	2024-08-22	2025-8-~~20~~ 22	365

These dates don't fall in any weekday or festivals.

b) $\text{Forward Rate} = \left(\left[\frac{(1+r_L \times \frac{d_L}{360})^{\cancel{\frac{d_L}{360}}}}{(1+r_S \times \frac{d_S}{360})^{\cancel{\frac{d_S}{360}}}}\right]^{\cancel{\frac{1}{\frac{d_L}{360}-\frac{d_S}{360}}}} - 1\right) \cdot \frac{1}{\frac{d_L}{360}-\frac{d_S}{360}}$

$F_0(1,3) = \frac{(1+0.0512\times\frac{92}{360})^{\cancel{\frac{92}{360}}}}{(1+0.0531\times\frac{31}{360})} - 1 = \cancel{8.475\%}$ 4.99%

$F_0(3,6) = \frac{(1+0.0483\times\frac{184}{360})}{(1+0.0512\times\frac{92}{360})} - 1 = \cancel{1.144\%}$ 4.480%

$F_0(6,12) = \frac{(1+0.0437\times\frac{365}{360})}{(1+0.0483\times\frac{184}{360})} - 1 = \cancel{1.924\%}$ 3.840%

Question 6: (1) $P = F/(1+r_n)^n \Rightarrow r_n = \left(\frac{1}{P(0,n)}\right)^{\frac{1}{n}} - 1$

$r_1 = \left(\frac{1}{0.97}\right) - 1 = 3.09\%$
$r_2 = \left(\frac{1}{0.96}\right)^{\frac{1}{2}} - 1 = 2.06\%$
$r_3 = \left(\frac{1}{0.94}\right)^{\frac{1}{3}} - 1 = 2.08\%$
$r_4 = \left(\frac{1}{0.92}\right)^{\frac{1}{4}} - 1 = 2.11\%$

(2) $C_n \cdot \sum_{i=1}^{n} P(0,i) + P(0,n) = F \Rightarrow C_n = \frac{F - P(0,n)}{\sum_{i=1}^{n} P(0,i)}$

$C_1 = \frac{F - P(0,1)}{P(0,1)} = \frac{1-0.97}{0.97} = 3.09\%$ $C_2 = \frac{F-P(0,2)}{P(0,1)+P(0,2)} = \frac{1-0.96}{0.97+0.96} = 2.07\%$

$C_3 = \frac{F-P(0,3)}{P(0,1)+P(0,2)+P(0,3)} = \frac{1-0.94}{0.97+0.96+0.94} = 2.09\%$ $C_4 = \frac{F-P(0,4)}{P(0,1)+P(0,2)+P(0,3)+P(0,4)}$

$= \frac{1-0.92}{0.97+0.96+0.94+0.92}$

$= 2.11\%$

(3) $f_{n-1,n} = \frac{P(0,n-1)}{P(0,n)} - 1$

$f_{0,1} = r_1 = 3.09\%$ $f_{1,2} = \frac{P(0,1)}{P(0,2)} - 1 = 1.04\%$

$f_{2,3} = \frac{P(0,2)}{P(0,3)} - 1 = 2.13\%$ $f_{3,4} = \frac{P(0,3)}{P(0,4)} - 1 = 2.17\%$

(4) $e^{-y_n \cdot t} \cdot \frac{F}{R} = \frac{P}{F}$, $y_n = -\frac{\ln(P/F)}{t}$

$y_1 = -\frac{\ln(0.97)}{1} = 3.05\%$ $y_3 = -\frac{\ln(0.94)}{3} = 2.06\%$
$y_2 = \frac{-\ln(0.96)}{2} = 2.04\%$ $y_4 = -\frac{\ln(0.92)}{4} = 2.08\%$

Question 7:

0 — 3 — 6 months

Sign FRA — Sign Loan — Pay

$$\text{FRA Settlement} = \text{Principal} \times (R_{SOFR} - R_{FRA}) \times \frac{T_1}{360}, \quad T_1 = \cancel{90}\ \cancel{180}\ 90$$

$$\text{Interest} = \text{Principal} \times R_{FRA} \times \frac{T_2}{360}, \quad T_2 = 90$$

$$\text{Total Cost} = \text{FRA Settlement} + \text{Interest}$$

For situation a) : $R_{SOFR} = 0.06$

$$\text{Total Cost} = 10{,}000{,}000 \times (0.06 - 0.0525) \times \frac{\cancel{180}\ 90}{360} + 10{,}000{,}000 \times 0.0525 \times \frac{90}{360}$$

$$= \cancel{37{,}500}\ 18{,}750 + 131{,}250 = \cancel{168{,}750}\ 131{,}250$$

For b) : $R_{SOFR} = 0.045$

$$\text{Total Cost} = 10{,}000{,}000 \times (0.045 - 0.0525) \times \frac{\cancel{180}\ 90}{360} + 10{,}000{,}000 \times 0.0525 \times \frac{90}{360}$$

$$= -\cancel{37{,}500}\ \cancel{18{,}750} + 131{,}250 = \cancel{93{,}750}\ 131{,}250$$

Therefore, the costs of this trade are ~~168,750~~ 131,250 or ~~93,750~~ 131,250 by situation a) or b).