Financial Modelling With Python - Practice Set1

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Practice

Q1: With an annual interest rate of 10% compounded twice per annum, what will be the equivalent interest rate compounded once per annum?

Q2: You are liable to pay Rs 20 million 4 years from now. So, you are thinking of investing some money today to exercise the liabilities. The SBI is offering 7% rate of interest semiannually compounded. How much money you must invest today?

Q3: Verify that, given an annual rate, the effective annual rate is higher the higher the frequency of compounding.

Q4: Suppose that r_1 is the annual rate with continuous compounding and r_2 is the equivalent rate compounded m times per annum. Express r_1 in terms of r_2 and r_2 in terms of r_1.

Q5: An annuity that lasts forever is called a perpetual annuity. Show that

$$PV = \frac{mC}{r}$$

Q6: Write a program to calculate amortization schedules with loan amount L and monthly interested rate r. Validate your program with the example given in slide no 12.

Practice

Q7: The effect of compounding frequency on FV and PV

Compute the FV and PV of a $1,000 single sum for an investment horizon of one year using a stated annual interest rate of 6.0% with a range of compounding periods.

Compounding Frequency	*Interest Rate per Period*	*Effective Rate of Interest*	*Future Value*	*Present Value*
Annual (m = 1)	6.000%	6.000%	$1,060.00	$943.396
Semiannual (m = 2)	3.000	6.090	1,060.90	942.596
Quarterly (m = 4)	1.500	6.136	1,061.36	942.184
Monthly (m = 12)	0.500	6.168	1,061.68	941.905
Daily (m = 365)	0.016438	6.183	1,061.83	941.769

Q8: FV of a single sum using quarterly compounding Compute the FV of $2,000 today, five years from today using an interest rate of 12%, compounded quarterly.

Practice

Q9: The amount an investor will have in 15 years if $ 1,000 is invested today at an annual interest rate of 9% will be closest to:

A. $1,350.
B. $3,518.
C. $3,642.
D. $9,000.

Q10: How much must be invested today, at 8% interest, to accumulate enough to retire $10,000 debt due seven years from today? The amount that must be invested today is closest to:

A. $3,265.
B. $5,835.
C. $6,123.
D. $8,794.

Q11: An analyst estimates that XYZ's earnings will grow from $3.00 a share to $4.50 per share over the next eight years. The rate of growth in XYZ s earnings is closest to:

A. 4.9%.
B. 5.2%.
C. 6.7%.
D. 7.0%.

Practice

Q12: If $5,000 is invested in a fund offering a rate of return of 12% per year, approximately how many years will it take for the investment to reach $10,000?
A. 4 years.
B. 5 years.
C. 6 years.
D. 7 years.

Q13: An investor is looking at a $150,000 home. If 20% must be put down and the balance is financed at 9% over the next 30 years, what is the monthly mortgage payment?
A. $652.25.
B. $799.33.
C. $895.21.
D. $965.55.

Q14: Prove that convexity is positive in normal market condition.

Q15: Suppose you have bought a 5-year corporate bond at Rs 90 with face value Rs 100 and annual coupon rate 9%. Write a program to find out YTM.

Practice

Q16: Explain that Liquidity premium theory explains the following 3 facts about term structures of interest rates.

- Interest rates on bonds of different maturities move together over time
- When short-term interest rates are low, yield curves are more likely to have an upward slope; when short-term rates are high, yield curves are more likely to slope downward and be inverted
- Yield curves almost always slope upward

Q17: Consider a bond whose modified duration is 11.54 with a yield of 10%. What will be the approximate price change (in %) if the yield increases instantaneously from 10% to 10.1%?

Q18: Explain Segmented Markets theory in term structures of interest rates.

Q19: Prove that $\partial(\text{duration})/\partial y = (\text{duration})2 - \text{convexity}$.

Done

Q20: Show that the convexity of a zero-coupon bond is $n(n+1)/(1+y)2$.

Practice

Done

Q21: What is the PV of an annuity that pays $200 per year at the end of each of the next 13 years given a 6% discount rate?

Done

Q22: A perpetuity is a financial instrument that pays a fixed amount of money at set intervals over an infinite period of time. In essence, a perpetuity is a perpetual annuity.
What will be the formula of PV of perpetuity?

Done

Q23: Suppose you have rented out your house for an infinite number of years. You will get C mount after 1st year and then the rent will be increased by g% every year. Assume the interest rate is r%. What is the PV of all future rents when

1. $r > g$
2. $r < g$

Done

Q24: Compute the FV of Rs 100 single sum for an investment horizon of one year using a stated annual interest rate of 6.0% with a range of compounding periods.

1. Annual
2. Semiannual
3. Continuous

Practice

All in Mid and Quiz 1

Done **Q25:** Suppose you have created a portfolio consisting of two one-year zero-coupon bonds with yields of y1 and y2. Prove that yield of the portfolio lies between individual yields.
Hint: you may use a continuous compounding framework.

Done **Q26:** Show that the convexity of a 'n' year zero-coupon bond is $n(n+1)/(1+ y)^2$ where y is the interest rate or yield.

Done **Q27:** Prove that greater convexity translates into greater price gains as interest rates fall and lessened price declines as interest rates rise.

Done **Q28:** Write down 3 facts about the term structure of interest rates. Show that `Expectations Theory` explain only two facts about the term structure of interest rates.

Done **Q29**: Prove that "The lower a bond's coupon, the longer its duration (Macaulay Duration)"

Done **Q30**: Prove that "Greater convexity translates into greater price gains as interest rates fall lessened price declines as interest rates rise"