# CHE374 – 2022 Problem Set #2

1. Determine the effective annual rate for an investment that earns 15% per year based on quarterly compounding for the first 4 months, then earns 11% per year based on continuous compounding for another 5 months.

2. Derive the equation that equates how much Principal (P) at time zero is required to create an annuity (A) for N periods with an interest rate i. (An annuity is a uniform series of equal cash flows.)
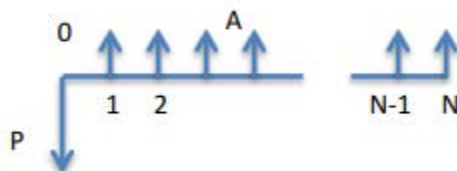


3. You are given the following T-bill maturity rates and prices.

| Maturity (Months) | T-Bill Price |
| --- | --- |
| 3 | 99.73 |
| 6 | 98.92 |
| 9 | 97.88 |
| 12 | 96.99 |

a) Calculate the yield rates (effective annual and continuously compounding annual) for each T-bill. Plot both yield curves.

b) What would be the effective annual and continuously compounding annual "risk-free" rates for an investment maturing in 7 months?

c) You know that you will have to invest at the risk-free rate 4 months from now for a term of 9 months (i.e. you will be investing from months 3 to 12). Based on the market conditions as given in the table, can you think of a way of determining the market's expectation of what the 9 month risk-free effective rate would be 3 months from now?

4. You are given the following price data for T-bills.

| Maturity (Months) | T-Bill Price |
|---|---|
| 2 | 99.11 |
| 6 | 98.72 |
| 9 | 96.85 |
| 12 | 95.97 |

Assume the risk-free rate for the first two months is flat (i.e. the two month rate is equivalent to the one month rate). Estimate the price of a T-bill maturing at the times in a) to e) (hint: calculate the continuously compounding rates for each of the T-bills in the table and use interpolation to estimate the interim rates from which you can calculate appropriate T-bill prices):

a) One month
b) Four months
c) Five and a half months
d) Seven months
e) Ten months
f) Given the following riskless cash flow, estimate the present worth.

| | 1 months | 4 months | 7 months | 10 months | 12 months |
|---|---|---|---|---|---|
| Cash Flow($) | 2000 | 500 | -1200 | -1000 | 500 |

5. You have won the lottery! They offer you four options:

   a) $15,500 per year for 10 years (starting in Y1)
   b) $140,000 right away.
   c) $155,000 at year 5.
   d) $170,000 at year 10.

Which one should you decide to take? Consider interest to be 2%.

6. The lottery found out you learned how to calculate annuities during your undergraduate degree, and is now offering another option:

   $10,000 per year, plus $1500 each year starting in the second year, for 10 years.

   How much is this worth at present? Consider interest to be 2%.

   Should you select this option, or the previous option from 5.

7. The lottery has come back with one final offer:

   $10000 at year 1, and 5% growth each following year, up to and including year 10. What is the present worth of this option? Interest is still 2%. Should you select this option, or the previous option from 5.