> *For Age and Want save while you may;*
> *No morning Sun lasts a whole Day.*

Ben Franklin

NOTE: Compute all dollar-denominated answers to the nearest dollar unless otherwise specified, and compute all other answers to four decimal places (*i.e.,* .0001). Unless otherwise stated, all interest rates or rates of return are annual rates. Excel function hints are given in brackets.

ANNUITIES AND PERPETUITIES

1. You have just won the Lucky Charms–they are magically delicious–cereal box-top lottery and have been offered the choice of the following prizes:

   (a) $250,000 today

   (b) $360,000 at the end of five years

   (c) $22,800 a year forever (assume that your heirs can receive the payments) with the first payment one year from today

   (d) $40,000 for the next ten years with the first payment starting *today*

   (e) $13,000 next year and each annual payment increasing 3% per year forever

   Which prize is the most valuable if the appropriate discount rate is 8%? *[PV]*

2. In 2023, it was announced that the Japanese baseball player, Shohei Ohtani, had signed a ten-year, $700 million contract with the Los Angeles Dodgers. The contract calls for ten annual payments of $2 million followed by ten annual deferred payments of $68 million for a total of $700 million.

   (a) Although the Dodgers are obligated to pay Ohtani a total of $700 million over the next twenty years, why may it be inaccurate to label the contract a $700 million contract?

   (b) Given the cash flows of Ohtani's contract, briefly describe two approaches to calculate the PV of the cash flows? No calculations are necessary.

   (c) Assuming a discount rate of 4.43%, what is the PV of the 20 contractual payments assuming the payments are received at year end?

   (d) In calculating CFs for revenues and expenses, such as salaries, it is often assumed that the payments are made or received in the middle of the year. Would such an adjustment increase or decrease the PV calculated in 2.c.? Describe at least one method for making the adjustment.

(e) One question is why the contract was structured with such large deferred payments. Apparently it has to do with the way a team's annual payroll is determined for purposes of the *Competitive Balance Tax* (CBT), which is a penalty that applies if a team's payroll exceeds a certain threshold specified in the 442-page Collective Bargaining Agreement (CBA) between the league and the MLB Players Association. The CBA also specifies the discount rate for deferred contract payments as being the *applicable federal mid-term rate*, which was 4.43% when the contract was signed.

In determining the annual cost of a player's contract (referred to as the *Annual Average Value* (AAV)) the non-deferred annual amounts ($2 million/year) are *not* discounted, but the deferred amounts ($68 million/year) are discounted at the above rate to the season to which they are attributed. (An amount is deferred compensation if it is received after services are required to be rendered.)

Thus, if there were no deferred amounts, Ohtani's AAV would be $70 million per year, but under the CBA, each year's AAV would be the sum of $2 million plus the PV of the deferred $68 million– $\frac{68}{(1+.0443)^{10}}$ –or $44.08 million, for a total of $46.08 million. The lower AAV therefore allows the Dodgers to sign better players while reducing any potential CBT liability.

Is the PV of Ohtani's contract calculated under the CBT greater or lesser than the value you calculated in 2.c.? Why?

(f) Why may the *appliciable federal mid-term rate* not be the appropriate discount rate?

3. This question addresses financial issues that may arise in certain discrete family law matters.

Mick Jagger (then age 78), lead singer of the Rolling Stones, welcomed at the end of 2016 his 8th child, Devereaux. The mother, Melanie Hamrick (then age 32!), is a retired ballerina with the American Ballet Theatre. Some recent updates for the truly curious: 4th of July Celebration and leaving Florida for NY. Ms. Hamrick apparently is a woman of many talents: in addition to her ballet achievements, she is a twice published author.

Being the responsible frontman he is, Jagger reportedly agreed to provide support of $15,000 per month for the newborn until he reaches the age of 18. (There apparently are other undisclosed financial payments for additional schooling and a humble abode for Ms. Hamrick, but we'll ignore those.) Thus, Mick will have no further financial obligations the year that young Devereaux turns 18.

Let's assume that Mick's newest scion was born on January 1, 2024, will live a long

and fruitful life, and the payments are very low risk, given Mick's wealth. The 20-year U.S. treasury bond is currently yielding 4.20%, so let's use 8.00% as the appropriate discount rate.

For this problem, *assume that each year's total monthly payments are paid annually*, and remember, the year that he turns 18 he will not be entitled to any further payments.

(a) What is the PV (as of Jan. 1, 2024) of the payments if the total payments for each year ($180,000) are paid on December 31 of each year? *[PV]*

(b) What is the PV (as of Jan. 1, 2024) of the payments if each year's total payments are paid at the beginning of each year, i.e., each January 1? *[PV]*

(c) Suppose that Melanie negotiates an escalator clause whereby each year's payment, *after* the first payment, will be increased by the year's inflation (let's assume 2% per year). What is the PV (as of Jan. 1, 2024) of the payments if they are paid *at the end of each year*, i.e., each December 31?

(d) Suppose that Melanie wants a lump sum payment on the day of the birth of her child (January 1, 2024) instead of the installment payments, but Mick insists on the annuity payout. Melanie turns to J.G. Wentworth and sells the promised payments for a lump sum in a structured settlement agreement. If J.G. Wentworth discounts the payments at 10% (assume they are made at year end and there is no escalator clause), how much would they offer her? *[PV]*

(e) Suppose that Melanie is a very responsible mommie and decides to invest the payments instead of spending them. If the payments are received at year end and there is no escalator clause, what will be the account balance when young Jagger turns 18 if Melanie is able to earn 5% per year? 7% per year? *[FV]*

4. You made the very wise choice to have borrowed $200,000 to finance your FLS education. What is your monthly payment if the APR on the loan is 7.20% and the term of the loan 10 years? *[PMT]*

5. Same facts as previous question. How long will it take to pay off 50% of the principal amount?

6. Your goal is to have $5 million when you retire in 35 years–it may seem like a lot, but remember the dreaded inflation tax. Assume that you begin saving one year from today and make 35 equal, annual additions at year end to your retirement account. How much do you have to save each year to reach this goal if your annual rate of return is 4%? 6%? *[PMT]*

7. Now that you have accumulated all of that wealth, you want to endow a chair in corporate finance at the FLS that will pay $300,000 per year beginning one year

from today–remember, be generous when you decide to give back. How much do you have to donate *today* to the FLS to fund the chair if you want the chair to be endowed for 25 years, after which there will be no funds left, and the market rate of interest is 7%? *[PV]*

8. Read the WSJ Cryonaut article on the class web site. The Reanimation Foundation states that a $10,000 investment could grow to $8,677,163 in 100 years. What is the annual rate of return they are assuming? Some interesting books that explore variations on this theme are Michel Houellebecq's The Possibility of an Island, and Dani and Eytan Kollin's The Unicorporated Man. *[Rate]*

9. On Immediate Annuities, for a payment today of $1 million, I can receive a guaranteed *monthly* payment of $10,200 for ten years (10-year period certain). (Note, when interest rates were very low over the last 10 years, the monthly payment has been as low as $4,000. Interest rates matter!) If each payment is received at month end, what's the *effective annual interest rate* the insurance company is offering me on the annuity investment? *[Rate]*