An investment in knowledge pays the best interest.

Ben Franklin

NOTE: Unless otherwise specified, compute all dollar-denominated answers to the nearest dollar (i.e., $24,325) and returns and interest rates to four decimal places (i.e., .0681, or 6.81%). Annual yield means the Effective Annual Rate (Yield). Unless otherwise stated, all interest rates are annual rates compounded annually. In brackets following some questions I have indicated Excel functions that you should explore and that could be helpful in answering the questions.

For questions 1-4 assume the interest rate is 3.00%.

1. How much must you invest today to have $10,000 in one year? *[Excel: PV]*
2. How much will you have in one year if you deposit $10,000 in a bank today? (Remember that interest is compounded yearly.)*[Excel: FV]*
3. How much must you invest today to have $100,000 in 10 years? *[Excel: PV]*
4. You will receive $25,000 ten years from today. To calculate the PV of the $25,000, what's the *discount factor* you would use?
5. It's 2020, and one-year bank CD rates are now a *negative* 1.5% p.a. If you need $10,000 in one year to purchase an engagement ring (and you live in a neighborhood where it's not a good idea to keep money under your mattress), how much money must you put into a CD today to have $10,000 in one year. *[Excel: PV]*
6. Upon his death on April 17, 1790, the great American, Ben Franklin, bequeathed in trust approximately $4,500 (it was actually £1,000) to each Boston and Philadelphia. (As a point of comparison, this is equivalent in purchasing power to about $120,000 today.) Both trusts were required to loan the money at 5% p.a. to married tradesmen who were seeking to establish their own businesses. The cities could not spend the money for 100 years, at which time they could spend £100,000; the remaining balance could not be spent for another 100 years (until 1990). The final balance in the Boston trust was about $5,000,000, but Philadelphia didn't fare nearly as well as its final balance was only $2,300,000–apparently the default rate was a bit higher in Philadelphia than in Boston. No surprise there. For the questions below, *disregard* the disbursements of funds in 1890 and use the dollar figures.
   (a) What was the 200-year holding period return ($r_{0,200}$) of the Boston trust? Assume that the funds were invested for exactly 200 years.
   (b) What was the Boston trust's annual rate of return? *[Excel: Rate]*

(c) What would have been the Boston trust's final balance if its investments had earned 5% p.a. over the 200 years, as envisioned by Ben Franklin? *[Excel: FV]*

7. *This question highlights two of the most important concepts that we cover this semester: the importance of time and annual returns in compounding wealth and an appreciation of the devastating effect of fees on wealth accumulation. You can't control returns, but you can control time and fees.*

   You decide to be generous to your first unborn great–great grandchild: you establish a trust on 1 Jan. 2020 and fund it with $1,000. Under the terms of the trust, when your great–great grandchild turns 18, the trust will distribute all of the trust assets to him or her or them. Assume that you make no other contributions to the trust, and your great–great grandchild turns 18 on 1 Jan. 2100.

   (a) What will be the amount distributed to the trust beneficiary if the trust earns 4% per annum? *[Excel: FV]*

   (b) What will be the amount distributed to the trust beneficiary if instead the trust earns 8% per annum? Although the annual return in this question is twice the return in the previous question, notice how many times greater the ending balance is. *[Excel: FV]*

   (c) Assume that the trust earns 8% per annum on its investments but pays an *administrative fee* to *helpers* of 2% per year at year end. Note, this is roughly the average annual administrative costs of an actively managed mutual fund. What's the final balance? *[Excel: FV]*

   Hint: To get the correct "r" in the compounding factor–the $(1+r)^T$*–it may be useful to write out an algebraic formula for the first year accumulation and reduction for the administrative fee. Remember that the 2% fee is levied on the year-end balance. Alternatively you can think of the administrative fee as being an annual negative return.*

   [Excel: FV]

8. Which would you prefer? Please show your work.

   (a) An investment paying 6.00% compounded annually.

   (b) An investment paying 5.75% compounded continuously.

   (c) An investment paying 5.88% compounded semiannually.

   [Excel: EFFECT]

9. You borrowed $100,000 to fund your law school education. The loan documents state that the APR is 5.25%, with interest payable monthly. What is the annual yield to

the bank on this loan (and your true annual economic cost)? *[Excel: EFFECT]*