Practice Final Exam (Solutions)

Section I. Multiple Choice

Please circle the correct answer for each of the following questions. Note that there is <u>only one correct answer for each question.</u> Each question is worth 2 points.

1. Which of the following statements is **true** about the balance of a single deposit in an interest earning savings account? (Only one is true.)

    A) The balance will not grow exponentially because multiple deposits are required to achieve exponential growth.

    B) The balance will grow exponentially, but only if the interest rate increases so that the dollar amount of interest earned increases.

    C) The balance will grow exponentially, but only if the interest rate is high enough.

    D) If the balance doubles after 15 years, it will more than triple after 30 years because of compound interest.

Answer: D

A is false. Multiple deposits are not required to achieve exponential growth. Any balance earning interest will grow exponentially because of compound interest.

B is false. Even if the interest rate remains constant, the balance will grow exponentially because of compound interest.

C is false. As long as the interest rate is above zero, the balance will grow exponentially. The higher the interest rate, however, the faster it will grow.

D is true. If a balance doubles after 15 years, it will double again after another 15 years. In total, after 30 years, a balance will quadruple.

2. Which of the following about Perkins loans is **false**? (Only one is false)

A) No interest accrues on the loan while a student is in school, and repayment does not begin immediately after a student graduates, but following a grace period after graduation.

B) The effect of subsidized interest and the grace period is that the implicit interest rate on the loan decreases below the stated APR.

C) If a Perkins loan did *not* have a grace period, but no interest accrued and no payments were due while the student is in school, the implicit rate on the loan would be equal to the stated APR.

D) If interest on a Perkins loan *did* accrue while the student is in school and throughout the grace period, but no payments were required while the student is in school or through the 9-month the grace period, the implicit interest rate on the loan would be equal to the stated APR.

Answer: C

A is true. A Perkins loan is a federal student loan with subsidized interest and an additional 9-month grace period.

B is true. By allowing the student to push payments further into the future without accruing any interest, the implicit interest rate on the loan decreases below the stated APR.

C is false. If the student is able to push payments until graduation day without accruing interest, the implicit interest rate on the loan decreases below the stated APR (but not by as much as it would if they were also able to further delay payment for an additional 9 months).

D is true. Although the student would be able to defer payment in this instance, they would be charged interest for doing so, and so the implicit interest rate on the loan would be equal to the stated APR.

3. Which of the following is **true** of the amortization of an installment loan with monthly payments? (Only one is true.)

A) The monthly payment increases over time.

B) The principal portion of the monthly payment decreases over time.

C) The interest portion of the monthly payment increases over time.

D) The interest portion of the monthly payment decreases over time.

Answer: D

A is false. The monthly payment on an installment loan remains constant over the life of the loan.

B and C are false and D is true. Each month, a portion of the payment reduces the loan principal. As the principal decreases, the interest due at the end of each period decreases, so C is false and D is true. Because the payments are fixed, lower interest payments implies that a greater share of the payment is going to principle, so B is false.

4. Which of the following statements about mortgage refinancing is **true**? (Only one is true.)

A) Refinancing is always a bad idea because of the large closing costs.

B) If the interest rate has dropped by at least 0.25%, refinancing is always a good deal because the lower future monthly payments will make up for all other costs.

C) With all other things being equal, refinancing a mortgage is more likely to be a good deal if the borrower still has many years left on the mortgage and plans to stay in the home for a long time after refinancing.

D) Refinancing is only a good deal if the borrower did not take any mortgage points on the original mortgage but takes at least two points during the refinance.

Answer: C

A is false. If the savings from a reduced monthly payment outweigh the initial large closing costs, refinancing is a good idea.

B is false. There are many factors to consider besides the drop in the interest rate on the loan. For example, if the interest rate dropped by 0.25% but the homeowner sold the home a couple of months later, the total of the monthly savings probably would not outweigh the large initial closing costs of refinancing.

C is true. The longer a borrower stays in a home, the more monthly payments they make. Therefore, the sum of the monthly savings from refinancing will be greater the longer the borrower stays in the home, and the more likely it will be that the savings outweigh the initial closing costs.

D is false. Refinancing can be a good deal regardless of whether the borrower took points on their original mortgage and/or takes points on their refinancing mortgage.

5. Which of the following statements is **true**? (Only one is true.)

A) It's only a good idea to buy a stock if you believe you will be able to sell it to somebody else at a higher price at a later date.

B) Generally, a stock issued by a company is safer than a bond because stockowners may achieve very high returns if the company performs well, while bondholders' returns are limited by the coupon rate of the bond.

C) Mutual funds provide superior diversification benefits than index funds because, in the U.S., index funds are legally required to only invest in the stocks of the largest 100 companies.

D) Some studies find that mutual fund managers are not able to outperform the market regularly after considering transaction costs. This is evidence that supports the efficient market hypothesis.

Answer: D

A is false. If a stock provides high enough dividends to justify its current price, it is a good idea to buy a stock even if you're not sure if you'll be able to sell it at a gain in the future.

B is false. Stocks are generally considered riskier than bonds. Even though they have the potential for higher returns than bonds, they also have the potential for lower returns.

C is false. Index funds in the U.S. are not required to invest only in the 100 largest companies. For example, many companies provide S&P 500 index funds, which invest in the 500 largest companies in the U.S.

D is true. The efficient market hypothesis states that it is excessively difficult to consistently outperform the stock market after considering all opportunity or transaction costs. The studies listed provide evidence that directly supports this claim.

6. Which of the following statements about Social Security is **true**? (Only one is true)

A) Social Security is necessarily a bad deal because the return implied by Social Security is usually lower than the historical return on stocks.

B) Collecting Social Security early is never a good idea because the drop in annual benefits from collecting early outweighs the ability to collect a few extra years' worth of benefits.

C) With all else being equal, Social Security benefits retirees with above-average life expectancies more than retirees with average life expectancies.

D) Social Security is the best asset for retirees because it is not subject to financial risk, longevity risk, inflation risk, or any other risk.

Answer: C

A is false. Though the returns implied by Social Security may tend to be lower than the historical returns on stocks post hoc, Social Security benefits are not subject to the same financial risks as stock, so a lower return does not make them necessarily inferior.

B is false. The extra years' worth of benefits may outweigh the drop in annual benefits. Further, because the extra benefits come earlier, they are more valuable because of the time value of money.

C is true. The longer a retiree lives, the more years' worth of benefits they will receive, so retirees who live longer will receive more benefits.

D is false. Though Social Security is not subject to any of the listed risks, it is subject to the political risk that the formula governing benefits may change over time. Further, even though it is less risky than other assets, other assets may provide a higher return.

7. Which of the following statements is **false?** (Only one is false)

A) A retiree may die before using all of his or her retirement funds. This is an example of **longevity risk**.

B) Because stock prices fluctuate often, an investor may be forced to sell his or her stock at a price lower than that at which it was purchased. This is an example of **financial risk**.

C) Corporations below investment grade have a higher risk of defaulting on their debt obligations than investment grade corporations. An investor that buys the bond of such a company may not receive the contractual payments promised by the bond in the event of such a default. This is an example of **default risk**.

D) If the cost of living increases faster than expected, a retiree may be unable to purchase as much as he or she planned during retirement. This is an example of **inflation risk**.

Answer: A

A is false. Longevity risk is the risk that a retiree will outlive his or her retirement funds, not die before using all of his or her retirement funds.

B, C, and D are all true. Each statement defines the listed risk.

8. Which of the following statements is **false**? (Only one is false.)

A) For a given change in interest rates, duration provides a better approximation for the change in a bond's price for a long-term bond than for a short-term bond.

B) The duration of a bond may be equal to its maturity.

C) For a given change in interest rates, the new price of a bond estimated using duration will always underestimate the actual new price of the bond (calculated by taking the present value of the cash flows).

D) The price of a longer-term bond is more sensitive to interest rate changes.

Answer: A

A is false. For long-term bonds, duration provides a less accurate estimate for a given change interest rates.

B is true. The duration of a zero-coupon bond is its maturity.

C is true. See slides.

D is true. The duration for is larger for longer-term bonds, and duration measures a bond's sensitivity to interest rate changes. Therefore, long-term bonds are more sensitive to interest rate changes.

9. Which of the following statements is **true**? (Only one is true.)

A) An investor may reduce the standard deviation of the returns on his or her portfolio by buying several shares of the same company's stock.

B) An investor may completely eliminate financial risk in a U.S. stock portfolio by diversifying across a sufficient number of stocks.

C) Risk diversification is only effective if two assets are positively correlated (i.e. have a correlation coefficient of greater than zero).

D) If two asset classes are uncorrelated, the standard deviation of returns on a portfolio weighted equally between these two assets will be less than it would be if the two assets were perfectly, positively correlated.

Answer: D

A is false. To diversify, an investor must purchase *different assets* (that move independently) not more of the *same* asset. Mathematically, since multiple shares of the same stock are perfectly positively correlated, there is no diversification benefit to purchasing several shares.

B is false. Because common factors affect all U.S. stocks, only a portion of the risk may be eliminated by diversifying across multiple stocks. Systematic, or non-diversifiable, risk will still remain.

C is false. The less positively correlated a two assets are, the greater the diversification benefits. If assets are completely uncorrelated, for example, the diversification benefits are strong. If assets are negatively correlated (which was not covered in the lectures), diversification benefits are even stronger.

D is true. If two assets are uncorrelated, the standard deviation for any given mix between the two assets will be less than it would be if they were perfectly positively correlated.

10. Which of the following statements is **false**? (Only one is false.)

A) With all else equal, an immediate life annuity is less expensive than a deferred life annuity because of the time value of money.

B) A life annuity can be purchased to insure against longevity risk.

C) A variable annuity indexed to the performance of the stock market is subject to financial risk, but a fixed annuity is not.

D) The implied return received on a fixed life annuity depends on how long the annuitant (the purchaser of the annuity) lives.

Answer: A

A is false. An immediate life annuity is *more* expensive than a deferred life annuity because the benefits are received earlier, so they are more valuable because of the time value of money.

B is true. A life annuity pays benefits for as long as the beneficiary lives, so it can be used to insure against the risk that a retiree may outlive their savings, which is longevity risk.

C is true. If the benefits paid by an annuity are indexed to the stock market, they will fluctuate up and down with the stock market, and so are subject to the same financial risk as the stock market.

D is true. The longer an annuitant lives, the more benefits they will receive, and so the higher their implied return from purchasing the annuity will be.

Section II. Short Answer

Please write your answers to the following questions <u>in the spaces provided</u>. Please show your work if you wish to receive partial credit. Each question is worth 3 points.

11. A worker is saving for a down payment on a house. If the down payment will be $40,000 and she can earn 5% interest on her savings, how much must she set aside today to make the down payment in 10 years?

Answer: $24,556

Using the interest rate formula:

$$F = P(1+r)^T \rightarrow P = \frac{F}{(1+r)^T} = \frac{\$40,000}{(1.05)^{10}} = \$24,556$$

12. Max borrows $400 for two weeks from a local payday lender. His fee for borrowing the $400 for two weeks is $56, which is due in two weeks along with the original $400. What is the APR on this payday loan?

Answer: 364%

Given that there are 52 weeks in a year, the APR of the loan can be calculated as:

$$APR = \left(\frac{\$56}{\$400} * \frac{52}{2} \right) * 100 = 364\%$$

Time Value of Money	
P/Y	26
PV	$400
FV	-$456
PMT	0
N	1
I/Y	364%

13. Amy recently graduated from college and has $12,000 in ten-year student loans carrying a 6% APR. If she makes monthly payments of $200, how long will it take her to pay down her balance?

Answer: 72 months (6 years)

Using a financial calculator:

Time Value of Money	
P/Y	12
PV	$12,000
PMT	-$200
FV	$0
I/Y	6%
N=	72

It will take 72 months, or 6 years.

14. A bond issued by Acme Inc. that pays quarterly coupons at a rate of 10% for the next five years is currently selling at $1,100 per $1,000 par. Calculate the yield-to-maturity of this issue.

Answer: 7.58%

Because the bond is selling at greater than $1,000 per $1,000 par, it is selling at a premium.

The bond costs $1,100 today, will pay 20 quarterly coupons of (0.10*$1,000)/4 = $25, and repay the $1,000 face value in five years (20 quarters). The implicit quarterly interest rate paid by the bond is therefore:

Time Value of Money	
P/Y	26
PV	-$1,100
FV	$1,000
PMT	$25
N	20
I/Y	7.58%

This is less than the 10% coupon rate because the bond sells at a premium.

15. Last year, Acme Inc. paid dividends of $15 per share. Value the company using a discount rate of 18% assuming that dividends grow by 3% per year.

Answer: $103

The value of each share of the company's stock can be found by applying the Gordon Growth Model:

$$P_0 = \frac{D_0(1+g)}{r-g} = \frac{\$15(1.03)}{0.18 - 0.03} = \$103$$

16. A man is saving for his daughter's college education. He expects to earn an average return of 6% on his investment account and will need $80,000 in 18 years. He plans to meet this goal by setting aside the same amount at the beginning of each year for the next 18 years. What amount must he set aside each year to meet this commitment?

Answer: $2,442

The amount may be found using a financial calculator:

Time Value of Money	
Mode	BEG
P/Y	1
PV	$0
FV	$80,000
I/Y	6%
N	18
PMT=	-$2,442

17. This year, Rob spent $1,000 on a new suit. If inflation is 2.5% per year, how much will it cost him to purchase the same suit in ten years? (Assume that the price change of the suit is in line with inflation.)

Answer: $1,280.08

After ten years, the same suit will cost:

$$P_T = P_0(1 + i)^T = \$1{,}000(1.025)^{10} = \$1{,}280.08$$

18. Today, Ryan takes out a 30-year, $240,000 mortgage with an APR of 6%. If inflation is 2% over the term of the mortgage, what will be the approximate *real* interest rate Ryan pays on the mortgage?

Answer: 4%

The real interest rate can be approximated as:

$$r \approx n - i = 6\% - 2\% = 4\%$$

19. Amy and Joe both invest $6,000 in the stock market. Amy invests passively and holds onto her stocks for 30 years. Joe actively trades, turning over his portfolio yearly. Consequently, Amy is subjected to a deferred long-term capital gains tax of 15%, while Joe is subject to an annual short-term capital gains tax at his marginal income tax rate, which is 25%. If both earn an annual return of 7% on their investment, how much more will money will Amy have in 30 years, after tax, compared to Joe?

Answer: $11,874

Because Amy invests for the long-term and is subject to a deferred capital gains tax of 15%, her final wealth will grow to:

$$F = P * [(1 + r)^N (1 - T) + T] = \$6{,}000[(1.07)^{30}(1 - 0.15) + 0.15] = \$39{,}723$$

Because Joe trades actively and turns over his portfolio every year, he is subject to a 25% accrual tax:

$$F = P[1 + r(1 - T)]^N = \$6{,}000[1 + .07(1 - 0.25)]^{30} = \$27{,}849$$

So Amy will have $39,723 − $27,849 = $11,874 more than Joe after 30 years.

20. Michael invests $40,000 in a start-up, $20,000 of which is borrowed from his parents at an interest rate of 0%. If the project returns 14%, what is Michael's return on equity?

Answer: 28%

Michael's return on equity can be found as:

$$R = L\, r = 14\% * \frac{\$40{,}000}{\$20{,}000} = 28\%$$

Section III. Long Answer

Please write your answers to the following questions in the spaces provided. Please show your work if you wish to receive partial credit. Each long question is worth 10 points.

21. Jack is considering opening a new restaurant. To do so would require an investment of $120,000 today. He estimates that the restaurant would generate profits of about $35,000 a year for the next six years.

For the following questions, assume all cash flows occur at the end of each year.

(a) Calculate the NPV of opening the restaurant using a discount rate of 18%.

NPV: $2,416

The NPV can be found using a financial calculator:

Cash Flow Worksheet	
CF_0	-$120,000
C01	$35,000
F01	6
I	18%
NPV=	$2,416.09

(b) Calculate the IRR of opening the restaurant.

IRR: 18.78%

The IRR may be found using a financial calculator:

Cash Flow Worksheet	
CF_0	-$120,000
C01	$35,000
F01	6
IRR=	18.78%

(c) Assuming Jack requires a return of 20%, should he invest in the restaurant?

No. Because the IRR of 18.78% does not exceed Jack's 20% required return, he should not invest in the restaurant.

22. Janice has a $2,000 balance on a credit card with a 18% APR, on which she usually just makes the minimum monthly payment of $30.

For the following questions, assume no additional borrowing.

(a) If Janice doubles the minimum monthly payment and makes payments of $60 per month, how long it take for Janice to pay off her credit card?

Months to pay off credit card: 47 months

This can be found using a financial calculator:

Time Value of Money	
P/Y	12
PV	$2,000
PMT	-$60
FV	$0
I/Y	18%
N=	46.6

(b) If Janice wants to completely pay off her credit card in two years, how much should her monthly payment be each month?

Monthly payment: $99.85

Using a financial calculator:

Time Value of Money	
P/Y	12
PV	$2,000
FV	$0
I/Y	18%
N	24
PMT=	-$99.85

(c) Instead, if Janice continues to make the minimum monthly payment of $30 for the next two years, will her balance be less than the $2,000 balance she started with?

No. If Janice makes only the minimum monthly payment of $30, she will only be paying interest, so her balance will not decline.

23. Ann and Andy are looking for a new home and find a $300,000 house that they like. Their bank offers them a 30-year mortgage at an 8% APR with a 20% down payment and no points. But if Ann and Andy are willing to pay two points, their bank will drop the APR on the mortgage to 7.5% points. They expect they will stay in the home for at least six years.

(a) If they take the points, what will be the outstanding balance on their mortgage after six years?

Balance: $223,867.11

After their 20% down payment, they must borrow $240,000. Their monthly payment will be $1,678.11. After 5 years (60 months), their mortgage balance will be $223,867.01.

Time Value of Money	
P/Y	12
PV	$240,000
FV	$0
I/Y	7.50%
N	360
PMT	-$1,678.11
N	72
FV	$223,867.01

(b) Assuming they take the points and stay in the home for six years, calculate the implicit APR on the mortgage with two points?

Implicit APR: 7.93%

If Ann and Andy take the points, they must pay 0.02*$240,000 = $4,800 up front. Because they receive $240,000 for the loan, but must immediately pay the bank $4,800, they only receive $235,200 on net. Using the monthly payment and ending balance found in part (a) above, the implied APR can be found using a financial calculator:

Time Value of Money	
P/Y	12
PV	$235,200.00
PMT	-$1,678.11
FV	-$223,866.58
N	72
I/Y	7.93%

(c) Should they take the points? **Yes**. The 7.93% implied APR with points is less than the 8.0% APR without points.

24. Caitlin is helping her parents plan for retirement. Her mother and father plan to retire in 25 years at age 65, but have only accumulated $100,000 of savings. The couple can earn an interest rate of 6% on their investment account while saving for retirement, but plan to move funds into a safer mix of assets that will yield 3% when they reach retirement. The couple wishes save enough to maintain withdrawals of $40,000 per year for 40 years after they retire.

For the following questions, assume zero inflation and that all cash flows occur at the end of the year.

(a) How much must Caitlin's parents set aside each year until retirement to meet their goal?

Annual contribution: $9,029.59

To sustain withdrawals of $40,000 per year for 40 years in retirement while earning an annual return of 3%, Caitlin's parents must have $924,591 when they retire:

Time Value of Money	
P/Y	1
PMT	$40,000
FV	$0
I/Y	3%
N	40
PV=	-$924,590.88

And to reach this level of savings in the next 25 years while earning an annual return of 6% on their assets, given that they already have $100,000 saved, they must save $9,029.59 per year:

Time Value of Money	
P/Y	1
PV	-$100,000
FV	$924,591
I/Y	6%
N	25
PMT=	-$9,029.59

(b) If Caitlin's parents make the annual contributions found in part (a) and realize their assumed return of 6%, how much will they have in their retirement account at retirement?

Balance at retirement: $924,591 (See the solution to part a)

(c) Statistically, Caitlin's parents don't expect to live for 40 years after retirement, but they might. By saving enough to last them 40 years in retirement, Caitlin's parents are insuring themselves against what risk?

Risk: Longevity Risk

Longevity risk is the risk that a retiree might outlive their savings. By saving enough to last longer than they expect to live, Caitlin's parents are insuring against this risk.