Name: _____

<span style="color:red">Solution Key</span>
Midterm exam I
266: Fi. Markets and Institutions
Spring 2016
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Grading: Subsections in questions 1 and 2 are worth 3 points. Subsections are worth 6 points in the rest of the exam, for a total of 135 points.

Directions:

You have 70 min. to do the exam (unless other arrangements have been made).

Some questions offer a bit of choice on which parts you do, so read carefully. If you answer too many parts, we will grade the first ones and ignore extras.

Where computations are required, full points will be given for the correct answer. Partial points will be given. For example, the proper formula with the relevant values plugged in will get near full points.

You may write on the backs of the exam pages and request additional paper.

If your answer extends outside the space provided, you must label clearly where the additional portion is located.

The last page of the exam is marked, 'The End'.

1 **Definitons.** Definitions taken from text:

1.1 Moral hazard.

**Answer/comment**
Risk that one party to a transaction will engage in behavior that is undesirable from the other party's point of view.

1.2 Collateral.

**Answer/comment**
Property that is pledged by a borrower to secure a loan. If the borrower defaults on the loan, the lender can seize the collateral.

1.3 Real interest rate.

**Answer/comment**
The nominal interest rate adjusted for expected inflation. Specifically, the nominal interest rate minus the inflation rate.

1.4 Net interest margin (of a bank)

**Answer/comment**
The difference between interest income and interest expense as a percentage of assets.
$$NIM = \frac{Interest\ Income - Interest\ Expense}{Assets}$$

1.5 Return on equity (ROE).

**Answer/comment**
Net profit after taxes per dollar of equity capital.

$$ROE = \frac{Net\ Profit}{Equity}$$

2 **Facts**. Give answers to the following questions. Be sure to state units when appropriate.

2.1 Short-term nominal interest rates in the U.S. reached a peak value of about [insert value:]around what year? [insert year:]
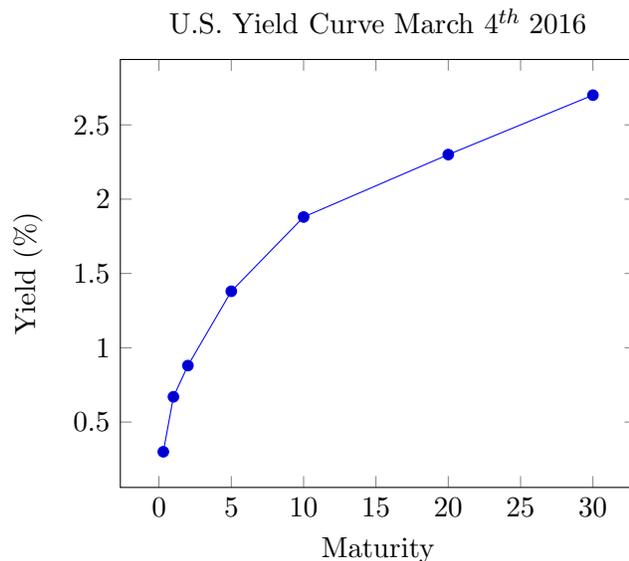
**Answer/comment**
Various short-term rates peaked between 15 and 20 percent around 1980.

2.2 Provide a rough sketch of the yield curve from three-months to 10-years for Treasury securities in the United States. Be sure to label properly.

**Answer/comment**
Solutions that identified 2 or more points on the yield curve obtained full credit. Below is a plot of the yield curve on March $4^{th}$:

U.S. Yield Curve March $4^{th}$ 2016



2.3 Name two central banks that currently have negative interest rates.

Circle Two: U.S. Fed, Bank of Japan, Bank of England, European Central Bank, Central Bank of Brazil, Central Bank of China

**Answer/comment**
European Central Bank and Bank of Japan.

2.4 Before the crisis, approximately what percent of bank reserves in the U.S. were excess reserves? And after the crisis, approximately what percent of bank reserves have been excess reserves?

**Answer/comment**
Answers in the range of less than 10% before the crisis, and more than 90% after the crisis, obtained full credit.

2.5 What is the approximate value for U.S. nominal GDP?

**Answer/comment**
About $18 trillion.

2.6 Household sector debt as a share of GDP in the U.S. has risen fairly steadily since the early 1950s. True/False.

**Answer/comment**
False. Household debt fell since peaking around 2007 at the beginning of the crisis.

2.7 U.S. government debt as a share of U.S. GDP has risen fairly steadily since the early 1950s. True/False.

**Answer/comment**
False. Government debt fell after WWII as the U.S. worked down debt accumulated during the Great Depression and WWII. It also fell in the 1990s.

**Short questions**

3 Annualizing rates. The number of workers on nonfarm payrolls in the U.S. fell from 138 million in Sept 30th, 2008, to 130 million in Dec 31st, 2009. What is the percent change? What is the annualized rate of change?

(Note: You may assume that each month is $1/12^{th}$ of a year.)

**Answer/comment**
15 months passed between Sept 30th, 2008 and Dec 31st, 2009, so the 'holding period' $h = 15/12$. We then use our formula for computing percent changes $X$ and annualized rates $AR$:

$$X = 100 \times \frac{130 - 138}{138} \approx -5.7\%$$
$$AR = 100 \times (1 + X)^{1/h} - 1 \approx -4.7\%$$

4 Contingent Convertible bonds. Trump Bank issues CoCos worth $10 million. Suppose that these bonds will convert into equity if the bank's ratio of equity to total assets falls below 5%.

  4.1 Trump Bank also issues otherwise identical bonds that are not convertible (they are 'plain vanilla' bonds). Will the CoCos or plain vanilla bonds sell for a higher price? Higher or lower and explain.

**Answer/comment**
CoCos should sell at a lower price. Because CoCos are riskier than plain vanilla bonds, investors will require additional compensation (a higher return, lower price).

  4.2 Here is Trump Bank's balance sheet, in $millions. Fill in the missing value:

Trump Bank

| A | | L | |
|---|---|---|---|
| Loans | 50 | Deposits | 30 |
| | | CoCos | 10 |
| | | **Net worth** | 10 |

  4.3 Suppose that the value of Trump Bank's loans fall to $42 million. What is Trump Bank's net worth after the fall, taking account of whether or not the CoCos convert? (Note: assume that when the CoCos convert, they simply cease to be a liability.)

**Answer/comment**
Net worth will first fall to $2 million. With assets down to $42 million, the ratio of net worth to assets will fall to $2/42 = 0.047$, and so the CoCos will convert into equity. When the $10 million liability disappears at the time of conversion, there is a net worth boost of $10 million, so net worth rises to $12 million.

5 Expectations theory of interest rates. Suppose the current 1-year spot rate is 1 percent, the 2-year spot rate is 3 percent, and the 3-year spot rate is 3 percent, or $i_{1,t} = 0.01, i_{2,t} = 0.03$, and $i_{3,t} = 0.03$.

Note: In this question, you may use the standard approximate formulation we have used.

5.1 Under the expectations theory of the term structure, what do market participants expect the 1-year rate to be 1 year from now? And 2 years from now?

**Answer/comment**
According to our approximation, the longer-term rate is the average of the expected future short rates:

$$i_{2,t} = (i_{1,t} + i^e_{1,t+1})/2$$
$$i_{3,t} = (i_{1,t} + i^e_{1,t+1} + i^e_{1,t+2})/3$$

If you stick in the relevant values, you can solve for $i^e_{1,t+1}$ and then $i^e_{1,t+2}$. You'll get the same answers as reported below for the full or nonapproximate method.

According to the expectations theory leaving aside the approximation, investing in a 2-year bond today should yield the same expected return as investing in 1-year bonds for the next 2 years:

$$(1 + i_{2,t})^2 = (1 + i_{1,t}) \times (1 + i^e_{1,t+1})$$

where $i^e_{1,t+1}$ stands for the expected 1-year rate 1 year from now. Solving for$i^e_{1,t+1}$ in the equation below gives us that $i^e_{1,t+1} \approx .05$.

$$(1 + .03)^2 = (1 + .01) \times (1 + i^e_{1,t+1})$$

Similarly, investing in a 3-year bond today should be equivalent to investing in a 1-year bond for the next 3 years:

$$(1 + i_{3,t})^3 = (1 + i_{1,t}) \times (1 + i^e_{1,t+1}) \times (1 + i^e_{1,t+2})$$

Using our finding that $i^e_{1,t+1} \approx .05$, we get that $i^e_{1,t+2} \approx .03$.

5.2 Suppose the Fed causes the 1-year spot rate to increase to 2 percent ($i_{1,t} = .02$), but expectations of future 1-year rates in years 2 and 3 remain as in the previous question. What is the new value for the 3-year spot rate $i_{3,t}$?

(Note: If you did not get the previous part, you may simply posit values for $i^e_{1,t+1}$ and $i^e_{1,t+2}$.)

**Answer/comment**

Note: you could get full points if you simply averaged the new $i_{1,t}$ with the $i^e_{1,t+1}$ and $i^e_{1,t+2}$ derived in the last problem. The 'full' (or non-approximate) method gives the following.

Using our values for $i^e_{1,t+1}$ and $i^e_{1,t+2}$, we can now solve for the 3-year spot rate:

$$(1 + i_{3,t})^3 = (1 + .02) \times (1 + .05) \times (1 + .03)$$

and find that $i_{3,t} \approx .033$.

6 Stress tests. The Fed's stress tests describe an adverse macroeconomic scenario. Banks then use a model of likely outcomes to project what would likely happen to the bank's net worth in that scenario. Suppose that the Fed considers a bank to be adequately capitalized if the bank's ratio of net worth to assets exceeds 5%.

6.1 Name two macroeconomic variables that the Fed uses to descibe the adverse scenarios.

**Answer/comment**
Scenarios included deteriorations in gross domestic product, unemployment rate, stock market prices, interest rates, and foreign GDP.

6.2 Here is a balance sheet for a bank. Fill in the three blanks with the proper values.

<div align="center">

Bank of DiCaprio ($Billions)

| A | | L | |
|---|---|---|---|
| Cash | 20 | Deposits | 90 |
| Loans | 80 | | |
| | | | |
| **Total Assets** 100 | | **Total Liab.** 90 | |
| | | **Net worth** 10 | |

</div>

6.3 In the Fed's adverse scenario, the Bank of DiCaprio projects that its loans will fall in value by $6 billion. Would the bank remain adequately capitalized? Yes/No.

**Answer/comment**
No. After the $6 billion drop, the ratio of net worth to assets will fall to $4/94 = .042 < .05$.

6.4 Suppose that as a result of a stress test, the Fed decides that a bank needs to have a stronger capital position. Name 2 actions that the Fed might require of the bank to improve its capital position.

**Answer/comment**
Companies that fail the test may be prohibited from buying back their own stock or issuing dividends. The companies could also choose to raise additional capital, by, e.g., selling additional shares.

7 General Banking.

    7.1 List 3 steps a commercial bank can take to restore liquidity if it faces unexpected deposit outflows. Rank the three steps from least to most costly to the bank.

    **Answer/comment**
From cheap to expensive:

- Borrow reserves from other banks in the fed funds market
- Borrow from the Fed at the discount window
- Issue additional deposits, say, by selling certificates of deposit
- Selling assets
- Calling in loans

    7.2 List three standard steps banks take to mitigate the asymmetric information problem between banks and business borrowers.

    **Answer/comment**
Banks can:

- Learning: Try to learn about credit-worthiness (screening) by looking at credit scores/ratings, financials, etc.
- Clever contracting: e.g., add covenants. This is combined with the next one.
- Monitoring: Monitor borrower behavior, for example.
- Demand collateral

    7.3 Explain why the too-big-too-fail problem might mean that very large banks would be able to sell debt or raise capital more cheaply than smaller banks.

    **Answer/comment**
Government backing lowers default risk. Large banks should then be able to issue bonds at a high price (low rate).

    7.4 The financial crisis greatly weakened banks in both the U.S. and Europe. Supposing that the weakness was roughly the same in the U.S. and Europe, why might that bank weakness have posed bigger problems for the general economy in Europe?

### Answer/comment

European firms rely more on bank lending than firms in the U.S., and so bank weakness could have hurt European firms more.

Also receiving credit: Governments support banks via liqudity provision, deposit insurance, potential bailouts, etc. European governments such as Greece are too indebted to offer credible protection to their own banking system. It's a perennial question whether European institutions such as the European Central Bank will step up and provide government support. In contrast, in the U.S, both the Fed and Congress acted in late 08/early 09 to stimulate the economy.

## 8 Duration.

For your reference: The duration formula for an asset that makes $n$ payments with payment $c_j$ coming $j$ years in the future, and assuming a constant interest rate $i$:

$$DUR = \frac{\sum_{j=1}^{n} j \times \frac{C_j}{(1+i)^j}}{PV}$$

where $PV$ is the present value of the flow of payments.

The approximate rate of capital gain (RCG) associated with a change in interest rates from $i_0$ to $i_1$ is:

$$RCG = -DUR \times \frac{i_1 - i_0}{1 + i_0}$$

For the question: Take a two-year bond with an annual coupon payment of \$3 and face value of \$100.

### 8.1 What is the present value of the bond at $i = 0.02$?

**Answer/comment**
Using our present value formula, we get

$$PV = \frac{3}{1.02} + \frac{103}{1.02^2} \approx 101.94$$

8.2 And the duration of the bond?

**Answer/comment**
Using the duration formula, we get:

$$DUR = \frac{1}{101.94} \times \left[\frac{1 \times 3}{1.02} + \frac{2 \times 103}{1.02^2}\right] \approx 1.97$$

8.3 And what would be the approximate rate of capital gain if the interest rate rose to $i = 0.025$?

**Answer/comment**
The rate of capital gain approximation gives:

$$RCG = -1.97 \times \frac{.005}{1.02} \approx -.010$$

Or about -1%.

**Congratulations. The End.**