No calculators. Total points on exam: 225**.** Good luck! Look over the entire exam before you begin. If I ask you to explain your answer, your grade for the question will depend on your *explanation*.

1) **5 pts.** Suppose you buy a two-year zero-coupon bond for $100. The "IOU" on the bond is $900. What is the yield on the bond?

_____ percent

2) **5 pts.** Suppose you buy a two-year zero-coupon bond for $100. The "IOU" on the bond is $400. After one year you sell the bond for $90. What rate of return did you receive?

_____ percent

3) **5 pts.** Suppose that current market yields to maturity for "zero-coupon" bonds are:
3 percent for bonds paying off May 2019 (one-year zero coupon bonds)
4 percent for bonds paying off May 2020 (two-year zero-coupon bonds)
7 percent for bonds paying off May 2021 (three-year zero-coupon bonds)
Consider a coupon bond that pays its face value in May 2021. The face value is $1000. Its coupon rate is 5 percent. The current price of the bond is $950. Write a formula that defines the *yield to maturity* on the coupon bond. Draw an arrow or arrows that point to the yield to maturity.

4) **10 pts.** Suppose the "expectations hypothesis" is correct: people care only about the expected value of the return on an investment. Suppose also that the Tesla corporation has issued bonds. Financial market participants believe there is a chance Tesla will default (totally default) on its bonds because its CEO, Elon Musk, is such a tool. What is the perceived probability that Tesla will default if:
- today's yield on one-year zero-coupon Treasury bonds is 50 percent
- today's market price of a one-year zero-coupon Tesla bond promising to pay $300 in one year is $100.

_____ (probability of default)

5) Below I list the three functions of money. Briefly define each.
a) **5 pts.** Store of value

b) **5 pts.** Unit of account.

c) **5 pts.** Medium of exchange.

6) **10 pts**. In recent years the market overnight rate has been a bit below the interest rate that the Fed pays banks on their excess reserve balances. Explain how this can be. Also, explain what the Fed has recently done to prevent the market overnight rate from falling *too* far below the interest rate paid on excess reserve balances.

7) Suppose the Fed follows a "Taylor rule" in setting the target overnight (fed funds) rate. The "NAIRU" or natural rate of unemployment is 5 percent. The target inflation rate is two percent. Draw what the yield curve will look like under each of the following sets of circumstances. With a dotted line, draw the "expectations hypothesis" yield curve. With a solid line, draw the "true" yield curve, that is what the yield curve will really look like. Assume the target overnight rate specified by the Taylor rule is always well above zero; there is no "zero bound" problem.

a) **5 pts.** Unemployment is 7 percent, inflation is 2 percent. People believe that in the long run, unemployment will be 5 percent and inflation will be 2 percent.

b) **5 pts.** Unemployment is 3 percent, inflation is 4 percent. People believe that in the long run, unemployment will be 5 percent and inflation will be 2 percent.

c) **5 pts.** Unemployment is 5 percent, inflation is 2 percent. People believe that after next year unemployment will rise to 7 and inflation will fall to one percent. In the longer run unemployment will fall back to 5 percent and inflation will rise back to 2 percent.

8) **20 pts.** Suppose the "expectations hypothesis" of the yield curve is correct. That is, there are no term premiums. Today, the Fed's target overnight rate is 0%. People are sure it will remain 0% through the end of this year. After that, they believe, there are two things that can happen. With a probability of 1/2, the Fed will keep the target overnight rate at 0% for many years. With a probability of 1/2, the Fed will raise the target overnight rate to 6% and keep it at 6% for many years. On the graph below, plot today's yield curve. Be precise. Exact numbers matter. Show your work.

9) **15 pts.** Assume the Fed follows an "inflation targeting" strategy. The FOMC's next meeting will be two months from today. The overnight rate is well above the "zero bound." The Fed's target inflation rate is 2 percent. Expected inflation is also two percent. The unemployment rate is equal to the NAIRU (natural rate).

a) Suppose that on MONDAY everyone
believes that, in the future, the IS curve may
shift back, or out, or remain stable
 - all possibilities equally likely.
Draw what the yield curve looks like on
MONDAY.Using a dotted line,
draw the "expectations hypothesis"
yield curve. Using a solid line, draw
what the yield curve really looks
like, given the existence of
term premiums.

b) On TUESDAY, as a surprise to everyone,
Donald Trump announces a plan to
greatly increase government spending on
infrastructure, without raising taxes to
pay for it. Everyone
believes Congress may go along with it.
Draw the CHANGE in the yield curve from
Monday to Tuesday. Using a line
labelled "Monday," reproduce Monday's
actual yield curve from a). Using a line
labelled "Tuesday," draw the yield curve
that will prevail after Tuesday's news comes
out.

c) Suppose that back on MONDAY you had owned bonds, and you knew what Trump was going to announce because you played golf with Trump at Mar-A-Lago. Would sell your bonds, buy more bonds, or neither? Explain.

10) **20 pts.** Suppose you receive all your income for the year on January 1st. Let Y stand for your real income. Every day in the following year you spend exactly 1/365th of your income on stuff. You cannot buy bonds. But you can keep funds in a bank, in a checking account and/or a savings account. The checking account pays i_C. The savings account pays a *higher* rate of interest i_S. (You get paid all this interest at the *end* of the year.) You cannot pay for things with the funds in your savings account. You CAN pay for things with the funds in your checking account (using a debit card). Every time you make a deposit into the bank or transfer funds between accounts, you must pay a fee F. Derive an equation that shows the *average real balance* you will keep in your checking account over the year. Use D/P to stand for your average real checking-account balance.

11) **35 pts.** Suppose that you and two friends each make a ton of money playing internet poker. You each take $100,000 of your individual winnings and combine the money for a total of $300,000. You get an additional $700,000 by borrowing money overnight. With the $1,000,000 total, you "acquire financial assets," that is buy bonds and/or make loans. (When you lend money to someone, you acquire that loan as an asset.)

a) What is the value of your financial intermediary's "capital"? $_____

Here is a list of the assets you and your friends can possibly acquire:
- Treasury bonds (long-term bonds issued by the US Treasury)
- Treasury bills (very short-term bonds issued by the US Treasury)
- Long-term loans (loans to businesses and people to be paid back years from now)
- Short- term loans (loans to businesses and people to be paid back in a few months)

b) Which of these assets would you acquire if you want to ensure you cannot possibly become insolvent as a result of interest-rate risk *or* suffer a liquidity crisis? List all the assets you might acquire in this case:

_____

c) Which of these assets would you acquire if you don't worry about interest-rate risk but want to make sure you cannot possibly suffer a liquity crisis? List all the assets you might acquire in this case:

_____

d) Which of these assets would you acquire if you want to earn the highest possible return on your assets, and you don't worry about interest-rate risk or liquidity crisis? List all the assets you might acquire in this case:

_____

e) On which of these assets might it be sensible to enter into "credit default swaps"?

_____

f) On which of these assets might it be sensible to enter into "interest-rate swaps"?

_____

Over the course of a year you continue to repeatedly borrow $700,000 overnight, day after day, paying out the interest on these loans. Meanwhile you receive payments on any loans you made and any bonds or bills you bought. You use all your net earnings to acquire more assets. At the end of the year the market value of your assets is $1,400,000. Then you and your friends sell $300,000 worth of the assets. You divide up the $300,000 among the three of you and spend it all on vacations, video games and vodka.

g) What is the value of your financial intermediary's "capital" now, that is at the end of the year *after* you and your friends have taken your $100,000 each?

$_____

12) Suppose you have data on inflation π, unemployment u and the natural rate of unemployment or "NAIRU" $\bar{u}$ from two countries, Attica and Boetia. With each country's data, you make two scatterplots. Here are the scatterplots:

ATTICA

BOETIA

i) **10 pts**. In Attica, are expectations "anchored" or "adaptive"? In Boetia, are expectations "anchored" or "adaptive"?
Attica: _____   Boetia: _____

ii) **10 pts.** Suppose there is an increase in world oil prices that tends to raise the price level in both countries. In one of the countries, the central bank is more likely to respond to this event by raising interest rates to cause a recession. Which country? Why?

13) Consider an economy with no banks and no central bank. Inflation behaves according to an "expectations augmented Phillips curve." Expectations are anchored: the expected value of future inflation is always zero (though people know inflation may actually turn out to be higher or lower). The natural rate of interest $\bar{r}$ is 3 percent.

a) **5 pts.** Suppose that, in year 1, the
money supply is such that output
is equal to potential output
(also known as the natural rate
of output). Draw what this situation
looks like in the graph to the
right (note the numbers!). Label
the money supply M_1 and the

interest rate i_1 .

b) **5 pts.** In year 2, there is an unexpected
decrease in the money supply.
Show what happens
in year 2. Label the year-2 money
supply M_2 and the interest rate

i_2 .

c) **10 pts.** In the long run, this economy is going to return to an equilibrium with output equal to potential output and the interest rate equal to the value it was in year 1. Explain how this will happen. Use a graph or graphs if you want.

14) Suppose you are planning a party. Let N denote the number of people who will come to the party. You are not sure what N will be - you are not sure how many people will come to the party - but you have a probability distribution for N. This distribution is *uniform*. The largest possible value of N (the most people who will possibly come) is 200. The smallest possible value of N (fewest people who will possibly come) is zero.

a) **2 pts.** Let Z denote a number between zero and 200. What is the probability that the number of people who come to the party N is less than or equal to Z?

b) **2 pts.** What is the probability that N turns out to be *more* than Z?

c) **3 pts.** *Assuming* more than Z people come to the party, what is the expected value of N (that is, on the condition that $N > Z$)? (Just take this to be the same as the expected value of N assuming Z or more people come to the party.)

d) **3 pts.** Each guest will want to drink exactly one case of beer. (You yourself will drink no beer.) You can buy beer the day before the party at a store where beer is cheap. You don't want to buy too much beer because your mother is coming to visit the morning after the party and you don't want her to know you keep beer in your apartment. Let B denote the number of cases you buy the day before the party. Assuming B is between zero and 200, what is the probability you will run out of beer at the party?

e) **5 pts.** If you run out of beer at the party, you will have to run to an expensive beer store next to your apartment building and buy the cases you lack. Given B (between zero and 200), what is the expected value of the number of cases you will have to buy from the expensive beer store *assuming* you run out of beer at the party (that is, *on the condition* that you run out of beer)?

f) **5 pts.** Suppose that the price of a case of beer at the cheap beer store is P. The price of a case at the expensive store next to your aparment building is $\hat{P}$. ($\hat{P}$ is greater than P.) Write a mathematical expression that gives the expected value of the total cost of beer that you buy, that is the total cost of beer from the cheap store plus the beer you have to buy from the expensive store, given B. (B still denotes the number of cases you buy at the cheap store, between zero and 200).

g) **10 pts**. When you are at the cheap beer store, you will buy the amount of beer that minimizes the expected value of the total cost of beer as you defined it in part f). Using your answer to f), figure out the number of cases you will buy at the cheap beer store (that is the optimal value of B).