SUNY-Binghamton **Name** _____

Fall 2025 Economics 450

No calculators. Total points on exam: 200**.** 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) Consider a zero-coupon bond that you buy today, in December 2025, for a price P_t. The bond will pay \$1000 thirty years from today, in December 2055 (maturity n=30). Ten years from today, in December 2035, you sell the bond for a price P_{t+10}. Taking P_t and P_{t+10} as given:

a) 5 pts Write down a formula (do not solve it) that defines the bond's yield in December 2025.

b) 5 pts Write down a formula (do not solve it) that defines the bond's yield in December 2035.

c) 5 pts Write down a formula (do not solve it) that defines the rate of return you receive from buying the bond in 2025 and selling it in 2035.

2) Consider a two-year coupon bond that you can buy today in December 2025. The bond will make coupon payments in December 2026 and December 2027, and also pay off its face value (par value) in December 2027. The face value is \$36. The coupon rate, expressed as a fraction, is 1/3 (as a percent that's 33.3333333....) You look on a website and see that current yields to maturity on "zero coupon" bonds are:

200% for bonds paying off in December 2026

100% for bonds paying off in December 2027

a) 5 pts Calculate the highest price anyone should be willing to pay for this bond. I am looking for an actual dollar value. You can do it!

b) 5 pts. Using the price you calculated in a) and as many actual numbers as possible, write down (do not solve) a formula that defines the bond's yield to maturity. Point out which symbol stands for yield to maturity.

3) 9 pts. In 1910, before the founding of the Federal Reserve system, there was a bank called the Binghamton National Bank. The only liabilities of this bank were $200 million in deposits (checking accounts and savings accounts). Its assets were $150 million in loans to local businesses, $50 million in Treasury bonds, and $20 million in cash in its vaults.

a) What was the bank's capital? _____

b) How much did the bank have in reserves? _____

c) How much did the bank have in secondary reserves? _____

4) 15 pts. Suppose that the owners of a financial intermediary (FI) want to maximize the rate of return on the FI's capital, which is the FI's annual profit divided by the amount of capital they invested in the FI. As in the notes, let C denote the amount of capital the owners invest in the FI, B denote the amount the FI borrows, i^B denote the interest rate the FI pays on its borrowing, and i^A denote the interest rate on the FI's assets. Let R denote the rate of return on the FI's capital. Then, as in the notes,

$$R = \frac{i^A(C+B) - i^B B}{C} = i^A + (i^A - i^B)\frac{B}{C}$$

Now further suppose that the interest rate the FI must pay on its borrowing i^B depends on the ratio of its borrowing to its capital *(B/C)*, because potential lenders to the FI know the FI is more likely to default on its borrowing if its capital is smaller relative to its borrowing. Specifically, $i^B = \frac{1}{3}\left(\frac{B}{C}\right)^2$

Suppose that the FI's owners can *choose* the ratio of borrowing to capital *(B/C)* to maximize R. What is the value of *(B/C)* that maximizes R? Hint: treat *(B/C)* as one variable. That is the variable controlled by the FI's owners. Use the calculus trick to find the optimal value of *(B/C)*.

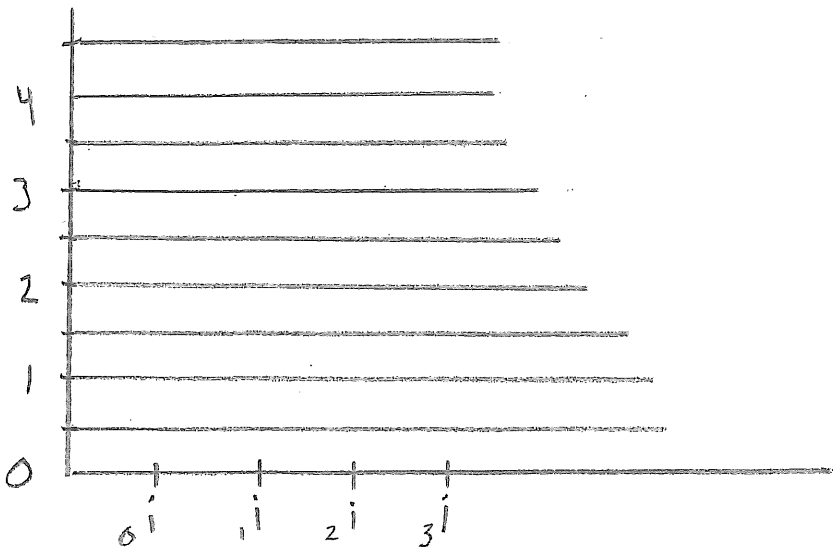
5) 12 pts. Suppose the "expectations hypothesis" of the yield curve is correct (there are no term premiums). Today, the Fed's target overnight rate is 1%. People are sure it will remain 1% for a year. *After that*, they believe, there are two things that can happen. With a probability of 1/2, the Fed will keep the target rate at 1% for several more years. With a probability of 1/2, the Fed will raise the target to 3 percent, hold it at 3% for a year, then cut the target to 2% and hold it at 2% for several years. In the space below, figure out what yields will be for one-year, two-year and three-year zero-coupon Treasury bonds. At the bottom, plot the yield curve. **Show your work. If I cannot see how you got an answer, you will not get credit for it.**

a) What is ${}_1i$? _____ percent

b) What is ${}_2i$? _____ percent

b) What is ${}_3i$? _____ percent

c) Yield curve



6) 20 pts. Suppose that Fed policymakers follow a strict inflation targeting strategy, attempting to hit a target of 2 percent ($\pi^T = 2$) all the time. Assume also that:
- the interest rate that matters for spending and output is the overnight interest rate that the FOMC controls.
- There are no supply shocks.
- Fed policymakers *correctly* estimate the natural rate of unemployment u^*, the natural rate of output Y^* and the slope of the IS curve. Based on this information and their guess at the position of the upcoming IS curve, the Fed policymakers estimate the natural rate of interest r^* to be **3 percent**.

For each situation below, consider what the FOMC will choose to do and what the outcome will be for the economy.

a) The public's expected value for future inflation is 2 percent. Government purchases, taxes net of transfers and other determinants of spending all turn out to be as the central bank expected at the time it met.

Is the interest rate target chosen by the FOMC, i^T, greater than, less than or equal to 6 percent? _____

Is the unemployment rate likely to turn out to be greater than, less than or equal to u^*? _____

Is the inflation rate likely to turn out to be greater than, less than or equal to 2 percent? _____

b) The public's expected value for future inflation is 3 percent. Government purchases, taxes net of transfers and other determinants of spending all turn out to be as the central bank expected at the time it met.

Is the interest rate target chosen by the FOMC, i^T, greater than, less than or equal to 6 percent? _____

Is the unemployment rate likely to turn out to be greater than, less than or equal to u^*? _____

Is the inflation rate likely to turn out to be greater than, less than or equal to 2 percent? _____

c) The public's expected value for future inflation is 2 percent. Government purchases turn out to be *less* than the central bank expected at the time it met.

Is the interest rate target chosen by the FOMC, i^T, greater than, less than or equal to 6 percent? _____

Is the unemployment rate likely to turn out to be greater than, less than or equal to u^*? _____

Is the inflation rate likely to turn out to be greater than, less than or equal to 2 percent? _____

d) The public's expected value for future inflation is 3 percent. Stock prices turn out to be lower than the FOMC expected at the time it met, due to an unexpected stock market crash.

Is the interest rate target chosen by the FOMC, i^T, greater than, less than or equal to 6 percent? _____

Is the unemployment rate likely to turn out to be greater than, less than or equal to u^*? _____

Is the inflation rate likely to turn out to be greater than, less than or equal to 2 percent? _____

7) Consider an economy in which a person faces a situation similar to the standard Baumol-Tobin model. As in that model, a person receives income Y at the beginning of the year and he spends an equal amount of his income every day to buy stuff. He can hold bonds, which pay interest at an annual rate i (but don't pay it until the end of the year). Every time he sells bonds or otherwise engages in a financial transaction, he must pay a cost F, so that the total cost of N financial transactions is FN. As in the notes, assume for simplicity that the price level P is equal to one.

Unlike the Baumol-Tobin model, a person cannot hold currency (money). To buy things, he must pay with funds in his *checking account*. Let D denote the average balance in his checking account over the course of the year.

$D = \frac{Y}{2N}$ is the average balance in his checking account if he engages in N financial transactions.

His bank does not pay interest on the checking account. Instead, it *charges* interest at an annual rate equal to i^D.

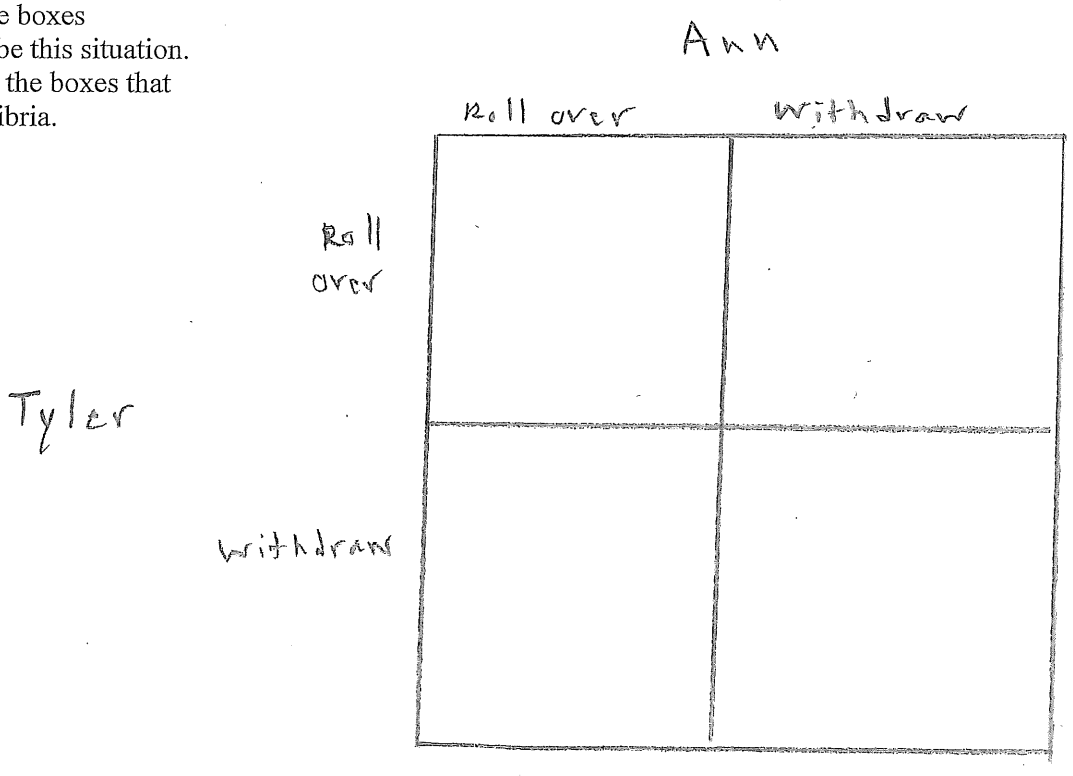
a) 10 pts Derive the average checking account balance that a person will choose to hold.

b) 5 pts. Suppose the bank always sets the interest rate charged on checking accounts equal to the market rate i minus one percent ($i^D = i - 1$). Using your answer to a), what is D in this case?

8) 10 pts. What does the phrase "double coincidence of wants" mean?

9) 10 pts. Theodora borrowed $100 from Tyler, and another $100 from Ann. Theodora promised to pay each lender (Tyler and Ann) an interest rate i. With the $200, Theodora bought an illiquid bond.
- If Tyler and Ann roll over (do not withdraw) their loans to Theodora, Theodora will pay both of them back with the promised interest (with the money she gets from the bond's coupon payments).
- If both Tyler and Ann withdraw their loans to Theodora, Theodora will sell the bond as quickly as possible for a low price, just $120, and divide the $120 evenly between Tyler and Ann (each will get $60).
- If one lender withdraws and the other rolls over, the bond will be sold as quickly as possible for the price of $120, and the $120 will be divided evenly between Tyler and Ann, but there will *also* be a difficult case in bankruptcy court. The case will cost *both* lenders - Tyler and Ann - $5 in lawyers' fees ($5 each).

Fill in the boxes
to describe this situation.
CIRCLE the boxes that
are equilibria.



10) 10 pts. How are "liquidity requirements" different from "capital requirements"?

11) 10 pts. What are the two types of "unconventional" monetary policy described in the article by John Williams, "The Federal Reserve's Unconventional Policies"? Name them and briefly explain them.

12) Suppose the Fed does *not* pay interest on reserves. There is no reserve requirement. The Fed charges an interest rate for emergency loans r_p to cover overdrafts. All banks in the country are identical. Each bank has *$100* to divide between its reserve account and overnight lending. At 5 pm each bank will choose how much to leave in its reserve account. Between 5 and 6 pm. the Fed will clear payments between banks, adding a net sum P to each bank's reserve account. P can be a positive or negative number. That leaves $R+P$ in the bank's reserve account at 6 pm. A bank will have overdrawn its reserve account if the balance after clearing, at 6 pm, falls below zero. A bank that overdraws its reserve account must take an emergency loan from the Fed to cover the overdraft, to bring its reserve account up to a zero balance. From a bank's point of view, P is a random variable, uniformly distributed between a minimum value (the smallest possible net payment into the bank's reserve account) of *-2*, and a maximum value (the largest possible payment into the bank's reserve account) of *+2*. The market overnight rate is denoted r.

a) 5 pts. Using the information given above, write an expression that gives the probability that a bank will run an overdraft in its reserve account, for any given value of R, assuming r is greater than zero but less than r_p.

b) 5 pts. *Assuming* a bank runs an overdraft in its reserve account, what is the expected value of the amount that the bank will have to borrow from the Fed, for any given value of R?

c) 5 pts. Using your answers to a) and b), write an expression that gives the expected value of the bank's profit. Rearrange it to get an expression that will be easy to differentiate with respect to R.

d) 5 pts. Using your answer to c), use calculus and algebra to find the reserve balance R^D that maximizes the expected value of profit.

e) 5 pts. Suppose $r_p = 2$ and the target overnight rate is *1/2*. What is the reserve supply per bank that will cause the market overnight rate to hit this target?

f) 5 pts. Suppose reserve supply per bank is *1* and the target overnight rate is *2*. What is the value of r_p that will cause the market overnight rate to hit the target?

13) 15 pts. Recall that the U.S. Treasury has an account in the Federal Reserve system. The Treasury makes and receives payments using this account. Recall also that, because the funds in this account are not part of "reserve supply," payments from people and businesses to the U.S Treasury tend to reduce reserve supply, while payments from the U.S. Treasury to people and businesses tend to increase reserve supply.

Now, some new information. Prior to 2007, unpredictable payments into and out of the Treasury's Federal Reserve account were correlated with changes in the market overnight rate. On a day when there were lots of payments *into* the Treasury's Fed account, which could not have been predicted at the beginning of the day, the market overnight rate went up. On a day when there were lots of payments *out of* the Treasury's Fed account, which could not have been predicted at the beginning of the day, the market overnight rate went down. Nowadays, that is not true. There are lots of unpredictable payments into and out of the Treasury's Fed account, but they no longer cause fluctuations in the market overnight rate. Explain why, using appropriate graphs.

14) 10 pts. In the United States, in the 1970s and 1980s, increases in oil prices were likely to be accompanied or followed by recessions. Since the late 1990s, increases in oil prices have *not* been accompanied or followed by recessions. Explain why, using appropriate equations.