ECON 121 FINAL EXAM - FALL 2025

Male and female business owners may face different access to finance, leading to disparate firm outcomes. In this exam, you will study (i) asset inequality between male- and female-owned firms, (ii) the effects of financial outreach on firm outcomes, and (iii) differences in these effects between male- and female-owned firms. The setting is 78 towns in China, where a large bank started offering a new type of loan that did not require firms to have collateral. Firms in the same town were typically close to each other and competing in the same industry. Firms in different towns were typically far from each other and operating in different industries.

All firms could apply for the new loan product, but the bank randomly chose a subset of firms to be visited by a loan officer, who promoted the new loan product and helped interested firms apply. Firms in the same town all faced the same probability of being visited by a loan officer, but firms in different towns faced different probabilities. We will refer to the visit by a loan officer as "loan outreach," and we will refer the taking out a loan as "loan takeup."

The R Markdown template loads data from a survey of firms in the 78 towns, with two observations per firm. Round 1 of the survey took place just before the loan outreach intervention, and round 2 took place two years after the intervention. The dataset includes firm and town identifiers (`firmid` and `townid`), the survey round (`round`), characteristics of the owner (`owner_male-owner_college`), variables related to firm inputs and finances (`labor-assets`), and variables related to loan outreach and loan takeup (`officer-loan_amount`).[1]

You may refer to books, internet resources (including AI), notes, and code from problem sets, solutions, and classroom examples. You may **not** communicate with any person but Prof. Vogl or Regina during the exam; evidence of such communication will result in failure. If you are taking the exam remotely, record yourself with Zoom and submit the recording by email; if you have questions during the exam, you may e-mail your question to Prof. Vogl. Write code and answers in the R Markdown template. When you finish, produce a PDF and submit the PDF on Gradescope. See the instructions.

Questions that require coding have a **C** next to them; you should explain your coding choices in comments, but no interpretation of the results is necessary. Questions that require words have a **W** next to them; here is where you will interpret and assess your results. Every question is worth the same number of points.

1. Investigate inequalities in assets between male- and female-owned firms over the life cycle. Draw a graph with assets on the vertical axis, owner age on the horizontal axis, and separate lines representing age-specific means for male- and female-owned firms. To reduce noise in the graph, you may want to use age groups instead of single years of age, and you may want to omit very young and old ages with few firm owners. **C**

[1] Monetary amounts are denominated in units of 10,000 Yuan, or approximately 1600 USD. On the exam, you may refer to 10,000 Yuan as a "unit" or a "wan" (which is the Mandarin word for 10,000).

2. Estimate a regression of assets on owner gender and owner age before any loan outreach occurred. Choose your standard error calculation carefully, and make the same choice for the rest of the exam. **C**
3. Using your estimates from Question 2, test whether the asset gap between male and female owners is different from the asset gap between 50- and 25-year-old owners. **C**
4. Interpret your results from Questions 1-3. Are assets higher for male or female owners? For younger or older owners? Are the gaps larger for gender or age? (4-5 sentences) **W**
5. Estimate the effect of loan outreach on loan takeup. Your analysis choices should reflect the experimental design. **C**
6. Interpret your result from Question 5. What is the effect of loan outreach on loan takeup? Is the estimated effect statistically significant? For your statement about statistical significance to be valid, is it necessary for the error term to be normally distributed? (3-5 sentences) **W**
7. Which firm characteristics are associated with loan takeup after a firm is visited by a loan officer? Estimate a single regression, and then use your estimates to calculate answers in terms of both the probability of takeup and the odds of takeup. **C**
8. Based on your results from Question 7, what is the difference in the *probability* of takeup between male- and female-headed firms? What is the ratio of the *odds* of takeup between male- and female-headed firms? For each of these quantities (difference in probability, ratio of odds), can you reject the null hypothesis that gender is not associated with takeup? (3-5 sentences) **W**
9. Estimate the effect of loan outreach on assets. **C**
10. Interpret your result from Question 9. What is the effect of loan outreach on assets? Is the estimated effect statistically significant? How large is the estimated effect relative to the male-female asset gap you estimated in Question 2? Using the point estimates and standard errors from Questions 2 and 9, can you test whether the effect is the same as the male-female gap? Explain. (4-7 sentences) **W**
11. Using the same regression specification as in Question 9, estimate whether assets differed between visited and unvisted firms before any loan outreach occurred. **C**
12. Interpret your result from Question 11. Did baseline assets differ significantly? What is this type of test usually called? What does it suggest about the integrity of the experimental design? (3-4 sentences) **W**
13. Does the effect of loan outreach on assets differ between male- and female-owned firms? Using a single regression, estimate a point estimate and standard error for this difference in effects. **C**
14. Interpret your result from Question 13. What is the difference in effects between male- and female-owned firms? Is it statistically significant? Did loan outreach increase or decrease asset inequality between male- and female-owned firms? Is there a way to answer question 13 using two regressions instead of one? Explain. (4-7 sentences) **W**

15. Applying simple arithmetic to your earlier results, compute an instrumental variables estimate of the effect of loan takeup on assets. **C**
16. Estimate the quantity from Question 15 using two-stage least squares. **C**
17. Would you characterize the estimated effect from Question 16 as a LATE or TOT? Why? What assumptions do you need for this interpretation? If these assumptions are met, whose average treatment effect is represented? (5-7 sentences) **W**
18. Which additional variables in the dataset could you include as covariates in the regressions you estimated in Questions 5, 9, and 16? Are these covariates necessary for identifying causal effects? If not, what purpose would they serve? (4-6 sentences) **W**
19. Estimate the effect of loan takeup on assets under a parallel trends assumption instead of under the intrumental variables assumptions. In other words, assume that borrowers and non-borrowers would have been on parallel trends in the absence of the loan. **C**
20. Suppose the bank wants to know if the new loan product generates enough profit to pay for itself. Can you estimate the effect of the *size* of the loan on profits? In other words, can you estimate how much profit is generated by lending one extra wan? If yes, estimate this effect in the code block. If not, erase the code block and explain why not in 2-4 sentences. **C or W**