Instructions

This examination has five questions and you are to do all five in a bluebook that you provide. Please number your answers clearly. Each question will be worth 20 points, so allocate your time accordingly. The exam is “closed book – closed notes.” You may use a calculator, although you shouldn’t need one.

You will have until 12:30 to complete the exam. Latecomers will not be given extra time to finish the exam.

The proctor will not answer questions. If you are unsure of a question, indicate what assumptions you are making and go forward.

The proctor will be asked to note any perceived cases of unusual behavior among those taking the exam. I will address such cases if they are reported, but I truly hope that there are none.
1. The figure above indicates the technology for providing school education in traditional public schools, related to the number of schools, and the average cost of providing that education.

   a. Draw a curve indicating the “average total cost” of providing school education.
   b. What features of schools lead the average production cost of education to have the shape that it does? How would “home schooling” change that shape?
   c. Why does the average transportation cost per student have the shape that it does?
   d. Indicate how we would determine the optimal number of schools. Indicate why this is the correct answer.
2. Suppose that there are three types of commerce in a region. Bakeries reach scale economies with a market size of 5,000 people. Gas stations reach scale economies with a market size of 10,000 people. Department stores reach scale economies with a market size of 100,000 people. Suppose your region has 100,000 people.

a. Suppose that the large city in the region has 40,000 people. Suppose that there are two medium sized cities, each with 10,000 people. How many small cities will there be? Why?

b. How many bakeries will there be in each medium sized city? Why?

c. Will people from the small cities every shop in the large cities? Will people in the large cities every shop in the small ones? Why?

3. Suppose that we wish to locate a sausage manufacturing plant. We must gather meat at location $M$, which we will transform into sausage to be sold at city $S$, 15 miles away. It takes 6 tons of meat, which costs $0.75 per ton-mile to transport, to produce 4 tons of sausage, which costs $1.00 per ton-mile to transport.

a. What are the monetary weights of the meat and the sausage?

b. What is our criterion for locating the plant.

c. Where will we locate it, and why?

4. Cities have traditionally begun as gathering places for both the goods that are produced and the people that produce them. This leads to the building of a substantial urban infrastructure. Then, as cities grow, they spread out.

a. Describe how the centralization that served as a foundation for the early cities, works against them, as the metropolitan areas grow.

b. What are the benefits that accompany the decentralization of cities? What are the costs?

c. How would you evaluate proposals to widen the Chrysler Expressway (I-75) in southern Oakland County based on your answers to parts a. and b.?

5. Consider a farmer with total revenue of $500 per acre. The nonland cost of producing the goods is $100 per acre. It costs $40 per mile to ship one acre’s worth of goods to market. Assume perfect competition for land.

a. What will the land rent be right next door to the market? Why?

b. What will the land rent be 4 miles away from the market? Why?

c. How far will the “market area” serving this market extend? Why?

d. Suppose that total revenue falls to $400 per acre at the same time that transportation costs fall to $30 per mile to ship one acre’s worth of goods to market. What will happen to the market area? Why?