

12. Suppose that Gloucester Old Bank's customers can complete their transactions at a teller's window (involving labor) or at an ATM (involving capital). The production function for the bank's services is given as follows:  $Q = 4K + 6L$ , where  $Q$  is the number of customers served,  $K$  is the number of ATMs the bank has installed in town, and  $L$  is the number of tellers the bank has hired.
- Suppose that Gloucester currently has 20 ATMs and 20 tellers. If 3 ATMs suddenly fail, how many additional tellers must the bank hire to maintain their original level of service?
  - Does your answer to (a) change if Gloucester originally only uses 17 ATMs? 30 ATMs?
  - What do production isoquants look like for Gloucester Old Bank? (*Hint*: Graph different combinations of tellers and ATMs that can serve an arbitrary number of customers, such as 200.)
  - How would you verbally describe the relationship between tellers and ATMs?
  - Suppose that installing and maintaining an ATM costs \$20, and hiring a teller costs \$32. What will happen to Gloucester's total number of customers served if it lays off 2 workers and installs 3 ATMs? What will happen to the bank's costs?
  - Using the idea developed in (e), if Gloucester Old Bank is interested in minimizing its costs, what strategy should it employ regarding its input mix?
  - Use calculus to derive the marginal products of  $K$  and of  $L$  and the marginal rate of technical substitution of  $L$  for  $K$ ?
  - Discuss how  $MRTS_{LK}$  changes as the firm uses more  $L$ , holding output constant.
  - Is the Lagrangian approach an appropriate way to solve for an optimum given this production function? Why or why not?