Cost

HSPM J712

Cost concepts

- Opportunity cost
- Total cost
- Fixed cost
- Variable cost
- Average cost
- Marginal cost

The economic problem

- The basic economic problem is the scarcity of social resources to satisfy human wants and needs.
- An economic system must make choices about the allocation of resources among the many possible uses.
- The economic system also chooses how the goods and services are distributed -- who gets what.

Cost and the necessity of choice, even in health care

When a high percentage of all spending in our economy is for health care, we wonder if some of the resources going into health care could be better used elsewhere, as

- other kinds of health care, that might give more benefit for the same resources
- other kinds of health-enhancing investments besides health care, such as education
- consumption goods and services that might enhance our lives more than spending on certain kinds of health care would,
- or as investments outside of health care that might improve our future ability to produce goods and services more than some investments in health do.

Opportunity cost

- Opportunity cost is the most fundamental cost concept.
  - The opportunity cost of doing or getting something is:
- what you could have done or gotten instead

Opportunity cost is what you forgo.

- Example: The opportunity cost of buying a box of Cracklin Oat Bran is one-and-a half boxes of Wheat Chex, if that's your second favorite cereal.

Opportunity cost is what you forgo.

- Example: Your opportunity cost for taking this class includes:
- Whatever else you could have bought with your tuition and fee money
  - plus
- the work, family participation, and recreation that you are not doing because you are here.

Opportunity cost is not resources used

- Strictly speaking, the cost of something is not the resources used up to get it.
- Instead, the cost is what else you could have done with those resources.
- Resources have value only because you can use them to make goods and services that have value.

Using prices for costs

- Opportunity cost can be hard to use in practice.
- Dollar costs (prices) are
- easier to determine
  - and
- easier to add up.

Nevertheless, we should not lose sight of opportunity cost.

For example:

- saving medical institutional costs by discharging patients early
- adds opportunity costs for family members drafted into being home caregivers
  - (one of the ways that the percentage of national health expenditure in the GDP understates the cost of our health care system)

Opportunity cost = price?

Prices can reflect society's opportunity cost

- "Reflect" here means that the ratio of prices of any two goods or services is the opportunity cost of the one in terms of the other.
- **If** the market system works properly then the price ratio of any two goods or services tells you what the social tradeoff actually is, how many of good X you give up to get each unit of good Y.
- For this to work properly, you have to have strong competition and savvy consumers. Competition will then force the sellers to be efficient, and provide goods and services at prices in line with costs.

If price ≠ opportunity cost then we're inefficient

- Suppose a recently-introduced drug is priced well above the what the manufacturer is paying for the resources that go into making it (manufacturing cost).
- If the high price discourages some people from using the drug, then society is missing out. Resources that could be used to make more of the drug are instead being used to make something less valuable.

Inefficiency

- How do I know that the resources that could be used to make more of the drug are instead being used to make something less valuable?
- Because the price of a resource depends on what it can be used for.
- If there are some resources that are not being used in the most valuable way, that is the definition of inefficiency.

Hospital day price example

- Reinhardt, in this week's assigned article, argues that
- Prices for hospital days late in a patient's stay are higher than opportunity cost.
- This leads to substituting other forms of care that have higher opportunity cost.

Price and Cost are different concepts

- Price – what you pay
- Cost – what you give up by using up resources

Emergency room care – Pricey? Costly?

- Trauma care is pricey and costly
- Primary care in the E.R.
  - Pricey
  - Not costly

Emergency room care – Pricey? Costly?

- Primary care in the E.R.
  - Pricey, because of Ramsay Principle.
    - Demand is inelastic. Hospitals can raise the price without driving customers away.
  - Not costly, because
    - The E.R. has to have people on duty at all times, ready to care for serious trauma and life-threatening illness at a moment's notice.
    - When they're not busy doing that, they take care of non-urgent patients in the waiting room.

Spending and cost

- Diverting people from the E.R. to doctors' offices would raise cost but reduce spending.
  - Spending is price X quantity

Money cost concepts

- In this section, we assume that we can use dollar costs for costs. Ignore, for now, what we just talked about.
  - The cost-accounting concepts we'll discuss:
- Total cost
- Fixed cost
- Variable cost
- Marginal cost
- Average cost

Total cost

- ... is a function of quantity
  - "function" in the mathematical sense
- Total cost = TC(Q)
- TC(Q) = the total cost per unit of time of producing Q units of output per unit of time

Costs are flows, not stocks

- The Q in the TC(Q) formula stands for Quantity per Unit of Time.
- Total cost, fixed cost, variable cost, marginal cost, average cost …
- All have a time dimension. They are denominated in units of currency per unit of time.
- For example, a U.S. firm presenting annual budget numbers would use "dollars per year" as its cost units. For a monthly budget, the cost units would be dollars per month.
- For brevity, I'll leave "per unit of time" out sometimes, but it's always implicitly there.

Total cost example

- Here was the total cost per month of providing different numbers of screening mammograms per day.
- This *whole table* is the total cost

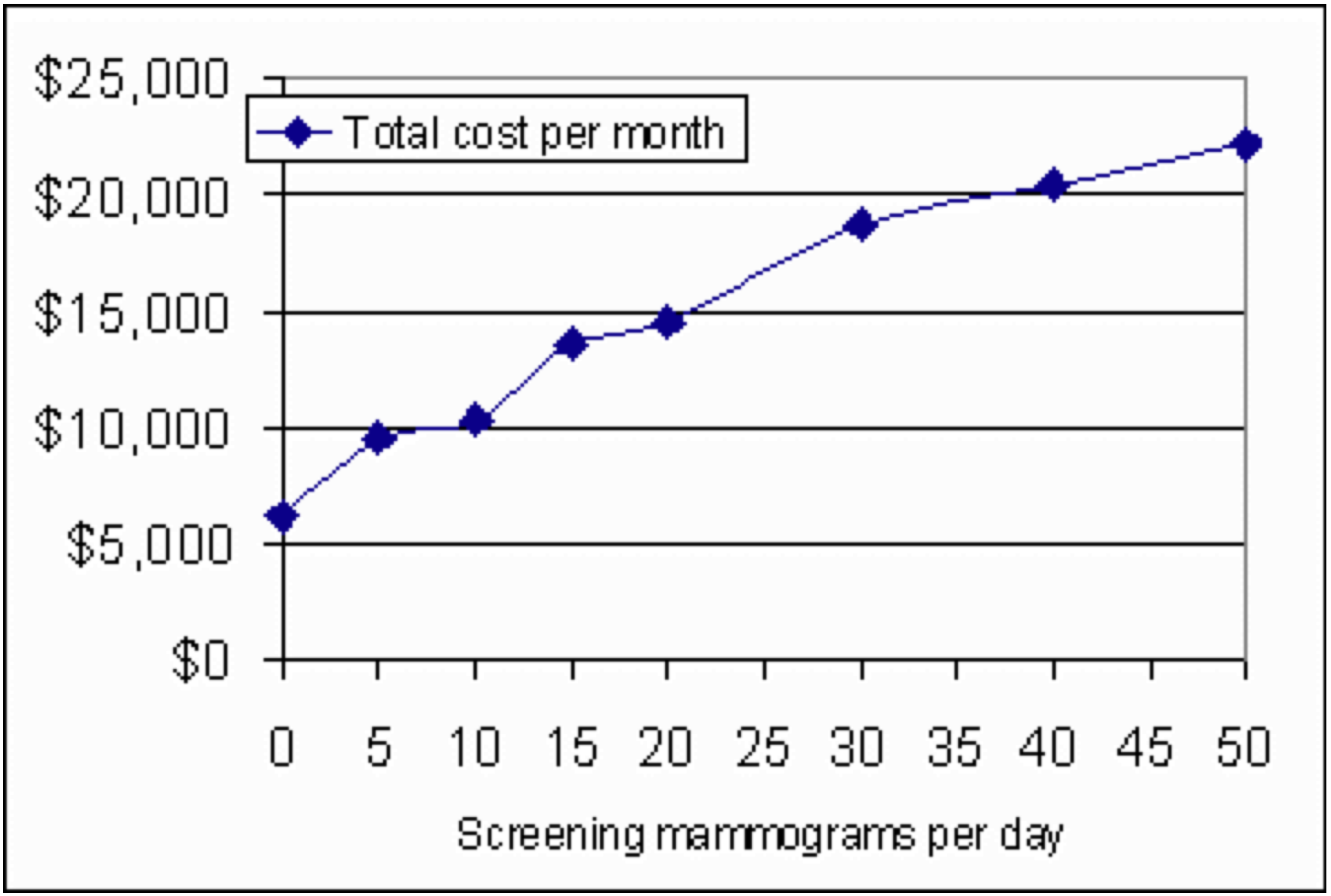
Output rate Mammograms/ day	0	5	10	15	20	30	40	50
Total cost per month	$6,172	$9,462	$10,337	$13,627	$14,502	$18,667	$20,417	$22,167

- Source: Physician Payment Review Commission, The Costs of Providing Screening Mammography, 1989. This study was done just after Medicare started paying for screening mammograms.

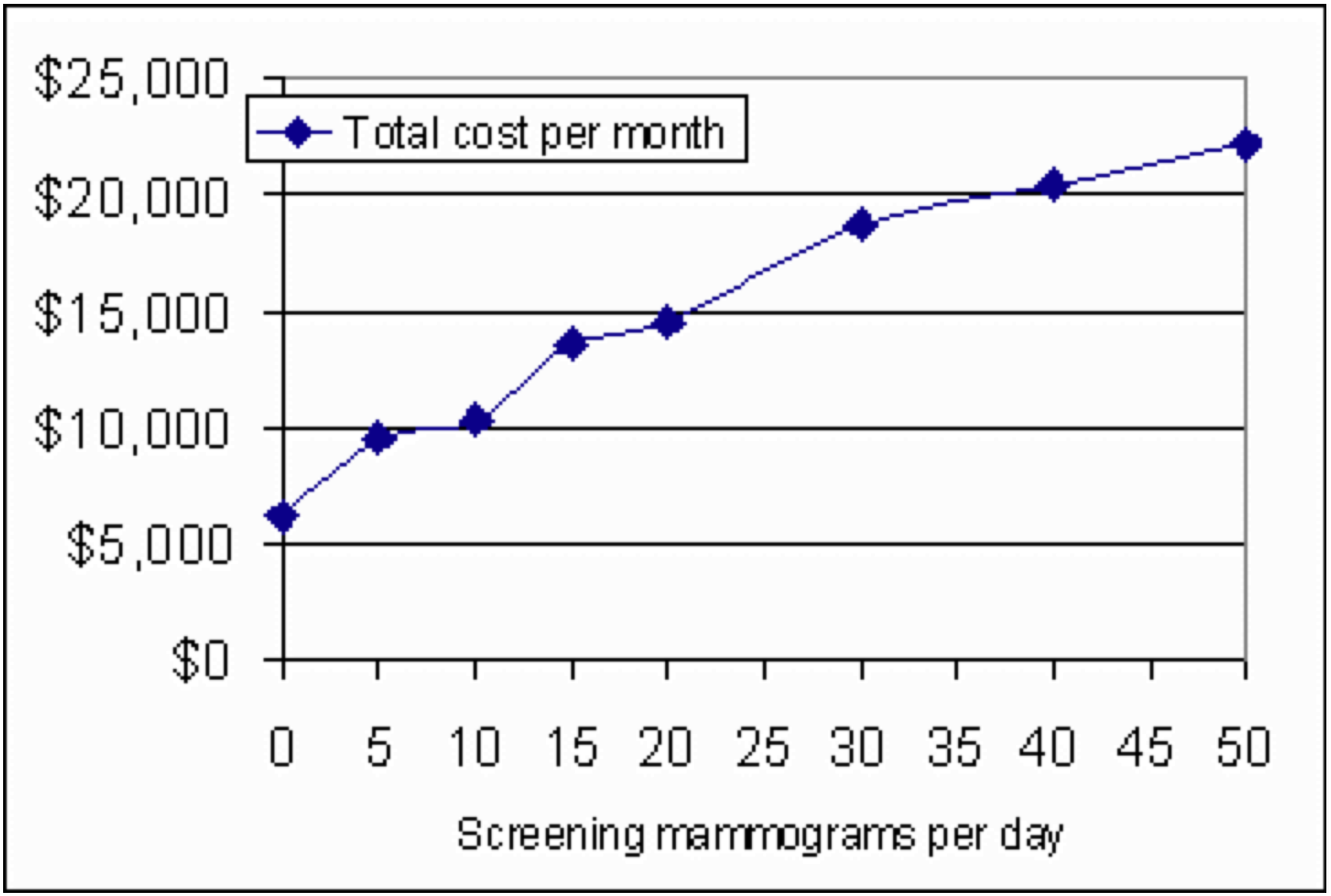
Screening mammography costs, 1989

Output rate Mammograms/day	Total cost per month
0	$6,172
5	$9,462
10	$10,337
15	$13,627
20	$14,502
30	$18,667
40	$20,417
50	$22,167

Total cost is an increasing function of quantity.
The faster you produce, the more your total cost at that rate.



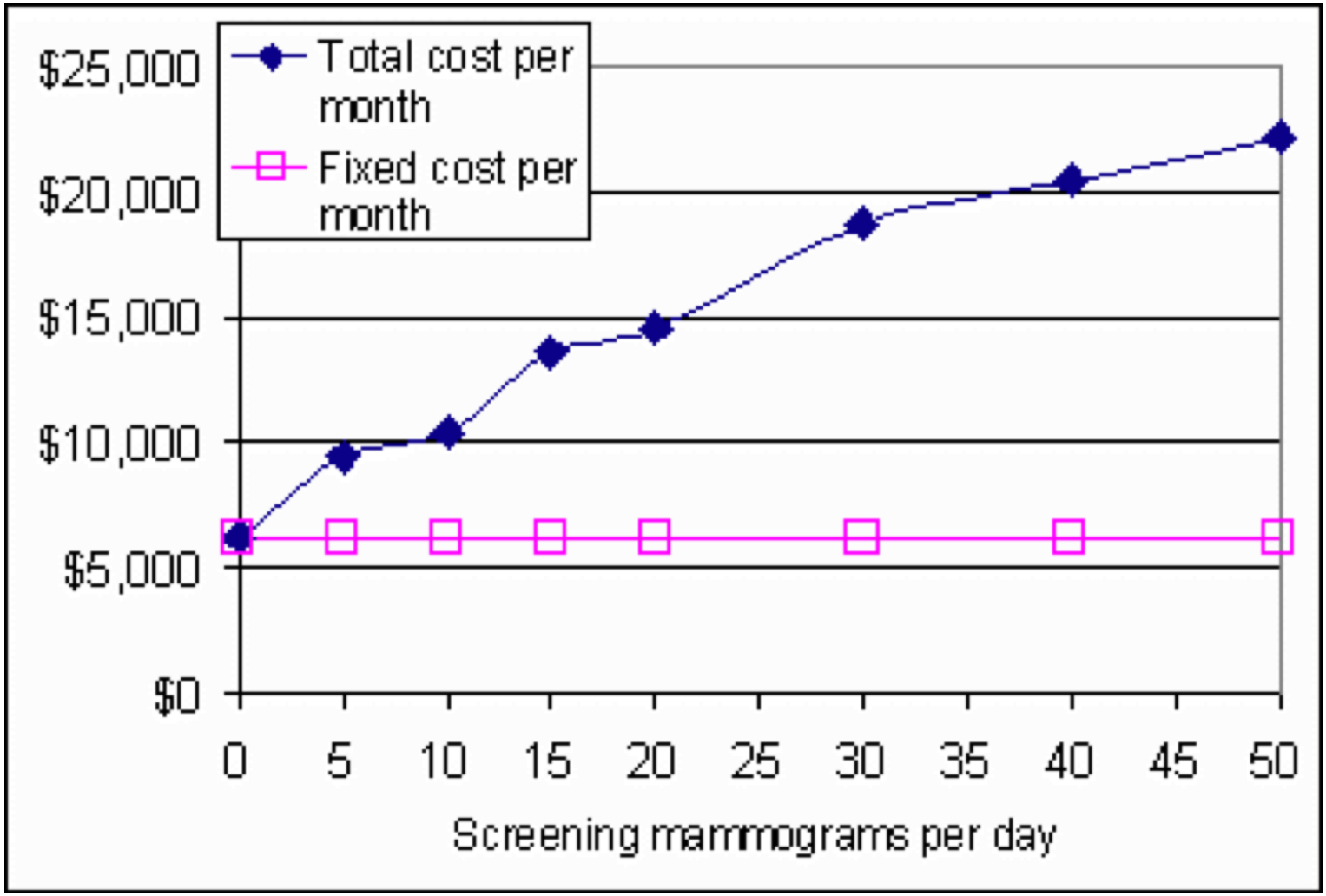
The cost of producing 0 is not $0.
The cost of producing 0 is the fixed cost.



Fixed cost

- Fixed cost is the cost of producing 0 output in a given time period.
- Fixed costs are costs that can't be avoided in the "short run"
- "Short run" means a time period in which fixed costs can't be avoided.
  - (Circular?)

- Fixed cost is a function of Quantity per unit of time in the trivial sense that it's a constant function. Fixed cost's line goes straight across.



Total and fixed cost

- In a table, fixed cost is "fixed" -- the same -- at all output rates

Output	0	5	10	15	20	30	40	50
Total cost	$6,172	$9,462	$10,337	$13,627	$14,502	$18,667	$20,417	$22,167
Fixed cost	$6,172	$6,172	$6,172	$6,172	$6,172	$6,172	$6,172	$6,172

What's in fixed cost.

Part is because of the capital needed.

Capital outlay required before the first patient is seen:	
Mammography unit and processor	$80,000
Start-up supplies	$2,000
Property improvements	$15,000
Furniture	$5,000
Office equipment	$3,500
Miscellaneous	$500
Capital outlay -- total of above	$106,000

Converting a stock to a flow

- The capital outlay is a stock, rather than a flow.
- To use our cost concepts, we have to convert it to a flow. Imagine that we borrow the $106K and intend to pay it back at so many dollars per month. That "so many dollars" per month is part of our fixed cost flow.
- Amortized capital cost per month, at a 12% interest rate for 6 years is $2,072.
  This is the monthly fixed cost flow associated with our initial capital outlay.

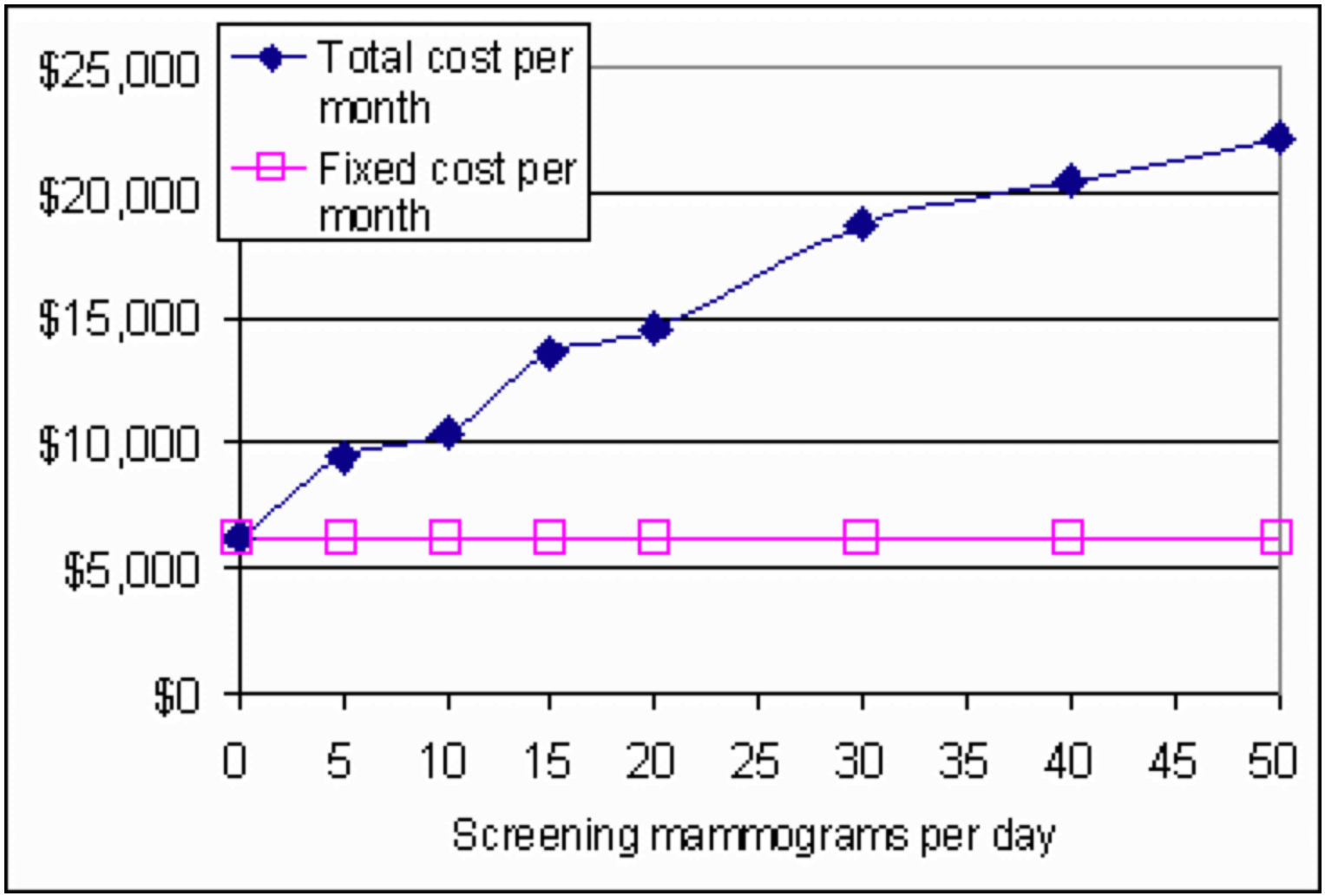
Expenses that happen even if no customers show

Other fixed costs per month	
Maintenance	$425
Promotion	$250
Accounting	$100
Insurance	$100
Rent	$875
Telephone	$100
Taxes	$750
Clerk/Receptionist salary and benefits	$1,500
TOTAL other fixed costs per month	$4,100

Fixed cost summary

Monthly capital cost	$2,072
Recurring fixed cost	$4,100
Total fixed cost -- flow per month	$6,172

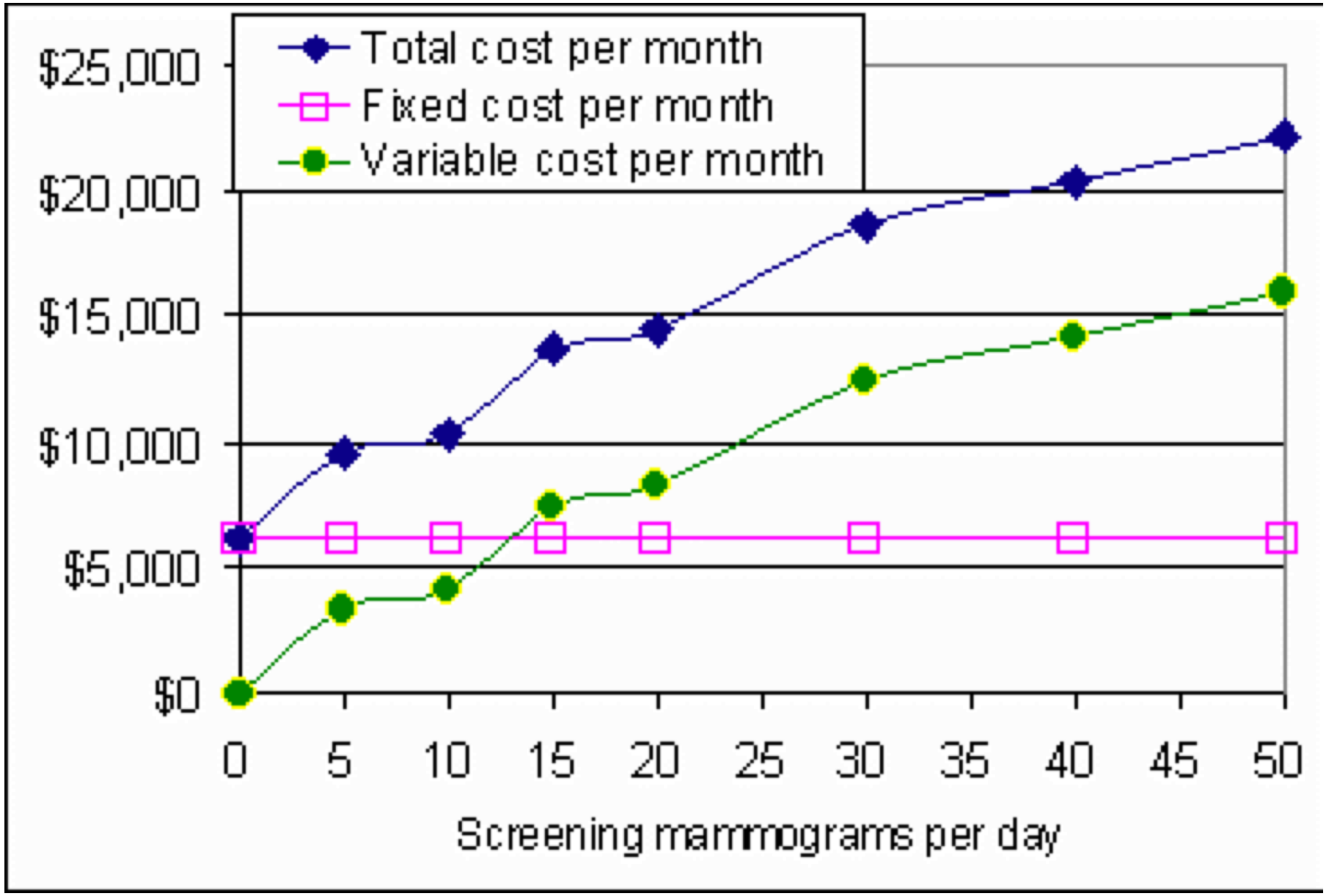
- Fixed cost is $6172.



Variable Cost

- Variable cost equals total cost minus fixed cost.
- The variable cost is extra cost of producing Q, above the cost of producing 0.
- In the "long run," all costs are variable.

Variable costs per month (20 working days per month)								
		Tests per day						
Cost category	Unit cost	5	10	15	20	30	40	50
Radiological technologist		$2,415	$2,415	$4,830	$4,830	$7,245	$7,245	$7,245
Film	$3.00	$300	$600	$900	$1,200	$1,800	$2,400	$3,000
Medical Records	$2.00	$200	$400	$600	$800	$1,200	$1,600	$2,000
Supplies and miscellaneous	$2.00	$200	$400	$600	$800	$1,200	$1,600	$2,000
Postage	$1.00	$100	$200	$300	$400	$600	$800	$1,000
Forms	$0.75	$75	$150	$225	$300	$450	$600	$750
Total monthly variable cost (all above added up)		$3,290	$4,165	$7,455	$8,330	$12,495	$14,245	$15,995


Total cost per month
Fixed cost per month
Variable cost per month
$25,000
$20,000
$15,000
$10,000
$5,000
$0
0
5
10
15
20
25
30
35
40
45
50
Screening mammograms per day

Marginal cost
Incremental cost

- Marginal cost is
- Total cost at output Q
- minus
- total cost at output Q-1.
- Marginal cost is the additional cost of producing one more.
- Or the reduction in cost from producing one less.

Calculating marginal cost

- … is a bit tricky, because the radiological technologist is "lumpy."
- "Lumpy" means not continuously variable.
  - The technologist is somewhat of a fixed cost over some mall changes in output rate,
- Apparently, you can only hire full-time technologists, not part-time, which would reduce the lumpiness.

Variable costs per month (20 working days per month)								
		Tests per day						
Cost category	Unit cost	5	10	15	20	30	40	50
Radiological technologist		$2,415	$2,415	$4,830	$4,830	$7,245	$7,245	$7,245
Film	$3.00	$300	$600	$900	$1,200	$1,800	$2,400	$3,000
Medical Records	$2.00	$200	$400	$600	$800	$1,200	$1,600	$2,000
Supplies and miscellaneous	$2.00	$200	$400	$600	$800	$1,200	$1,600	$2,000
Postage	$1.00	$100	$200	$300	$400	$600	$800	$1,000
Forms	$0.75	$75	$150	$225	$300	$450	$600	$750
Total monthly variable cost (all above added up)		$3,290	$4,165	$7,455	$8,330	$12,495	$14,245	$15,995

The other marginal costs total $8.75 per patient

Cost category	Unit cost (cost per mammogram)
Film	$3.00
Medical Records	$2.00
Supplies and miscellaneous	$2.00
Postage	$1.00
Forms	$0.75

The physician's fee is billed separately, so it's not included here.

You make money if your price is more than your marginal cost.

- $8.75 is the marginal cost of a screening mammogram
  if the technologist is not fully busy.
- If a woman walks in unexpectedly and offers $8.76 for a screening mammogram,
  and your technologist is not busy,
  then you can make $0.01 by doing a mammogram for her.

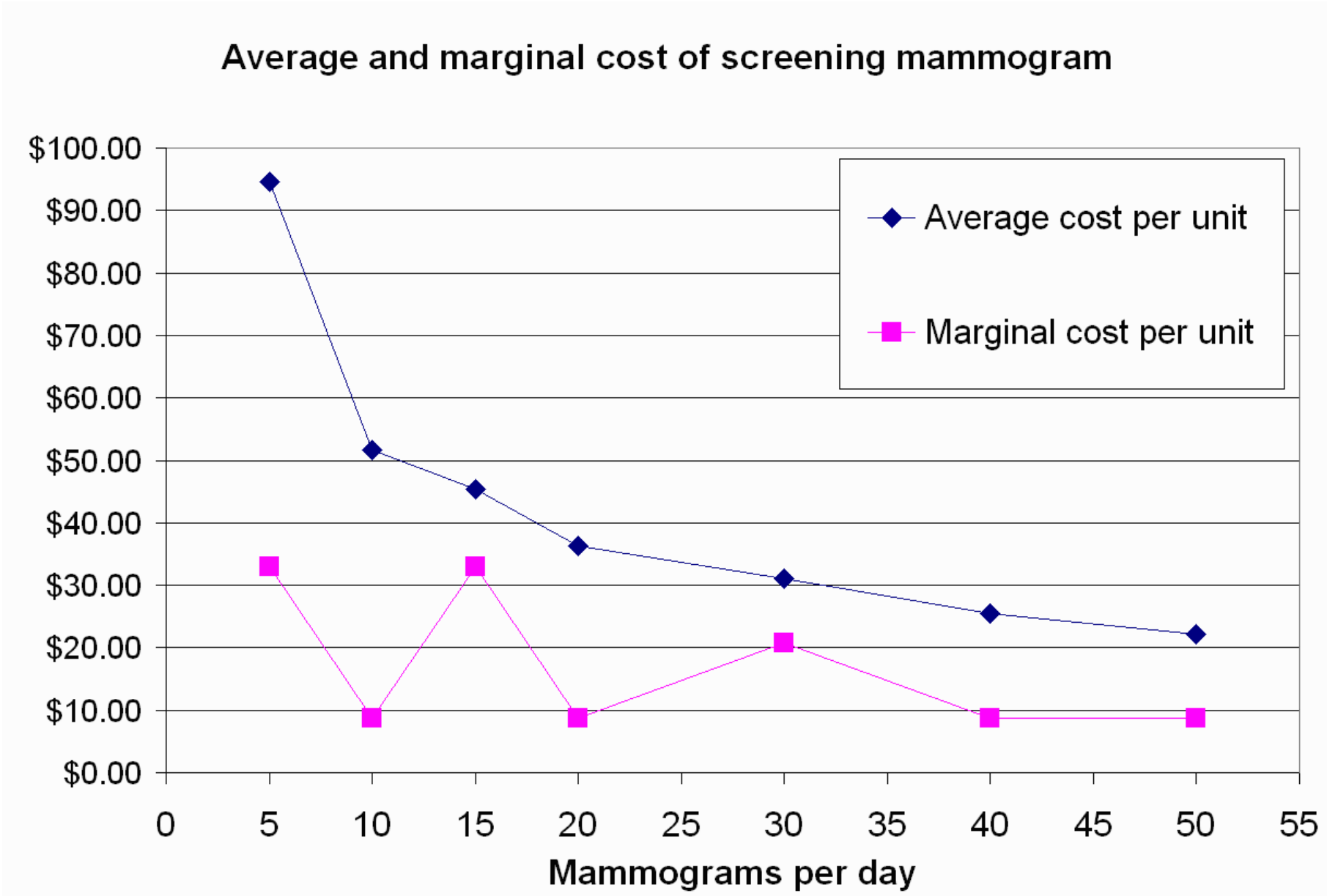
If you need to add a technologist, the marginal cost is higher.

- If you are doing 10 mammograms a day, and you are considering signing a contract to provide, say, 5 more mammograms per day, $8.75 will not be your marginal cost per mammogram, because you will have to add a technologist.
- For the table that follows, I've considered only output rates 0, 5, 10, 15, etc., to simplify the calculation.

Tests per day	0	5	10	15	20	30	40	50
Tests per month	0	100	200	300	400	600	800	1000
Total cost	$6,172	$9,462	$10,337	$13,627	$14,502	$18,667	$20,417	$22,167
Fixed cost	$6,172	$6,172	$6,172	$6,172	$6,172	$6,172	$6,172	$6,172
Technologists needed	**0**	**1**	**1**	**2**	**2**	**3**	**3**	**3**
Variable cost	$0	$3,290	$4,165	$7,455	$8,330	$12,495	$14,245	$15,995
Marginal cost from previous output rate	Not applicable	$3,290	$875	$3,290	$875	$4,165	$1,750	$1,750
Corresponding marginal cost per unit	Not applicable	$32.90	$8.75	$32.90	$8.75	$20.83	$8.75	$8.75

- The lumpiness of the technologist makes the marginal cost jump up or down, depending on whether we do or do not have to add a technologist to achieve the next higher output rate.

  The marginal cost is high when we have to add a technologist. It's low otherwise.
- The next slide assumes that we can change the output rate only by a multiple of 5 per day.


Average and marginal cost of screening mammogram
$100.00
$90.00
$80.00
$70.00
$60.00
$50.00
$40.00
$30.00
$20.00
$10.00
$0.00
0
5
10
15
20
25
30
35
40
45
50
55
Mammograms per day
Average cost per unit
Marginal cost per unit

Marginal cost and your minimum price

Tests per day	0	5
Tests per 20-day month	0	100
Total cost	$6,172	$9,462
Fixed cost	$6,172	$6,172
Technologists needed	0	1
Variable cost	$0	$3,290
Marginal cost from previous output level	Not applic-able	$3,290
Corresponding marginal cost per unit (row above divided by 100 tests per day)	Not applic-able	$32.90

- If you're seeing nobody, and you want to contract for doing 5 visits a day,
- Your price must be at least $32.90 per mammogram, if you want to gain money from the contract.

Tests per day	30	40
Tests per 20-day month	600	800
Total cost	$18,667	$20,417
Fixed cost	$6,172	$6,172
Technologists needed	3	3
Variable cost	$12,495	$14,245
Marginal cost from previous output level	$4,165	$1,750
Corresponding marginal cost per unit	$20.83	$8.75

- If you're currently doing 30 tests per day, you can make money if you can get a price above $8.75 each for additional tests.

Marginal cost is the concept to use when considering changes.

- Compare the costs with the change to the cost without the change.
- The difference is the marginal cost of the change.
- Compare that with the marginal benefit of the change to decide whether the change is advantageous.

Average cost

- Average cost is
  Total cost at output = Q, divided by Q.
- Average cost is sometimes mistakenly used in place of marginal cost.
  - The upcoming Stool Guaiac test article shows an example of that confusion.

Average cost

- Marginal cost is what to use to decide whether to do something.
- Average cost is good for telling you whether you're making money overall.
- Profit = Revenue minus cost.
- Average profit per unit =

Revenue ÷ Units − Average Cost per unit.

- If you charge all customers the same price
  - (in health care, you generally don't. But, suppose you did.)
- Revenue is the total amount you take in.
- Revenue = Price times Quantity.
- Therefore Price equals Revenue divided by Quantity.
- Profit = Revenue minus Cost,
  so profit per unit = Price minus Average Cost.
- If Price exceeds Average Cost then your unit profit is positive.
- If the price is less than the average cost, your average profit per unit is negative.

Average cost

Tests per day	0	5	10	15	20	30	40	50
Tests per month	0	100	200	300	400	600	800	1000
Total cost	$6,172	$9,462	$10,337	$13,627	$14,502	$18,667	$20,417	$22,167
Average cost	(Can't divide by 0.)	$94.62	$51.69	$45.42	$36.26	$31.11	$25.52	$22.17

Economies of scale. AC falls as Q rises. That's because the fixed cost gets spread over more tests.

Average cost and marginal cost

Tests per day	0	5	10	15	20	30	40	50
Tests per month	0	100	200	300	400	600	800	1000
Total cost	$6,172	$9,462	$10,337	$13,627	$14,502	$18,667	$20,417	$22,167
Average cost	Can't divide by 0	$94.62	$51.69	$45.42	$36.26	$31.11	$25.52	$22.17
Marginal cost from previous output level	Not applic-able	$3,290	$875	$3,290	$875	$4,165	$1,750	$1,750
Corresponding marginal cost per unit	Not applic-able	$32.90	$8.75	$32.90	$8.75	$20.83	$8.75	$8.75

- In the 40 column:
- The marginal cost per test is $8.75,
- but the average cost is $25.52.
- Can we really provide extra tests at a price just over $8.75 each and make money?

- Yes, if we don't have to charge all our customers that price.
- Offering a group a price just above its marginal cost will let us make money on that group.
- But if we offer all customers prices just above their marginal costs, we won't cover our fixed costs, so we'll lose money overall.

Price discrimination

- Jargon term for charging different customers different prices.
- Not illegal.
- In health care, often encouraged.
  - Sliding scale fees for doctors
  - Payment plans and write-offs for hospitals
  - Drug samples
  - Negotiated contracts with insurers

Average cost is the break-even price

Tests per day	0	5	10	15	20	30	40	50
Tests per month	0	100	200	300	400	600	800	1000
Total cost	$6,172	$9,462	$10,337	$13,627	$14,502	$18,667	$20,417	$22,167
Average cost	Can't divide by 0	$94.62	$51.69	$45.42	$36.26	$31.11	$25.52	$22.17
Marginal cost from previous output level	Not applic-able	$3,290	$875	$3,290	$875	$4,165	$1,750	$1,750
Corresponding marginal cost per unit	Not applic-able	$32.90	$8.75	$32.90	$8.75	$20.83	$8.75	$8.75

At 40 tests per day, the break-even price is $25.52. Any higher price Is profitable.

Long-run and short-run

- In the short run, it pays to sell to any customer who'll pay marginal cost.
- Even if you're losing money overall, you're losing less than if you had turned down the sale.
- In the long run, when you can get out of your fixed cost, you shut down if your average price is not more than average cost.

Review

- Opportunity cost is
- what you give up to get something

Review of money cost concepts

- Total cost -- the dollars you give up by being in business and operating at your current rate.
- Fixed cost -- the dollars you give up by being in business, even if you produce nothing.
- Variable cost -- the dollars you give up to produce at your current rate, over and above your fixed cost.
- Marginal cost -- the dollars you give up to add one to your rate of production.
- Average cost -- total cost divided by output rate

Review

- Price discrimination is

Charging different customers different prices for the same thing.