



Cost Concepts

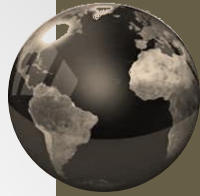
You tell them - you tell them there's a cost ... Every decision we make in life, there's always a cost.

Brad Meltzer



Cost Concepts

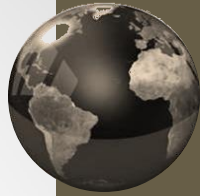
- Opportunity cost
- Total cost
- Fixed cost
- Variable cost
- Marginal cost
- Average cost



Opportunity Cost

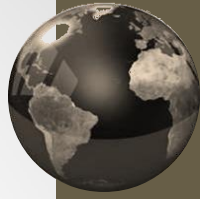
- Opportunity cost is the most fundamental cost concept. The opportunity cost of doing or getting something is:
 - *what you could have done or gotten instead*
 - example: The opportunity cost of buying a \$50 textbook is the \$50 ticket to the concert you really wanted to attend.

**OPPORTUNITY COST
IS WHAT A PERSON
SACRIFICES WHEN THEY
CHOOSE ONE OPTION
OVER ANOTHER**



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 taking the course



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.

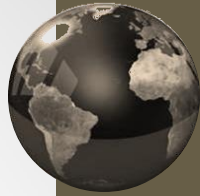
Dollar costs (prices) are easier to determine and
easier to add up.



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.

This is 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.



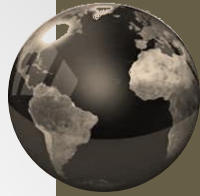
If price \neq opportunity cost then we're inefficient.

- 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.



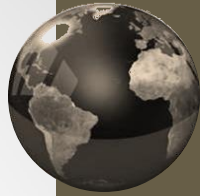
Inefficiency

- How do we know that the resources that could be used to make more of the drug are instead being used to make something less valuable?
- 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.



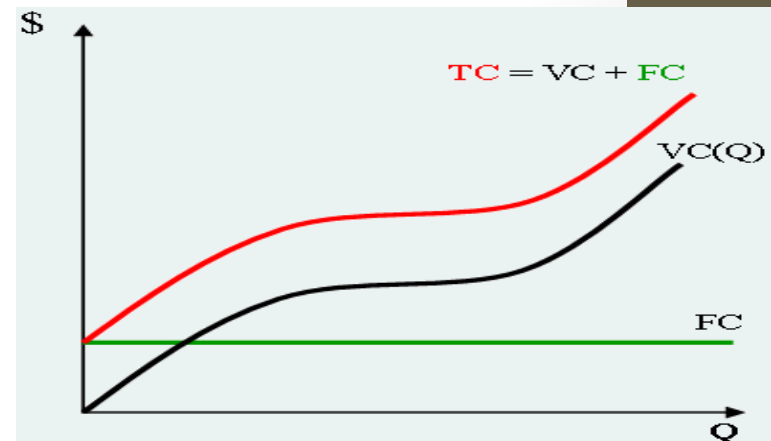
Money Cost Concepts

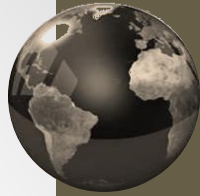
- Let's assume that we can use dollar costs for costs. Ignore, for now, what we just talked about as we look at:
 - total cost
 - fixed cost
 - variable cost
 - marginal cost
 - average cost



Total Cost (TC)

- ... is a function (in the mathematical sense) of quantity
- Total cost = $TC(Q)$
- $TC(Q)$ = the total cost per unit of time of producing Q units of output per unit of time
- The Q in the $TC(Q)$ formula stands for **Quantity** per unit of time.





Costs are flows, not stocks.

- Total cost, fixed cost, variable cost, marginal cost, average cost ... all have a time dimension, units of currency per unit of time.
- For example: A US 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.
- "Per unit of time" is often left out but it's always implicitly there.

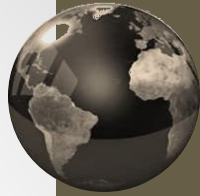


Table: Total Cost Example

- Below is the total cost per month of providing different numbers of screening mammograms per day.
- The *whole table* is the total cost.

Output Rate: Mammogram / Day	0	5	10	15	20	30	40	50
Total Cost / Month	\$6,172	\$9,462	\$10,337	\$13,627	\$14,502	\$18,667	\$20,417	\$22,167



Table: Screening Mammography Costs

Output Rate: Mammograms/ Day	Total Cost / 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

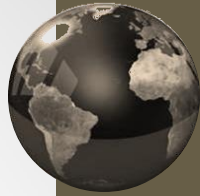


Chart: Screening Mammography Costs

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

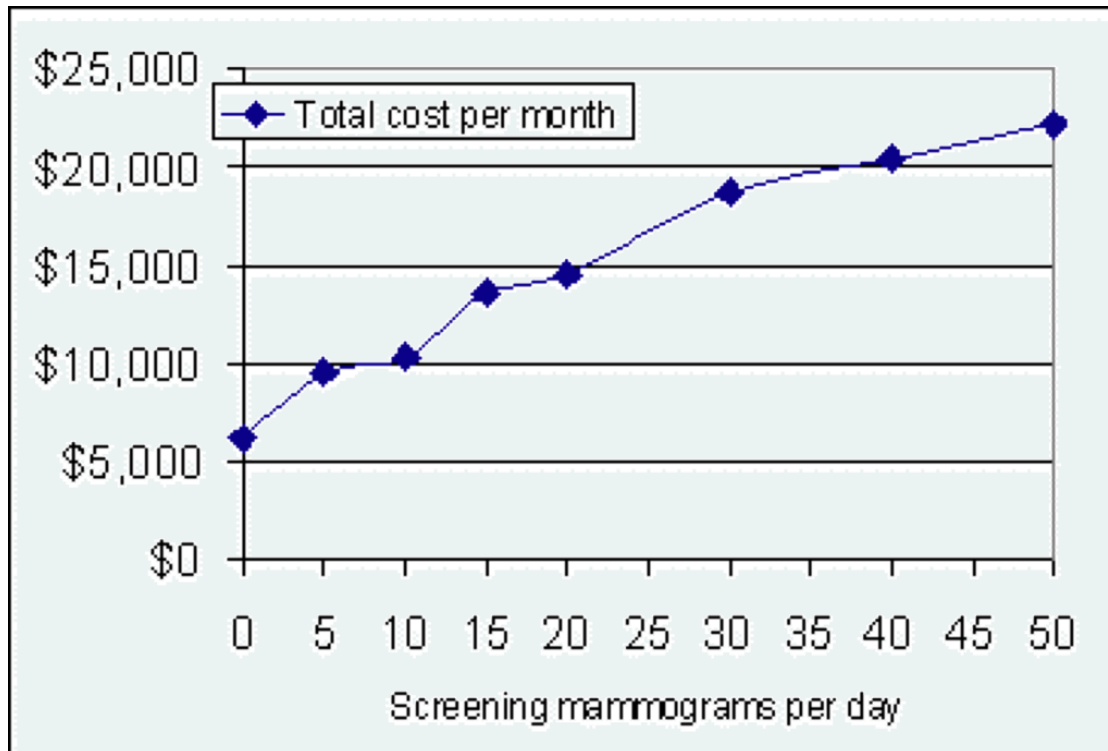
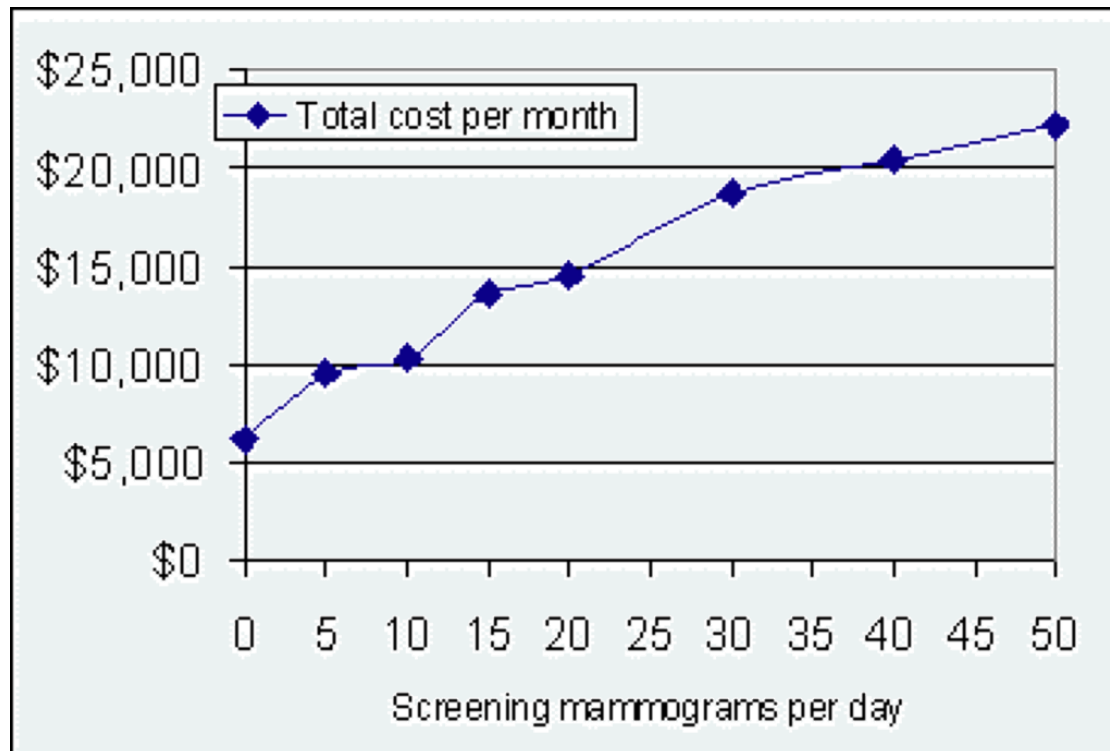




Chart: Screening Mammography Costs

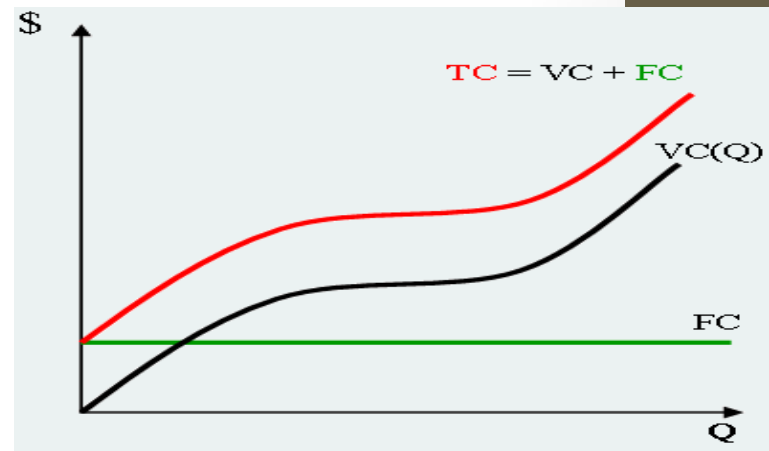
- The cost of producing 0 is not \$0.
- The cost of producing 0 is the **fixed cost**.





Fixed Cost (FC)

- 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**: a time period in which fixed costs can't be avoided, in which the cost of at least one variable is fixed



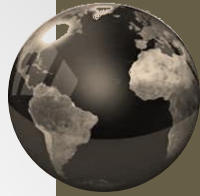
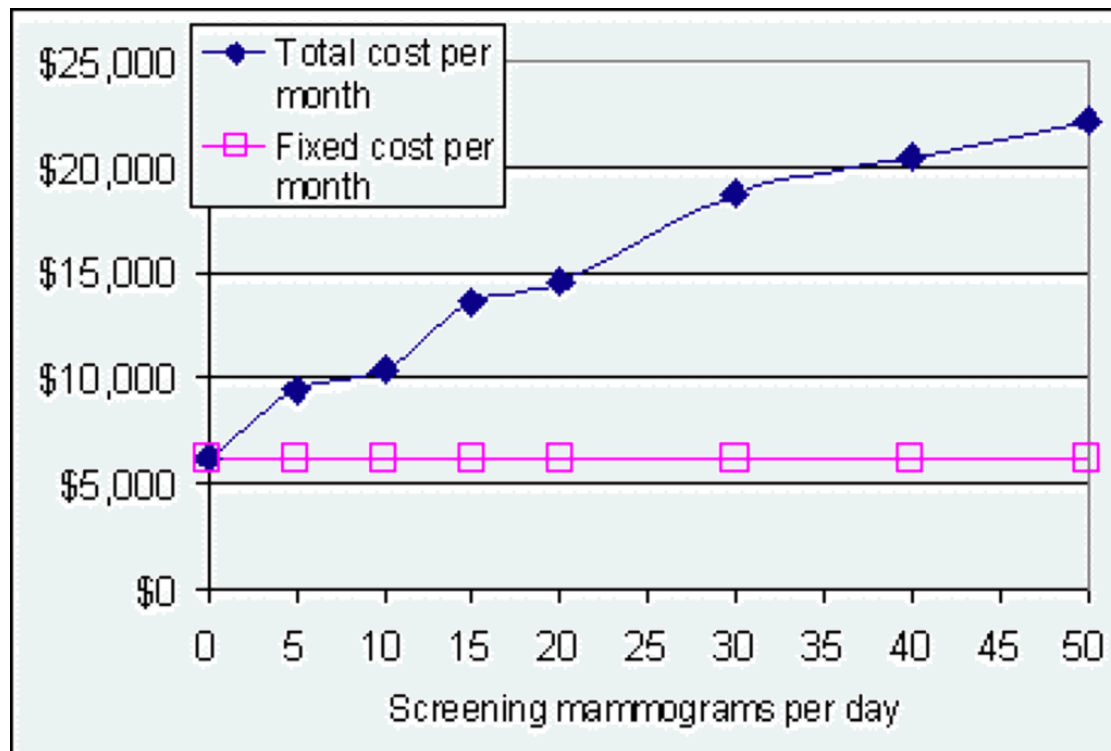


Chart: Fixed Costs

Fixed cost is a function of quantity per unit of time in the trivial sense that it's a **constant** function. A fixed cost's line goes straight across.



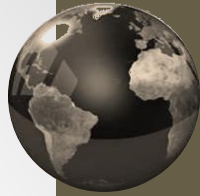
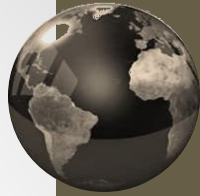


Table: Fixed Costs

What's in fixed cost?

Part is the capital needed to operate the business.

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

- **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.

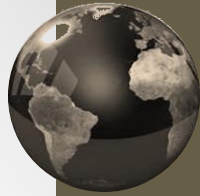


Table: Fixed Costs

Other Fixed Costs / Month: Expenses that happen even if no customers show	
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 / month	\$4,100



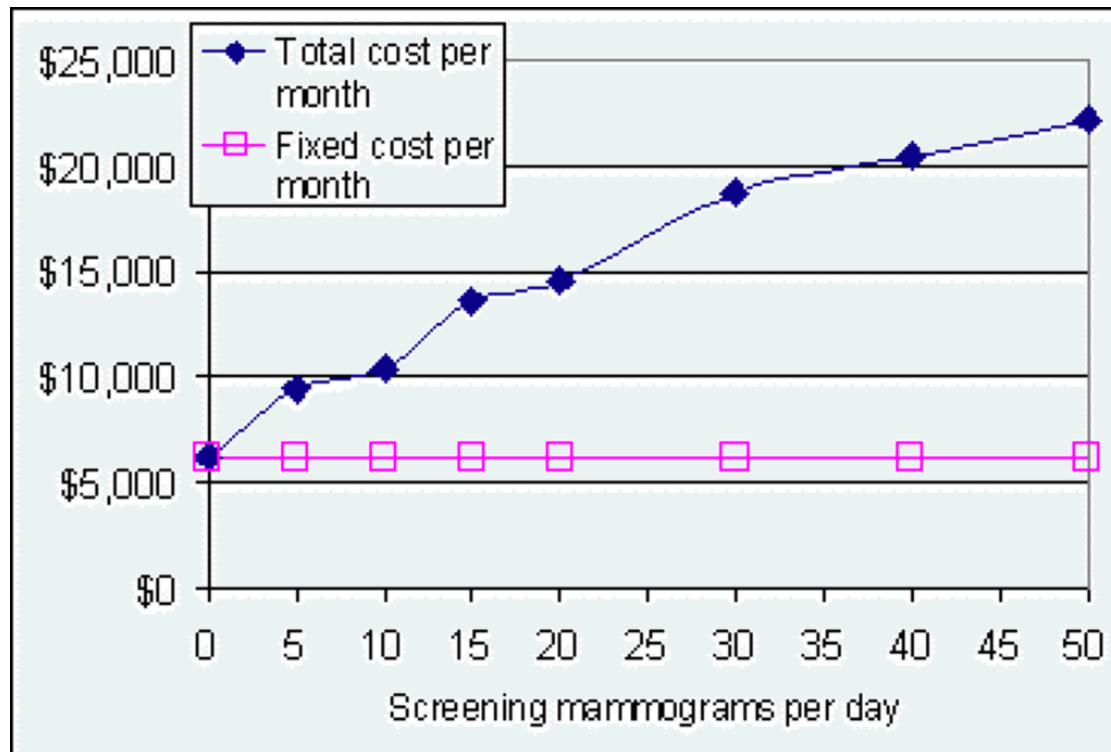
Table: Fixed Costs Summary

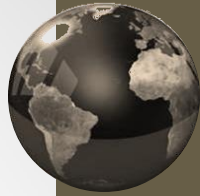
Monthly Capital Cost	\$2,072
Recurring Fixed Cost	\$4,100
Total Fixed Cost: Flow Per Month	\$6,172



Chart: Fixed Costs Summary

Fixed cost is \$6172.





Variable Cost (VC)

- Variable cost equals total cost minus fixed cost.
- The variable cost is *the extra cost of producing Q , above the cost of producing 0 .*
- In the long run, all costs are variable.
- **long run**: the time period in which all costs are variable ... example: If you have a year's lease on your facility, your short run is at least one year since your rent is fixed for one year. Longer than one year is your long run since you could change your location so that at that point your rent is variable.

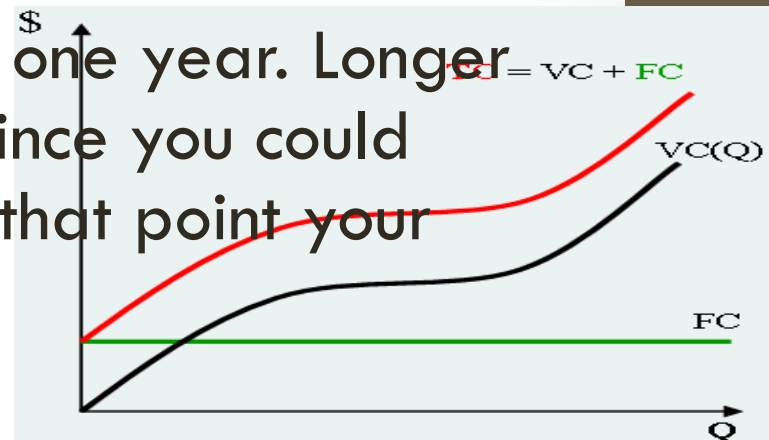




Table: Variable Costs

Variable Costs / Month (20 working days / month)								
Cost Category	Unit Cost	Tests / Day						
		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		\$3,290	\$4,165	\$7,455	\$8,330	\$12,495	\$14,245	\$15,995

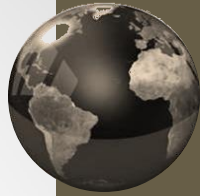
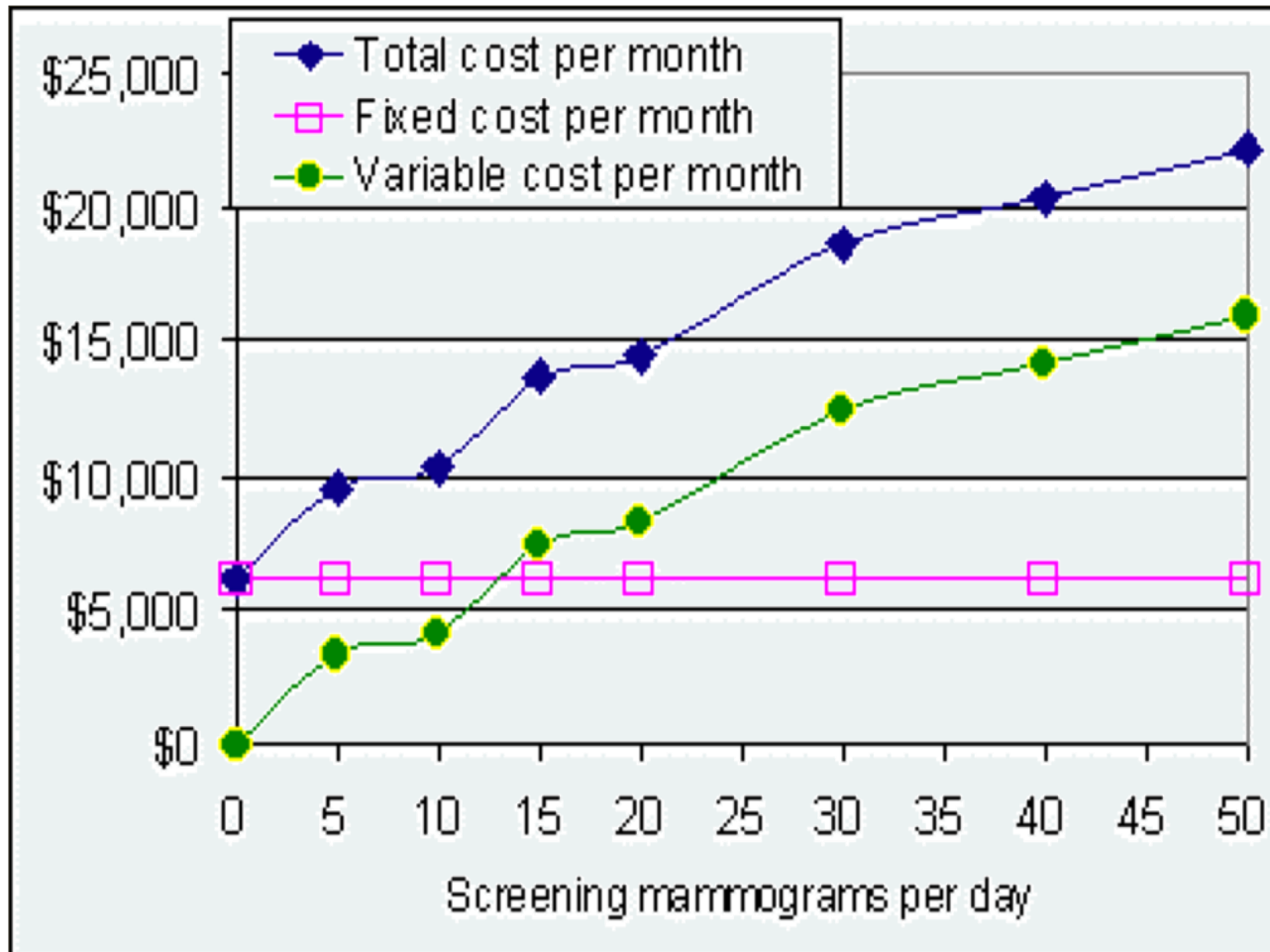
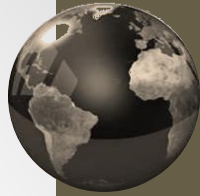


Chart: Variable Costs

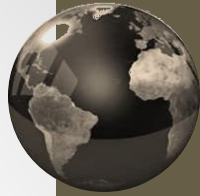




Marginal Cost (MC)

- Marginal Cost: Total Cost at output Q minus Total Cost at output Q-1
- Marginal cost is **incremental** cost.
- Marginal cost is the **additional cost of producing one more unit** or the reduction in cost from producing one less unit.

$$\text{marginal cost} = \frac{\Delta \text{ total cost}}{\Delta \text{ total quantity}}$$



Calculating Marginal Costs

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



Table: Marginal Costs

Variable Costs / Month (20 working days / month)								
Cost category	Unit cost	Tests / Day						
		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 (sum of above)		\$3,290	\$4,165	\$7,455	\$8,330	\$12,495	\$14,245	\$15,995

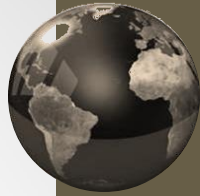
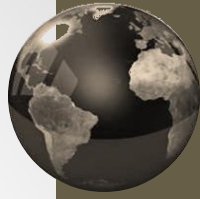


Table: Other Marginal Costs

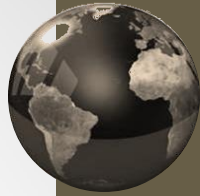
The other marginal costs total \$8.75 per patient.
(The physician's fee is billed separately, so it's not included here.)

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

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 patient 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 the patient.



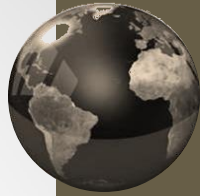
If you need to add a technologist, the marginal cost is higher.

- 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, consider only the output rates 0, 5, 10, 15, etc, to simplify the calculation.



Table: Marginal Costs

Tests / Day	0	5	10	15	20	30	40	50
Tests / 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	N/A	\$3,290	\$875	\$3,290	\$875	\$4,165	\$1,750	\$1,750
Corresponding Marginal Cost / Unit	N/A	\$32.90	\$8.75	\$32.90	\$8.75	\$20.83	\$8.75	\$8.75



Marginal Costs and Lumpiness

- 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.

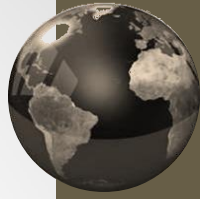
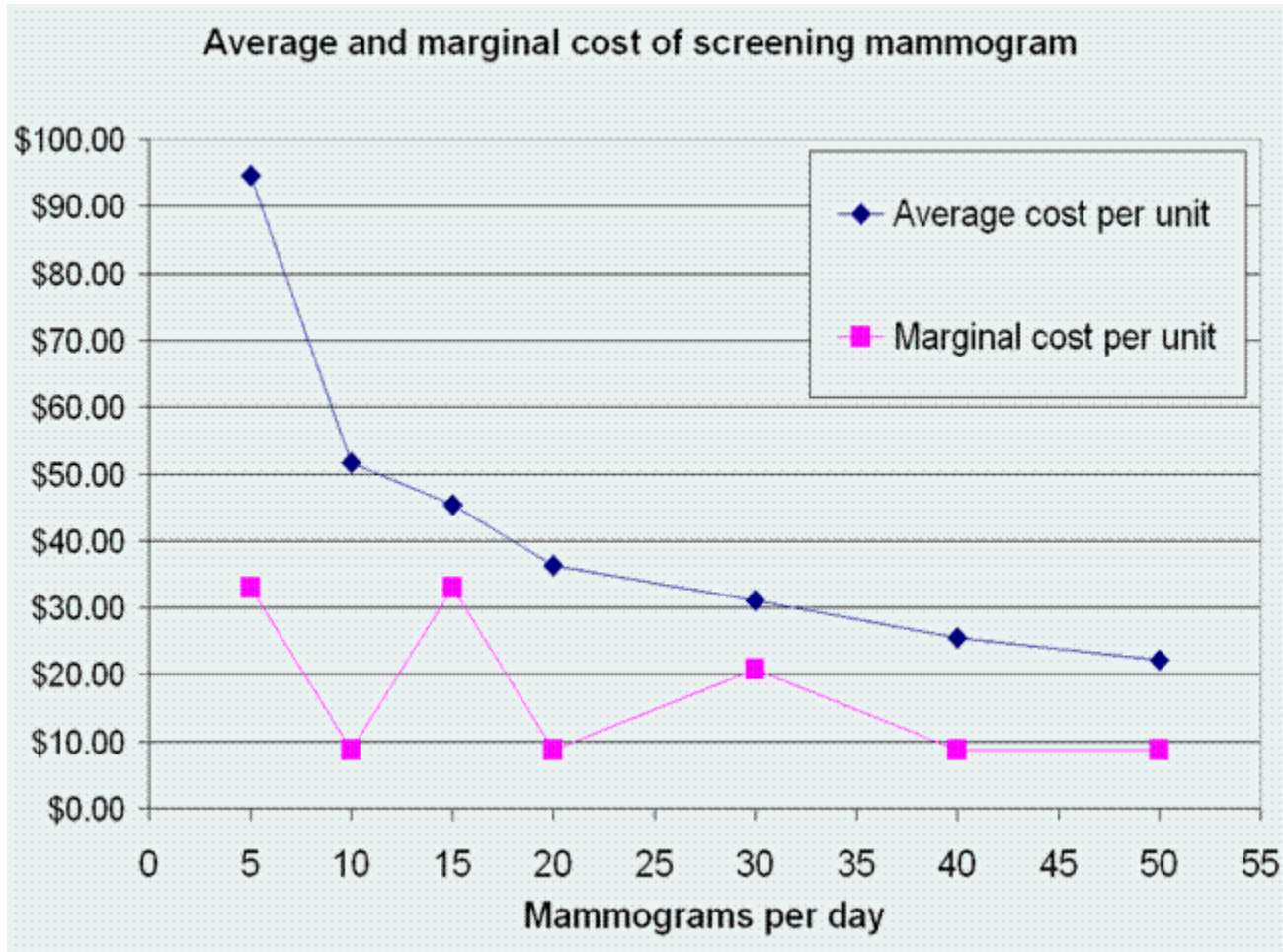


Chart: Marginal Costs



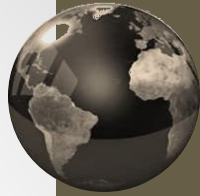


Table: Marginal Cost and Minimum Price

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

Tests / Day	0	5
Tests / 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	N/A	\$3,290
corresponding Marginal Cost / Unit (row above divided by 100 tests per day)	N/A	\$32.90

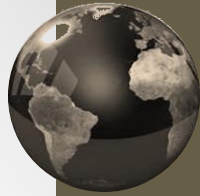
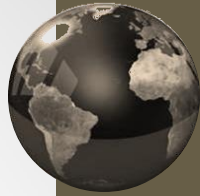


Table: Marginal Cost and Minimum Price

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.

Tests / Day	30	40
Tests / 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 / Unit	\$20.83	\$8.75



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 (AC)

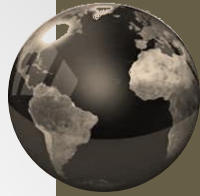
- Average Cost: Total Cost at output = Q , divided by Q .
- Average cost is sometimes mistakenly used in place of marginal cost.

$$ATC = \frac{TC}{Q} = \frac{TFC}{Q} + \frac{TVC}{Q} = AVC + AFC$$



Average Costs and Making Money

- Marginal cost is what to use to decide *whether or not to do something*.
- Average cost is good for telling you *whether you're making money overall*.
- **Profit = Revenue minus Cost.**
- Average Profit / Unit = Revenue \div # Units - Average Cost / Unit.



Average Costs and Price

- 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.
 - So Price equals Revenue divided by Quantity.
- Profit = Revenue minus Cost.
 - So Profit / Unit = Price minus Average Cost.
- If Price exceeds Average Cost then your unit profit is *positive*.
- If Price is *below* Average Cost then your unit profit is *negative*.



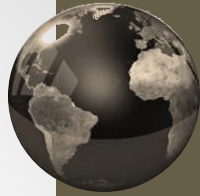
Table: Average Costs and Economies of Scale

Economies of scale: AC falls as Q rises.

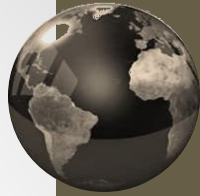
That's because the fixed costs gets spread over more units.

Tests / Day	0	5	10	15	20	30	40	50
Tests / 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	N/A	\$94.62	\$51.69	\$45.42	\$36.26	\$31.11	\$25.52	\$22.17

Table: Average Costs and Marginal Costs



Tests / Day	0	5	10	15	20	30	40	50
Tests / 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	N/A	\$94.62	\$51.69	\$45.42	\$36.26	\$31.11	\$25.52	\$22.17
Marginal Cost from previous output level	N/A	\$3,290	\$875	\$3,290	\$875	\$4,165	\$1,750	\$1,750
corresponding Marginal Cost / Unit	N/A	\$32.90	\$8.75	\$32.90	\$8.75	\$20.83	\$8.75	\$8.75



Average Costs and Marginal Costs

- 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.
 - If we offer all customers prices just above their marginal costs, we won't cover our fixed costs, so we'll lose money overall.

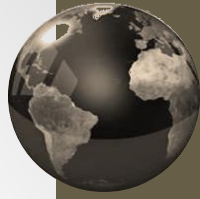


Price Discrimination

- ...jargon term for charging different customers different prices
- not illegal
- In health care, it's often encouraged.
 - sliding scale fees for doctors
 - payment plans and write-offs for hospitals
 - drug samples
 - negotiated contracts with insurers



Table: Average cost is the break-even price.



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

Tests / Day	0	5	10	15	20	30	40	50
Tests / 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
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corresponding Marginal Cost / Unit	N/A	\$32.90	\$8.75	\$32.90	\$8.75	\$20.83	\$8.75	\$8.75

The End

