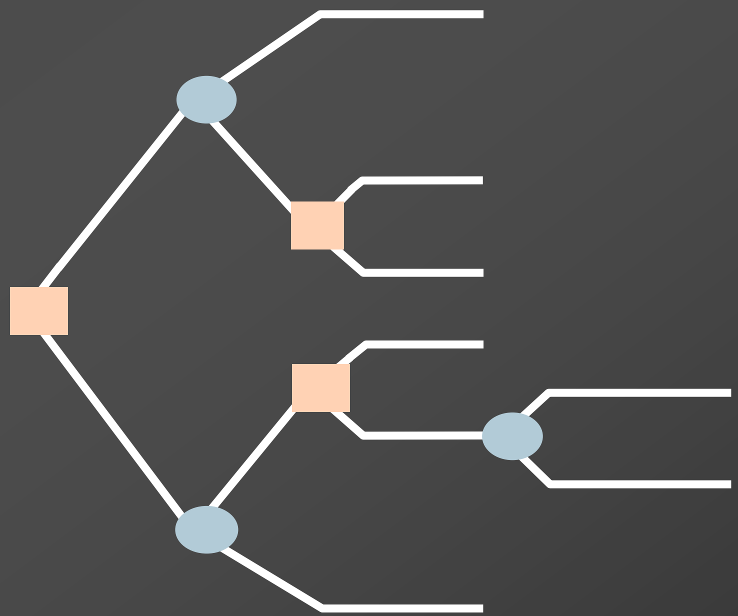
# CHAPTER II – Decision making



# 1-Break-even analysis

***Evaluating services or products***

***Volume sufficient to break even***

***The portion of the total cost that varies directly***
***The variable cost per unit***

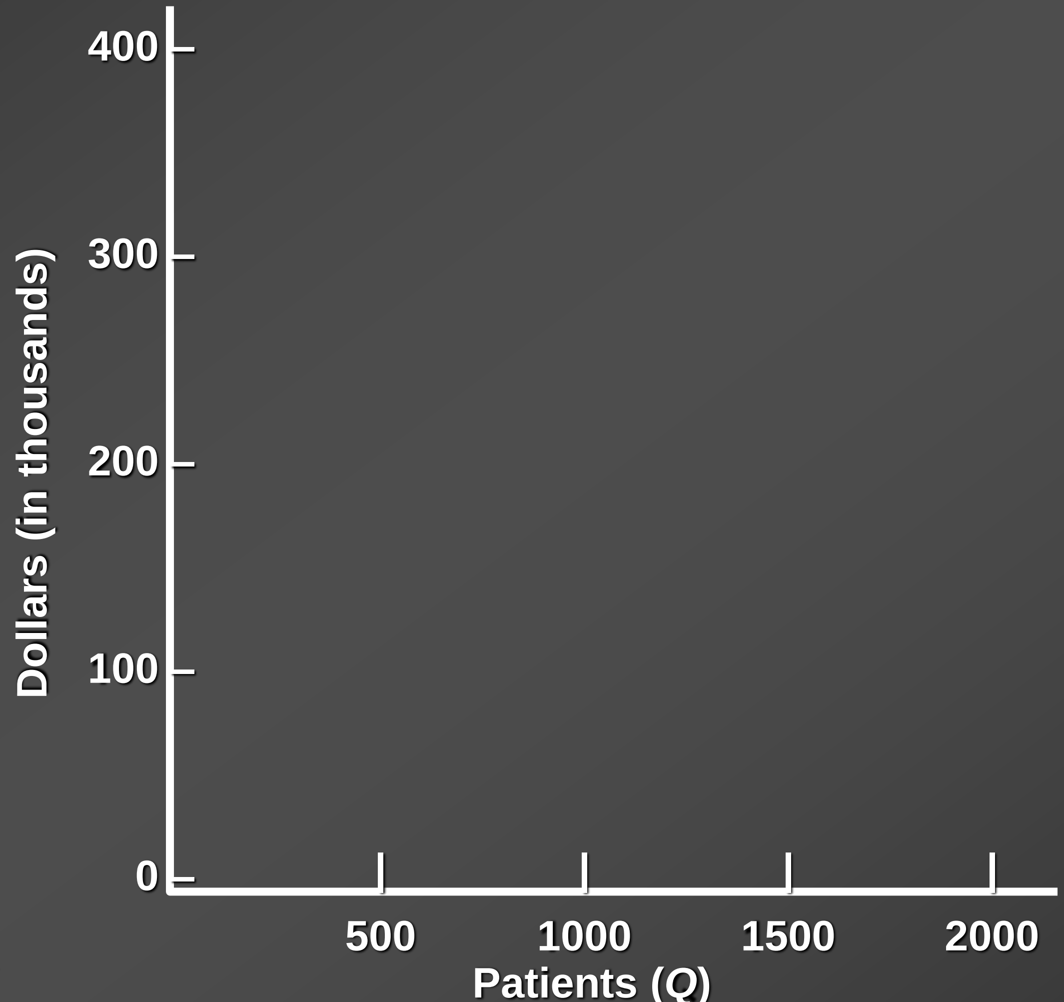
# Example

***FINDING THE BREAKEVEN QUANTITY***

***A hospital is considering a new procedure to be offered at $200 per patient. The fixed cost per year would be $100,000, with total variable costs of $100 per patient. What is the break-even quantity for this service? Use both algebraic and graphic approaches to get the answer.***

# Break-Even Analysis

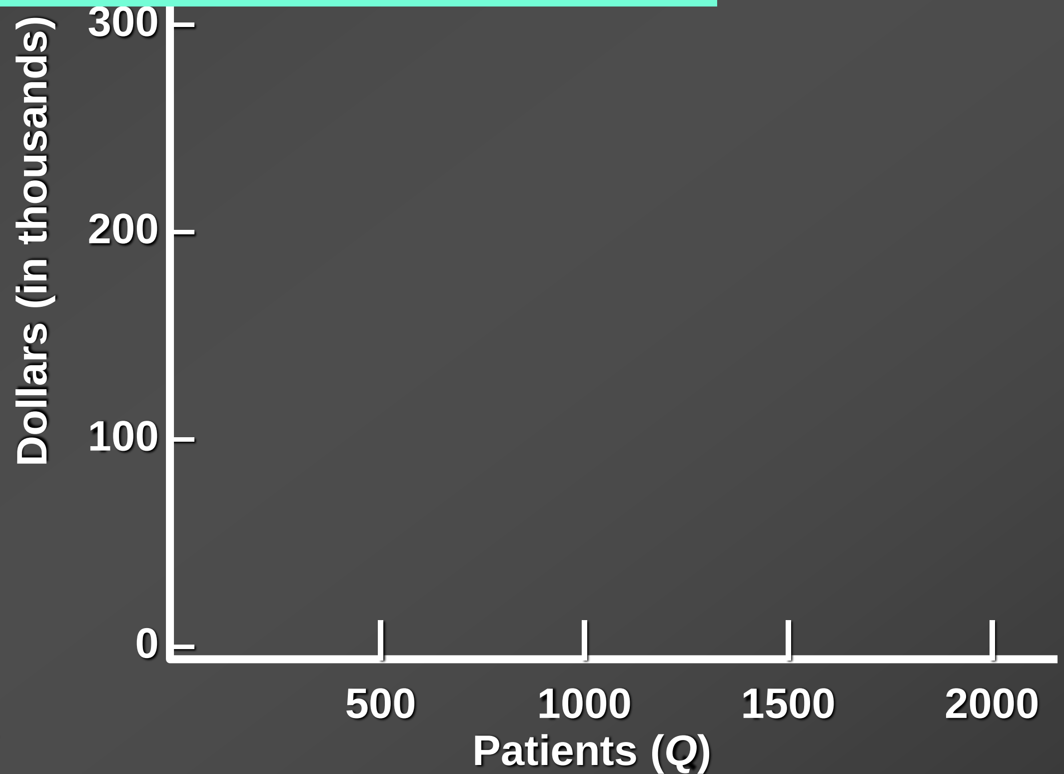
# *Break-Even Analysis*




***Example A.1***

# Break-Even Analysis

| Quantity (patients) ($Q$) | Total Annual Cost ($) (100,000 + 100$Q$) | Total Annual Revenue ($) (200$Q$) |
|---|---|---|
| 0 | 100,000 | 0 |
| 2000 | 300,000 | 400,000 |




*Example A.1*

# Break-Even Analysis

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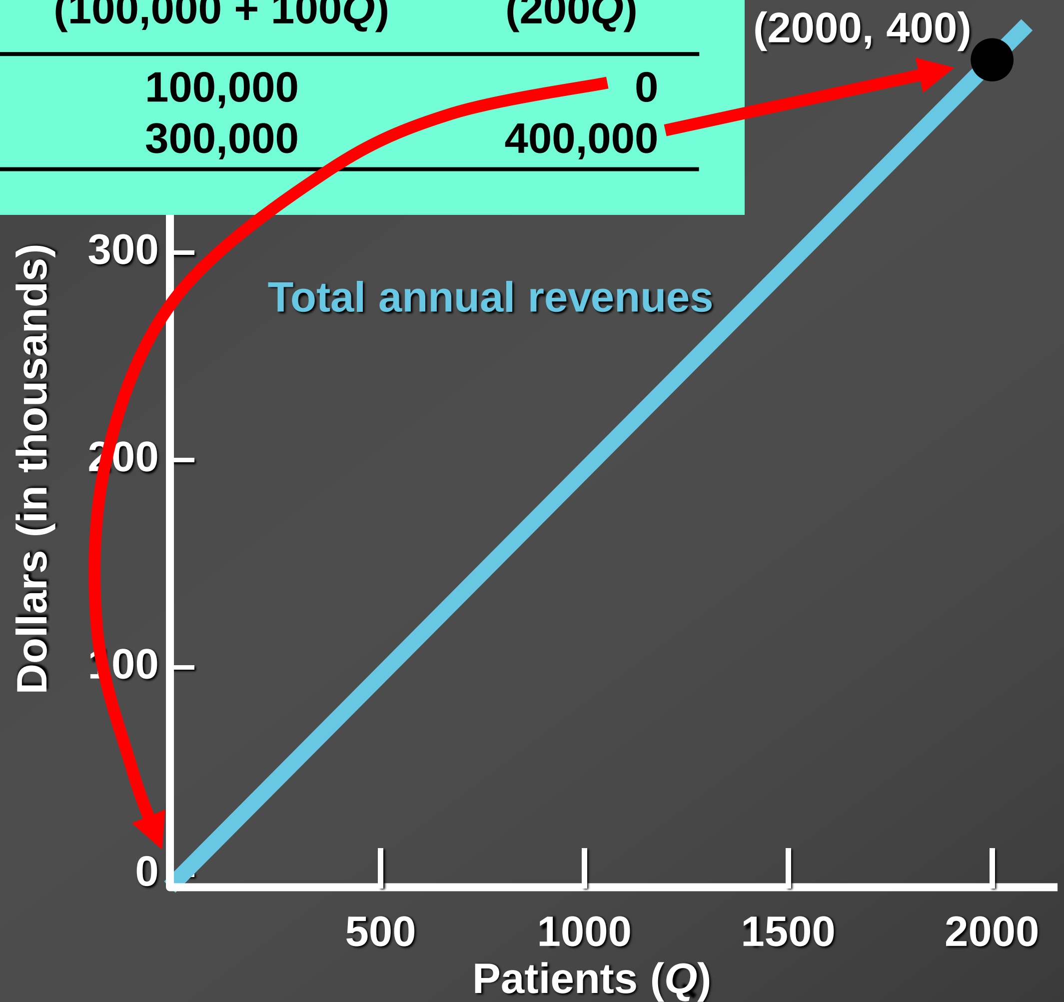
|---|---|---|
| 0 | 100,000 | 0 |
| 2000 | 300,000 | 400,000 |




*Example A.1*

# Break-Even Analysis

| Quantity (patients) (*Q*) | Total Annual Cost ($) (100,000 + 100*Q*) | Total Annual Revenue ($) (200*Q*) |
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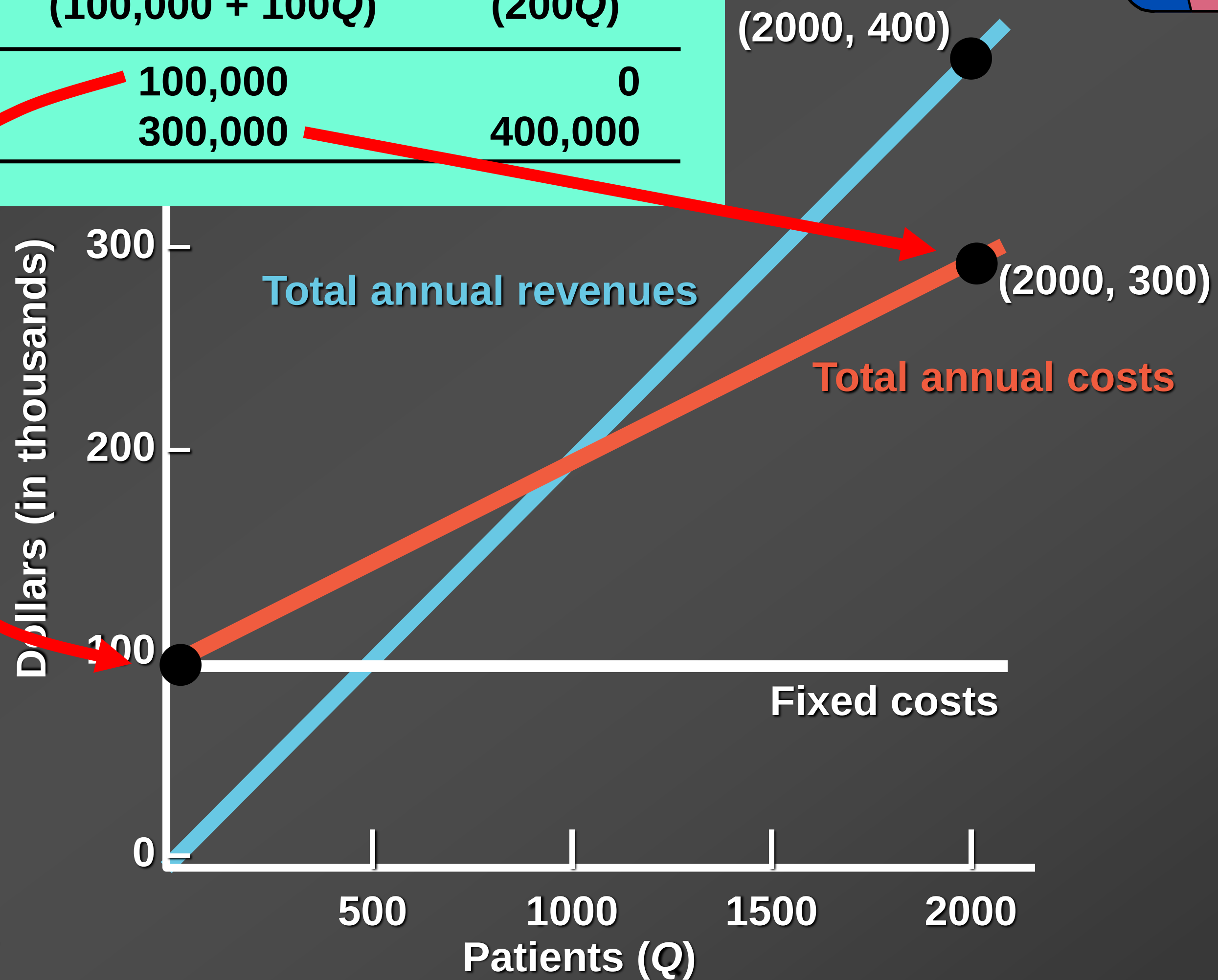


*Example A.1*

# Break-Even Analysis

| Quantity (patients) (*Q*) | Total Annual Cost ($) (100,000 + 100*Q*) | Total Annual Revenue ($) (200*Q*) |
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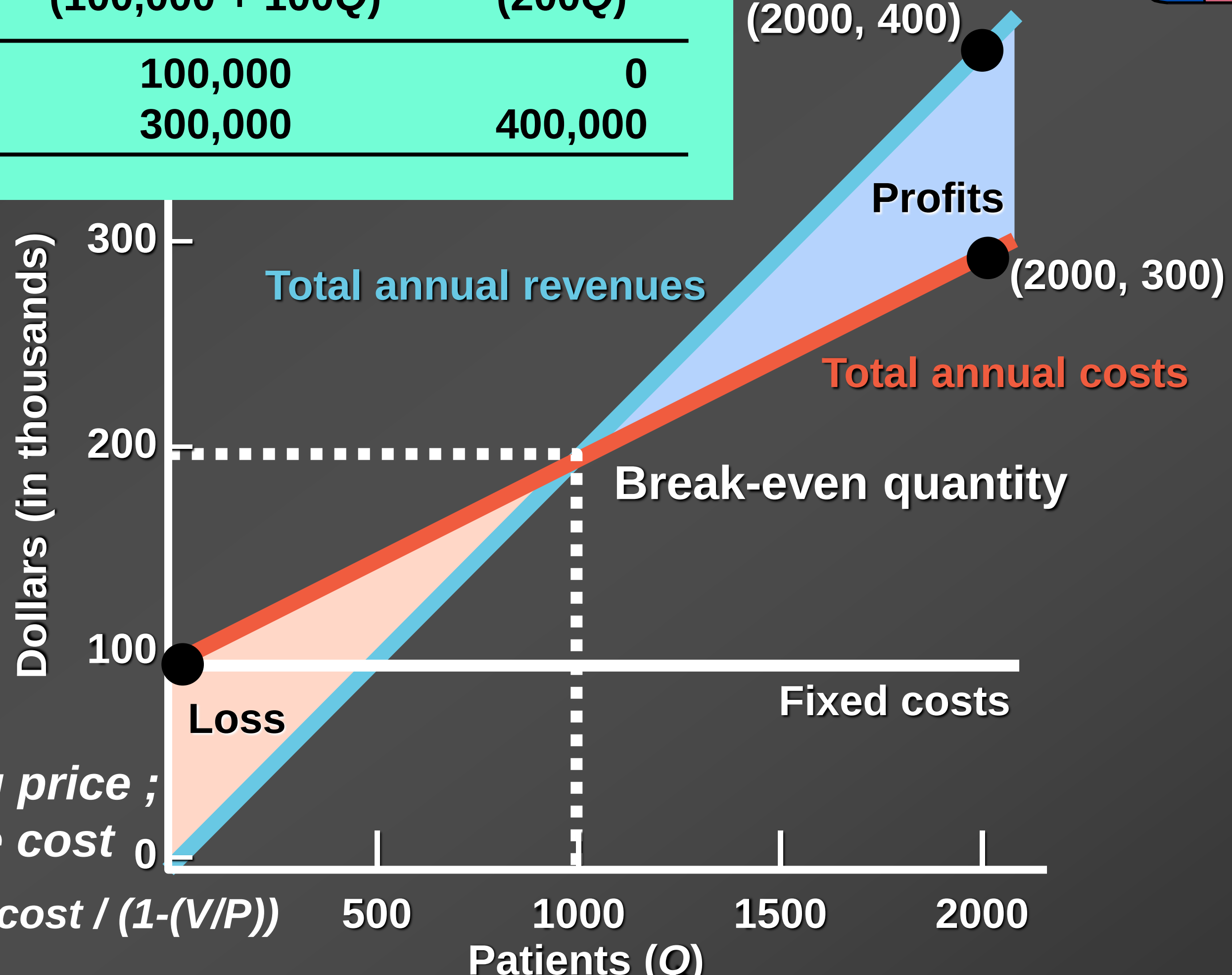



*Q=F/(p-c)*
*F Fixed cost*
*P = unit selling price ;*
*c=unit variable cost*

*Or Value = Fixed cost / (1-(V/P))*
*i.e.*
*(F / (P-V)) x P*

# Break-Even Analysis

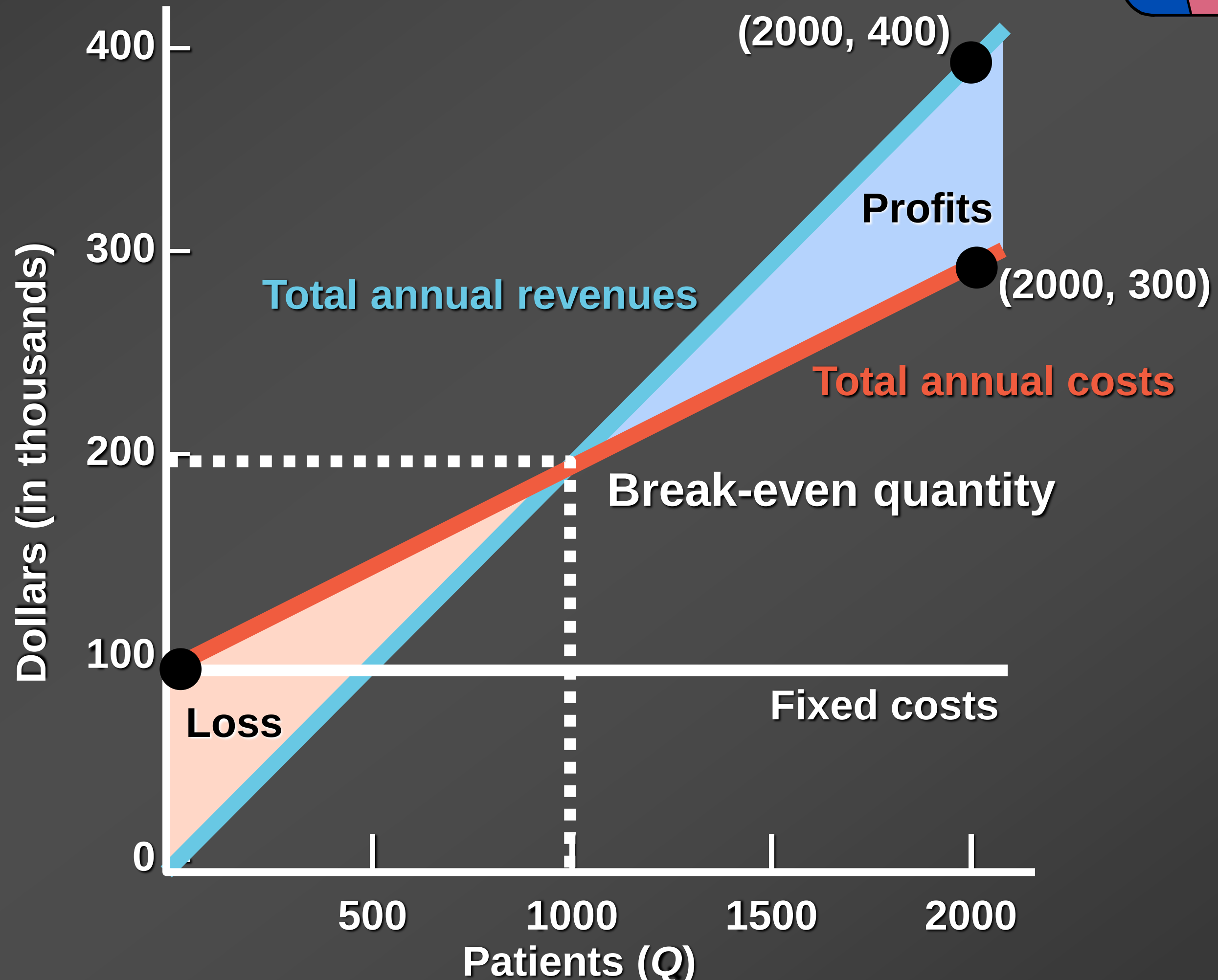



*Figure A.1*

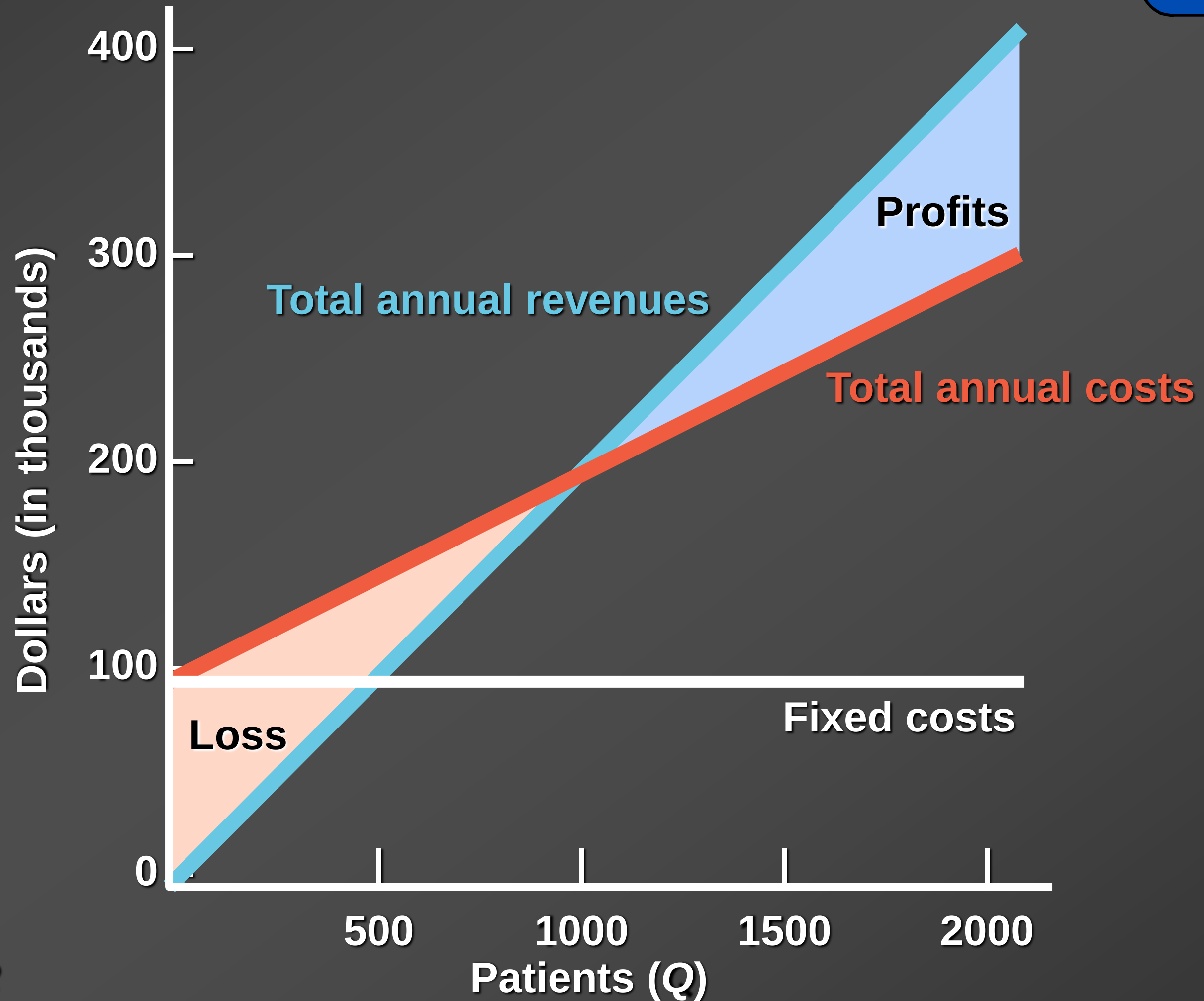
# Sensitivity analysis of sales forecasts

If the most pessimistic sales forecast for the proposed service in Figure A.I were 1,500 patients, what would be the procedure's total contribution to profit and overhead per year?

# Sensitivity analysis of sales forecasts

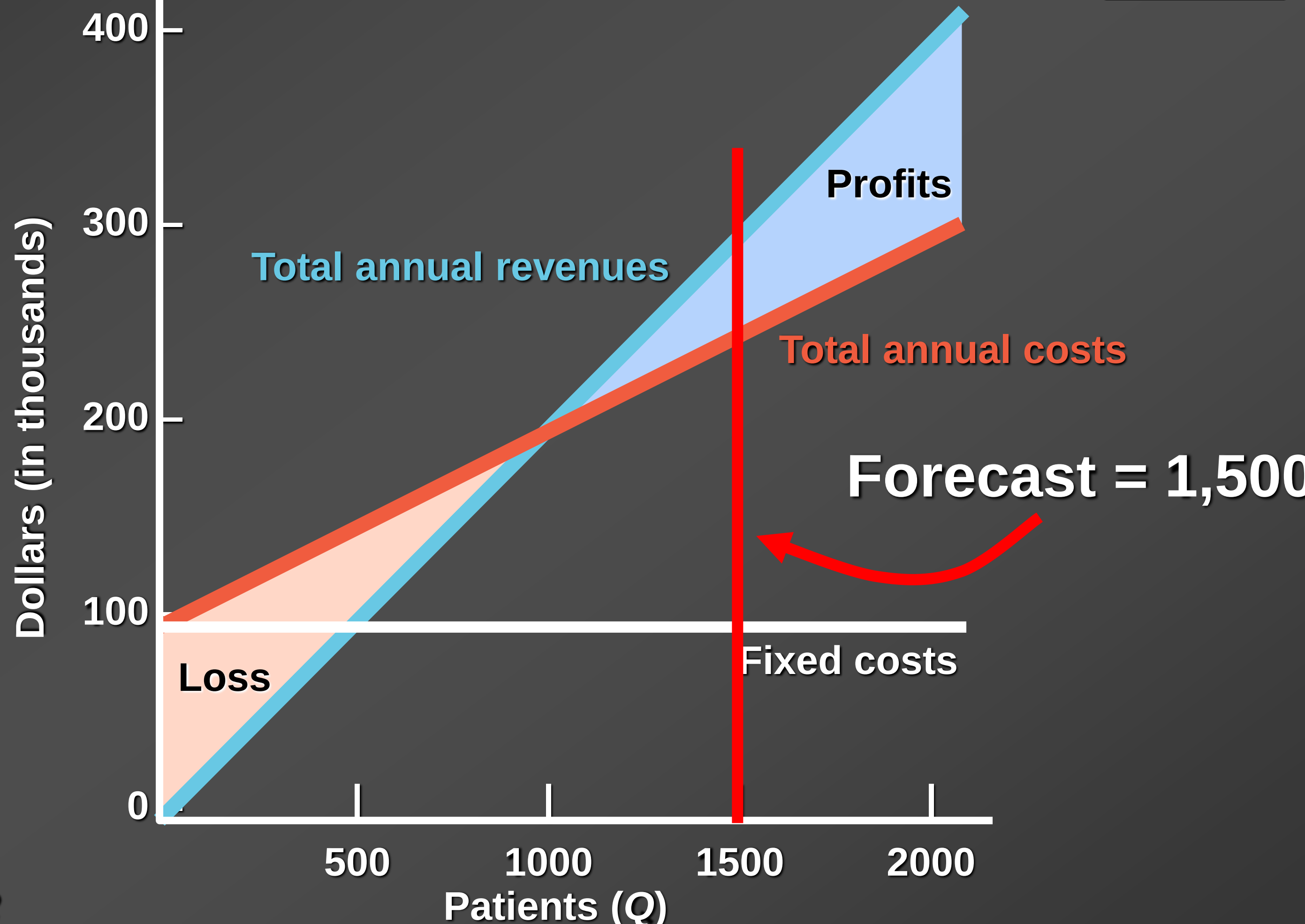
If the most pessimistic sales forecast for the proposed service in Figure A.I were 1,500 patients, what would be the procedure's total contribution to profit and overhead per year?

# Sensitivity Analysis




*Example A.2*

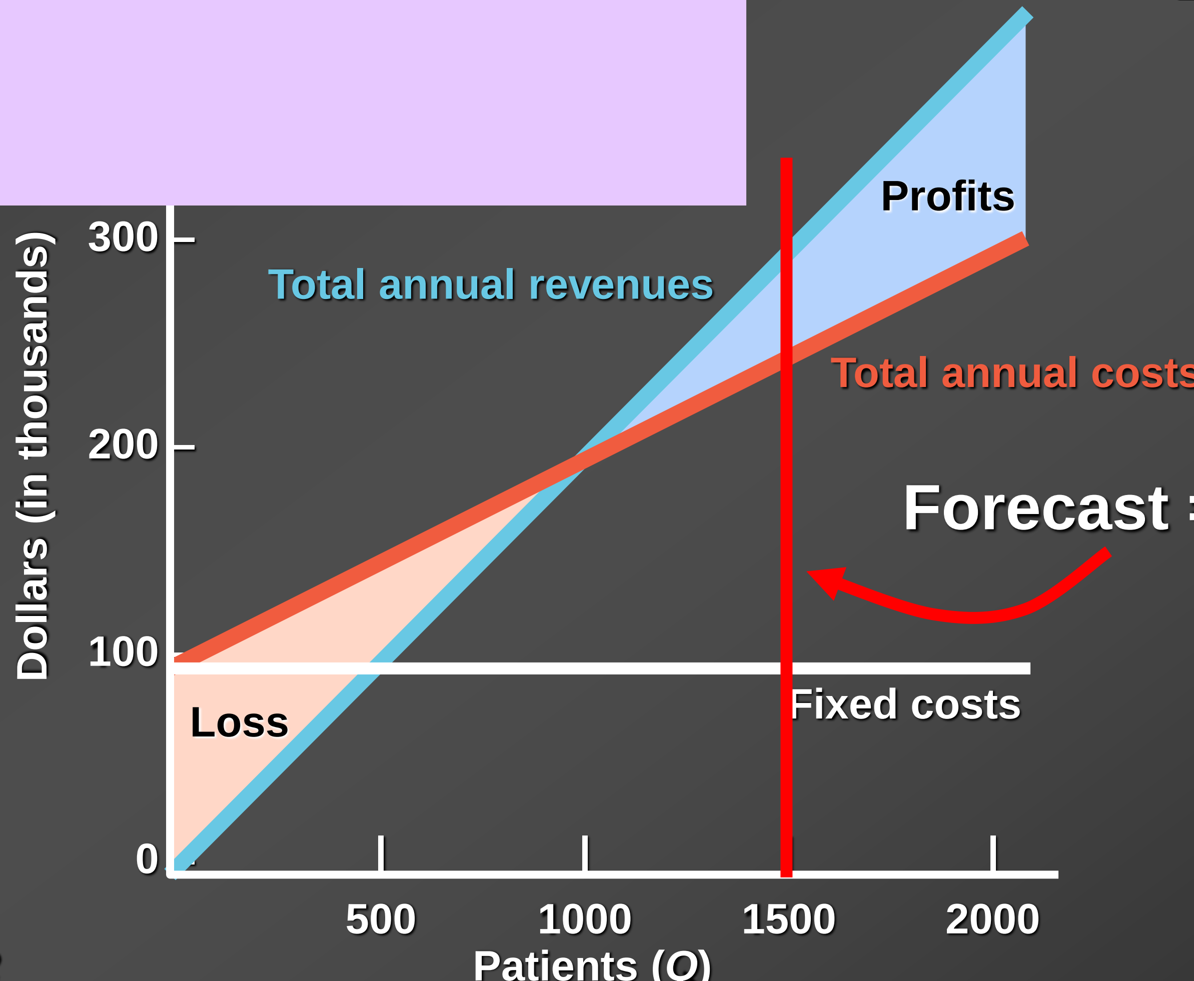
# Sensitivity Analysis




*Example A.2*

# Sensitivity Analysis

$$pQ - (F + cQ)$$




Forecast = 1,500

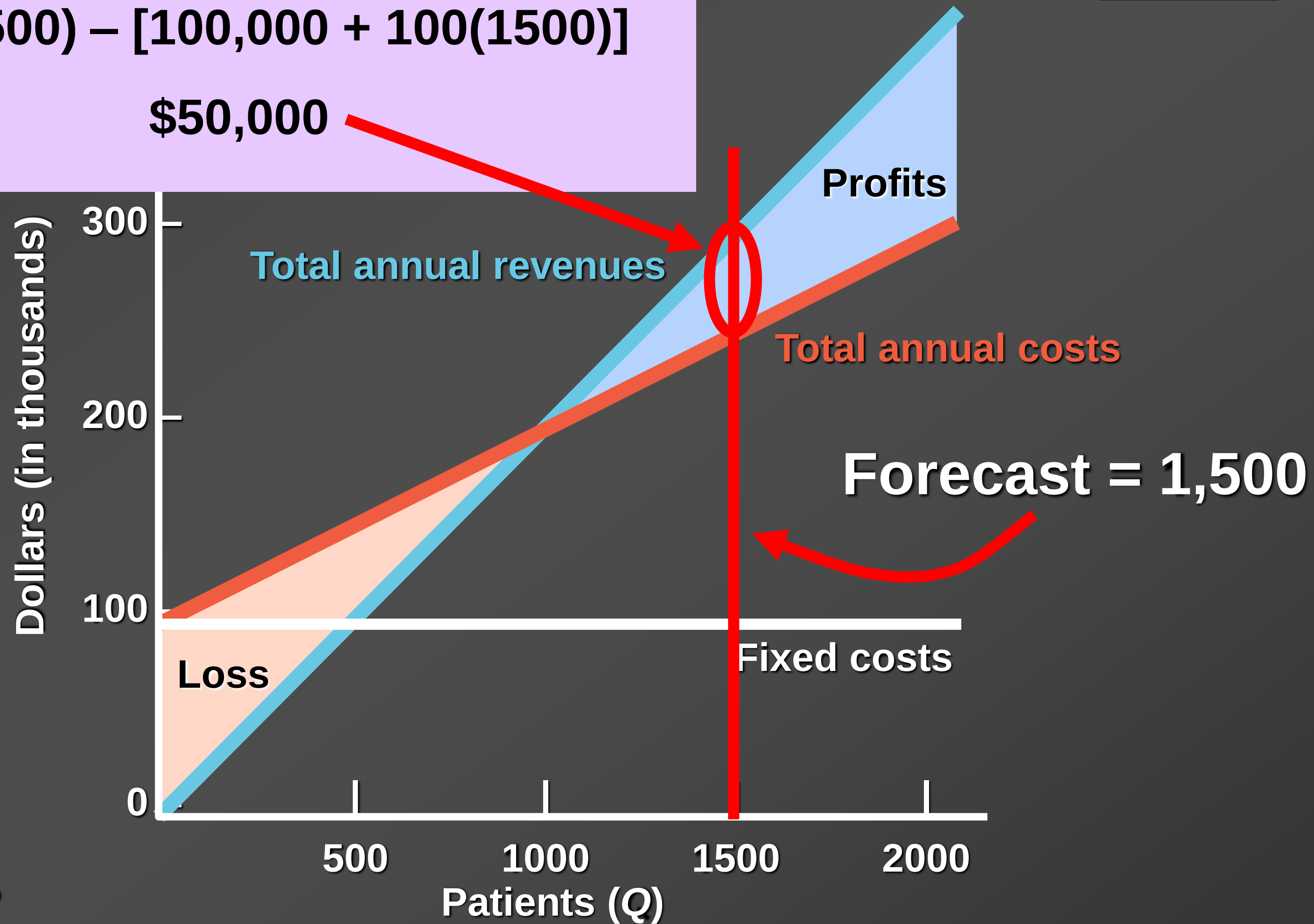
*Example A.2*

# Sensitivity Analysis

$$pQ - (F + cQ)$$

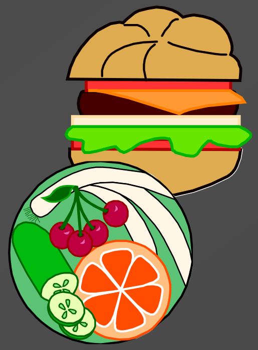
**200(1500) – [100,000 + 100(1500)]**

**$50,000**




*Example A.2*

# Make-or-Buy Decisions



***Evaluating processes***

# Buying choice exercice

- Bagot Copy Shop has a volume of 125,000 black-and-white copies per month. Two salespeople have made presentations to Gordon Bagot for machines of equal quality and reliability.
- The Print Shop 5 has a cost of $2,000 per month and a variable cost of $.03. The other machine (a Speed Copy 100) will cost only $1,500 per month, but the toner is more expensive, driving the cost per copy up to $.035.
- If cost and volume are the only considerations, which machine should Bagot purchase?

The manager of a fast-food restaurant featuring hamburgers is adding salads to the menu.
There are two options, and the price to the customer will be the same for each. The make option is to install a salad bar stocked with vegetables, fruits, and toppings and let the customer assemble the salad. The salad bar would have to be leased and a part-time employee hired. The manager estimates the fixed costs at $12,000 and variable costs totaling $1.50 per salad. The buy option is to have preassembled salads available for sale. They would be purchased from a local supplier at $2.00 per salad. Offering preassembled salads would require installation and operation of additional refrigeration, with an annual fixed cost of $2,400. The manager expects to sell 25,000 salads per year.

What is the break-even quantity?

# Make-or-Buy Decisions

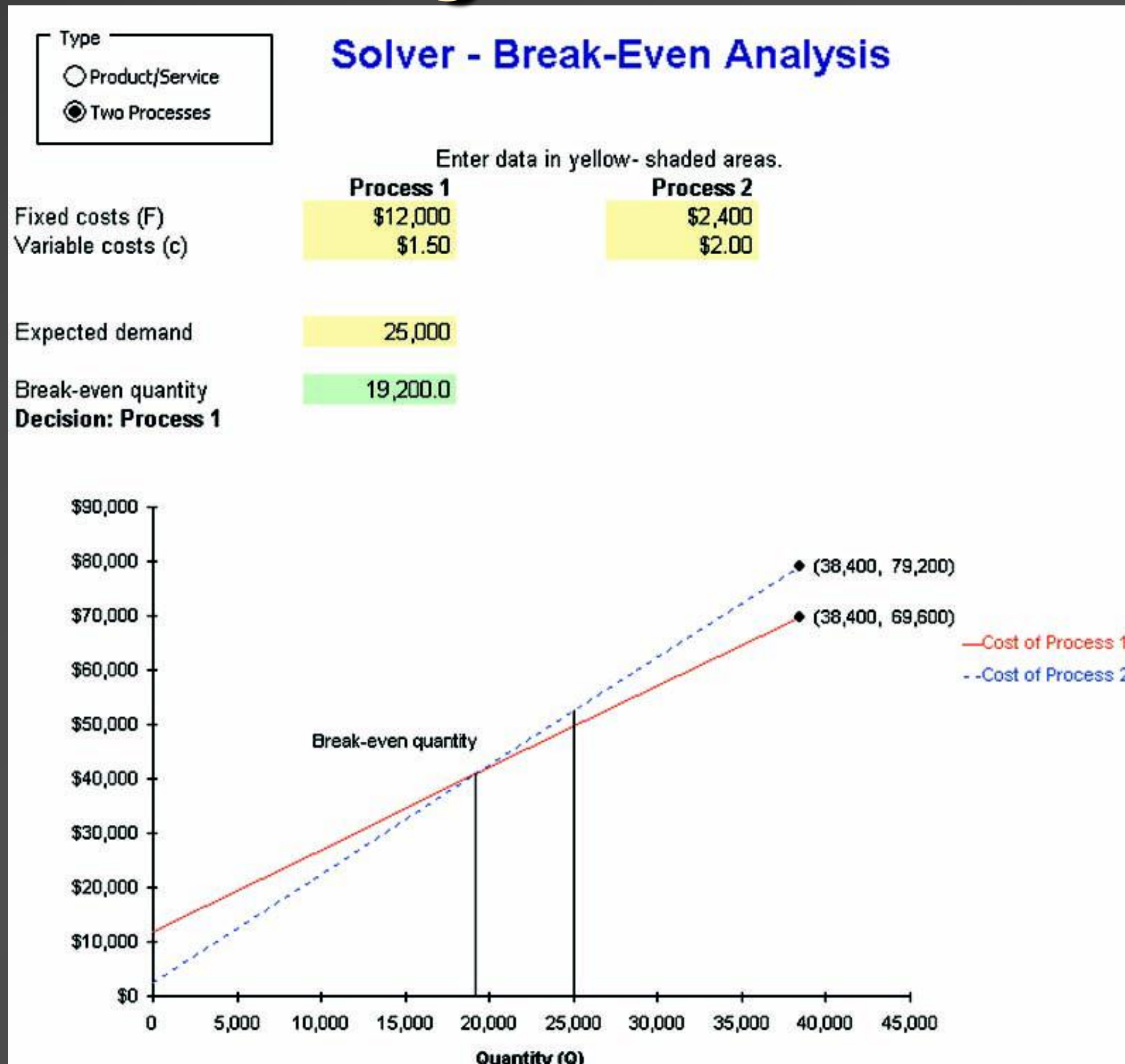
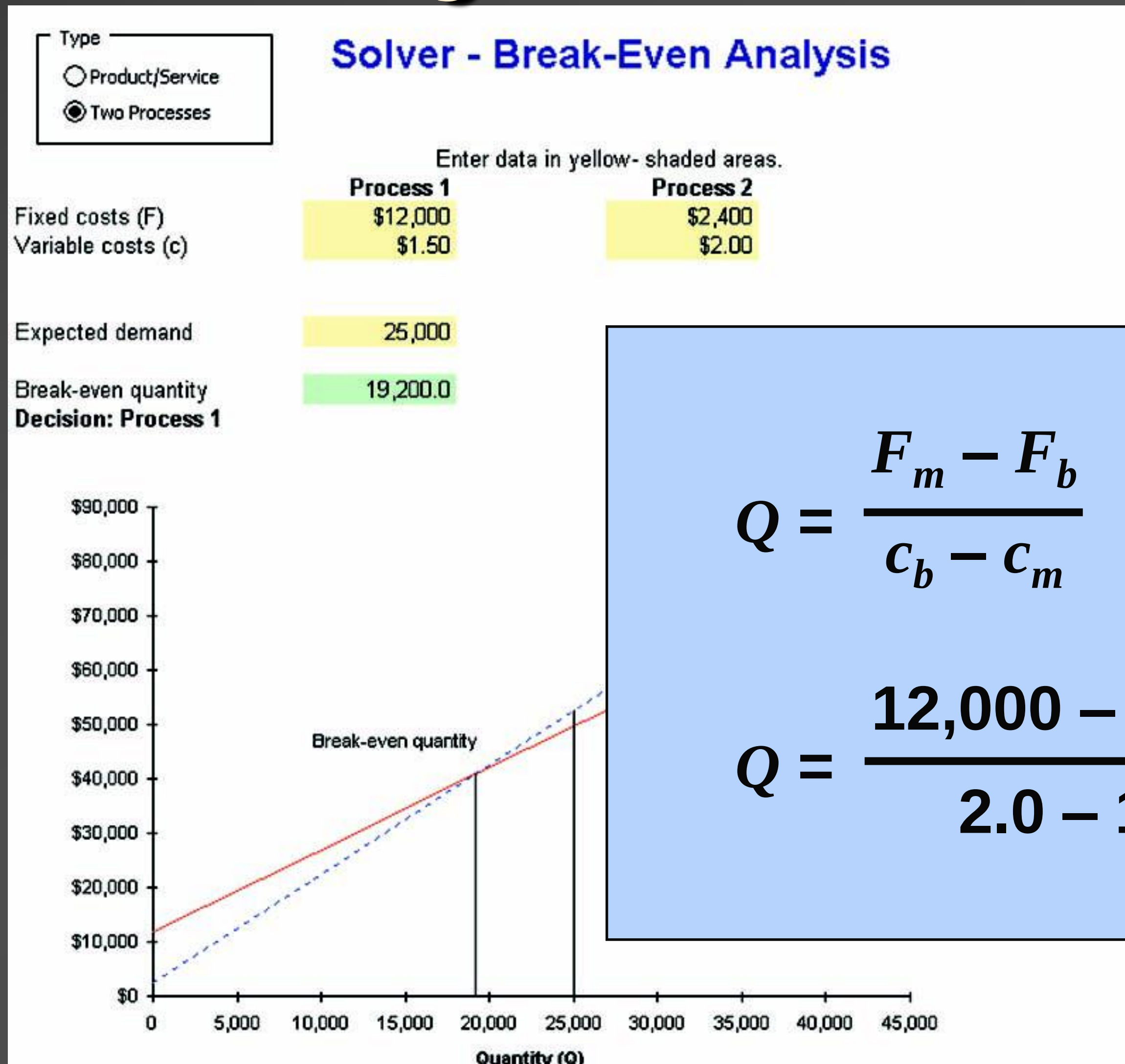



*Figure A.2*

# Make-or-Buy Decisions

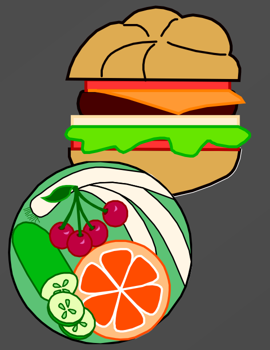



$$Q = \frac{F_m - F_b}{c_b - c_m}$$

$$Q = \frac{12{,}000 - 2{,}400}{2.0 - 1.5}$$

***Example A.3***

# Make-or-Buy Decisions



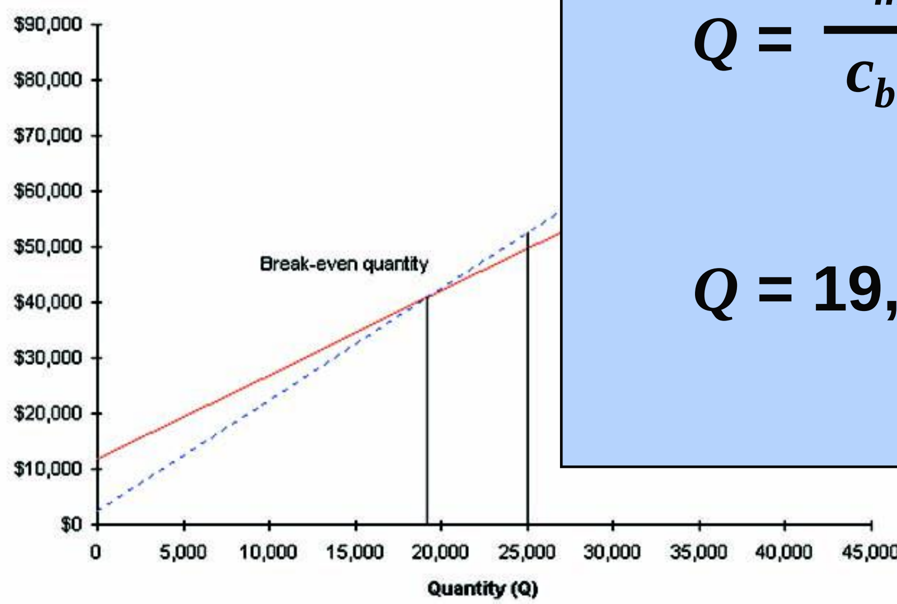
**Solver - Break-Even Analysis**

Type
- ○ Product/Service
- ◉ Two Processes

Enter data in yellow- shaded areas.

| | Process 1 | Process 2 |
|---|---|---|
| Fixed costs (F) | $12,000 | $2,400 |
| Variable costs (c) | $1.50 | $2.00 |
| Expected demand | 25,000 | |
| Break-even quantity | 19,200.0 | |

**Decision: Process 1**




$$Q = \frac{F_m - F_b}{c_b - c_m}$$

$Q$ = 19,200 salads

*Example A.3*

# *Break-even including several products*

John has been asked to determine whether the $22.50 cost of tickets for the community dinner theater will allow the group to achieve break-even and whether the 175 seating capacity is adequate. The cost for each performance of a 10-performance run is $2,500. The facility rental cost for the entire 10 performances is $10,000. Drinks and parking are extra charges and have their own price and variable costs, as shown below:

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| | SELLING PRICE (*P*) | VARIABLE COST (*V*) | PERCENT VARIABLE COST (*V/P*) | CONTRIBUTION 1 − (*V/P*) | ESTIMATED QUANTITY OF SALES UNITS (SALES) | DOLLAR SALES (SALES × *P*) | PERCENT OF SALES | CONTRIBUTION WEIGHTED BY PERCENT SALES (COL.5 × COL. 8) |
| Tickets with dinner | $22.50 | $10.50 | 0.467 | 0.533 | 175 | $3,938 | 0.741 | 0.395 |
| Drinks | $ 5.00 | $ 1.75 | 0.350 | 0.650 | 175 | $ 875 | 0.165 | 0.107 |
| Parking | $ 5.00 | $ 2.00 | 0.400 | 0.600 | 100 | $ 500 | 0.094 | 0.056 |
| | | | | | 450 | $5,313 | 1.000 | 0.558 |

John has been asked to determine whether the $22.50 cost of tickets for the community dinner theater will allow the group to achieve break-even and whether the 175 seating capacity is adequate. The cost for each performance of a 10-performance run is $2,500. The facility rental cost for the entire 10 performances is $10,000. Drinks and parking are extra charges and have their own price and variable costs, as shown below:

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|---|---|---|---|---|---|---|---|---|
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| Tickets with dinner | $22.50 | $10.50 | 0.467 | 0.533 | 175 | $3,938 | 0.741 | 0.395 |
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| Parking | $ 5.00 | $ 2.00 | 0.400 | 0.600 | 100 | $ 500 | 0.094 | 0.056 |
| | | | | | 450 | $5,313 | 1.000 | 0.558 |

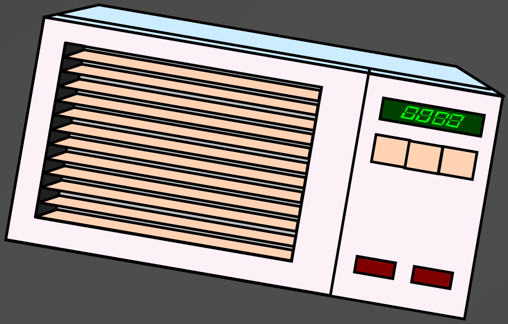
## SOLUTION

$$BEP_\$ = \frac{F}{\sum\left[\left(1 - \frac{V_i}{P_i}\right) \times (W_i)\right]} = \frac{\$(10 \times 2{,}500) + \$10{,}000}{0.558} = \frac{\$35{,}000}{0.558} = \$62{,}724$$

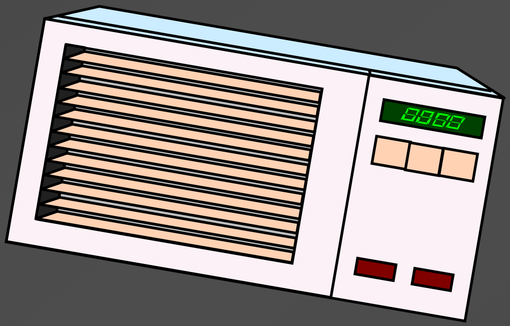
Revenue for each performance (from column 7) = $5,313
Total forecasted revenue for the 10 performances = (10 × $5,313) = $53,130
Forecasted revenue with this mix of sales shows a break-even of $62,724

Thus, given this mix of costs, sales, and capacity John determines that the theater will not break even.

# Preference Matrix



# Preference Matrix

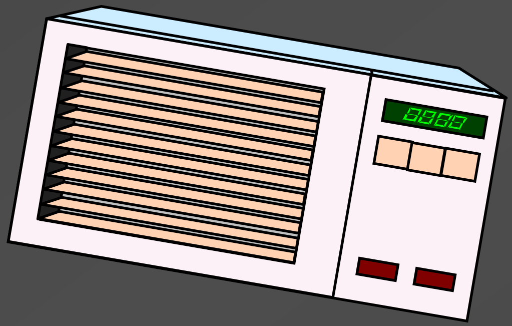


***Threshold score* = 800**

| Performance Criterion | Weight (*A*) | Score (*B*) | Weighted Score (*A* x *B*) |
|---|---|---|---|
| Market potential | | | |
| Unit profit margin | | | |
| Operations compatibility | | | |
| Competitive advantage | | | |
| Investment requirement | | | |
| Project risk | | | |

*Example A.4*

# *Preference Matrix*

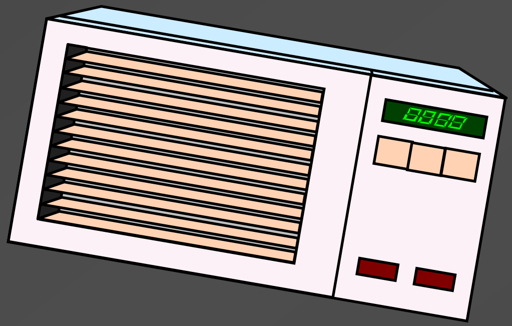


***Threshold score*** **= 800**

| Performance Criterion | Weight (*A*) | Score (*B*) | Weighted Score (*A* x *B*) |
|---|---|---|---|
| Market potential | 30 | | |
| Unit profit margin | 20 | | |
| Operations compatibility | 20 | | |
| Competitive advantage | 15 | | |
| Investment requirement | 10 | | |
| Project risk | 5 | | |

***Example A.4***

# Preference Matrix

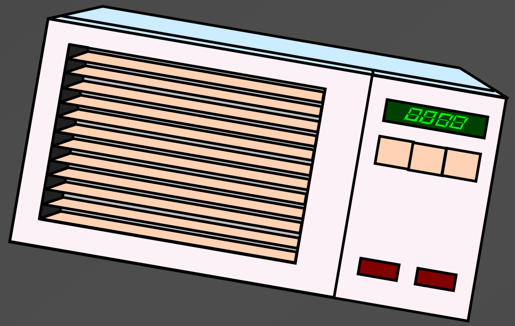


***Threshold score*** **= 800**

| Performance Criterion | Weight (*A*) | Score (*B*) | Weighted Score (*A* x *B*) |
|---|---|---|---|
| Market potential | 30 | 8 | |
| Unit profit margin | 20 | 10 | |
| Operations compatibility | 20 | 6 | |
| Competitive advantage | 15 | 10 | |
| Investment requirement | 10 | 2 | |
| Project risk | 5 | 4 | |

*Example A.4*

# Preference Matrix

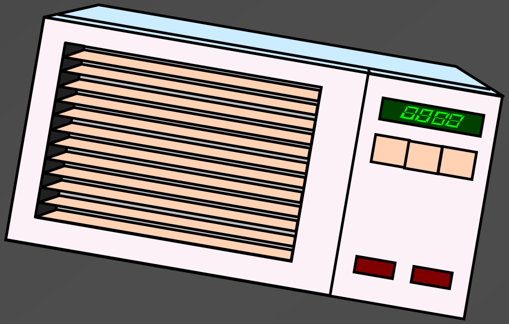


***Threshold score* = 800**

| Performance Criterion | Weight (*A*) | Score (*B*) | Weighted Score (*A* x *B*) |
|---|---|---|---|
| Market potential | 30 | 8 | 240 |
| Unit profit margin | 20 | 10 | 200 |
| Operations compatibility | 20 | 6 | 120 |
| Competitive advantage | 15 | 10 | 150 |
| Investment requirement | 10 | 2 | 20 |
| Project risk | 5 | 4 | 20 |

*Example A.4*

# *Preference Matrix*



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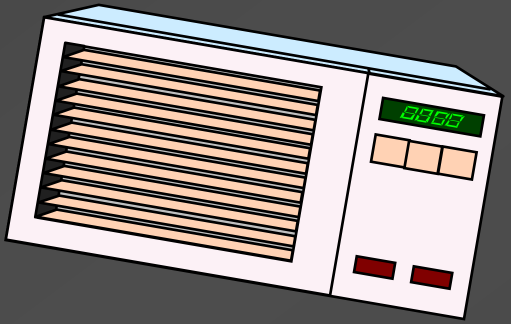
**Weighted score = 750**

***Example A.4***

# Preference Matrix



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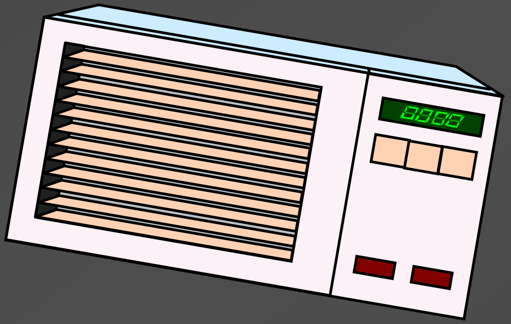
| Investment requirement | 10 | 2 | 20 |
| Project risk | 5 | 4 | 20 |

Weighted score = 750

< 800

*Example A.4*

# Preference Matrix



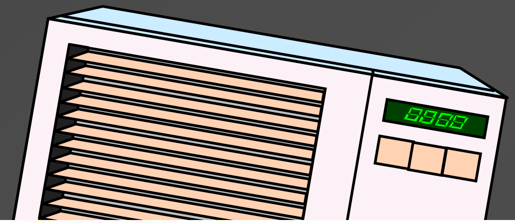
***Threshold score*** **= 800**

| Performance Criterion | Weight (*A*) | Score (*B*) | Weighted Score (*A* × *B*) |
|---|---|---|---|
| Market potential | 30 | 8 | 240 |
| Unit profit margin | 20 | 10 | 200 |
| Operations compatibility | 20 | 6 | 120 |
| Competitive advantage | 15 | 10 | 150 |
| Investment requirement | 10 | 2 | 20 |
| Project risk | 5 | 4 | 20 |
| | | Weighted score = | 750 |

**Not At This Time**

*Example A.4*

# Preference Matrix



## Solver - Preference Matrix

Replace the labels Criterion 1, Criterion 2, etc. with descriptions of your own criteria. Use the buttons above the list if you want to insert a criterion (between existing ones), add a criterion (at the end of the list), or remove a criterion. (You will not be able to reduce the number of criteria below two).

Enter the relative weights for the criteria. Remember that the weights must add up to 100. Enter the score for each criterion. Formulas in the weighted score column do the rest. The Final Weighted Score is the overall score for the product, procedure, or strategy you're considering.

Insert a Criterion | Add a Criterion | Remove a Criterion

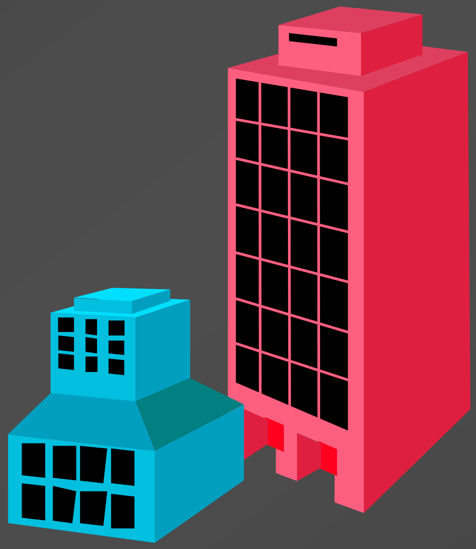
| | Weight (A) | Score (B) | Weighted Score (A x B) |
|---|---|---|---|
| Market potential | 30 | 8 | 240 |
| Unit profit margin | 20 | 10 | 200 |
| Operations compatability | 20 | 6 | 120 |
| Competitive advantage | 15 | 10 | 150 |
| Investment requirement | 10 | 2 | 20 |
| Project risk | 5 | 4 | 20 |
| Final Weighted Score | | | 750 |

**Figure A.3**

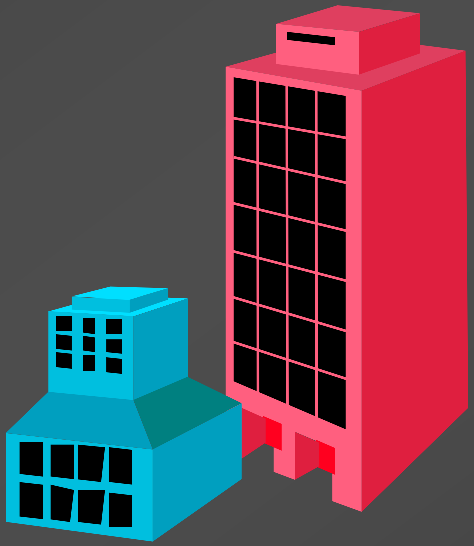
# 3- decision theory

- ***List the feasible alternatives***
- ***List the events***
- ***Calculate the payoff***
- ***Estimate the likelihood of each events***
- ***Select a decision rule***

# *Under Certainty*



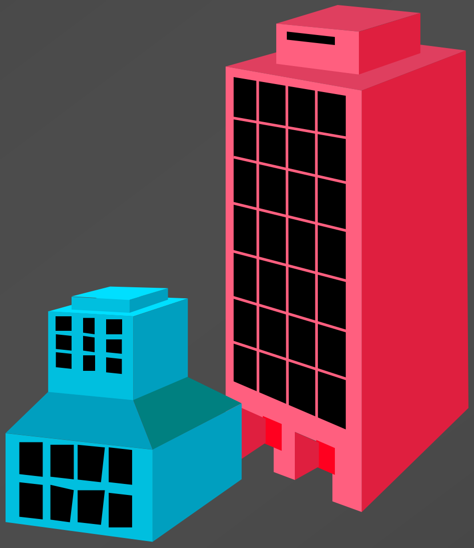
# Under Certainty



| Alternative | Possible Future Demand: Low | High |
|---|---|---|
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

*Example A.5*

# Under Certainty

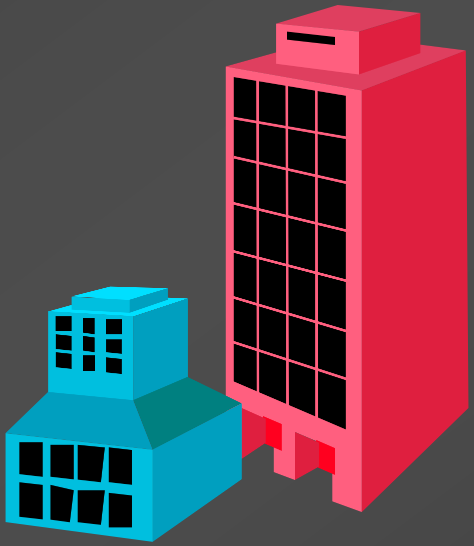


| | Possible Future Demand | |
|---|---|---|
| Alternative | Low | High |
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

***If future demand will be low –***

***Example A.5***

# Under Certainty

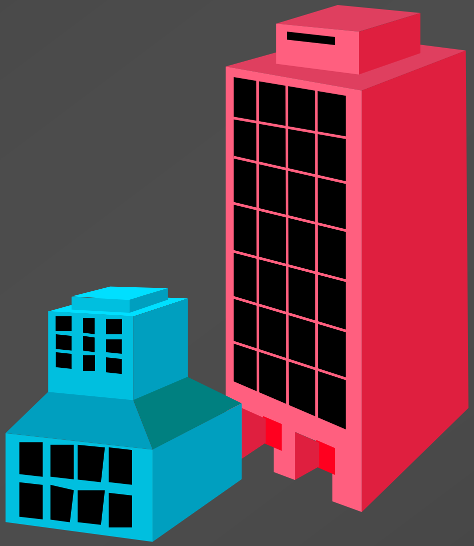


| Alternative | Possible Future Demand Low | High |
|---|---|---|
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

***If future demand will be low – Choose the small facility.***

***Example A.5***

# Under Certainty



| | Possible Future Demand | |
|---|---|---|
| Alternative | Low | High |
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

***If future demand will be low – Choose the small facility.***

***Example A.5***

# Under Uncertainty

| Alternative | Possible Future Demand: Low | High |
|---|---|---|
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

*Example A.6*

# *Under Uncertainty*

| Alternative | Possible Future Demand Low | High |
|---|---|---|
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

**Maximin –**

***Example A.6***

# Under Uncertainty

| | Possible Future Demand | |
|---|---|---|
| Alternative | Low | High |
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

Maximin –

***Best of the worst***

***Example A.6***

# Under Uncertainty

| Alternative | Possible Future Demand Low | High |
|---|---|---|
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

Maximin – Small

***Best of the worst***

***Example A.6***

# Under Uncertainty

| Alternative | Possible Future Demand: Low | High |
|---|---|---|
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

Maximin – Small
Maximax –

*Example A.6*

# *Under Uncertainty*

| Alternative | Possible Future Demand: Low | High |
|---|---|---|
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

Maximin – Small
Maximax –

***Best of the best***

*Example A.6*

# Under Uncertainty

| | Possible Future Demand | |
|---|---|---|
| Alternative | Low | High |
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

Maximin – Small
Maximax – Large

***Best of the best***

*Example A.6*

# *Under Uncertainty*

| Alternative | Possible Future Demand: Low | High |
|---|---|---|
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

**Maximin – Small**
**Maximax – Large**
**Laplace –**

***Example A.6***

# Under Uncertainty

| | Possible Future Demand | |
|---|---|---|
| Alternative | Low | High |
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

Maximin – Small
Maximax – Large
Laplace –

Small facility 0.5(200) + 0.5(270) = 235

***Best weighted payoff***

*Example A.6*

# *Under Uncertainty*

| Alternative | Possible Future Demand: Low | High |
|---|---|---|
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

**Maximin – Small**
**Maximax – Large**
**Laplace –**

| | |
|---|---|
| Small facility | 0.5(200) + 0.5(270) = 235 |
| Large facility | 0.5(160) + 0.5(800) = 480 |

***Best weighted payoff***

*Example A.6*

# Under Uncertainty

| | Possible Future Demand | |
|---|---|---|
| Alternative | Low | High |
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

Maximin – Small
Maximax – Large
Laplace – Large

Small facility 0.5(200) + 0.5(270) = 235
Large facility 0.5(160) + 0.5(800) = 480

***Best weighted payoff***

*Example A.6*

# *Under Uncertainty*

| Alternative | Possible Future Demand: Low | High |
|---|---|---|
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

**Maximin – Small**
**Maximax – Large**
**Laplace – Large**
**Minimax Regret –**

***Example A.6***

# Under Uncertainty

| Alternative | Possible Future Demand: Low | High |
|---|---|---|
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

Maximin – Small
Maximax – Large
Laplace – Large
Minimax Regret –

| | Regret: Low Demand | High Demand |
|---|---|---|
| Small facility | 200 – 200 = 0 | 800 – 270 = 530 |

***Best worst regret***

***Example A.6***

# *Under Uncertainty*

| | Possible Future Demand | |
|---|---|---|
| **Alternative** | **Low** | **High** |
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

Maximin – Small
Maximax – Large
Laplace – Large
Minimax Regret –

| | Regret | |
|---|---|---|
| | **Low Demand** | **High Demand** |
| Small facility | 200 – 200 = 0 | 800 – 270 = 530 |
| Large facility | 200 – 160 = 40 | 800 – 800 = 0 |

***Best worst regret***

*Example A.6*

# *Under Uncertainty*

| Alternative | Possible Future Demand: Low | High |
|---|---|---|
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

Maximin – Small
Maximax – Large
Laplace – Large
Minimax Regret – Large

Regret

| | Low Demand | High Demand |
|---|---|---|
| Small facility | 200 – 200 = 0 | 800 – 270 = 530 |
| Large facility | 200 – 160 = 40 | 800 – 800 = 0 |

***Best worst regret***

*Example A.6*

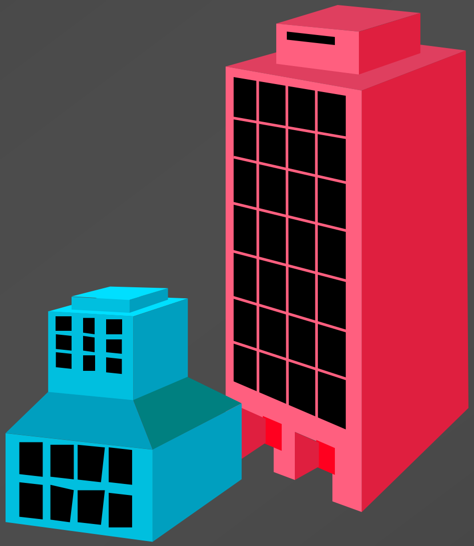
# *Under Uncertainty*

| Alternative | Possible Future Demand: Low | High |
|---|---|---|
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

**Maximin – Small**
**Maximax – Large**
**Laplace – Large**
**Minimax Regret – Large**

***Example A.6***

# *Under Risk*



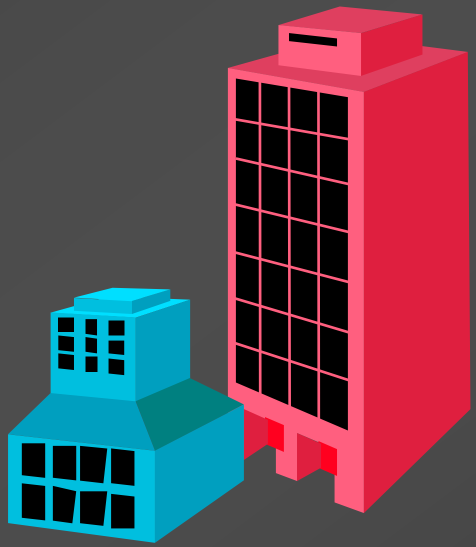
| Alternative | Possible Future Demand Low | High |
|---|---|---|
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

$P_{\text{small}} = 0.4$

$P_{\text{large}} = 0.6$

***Example A.7***

# Under Risk



| | Possible Future Demand | |
|---|---|---|
| **Alternative** | **Low** | **High** |
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

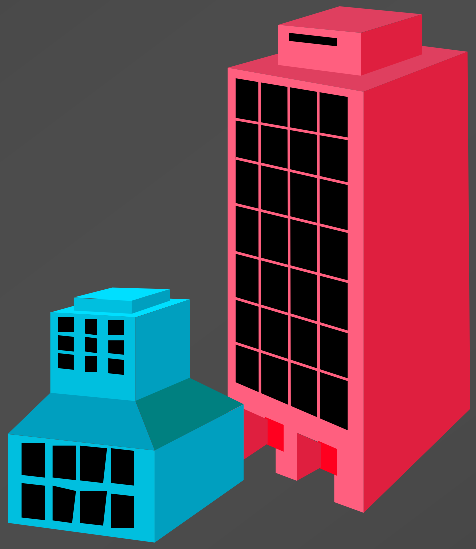
$P_{small} = 0.4$

$P_{large} = 0.6$

| Alternative | Expected Value |
|---|---|
| Small facility | 0.4(200) + 0.6(270) = 242 |

*Example A.7*

# Under Risk



| Alternative | Possible Future Demand Low | High |
|---|---|---|
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

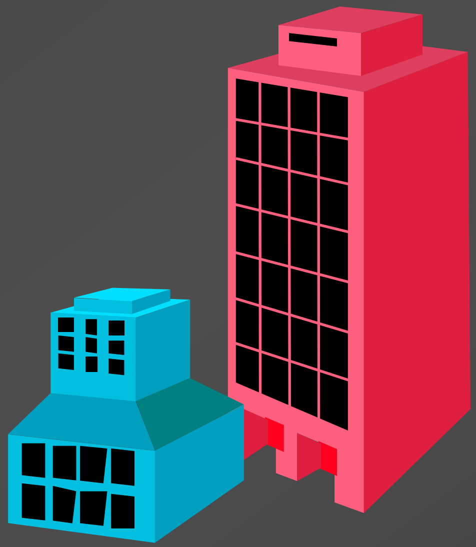
$P_{small} = 0.4$

$P_{large} = 0.6$

| Alternative | Expected Value |
|---|---|
| Small facility | 0.4(200) + 0.6(270) = 242 |
| Large facility | 0.4(160) + 0.6(800) = 544 |

*Example A.7*

# Under Risk



| Alternative | Possible Future Demand: Low | High |
|---|---|---|
| Small facility | 200 | 270 |
| Large facility | 160 | 800 |
| Do nothing | 0 | 0 |

$P_{small} = 0.4$

$P_{large} = 0.6$

| Alternative | Expected Value |
|---|---|
| Small facility | 0.4(200) + 0.6(270) = 242 |
| Large facility | 0.4(160) + 0.6(800) = 544 |

**Highest Expected Value**

*Example A.7*

# Under Risk

Figure A.4

## Solver - Decision Theory

Enter data in yellow-shaded areas.

This solver can accommodate between two and five events and between two and six alternatives. Replace the event and alternative names with your own (delete any unused labels). Then enter the payoff estimates directly in the first table. Also, enter probabilities for the events if you plan to use the Expected Value decision rule. Using the dropdown menu, you can then view the alternative chosen for each decision rule, and the payoff that goes with its choice.

**Payoff Scenarios**

| | 1: | 2: | 3: | 4: | 5: |
|---|---|---|---|---|---|
| | Low Demand | High Demand | | | |
| Probabilities----> | 0.4 | 0.6 | | | |
| Small Facility | 200 | 270 | | | |
| Large Facility | 160 | 800 | | | |

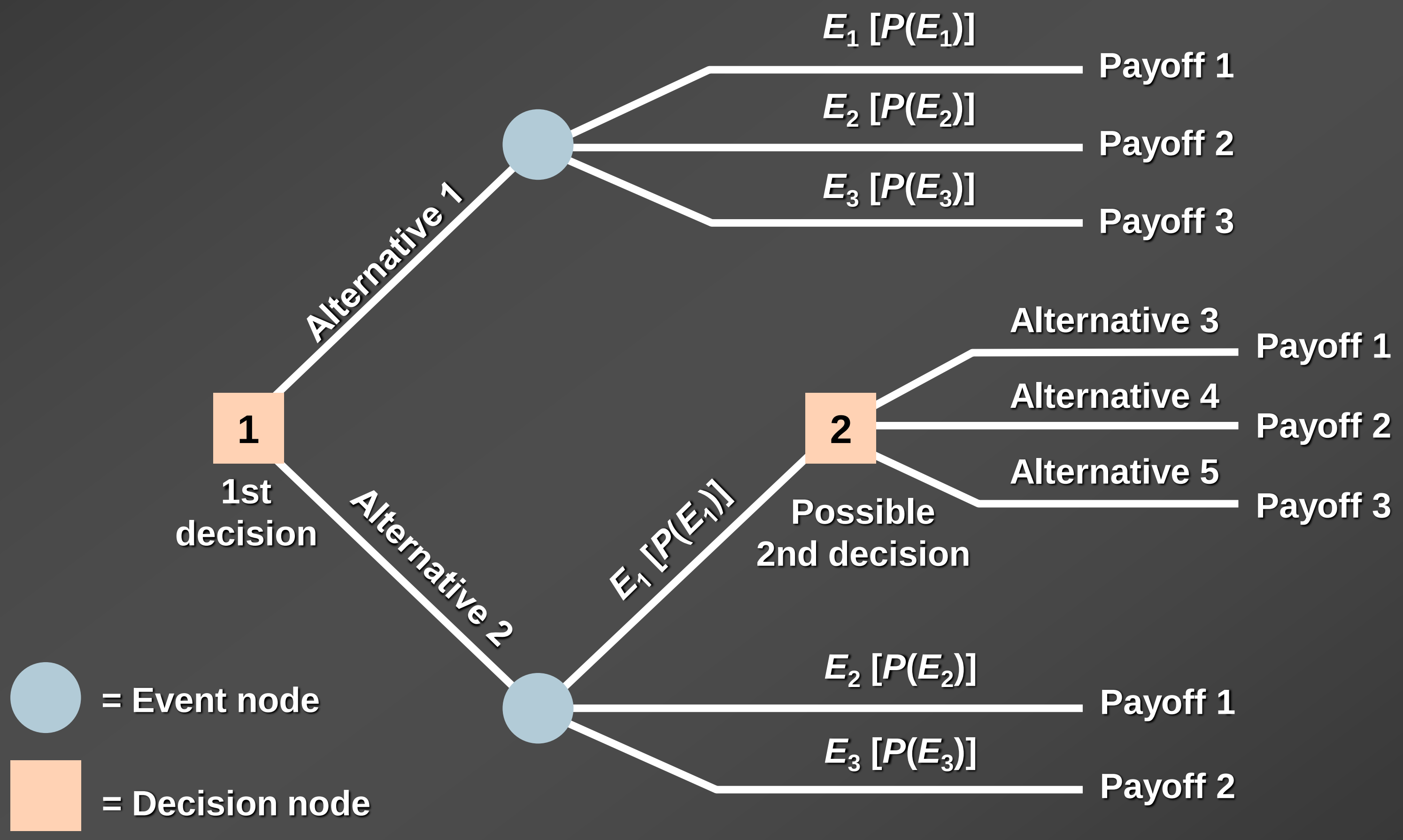
**Use the dropdown list to select the decision rule >>>** Expected Value

**Selected decision rule indicates you should select:** Large Facility

**Expected Payoff** $544

# Decision Trees

# Decision Trees

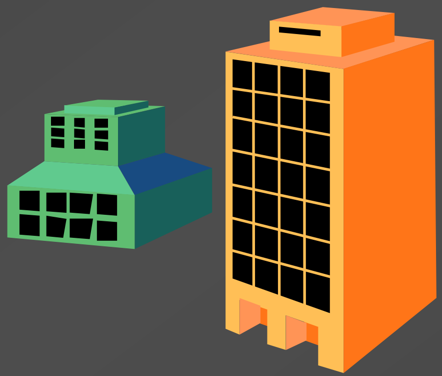



$E_i$ = Event *i*

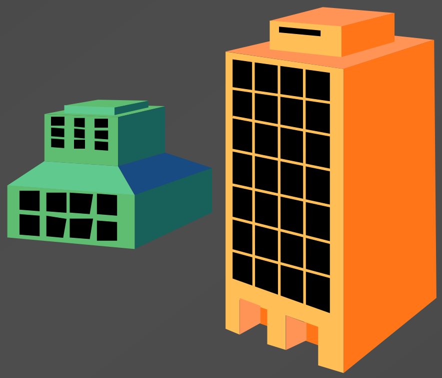
$P(E_i)$ = Probability of event *i*

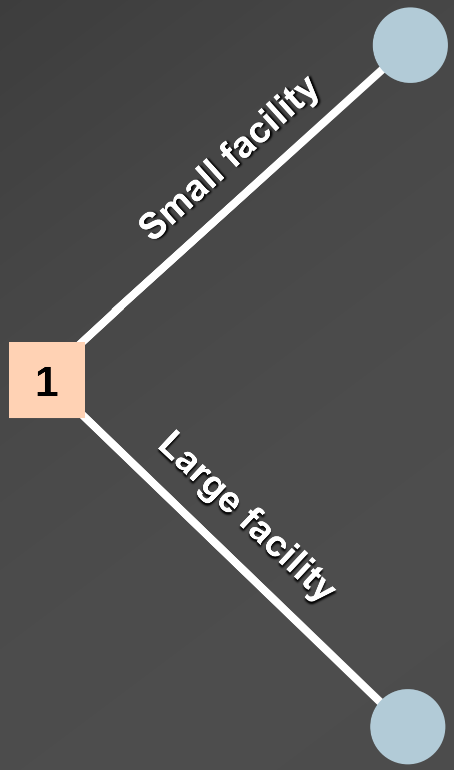
*Figure A.5*

# Decision Trees



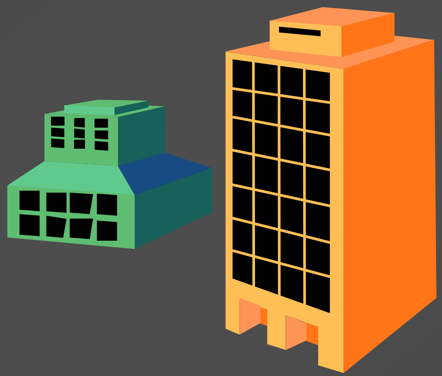
# *Decision Trees*

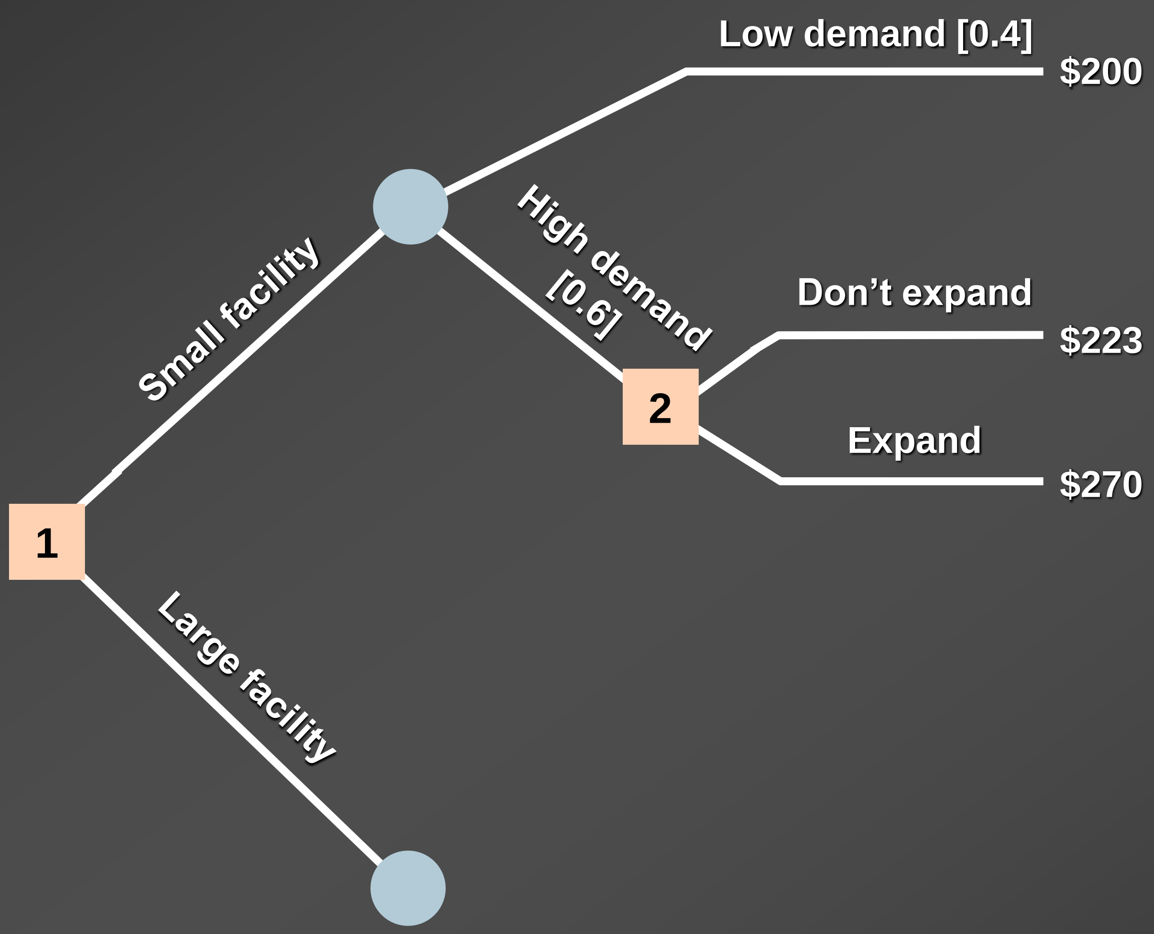





***Example A.9***

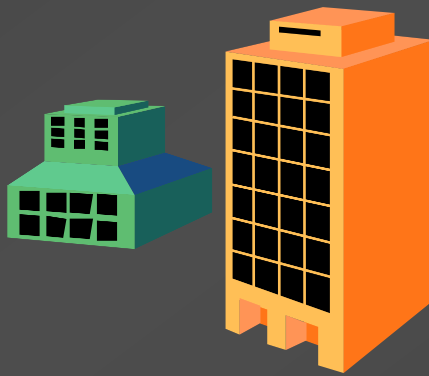
# Decision Trees

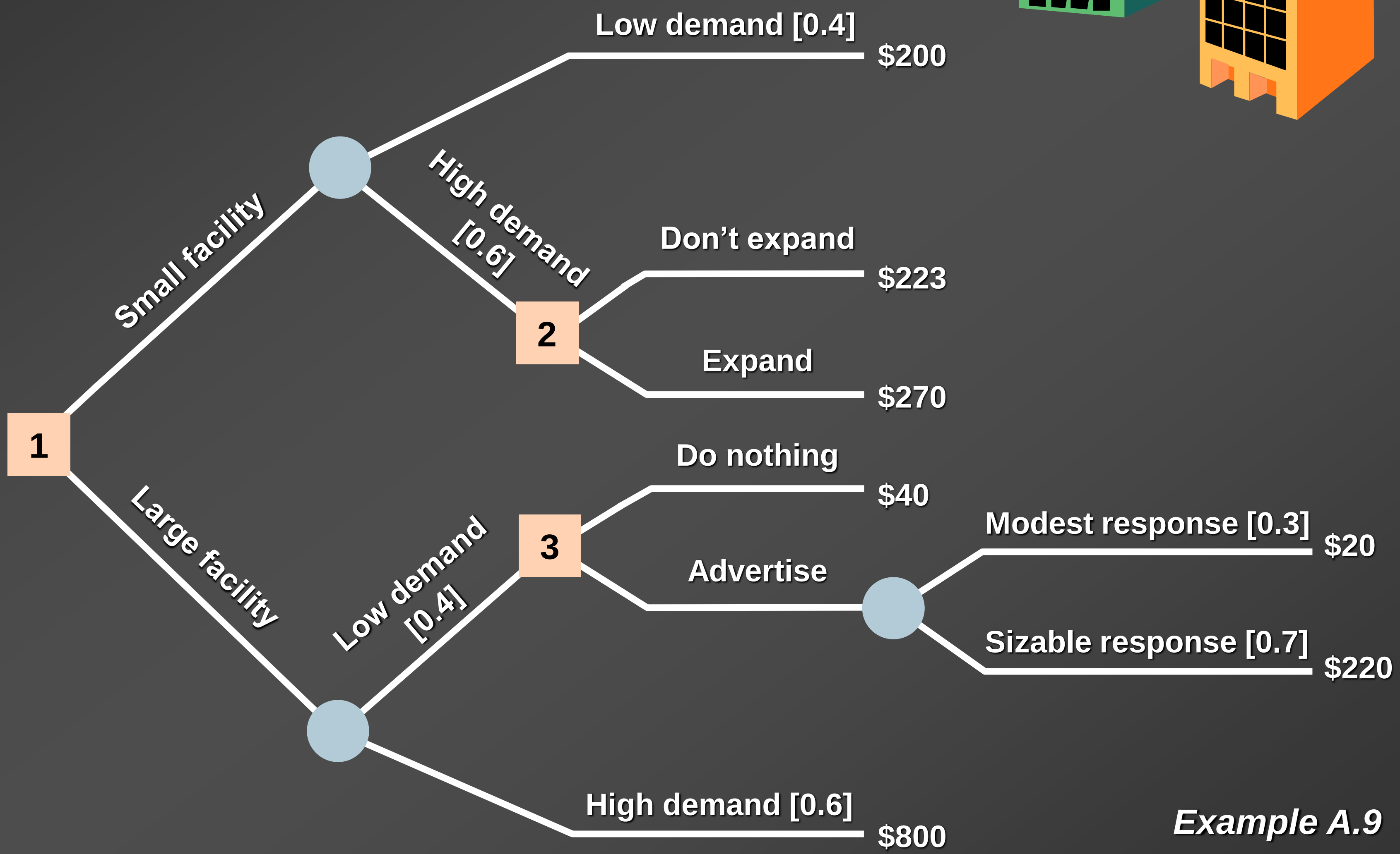





*Example A.9*

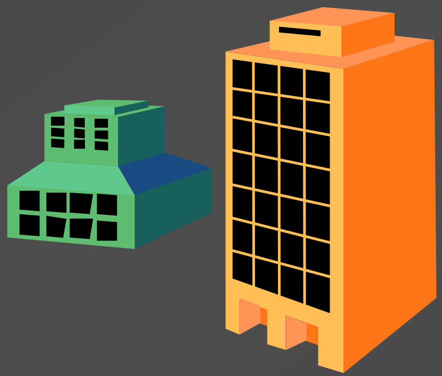
# Decision Trees

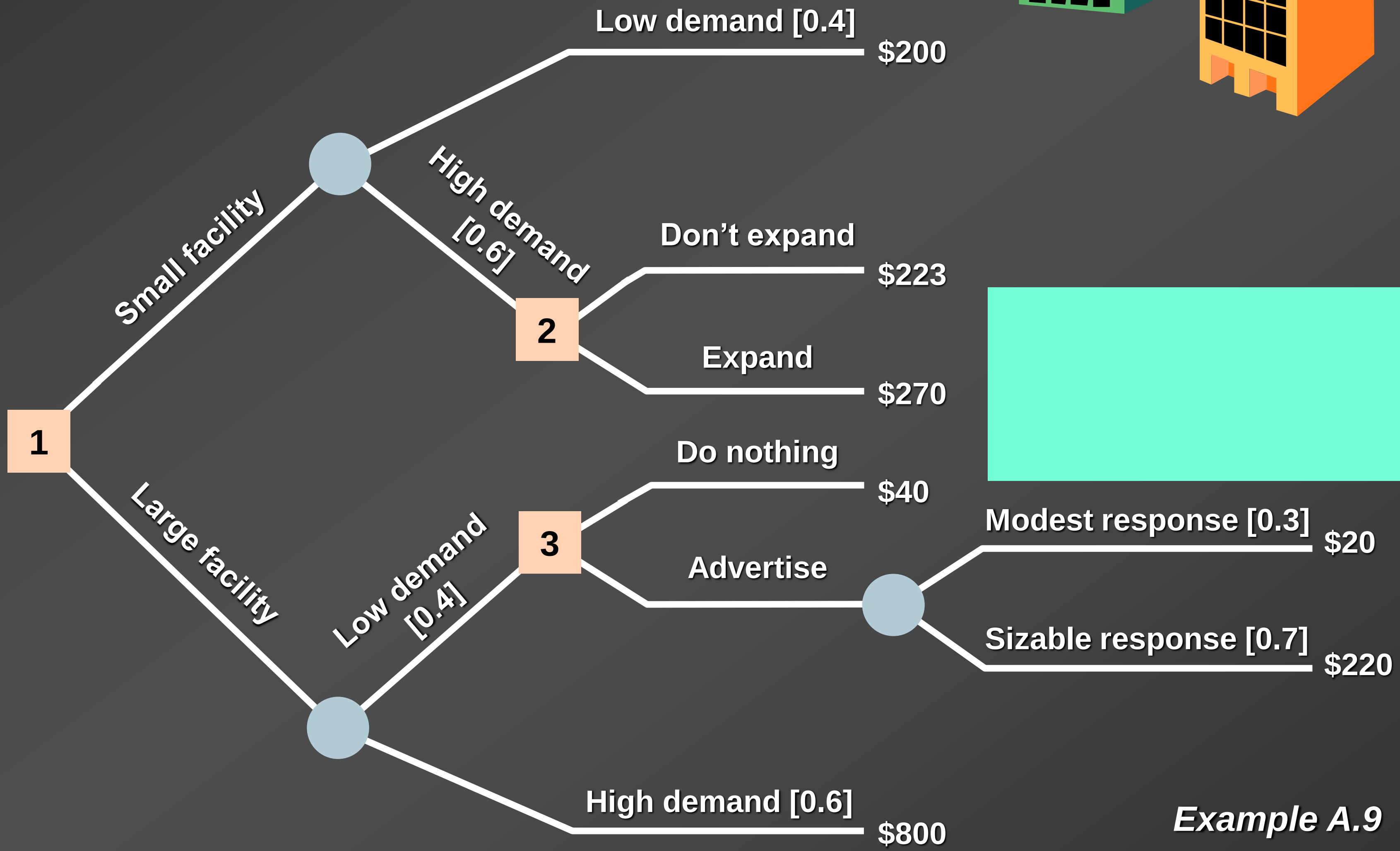





*Example A.9*

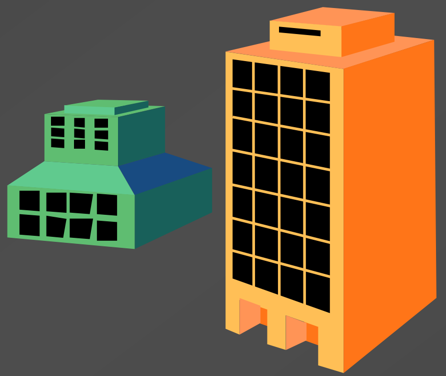
# Decision Trees

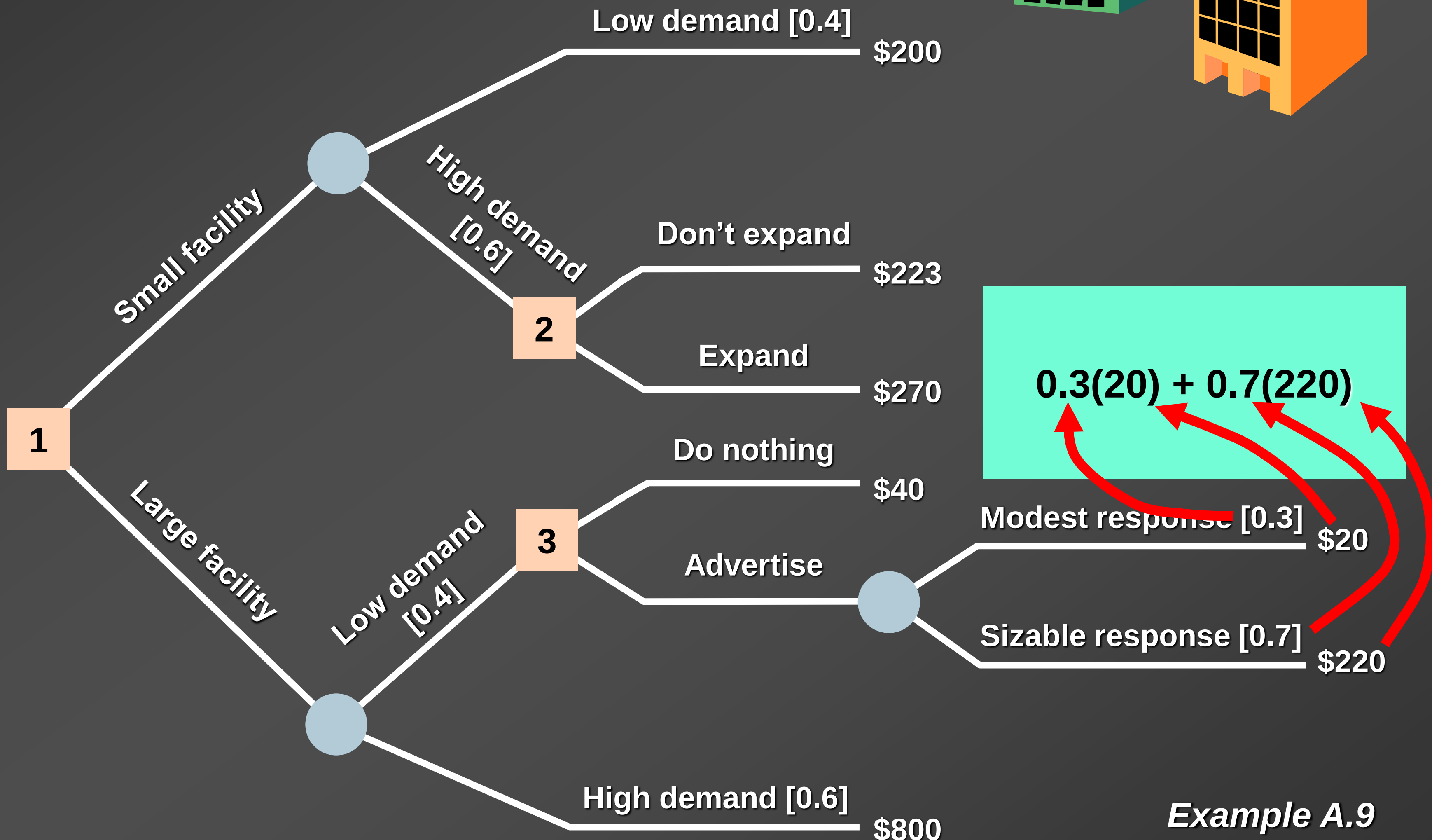





*Example A.9*

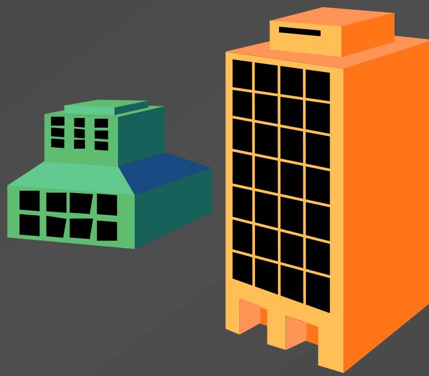
# Decision Trees

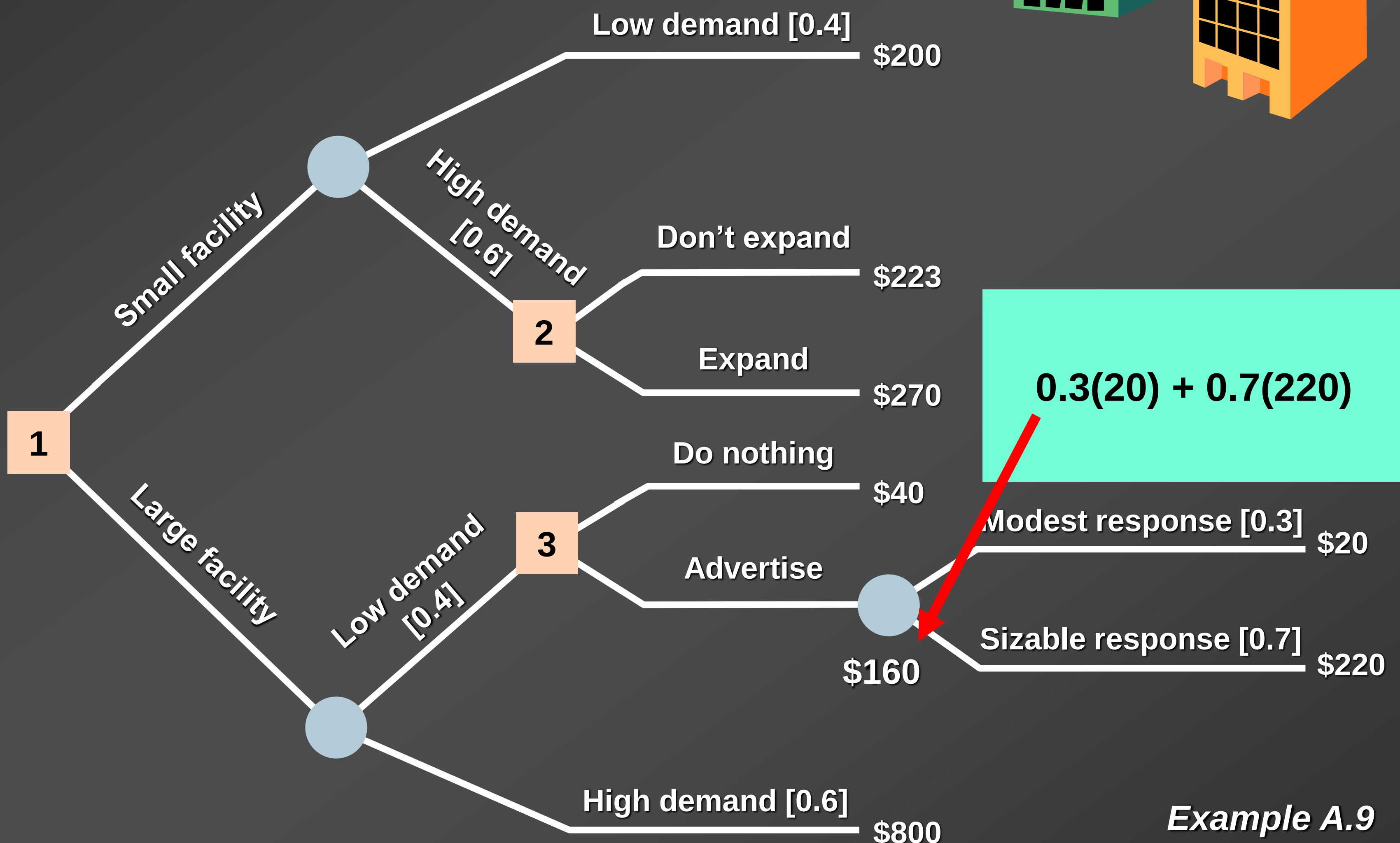





*Example A.9*

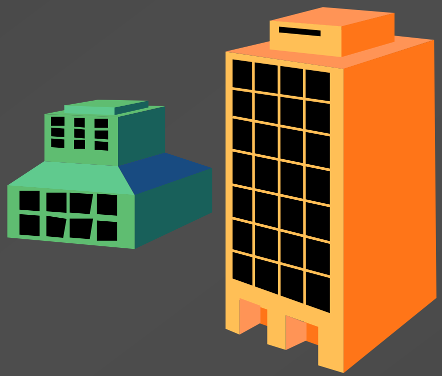
# *Decision Trees*

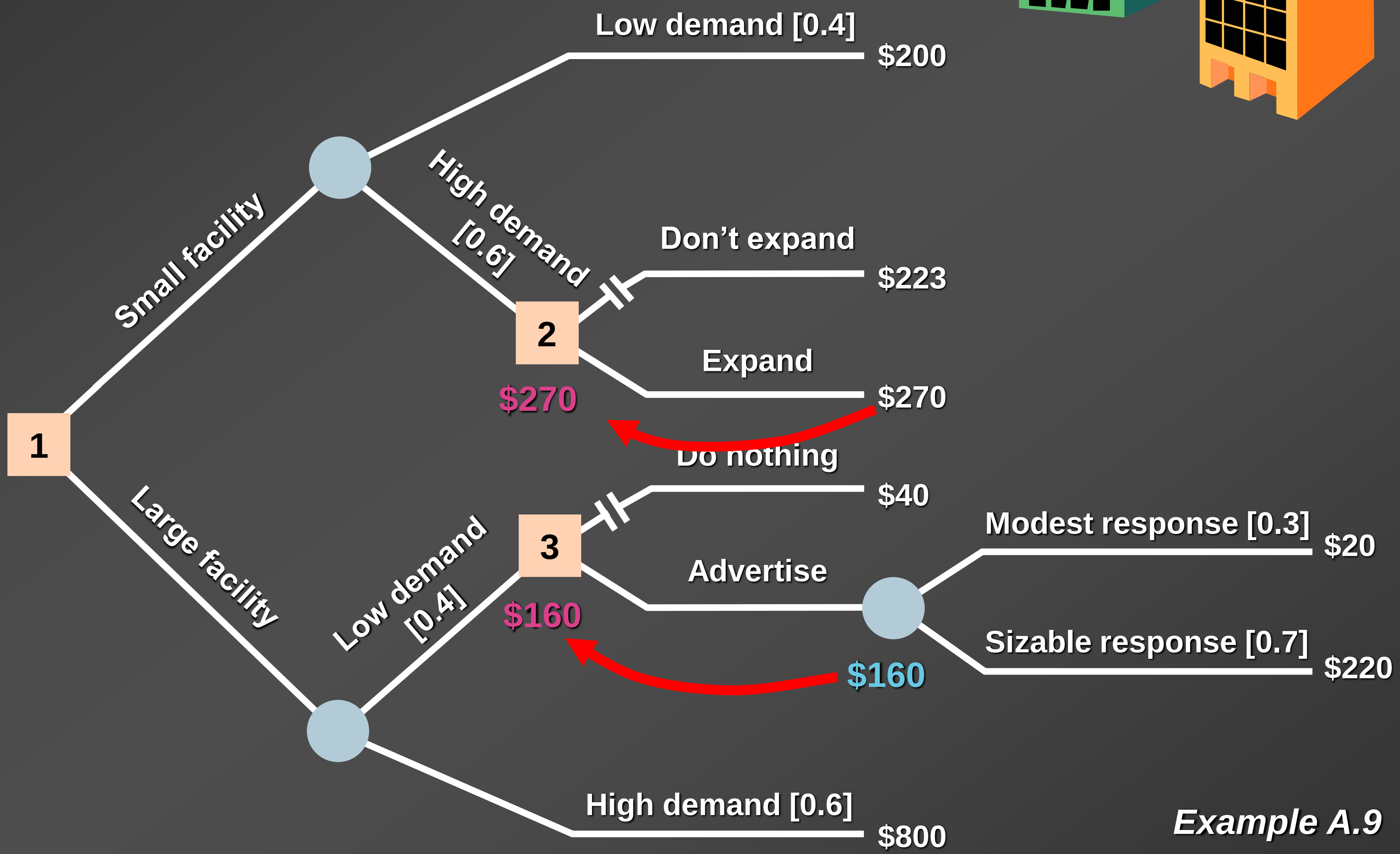





*Example A.9*

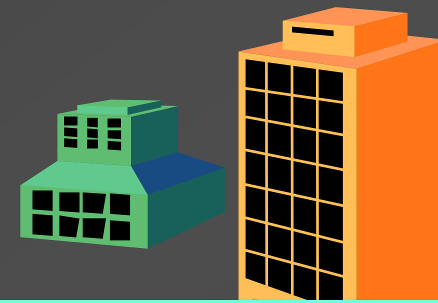
# Decision Trees

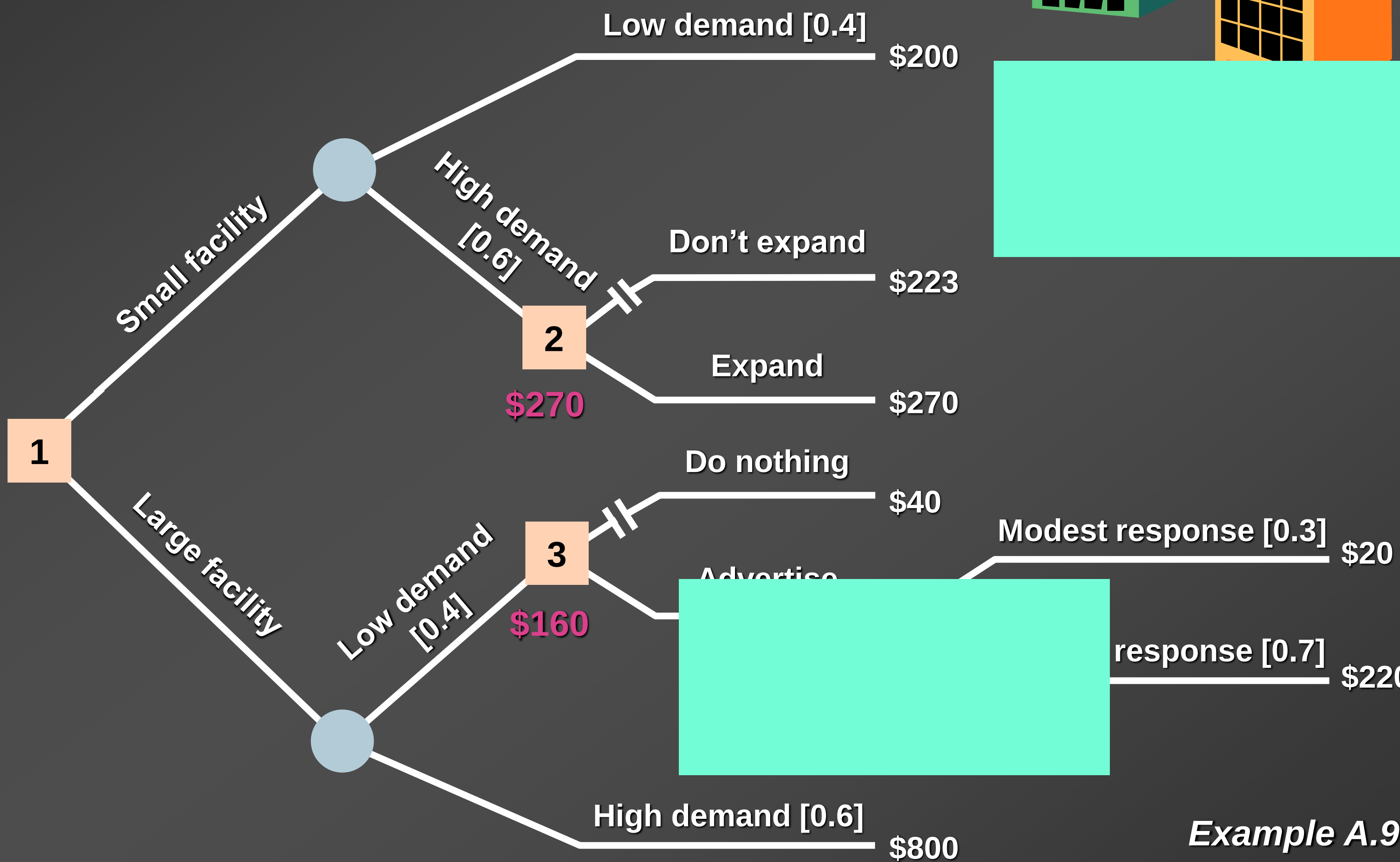





*Example A.9*

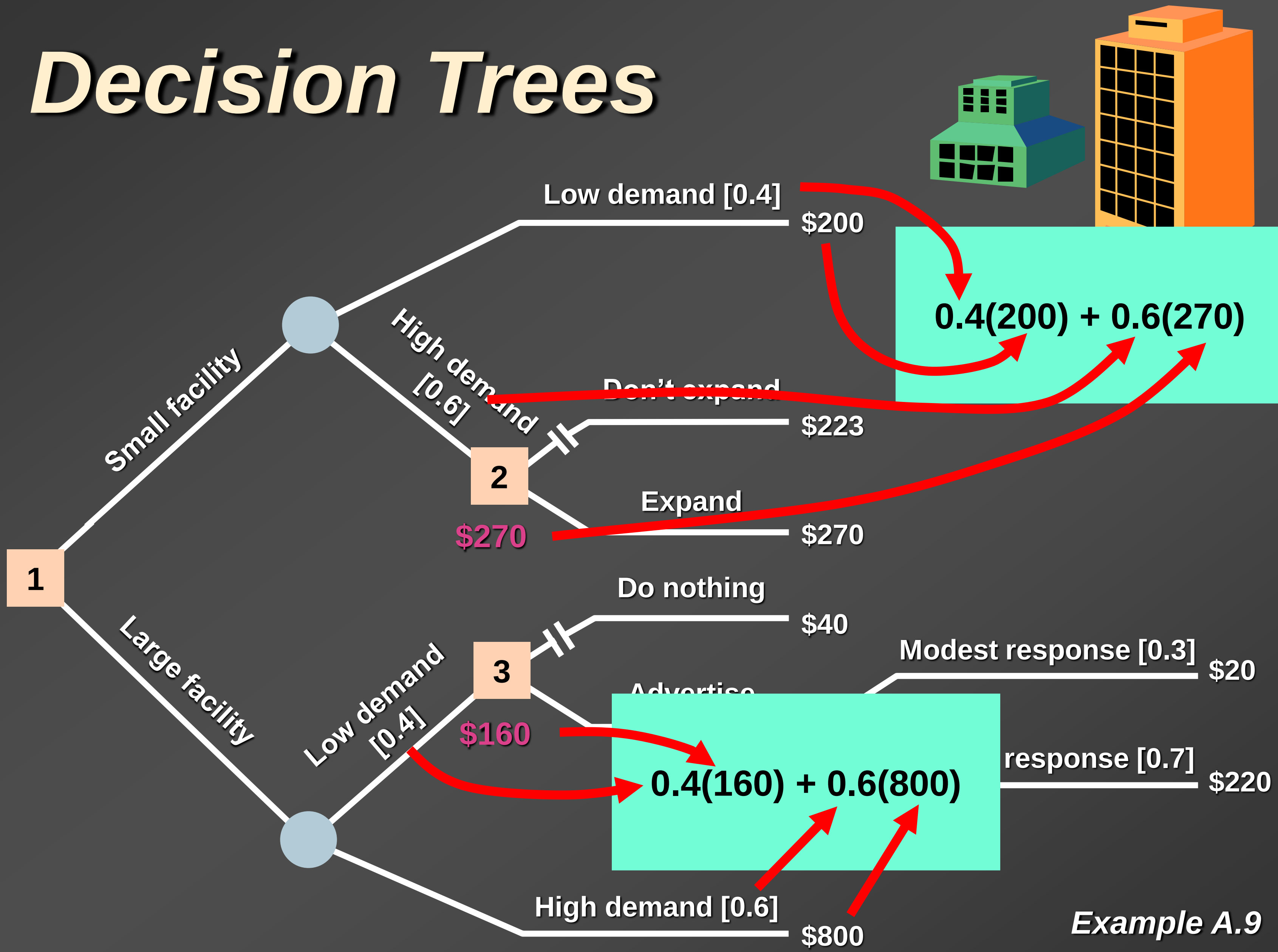
# *Decision Trees*





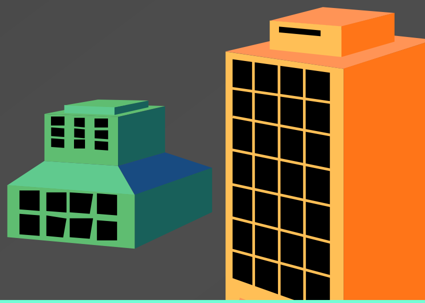

*Example A.9*

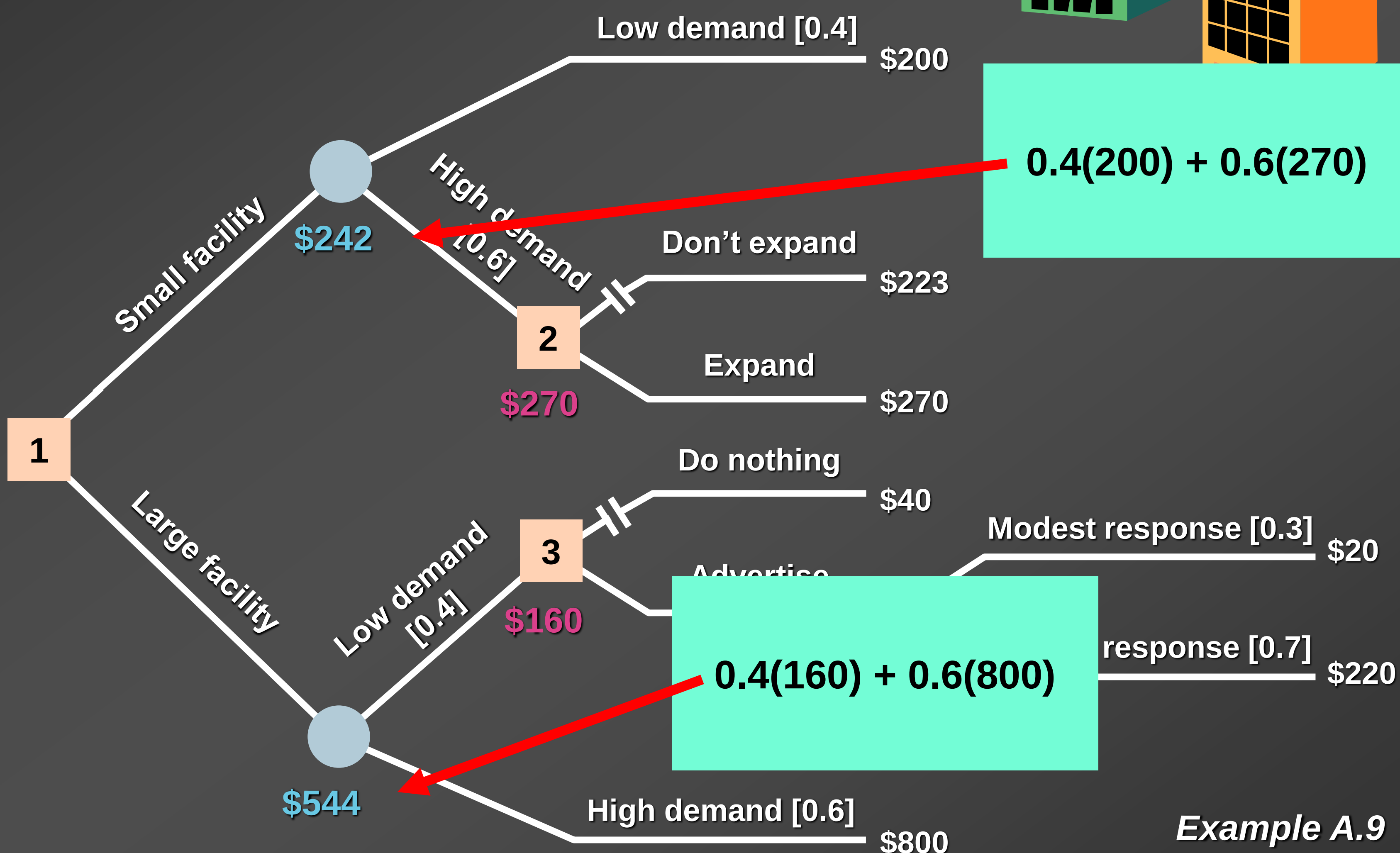
# Decision Trees




*Example A.9*

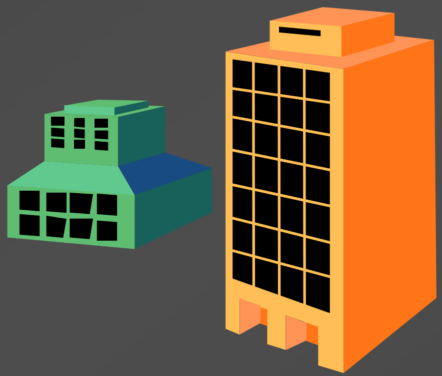
# Decision Trees

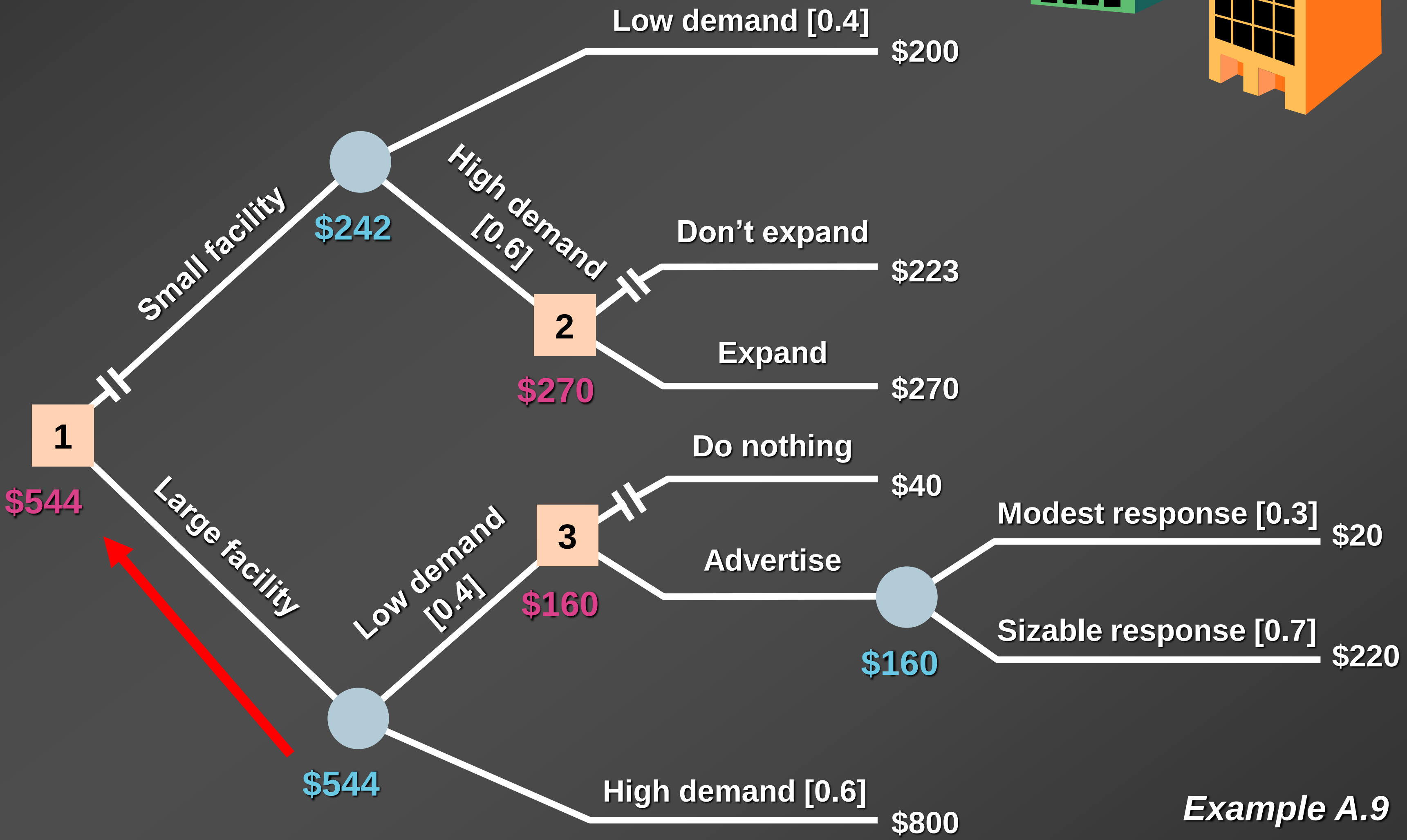





*Example A.9*

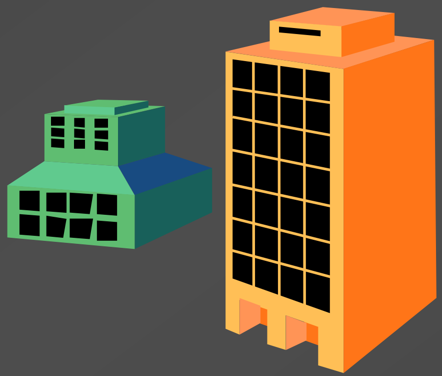
# Decision Trees






*Example A.9*

# Decision Trees



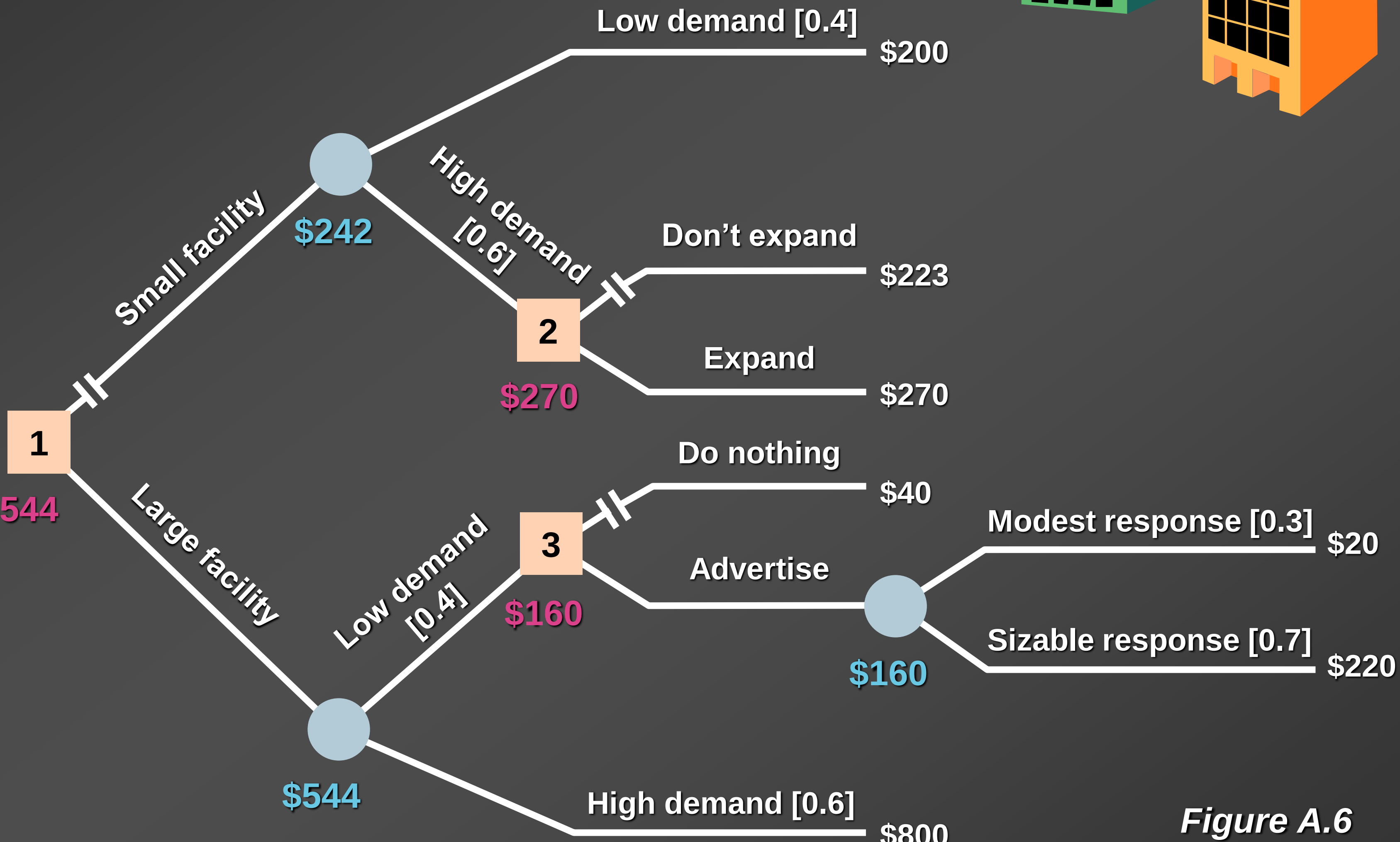



*Figure A.6*

# Problem 3

Adele Weiss manages the campus flower shop. Flowers must be ordered three days in advance from her supplier in Mexico. Although Valentine's Day is fast approaching, sales are almost entirely last-minute, impulse purchases. Advance sales are so small that Weiss has no way to estimate the probability of low (25 dozen), medium (60 dozen), or high (130 dozen) demand for red roses on the big day. She buys roses for $15 per dozen and sells them for $40 per dozen. Construct a payoff table. Which decision is indicated by each of the following decision criteria?

a. Maximin
b. Maximax
c. Laplace
d. Minimax regret

# NETWORK DESIGN DECISIONS

- ***Introducing method***
  - ***Fixed and variable cost***
  - ***Identified forecasts***
  - ***One product***
  - ***Total cost is fixed cost +unit variable cost x Quantity***
  - ***Example and identification of equivalence levels***
  - ***Best choice is ….***

# Fixed and variable cost

| Site | Fixed cost | Variable cost |
|---|---|---|
| A | 250 000 $ | 11 $ per unit |
| B | 100 000 $ | 30 $ per unit |
| C | 150 000 $ | 20 $ per unit |
| D | 200 000 $ | 35 $ per unit |

| Site | Fixed cost | Variable cost … | Total cost |
|---|---|---|---|
| A | 250 000 $ | 11x10 000 u | 360 000 $ |
| B | 100 000 $ | 30x 10 000 u | 400 000 $ |
| C | 150 000  $ | 20 x 10 000 u | 350 000 $ |
| D | 200 000 $ | 35 x 10 000 u | 550 000 $ |

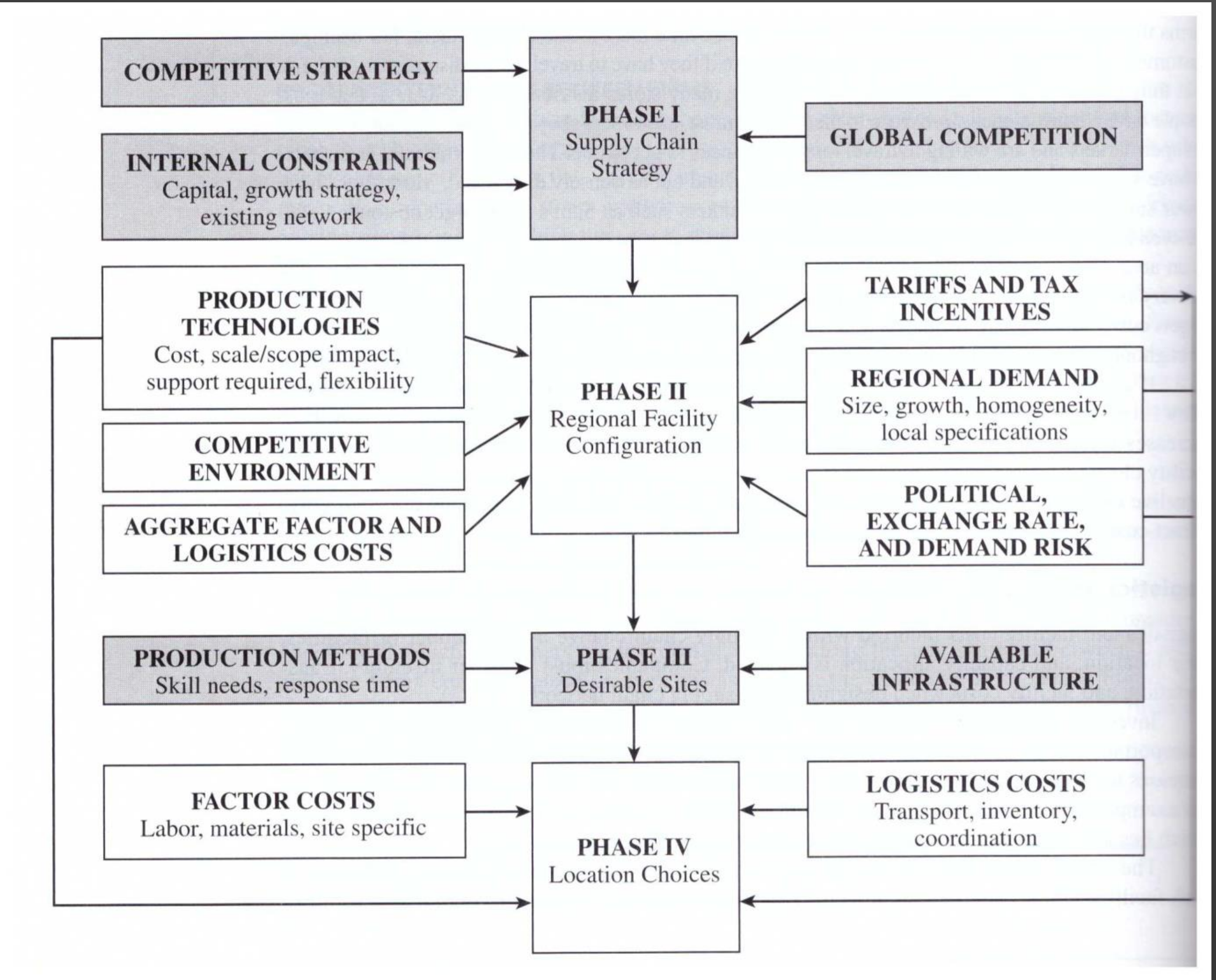
# Let’s come back to break even

| |
|---|
| **100 000 $ + 30 $ x Q = 150 000 $ + 20 $ x Q    Q= 5000 u** |
| 150 000 $ +20$ x Q = 250 000 $ + 11 $ x Q    Q = 11 111 u |
| 100 000 $ + 30 $ x Q = 250 000 $ + 11 $ x Q Q = 7 895 u |
| |

# NETWORK DESIGN DECISIONS

- ***Transport cost***
  - ***Impact***
  - ***Finished goods flows***
  - ***Raw materials***
  - ***Multi choice to be solved through transport model***
- ***Weighing method***
  - ***Relevant factors***
  - ***Weighing***
- ***Gravity center method***
  - ***Geographical coordinates***

# NETWORK DESIGN DECISIONS



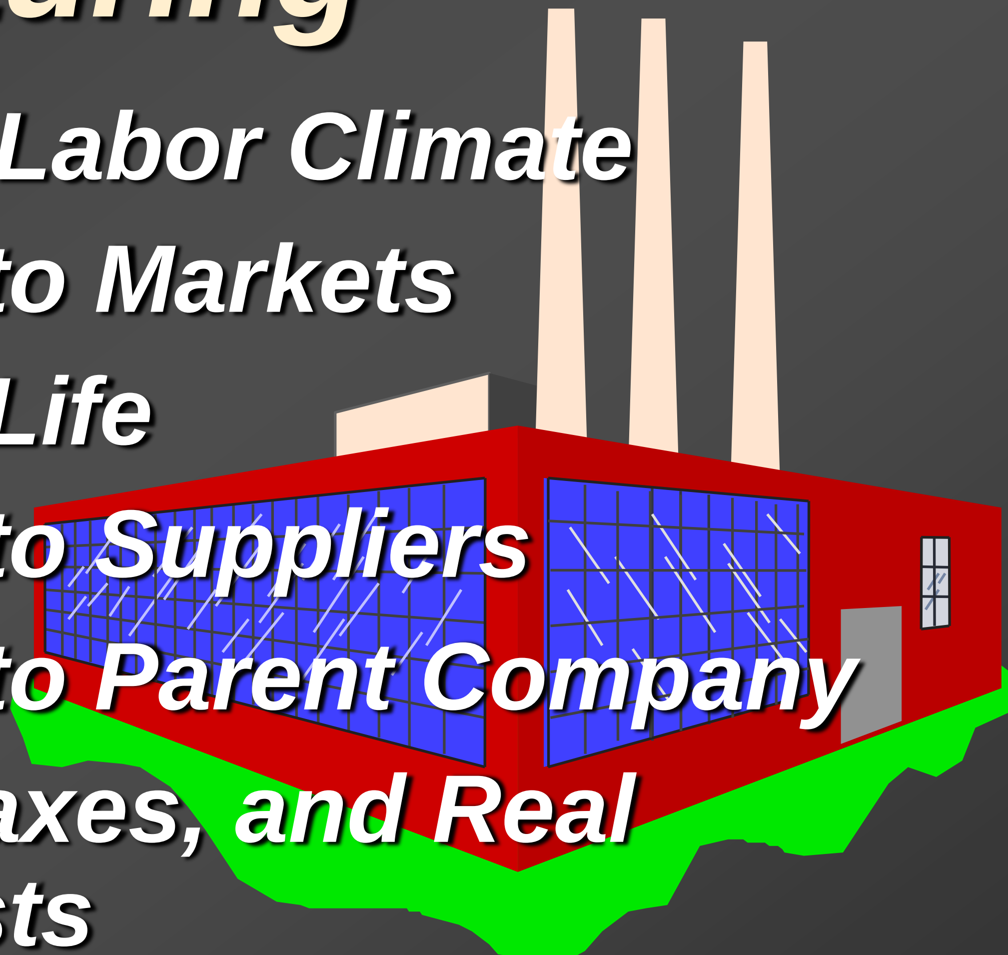
# *Location*

# To sum up some business tools

- Other Languages
- Different Norms and Customs
- Workforce Management
- Unfamiliar Laws and Regulations
- Unexpected Cost Mix

# Location Decisions - Manufacturing

- Favorable Labor Climate
- Proximity to Markets
- Quality of Life
- Proximity to Suppliers
- Proximity to Parent Company
- Utilities, Taxes, and Real Estate Costs



# Location Decisions - Services

- Proximity to Customers
- Transportation Costs and Proximity to Markets
- Location of Competitors
- Site-Specific Factors

# Gravity center method

***Coordonates of x,y***

***Average of x = Sum of xi / n destinations***

***Average of y = sum of yi / n destinations***

***Average of x,y will be optimum location***

# BUT
# we have to take into account quantities carried

- ***Average of x becomes***

  ***sum of xi.Qi / sum Qi***

- ***Average of y becomes***

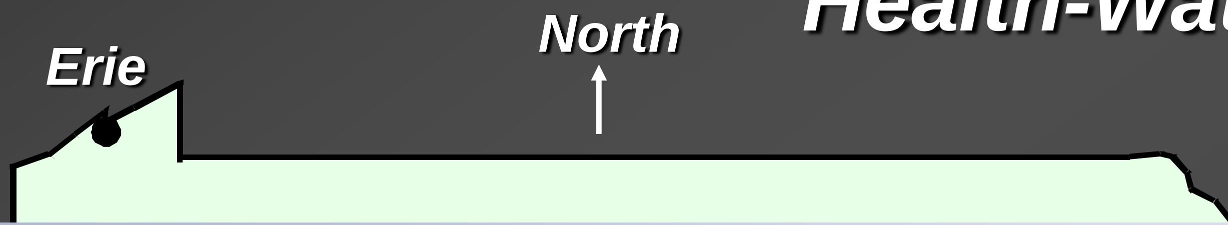
  ***sum of yi.Qi/sum Qi***

# Location
## Health-Watch


Example 10.1

# Location

## Health-Watch

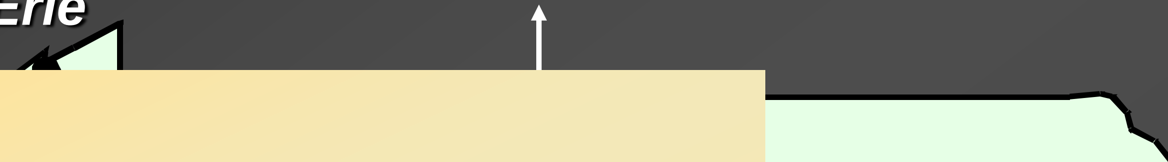



| Location Factor | Weight | Score |
|---|---|---|
| Total patient miles per month | 25 | 4 |
| Facility utilization | 20 | 3 |
| Average time per emergency trip | 20 | 3 |
| Expressway accessibility | 15 | 4 |
| Land and construction costs | 10 | 1 |
| Employee preference | 10 | 5 |

***Example 10.1***

# Location

## Health-Watch

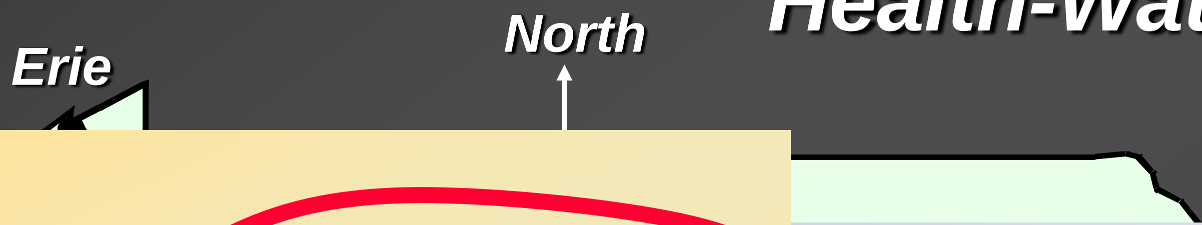



**Weighted Score**

| | Weight | Score |
|---|---|---|
| | 25 | 4 |
| | 20 | 3 |
| | 20 | 3 |
| Expressway accessibility | 15 | 4 |
| Land and construction costs | 10 | 1 |
| Employee preference | 10 | 5 |

*Example 10.1*

# Location
## Health-Watch




**Weighted Score**

*WS = (25 x 4)*

| | Weight | Score |
|---|---|---|
| | 25 | 4 |
| | 20 | 3 |
| | 20 | 3 |
| Expressway accessibility | 15 | 4 |
| Land and construction costs | 10 | 1 |
| Employee preference | 10 | 5 |

*Example 10.1*

# Location

## Health-Watch

Erie

North

### Weighted Score

$$WS = (25 \times 4) + (20 \times 3)$$

| | Weight | Score |
|---|---|---|
| | 25 | 4 |
| | 20 | 3 |
| | 20 | 3 |
| Expressway accessibility | 15 | 4 |
| Land and construction costs | 10 | 1 |
| Employee preference | 10 | 5 |

Example 10.1

# Location

## Health-Watch

Erie

North

**Weighted Score**

$$WS = (25 \times 4) + (20 \times 3) + (20 \times 3)$$

| | Weight | Score |
|---|---|---|
| | 25 | 4 |
| | 20 | 3 |
| | 20 | 3 |
| Expressway accessibility | 15 | 4 |
| Land and construction costs | 10 | 1 |
| Employee preference | 10 | 5 |

*Example 10.1*

# Location
## Health-Watch

Erie

North

### Weighted Score

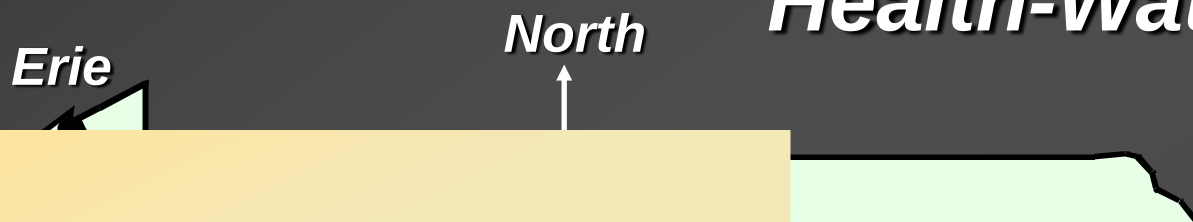
$$WS = (25 \times 4) + (20 \times 3) + (20 \times 3) + (15 \times 4) + (10 \times 1) + (10 \times 5)$$

| | Weight | Score |
|---|---|---|
| | 25 | 4 |
| | 20 | 3 |
| | 20 | 3 |
| Expressway accessibility | 15 | 4 |
| Land and construction costs | 10 | 1 |
| Employee preference | 10 | 5 |

Example 10.1

# Location

## Health-Watch




### Weighted Score

WS = 340

| | Weight | Score |
|---|---|---|
| | 25 | 4 |
| | 20 | 3 |
| | 20 | 3 |
| Expressway accessibility | 15 | 4 |
| Land and construction costs | 10 | 1 |
| Employee preference | 10 | 5 |

*Example 10.1*

# Location

## Center of Gravity Approach

| Census Tract | (x, y) | Population (l) | lx | |
|---|---|---|---|---|
| A | (2.5, 4.5) | 2 | 5 | |
| B | (2.5, 2.5) | 5 | 12.5 | |
| C | (5.5, 4.5) | 10 | 55 | |
| D | (5, 2) | 7 | 35 | |
| E | (8, 5) | 10 | 80 | |
| F | (7, 2) | 20 | 140 | |
| G | (9, 2.5) | 14 | 126 | |
| | Totals | 68 | 453.5 | 205.5 |

$x^* =$

$y^* =$

*Example 10.2*

# Location

## Center of Gravity Approach

| Census Tract | (x, y) | Population (l) | lx | |
|---|---|---|---|---|
| A | (2.5, 4.5) | 2 | 5 | |
| B | (2.5, 2.5) | 5 | 12.5 | |
| C | (5.5, 4.5) | 10 | 55 | |
| D | (5, 2) | 7 | 35 | |
| E | (8, 5) | 10 | 80 | |
| F | (7, 2) | 20 | 140 | |
| G | (9, 2.5) | 14 | 126 | |
| | Totals | 68 | 453.5 | 205.5 |

$$x^* = \frac{453.5}{68}$$

$$y^* = \frac{205.5}{68}$$

*Example 10.2*

# Location

## Center of Gravity Approach

| Census Tract | (x, y) | Population (l) | lx | |
|---|---|---|---|---|
| A | (2.5, 4.5) | 2 | 5 | |
| B | (2.5, 2.5) | 5 | 12.5 | |
| C | (5.5, 4.5) | 10 | 55 | |
| D | (5, 2) | 7 | 35 | |
| E | (8, 5) | 10 | 80 | |
| F | (7, 2) | 20 | 140 | |
| G | (9, 2.5) | 14 | 126 | |
| | Totals | 68 | 453.5 | 205.5 |

$$x^* = \frac{453.5}{68}$$

$$y^* = \frac{205.5}{68}$$

*Example 10.2*

# Location

## Center of Gravity Approach

| Census Tract | (x, y) | Population (l) | lx | |
|---|---|---|---|---|
| A | (2.5, 4.5) | 2 | 5 | |
| B | (2.5, 2.5) | 5 | 12.5 | |
| C | (5.5, 4.5) | 10 | 55 | |
| D | (5, 2) | 7 | 35 | |
| E | (8, 5) | 10 | 80 | |
| F | (7, 2) | 20 | 140 | |
| G | (9, 2.5) | 14 | 126 | |
| | Totals | 68 | 453.5 | 205.5 |

$x^* =$ 6.67

$y^* =$ 3.02

*Example 10.2*

# Location

## Center of Gravity Approach

**Solver - Center of Gravity**

Enter data in yellow - shaded areas.

Enter the names of the towns and the coordinates (*x* and *y*) and population (or load, *l*) of each town.

Add A Town

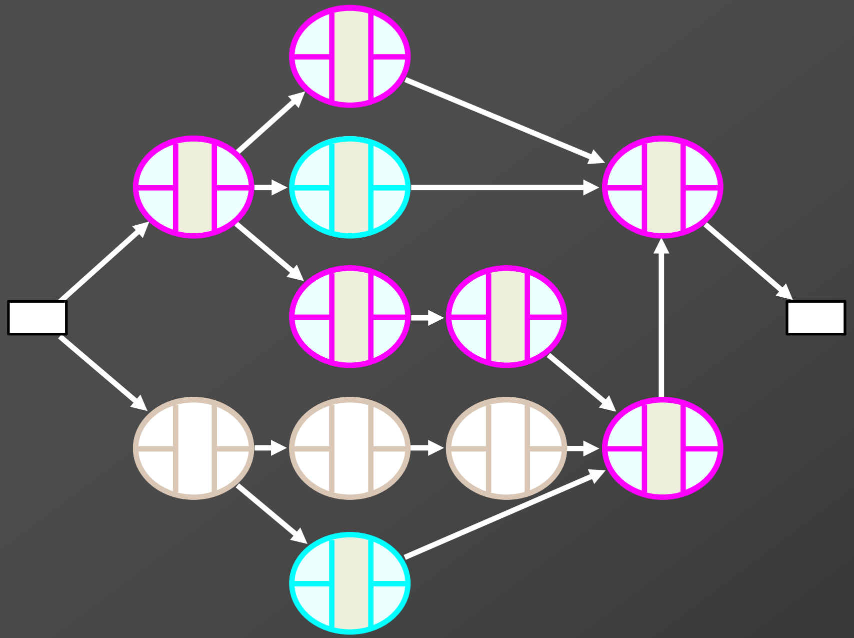
Remove A Town

| City/Town Name | x | y | l | lx | ly |
|---|---|---|---|---|---|
| A | 2.5 | 4.5 | 2 | 5 | 9 |
| B | 2.5 | 2.5 | 5 | 12.5 | 12.5 |
| C | 5.5 | 4.5 | 10 | 55 | 45 |
| D | 5 | 2 | 7 | 35 | 14 |
| E | 8 | 5 | 10 | 80 | 50 |
| F | 7 | 2 | 20 | 140 | 40 |
| G | 9 | 2.5 | 14 | 126 | 35 |
| | | | 68 | 453.5 | 205.5 |

| Center-of-Gravity Coordinates | | |
|---|---|---|
| | x* | 6.67 |
| | y* | 3.02 |

***Figure 10.1***

# Designing Supplychain Projects



# Implementing Changes

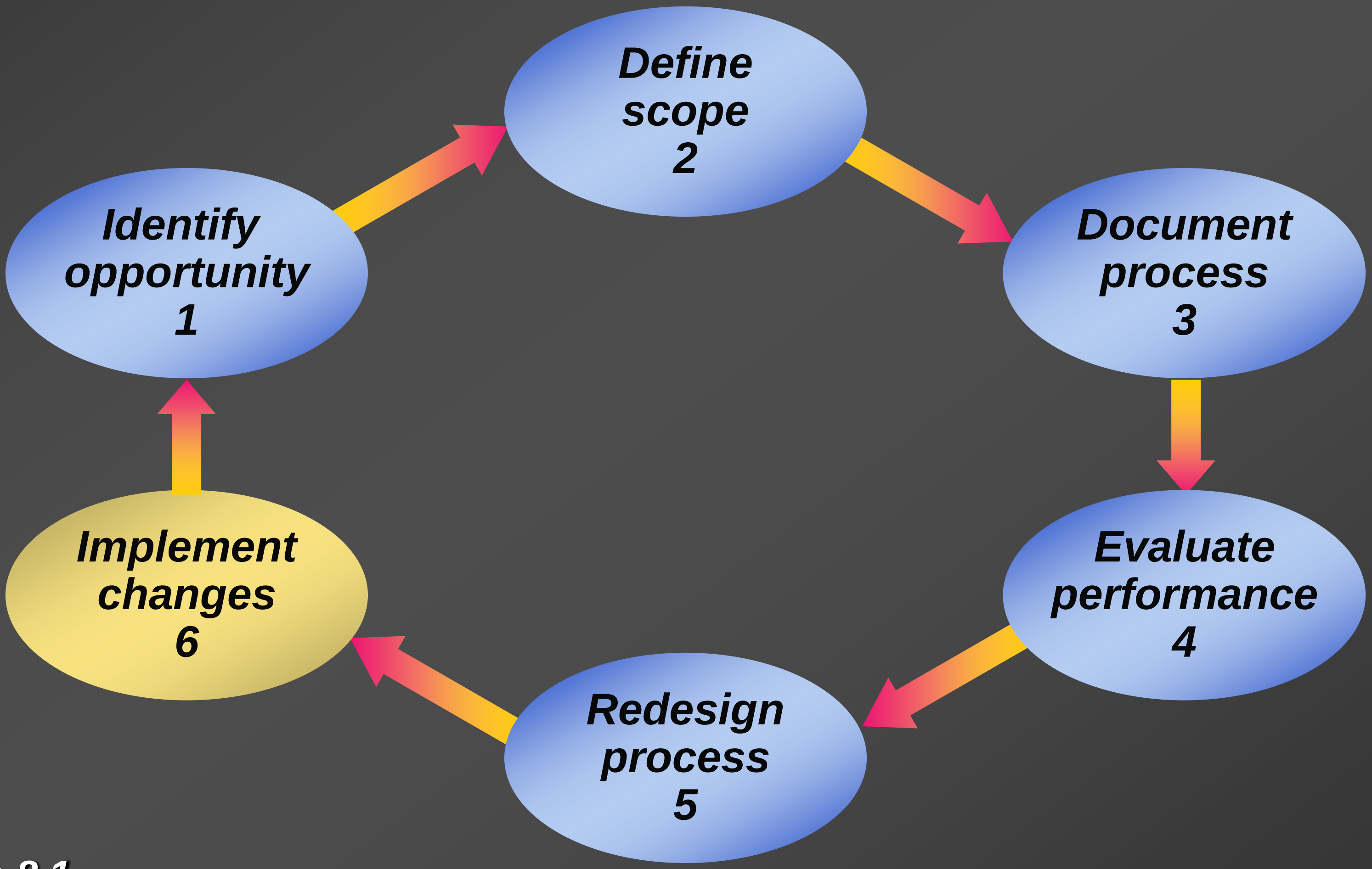



***Figure 8.1***

# Work Breakdown Structure

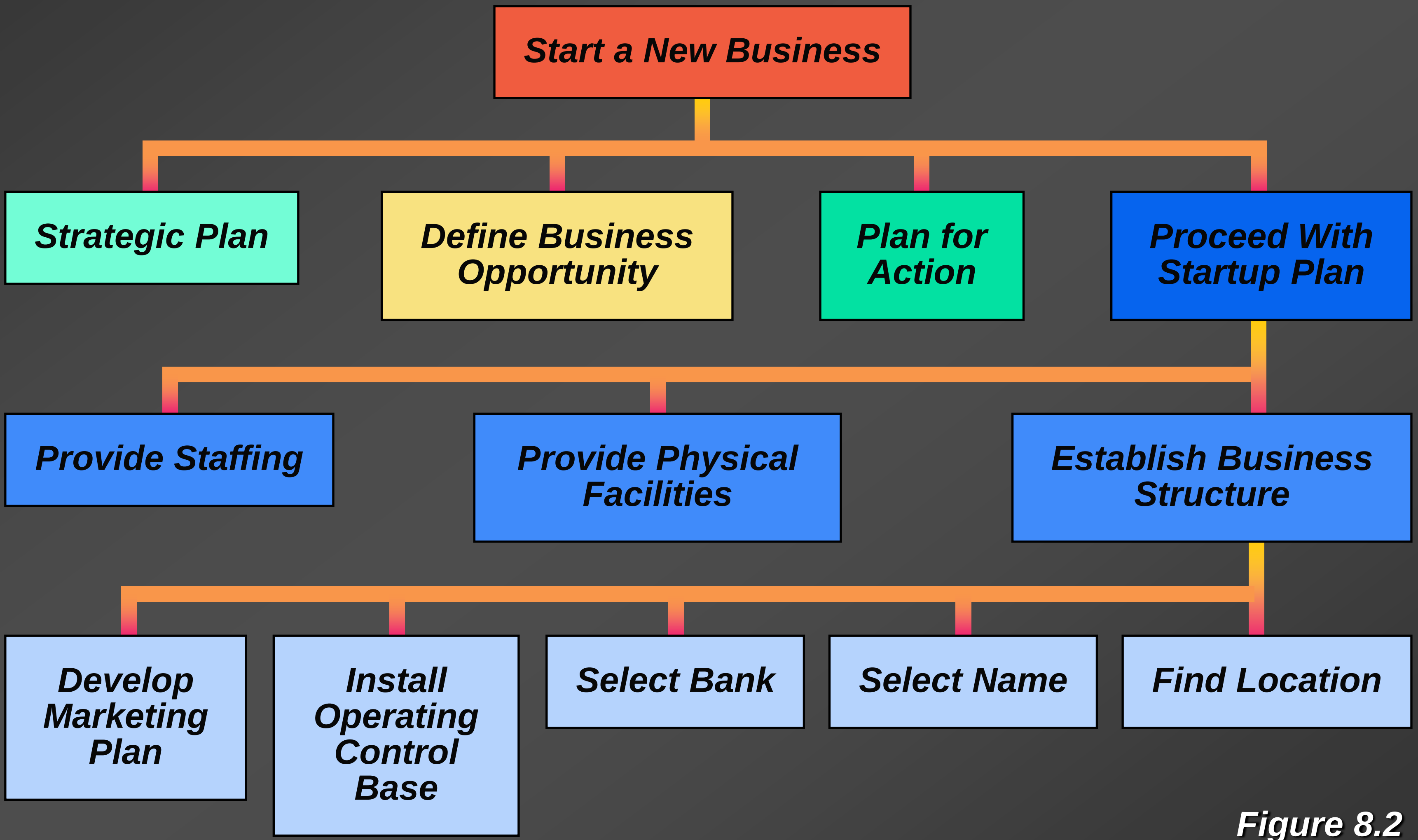
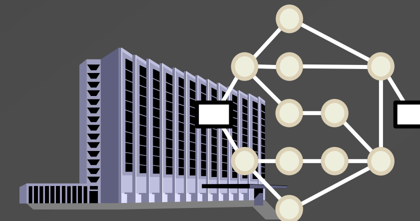
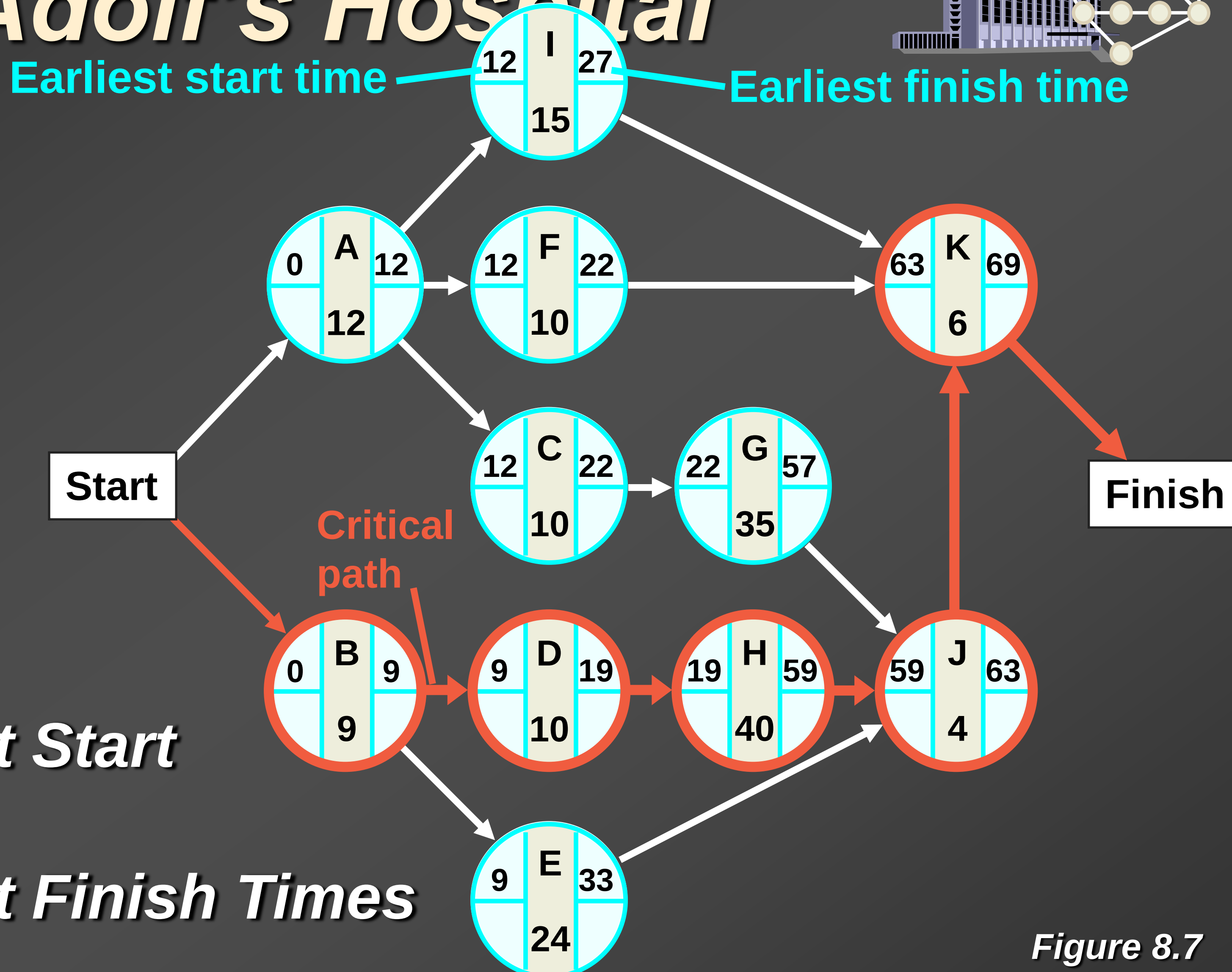



Figure 8.2

# St. Adolf's Hospital



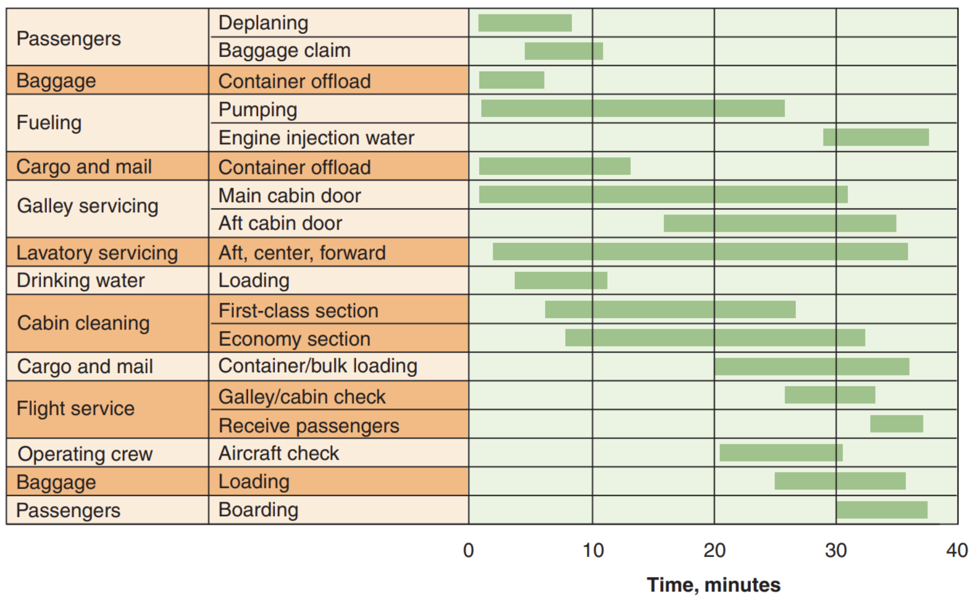



***Earliest Start and Earliest Finish Times***

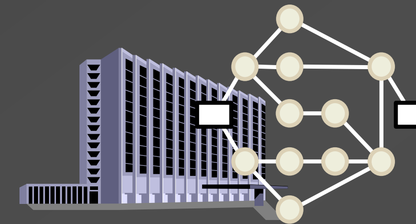
*Figure 8.7*

# GANTT chart in production …

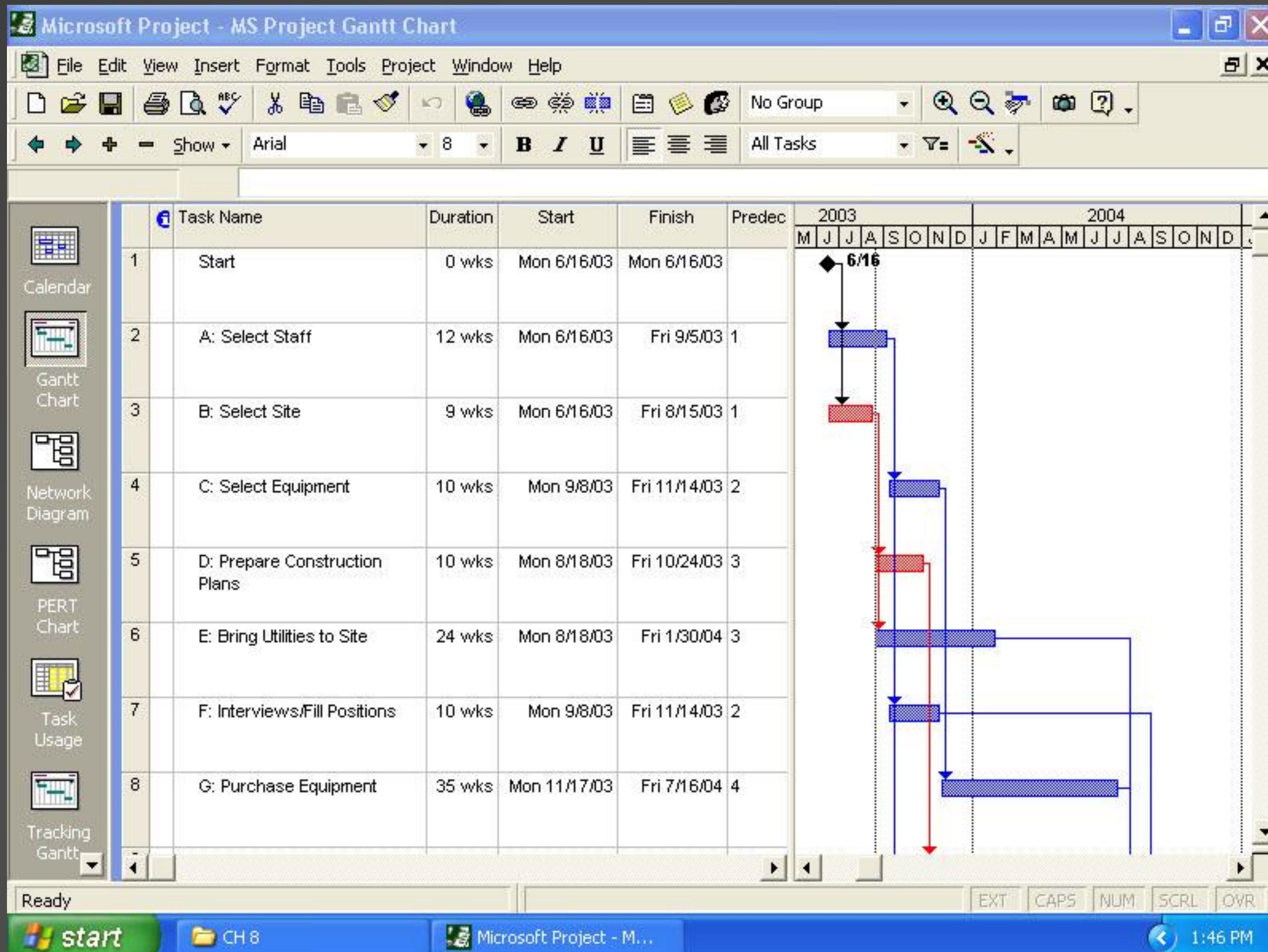
1. It shows the relationship of each activity to others and to the whole project.
2. It identifies the precedence relationships among activities.
3. It encourages the setting of realistic time and cost estimates for each activity.
4. It helps make better use of people, money, and material resources by identifying critical bottlenecks in the project.



# St. Adolf's Hospital



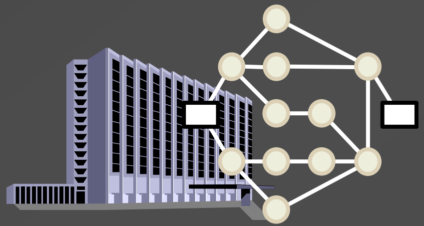
## Gantt Charts



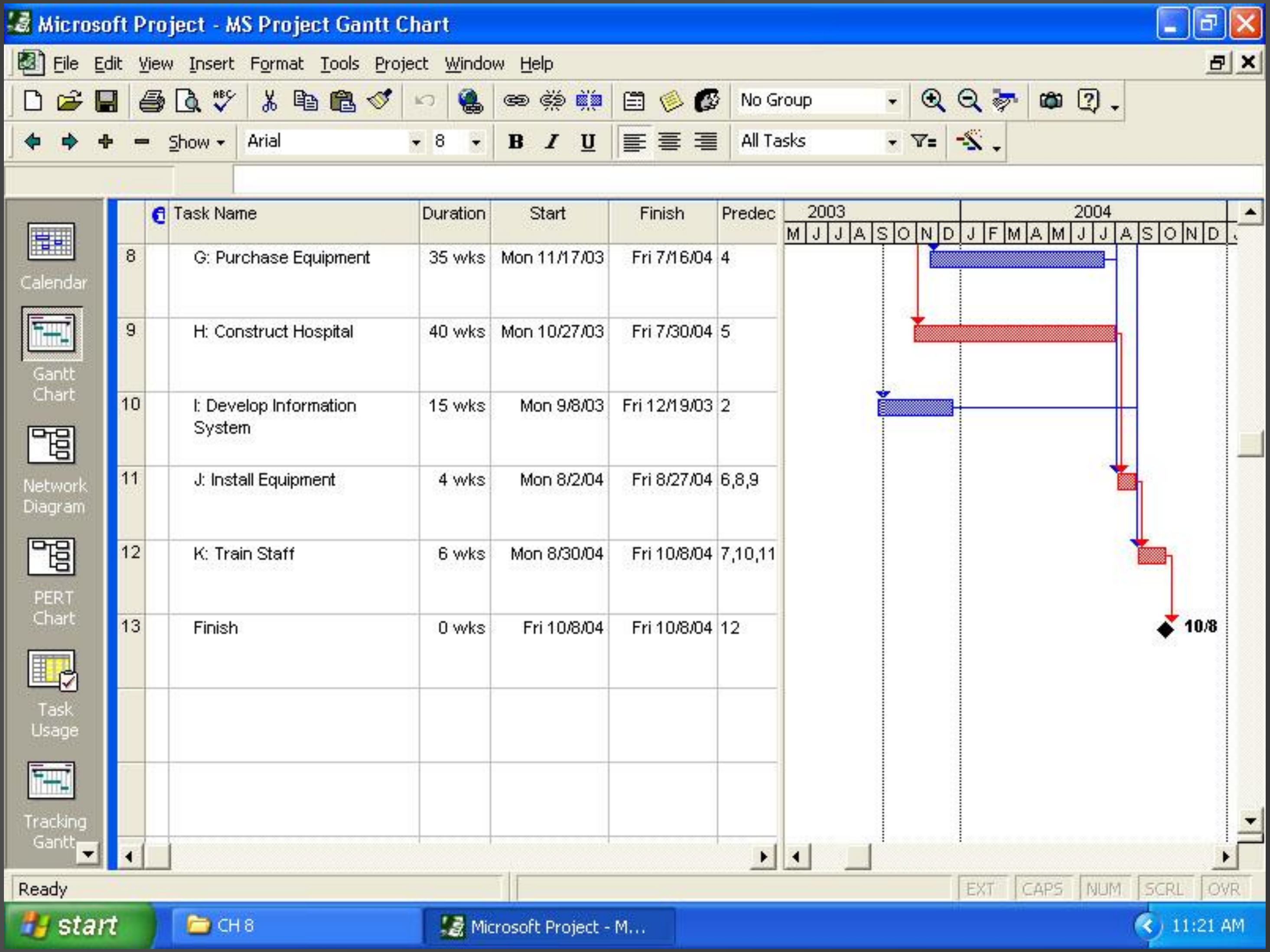

| | Task Name | Duration | Start | Finish | Predec |
|---|---|---|---|---|---|
| 1 | Start | 0 wks | Mon 6/16/03 | Mon 6/16/03 | |
| 2 | A: Select Staff | 12 wks | Mon 6/16/03 | Fri 9/5/03 | 1 |
| 3 | B: Select Site | 9 wks | Mon 6/16/03 | Fri 8/15/03 | 1 |
| 4 | C: Select Equipment | 10 wks | Mon 9/8/03 | Fri 11/14/03 | 2 |
| 5 | D: Prepare Construction Plans | 10 wks | Mon 8/18/03 | Fri 10/24/03 | 3 |
| 6 | E: Bring Utilities to Site | 24 wks | Mon 8/18/03 | Fri 1/30/04 | 3 |
| 7 | F: Interviews/Fill Positions | 10 wks | Mon 9/8/03 | Fri 11/14/03 | 2 |
| 8 | G: Purchase Equipment | 35 wks | Mon 11/17/03 | Fri 7/16/04 | 4 |

*Figure 8.9(a)*

# St. Adolf's Hospital



## Gantt Charts




| | Task Name | Duration | Start | Finish | Predec |
|---|---|---|---|---|---|
| 8 | G: Purchase Equipment | 35 wks | Mon 11/17/03 | Fri 7/16/04 | 4 |
| 9 | H: Construct Hospital | 40 wks | Mon 10/27/03 | Fri 7/30/04 | 5 |
| 10 | I: Develop Information System | 15 wks | Mon 9/8/03 | Fri 12/19/03 | 2 |
| 11 | J: Install Equipment | 4 wks | Mon 8/2/04 | Fri 8/27/04 | 6,8,9 |
| 12 | K: Train Staff | 6 wks | Mon 8/30/04 | Fri 10/8/04 | 7,10,11 |
| 13 | Finish | 0 wks | Fri 10/8/04 | Fri 10/8/04 | 12 |

*Figure 8.9(b)*


QUIZ
LOCATION

***1- The factors involved in location decisions include***

- *a) foreign exchange.*
- *b) attitudes.*
- *c) labor productivity.*
- *d) all of the above.*

***2- If Fender Guitar pays $30 per day to a worker in its Ensenada, Mexico, plant, and the employee completes four instruments per 8-hour day, the labor cost/unit is***

- *a) $30.00.*
- *b) $3.75.*
- *c) $7.50.*
- *d) $4.00.*
- *e) $8.00. LO*

***3- Evaluating location alternatives by comparing their composite (weighted-average) scores involves***

- *a) factor-rating analysis.*
- *b) cost–volume analysis.*
- *c) transportation model analysis.*
- *d) linear regression analysis.*
- *e) crossover analysis.*

***4- On the cost–volume analysis chart where the costs of two or more location alternatives have been plotted, the quantity at which two cost curves cross is the quantity at which:***

- *a) fixed costs are equal for two alternative locations.*
- *b) variable costs are equal for two alternative locations.*
- *c) total costs are equal for all alternative locations.*
- *d) fixed costs equal variable costs for one location.*
- *e) total costs are equal for two alternative locations.*

**5-A regional bookstore chain is about to build a distribution center that is centrally located for its eight retail outlets. It will most likely employ which of the following tools of analysis?**

Assembly-line balancing

Load–distance analysis

Center-of-gravity model

Linear programming

All of the above

**6- What is the major difference in location decisions in the service s manufacturing sector?**

There is no difference in focus.

The focus in manufacturing is revenue maxim in service is cost minimization.

The focus in service is revenue maximization, manufacturing is cost minimization.

The focus in manufacturing is on raw material service is on labor.

# Reminding problem

The owner of a small manufacturing business has patented a new device for washing dishes and cleaning dirty kitchen sinks. Before trying to commercialize the device and add it to her existing product line, she wants reasonable assurance of success. Variable costs are estimated at $7 per unit produced and sold. Fixed costs are about $56,000 per year.

**a.** If the selling price is set at $25, how many units must be produced and sold to break even? Use both algebraic and graphic approaches.

**b.** Forecasted sales for the first year are 10,000 units if the price is reduced to $15. With this pricing strategy, what would be the product's total contribution to profits in the first year?

# Reminding problem

Binford Tool Company is screening three new product ideas, A, B, and C. Resource constraints allow only one of them to be commercialized. The performance criteria and ratings, on a scale of 1 (worst) to 10 (best), are shown in the following table. The Binford managers give equal weights to the performance criteria. Which is the best alternative, as indicated by the preference matrix method?

| | RATING | | |
|---|---|---|---|
| PERFORMANCE CRITERION | PRODUCT A | PRODUCT B | PRODUCT C |
| 1. Demand uncertainty and project risk | 3 | 9 | 2 |
| 2. Similarity to present products | 7 | 8 | 6 |
| 3. Expected return on investment (ROI) | 10 | 4 | 8 |
| 4. Compatibility with current manufacturing process | 4 | 7 | 6 |
| 5. Competitive advantage | 4 | 6 | 5 |

# Last one

White Valley Ski Resort is planning the ski lift operation for its new ski resort. Management is trying to determine whether one or two lifts will be necessary; each lift can accommodate 250 people per day. Skiing normally occurs in the 14-week period from December to April, during which the lift will operate seven days per week. The first lift will operate at 90 percent capacity if economic conditions are bad, the probability of which is believed to be about a 0.3. During normal times the first lift will be utilized at 100 percent capacity, and the excess crowd will provide 50 percent utilization of the second lift. The probability of normal times is 0.5. Finally, if times are really good, the probability of which is 0.2, the utilization of the second lift will increase to 90 percent. The equivalent annual cost of installing a new lift, recognizing the time value of money and the lift's economic life, is $50,000. The annual cost of installing two lifts is only $90,000 if both are purchased at the same time. If used at all, each lift costs $200,000 to operate, no matter how low or high its utilization rate. Lift tickets cost $20 per customer per day.

**a.** Should the resort purchase one lift or two?

**b.** What is the value of perfect information?