PART TWO

DEFINING OPERATIONS RESEARCH

- Operations research (OR) is an analytical method of problem-solving and decision-making that is useful in the management of organizations. In operations research, problems are broken down into basic components and then solved in defined steps by mathematical analysis.

AGENDA

OPERATIONS RESEARCH

- FLOW CHART SYMBOLS
- CHARTS FOR REPORTS
- DECISION MATRIX
- PROJECT PLANNING CHARTS

FLOW CHART

- Flowcharts are used in designing and documenting complex processes or programs. Like other types of diagrams, they help visualize what is going on and thereby help the viewer to understand a process, and perhaps also find flaws, bottlenecks, and other less-obvious features within it. There are many different types of flowcharts, and each type has its own repertoire of boxes and notational conventions.

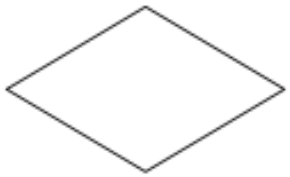
- FLOW CHARTS SHOULD BE CREATED AND READ LIKE AN ENGLISH WRITTEN BOOK.

FLOW CHART SYMBOLS

COMMONLY USED SYMBOLS FOR FLOW CHARTS

- TERMINAL
- PROCESSING
- INPUT/OUTPUT
- DOCUMENT
- DECISION

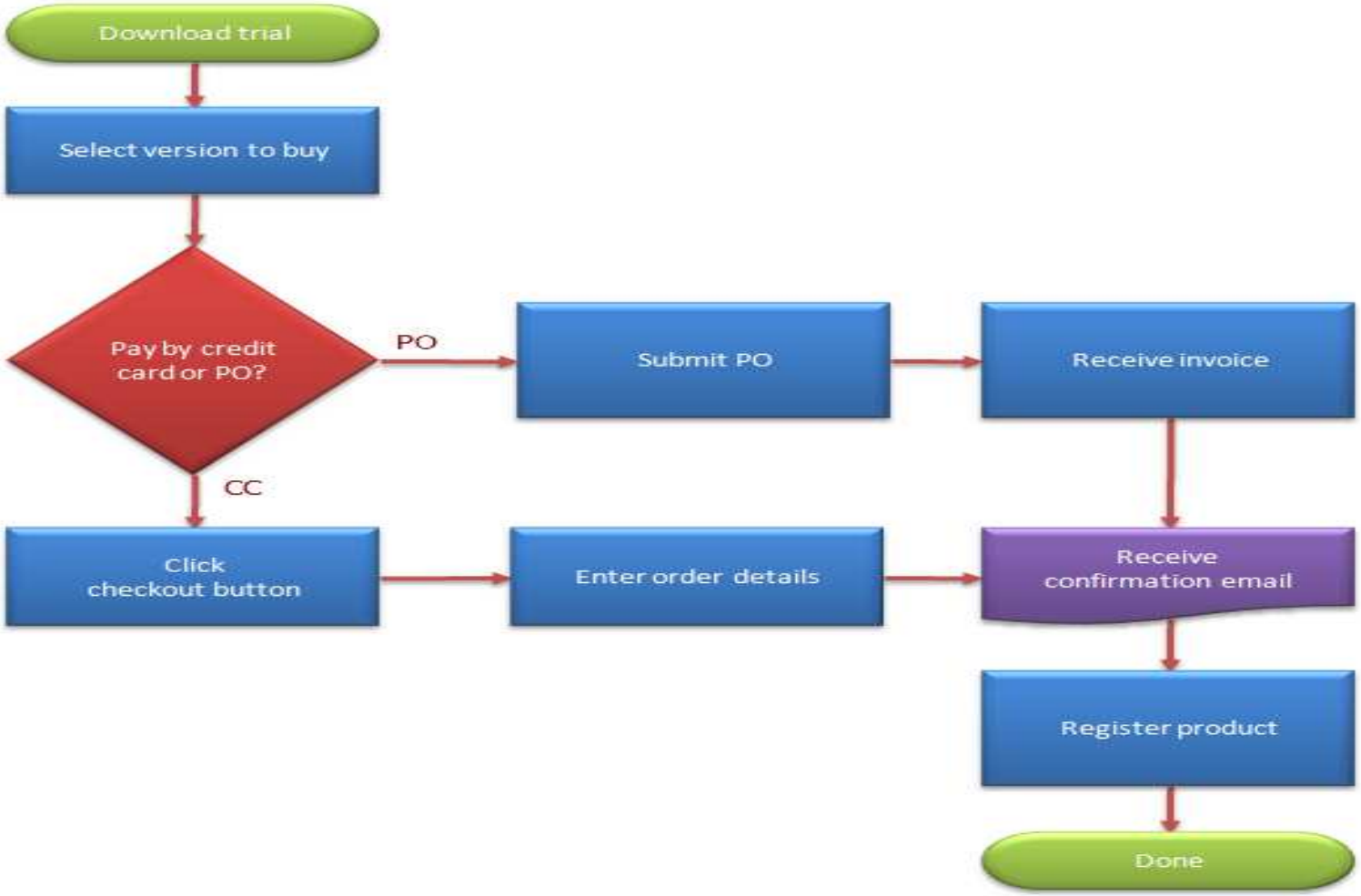
FLOW CHART SYMBOLS

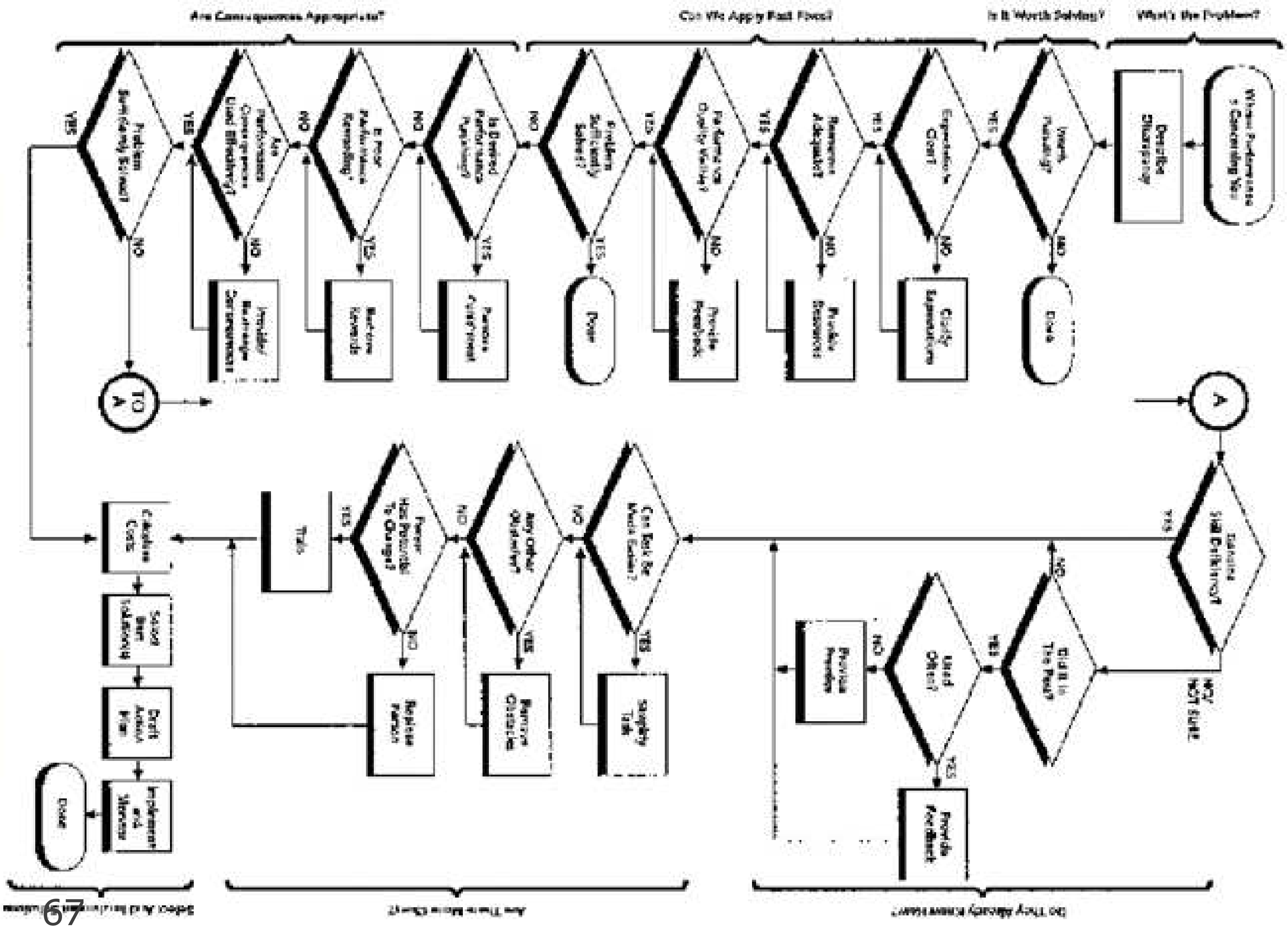
Some Common Flowchart Symbols		
Symbol	Represents	Purpose
	Terminal	Used to indicate the start and end of a flowchart. Flow begins or terminates here.
	Processing	Used whenever data is being manipulated.
	Document	Used to indicate that a hard copy is generated.
	Decision	Used to represent operations in which there are two possible alternatives. One flow line enters and two flow lines exit. (Labeled **Yes** and **No.**)

FLOW CHART SYMBOLS

	Predefined Process	Used to identify an operation that is more fully described in a separate flowchart segment.
	On-page connector	Used to go to another point on the same page.
	Off-page connector	Used to go to another point on a different page.
	Data	Input or Output of data.

EXAMPLE OF A FLOWCHART




Are Consequences Appropriate?
Can We Apply Fast Fixes?
Is It Worth Solving?
What's the Problem?

COMMONLY USED Charts

- **Bar**
- **Line**
- **Area**

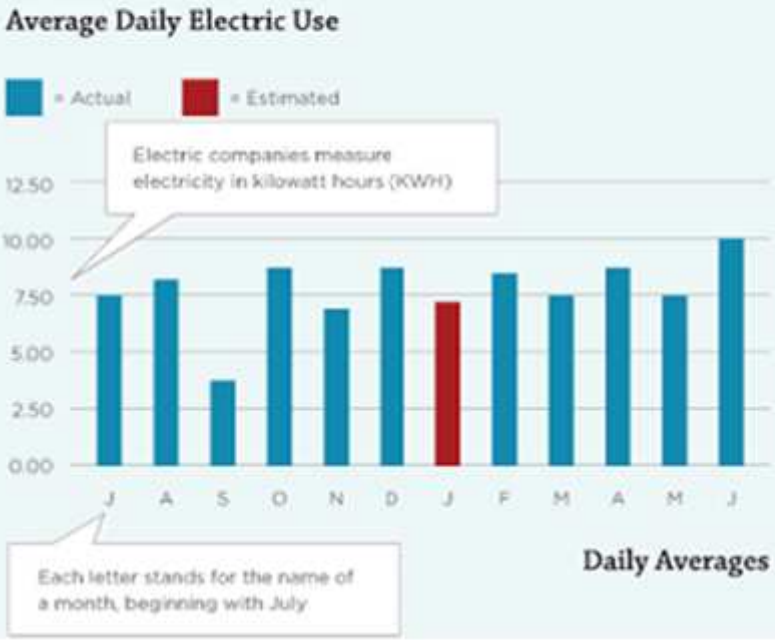
BAR Chart

- Bar charts compare the data for the same item at specific intervals of time.
- The height of each column is used to represent each respective quantity and demonstrate how the quantities vary from time period to time period.
- Consistent time intervals should be used. If more than approximately 12 time periods are going to be used, then a curve chart may be more effective.

BAR Chart

Directions

Electric companies usually include bar graphs in their bills to show how much electricity you've used every day or every month. See what you can figure out from this graph.



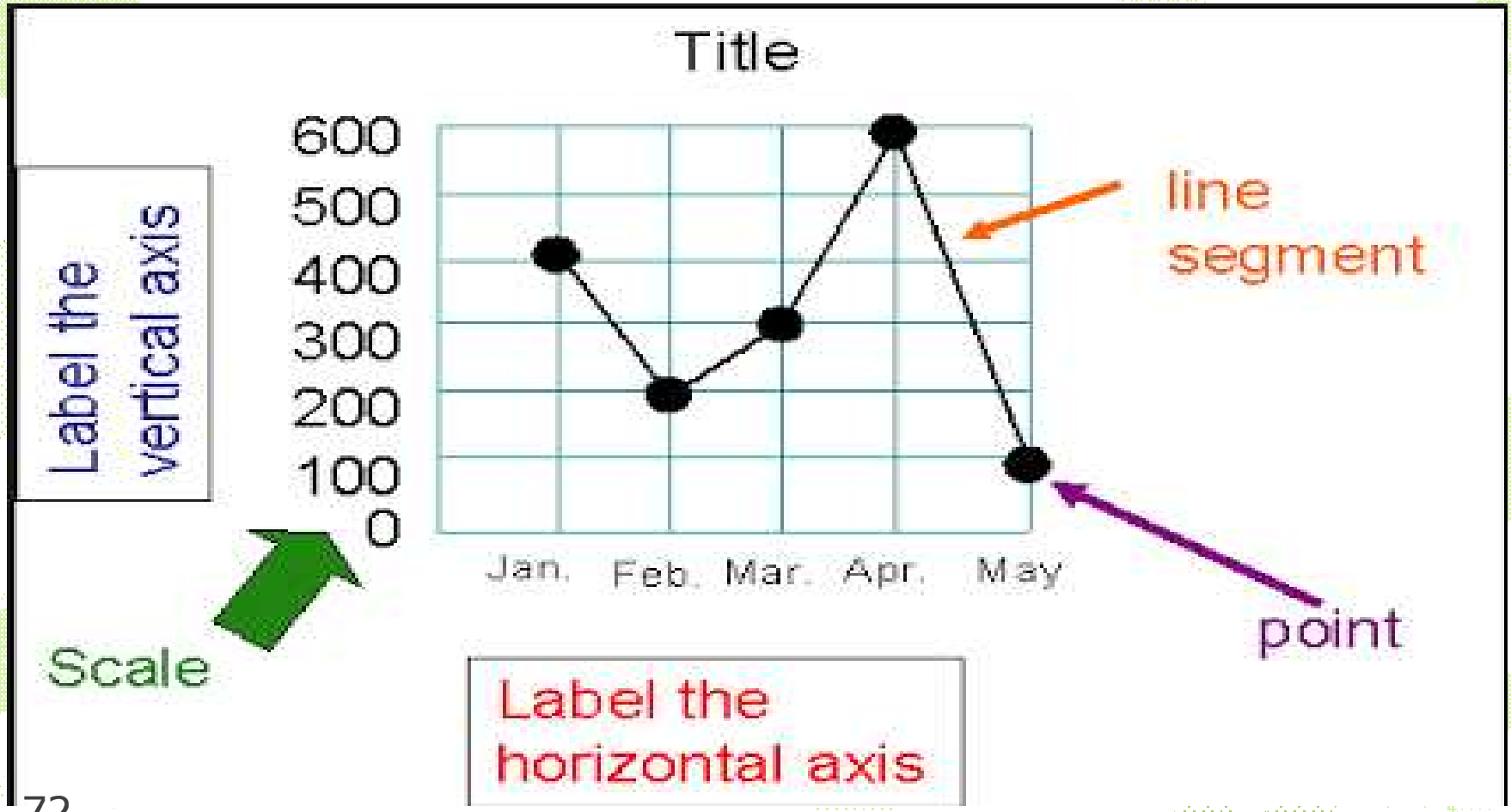
In which month was the most electricity used on an average day?

- October
- July
- May
- June

LINE Chart

- Line charts effectively show trends and time series data by showing one item at different points in time as a single, unbroken line.
- Multiple lines show on a single chart, but each line must be clearly distinguishable from the other lines through the use of patterns or color.
- A good rule of thumb is to place no more than four lines on a single chart.

LINE CHART


Title
600
500
400
300
200
100
0
Label the vertical axis
Scale
Jan.
Feb.
Mar.
Apr.
May
line segment
point
Label the horizontal axis

Area/Band Charts

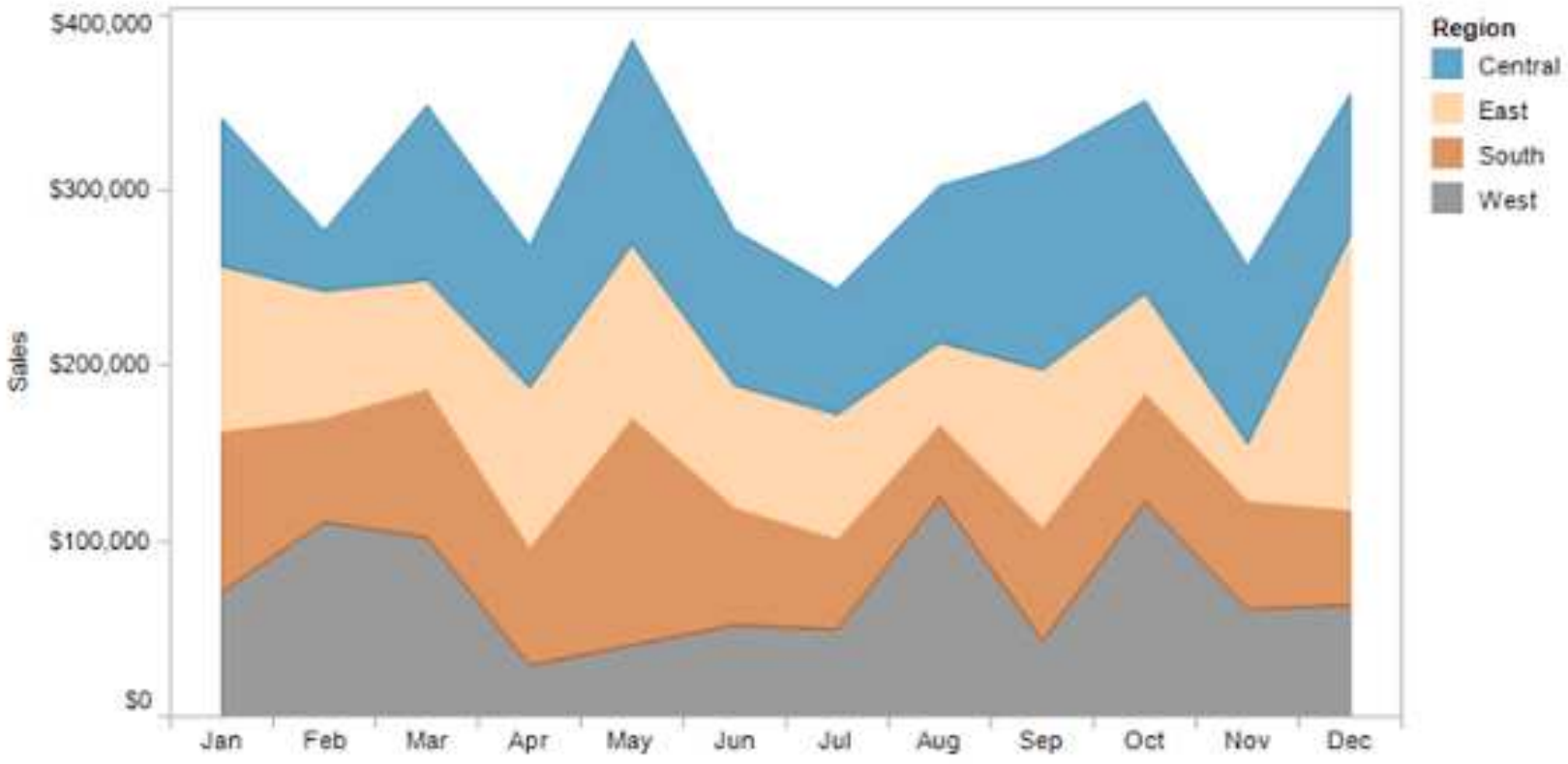
- Area charts are useful for emphasizing the magnitude of change over time. Stacked area charts are also used to show the relationship of parts to the whole.
- Area charts are like line charts that have the areas below the lines filled with colors or patterns.
- Area charts are not normally effective when the curves intersect because it is possible for areas with lower values to be obscured by the higher values.

Area/Band Chart

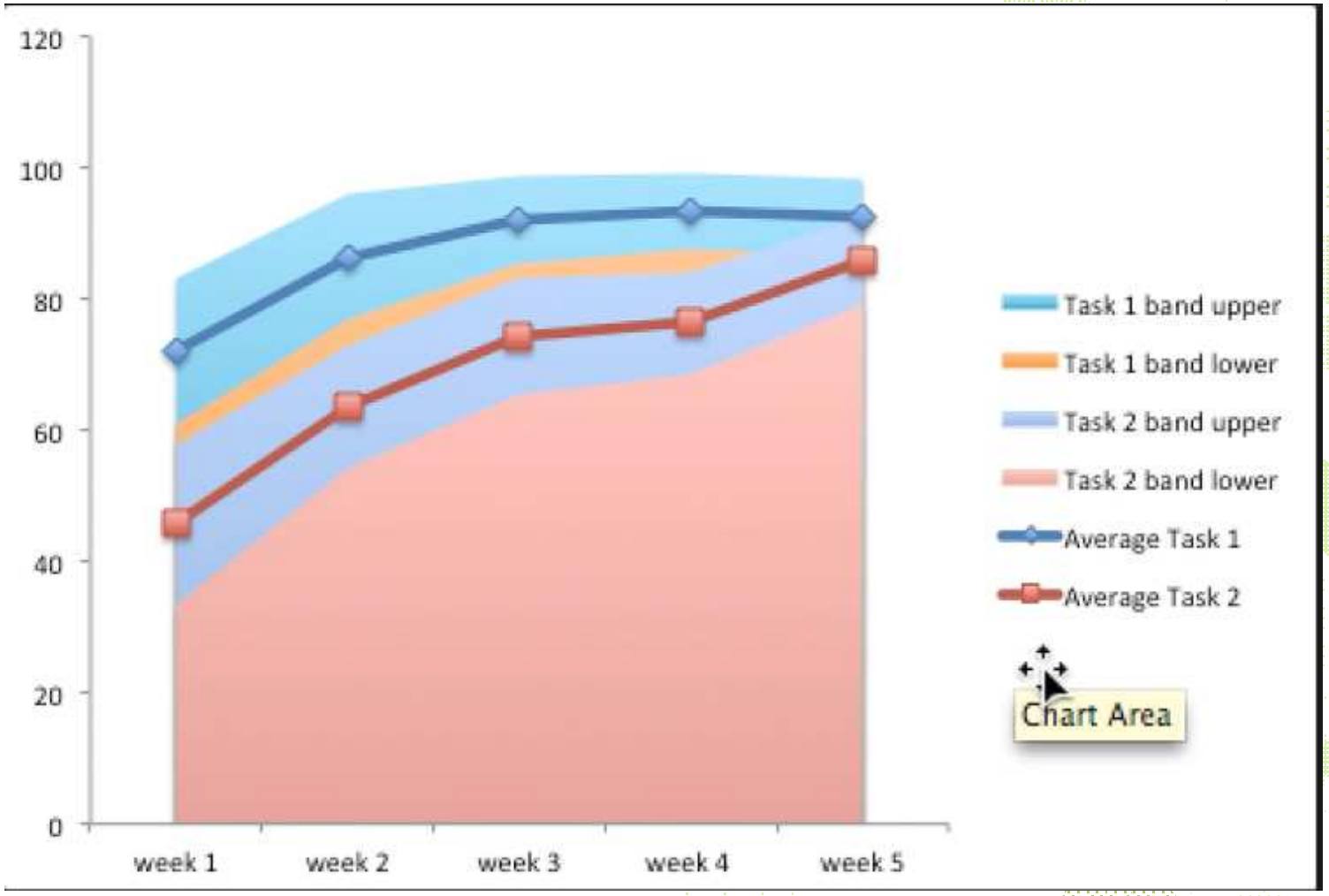
Area chart - Area charts are used to represent cumulated totals using numbers or percentages (stacked area charts in this case) over time.

Band chart - a standard line chart enhanced with a shaded area displaying the upper and lower boundaries of groups of data (e.g. the range between the minimum and the maximum of all members of the category). Band charts are very often supplemented by another lineshowing the arithmetic mean (the average).

Area Chart


$400,000
$300,000
$200,000
$100,000
$0
Sales
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Region
Central
East
South
West

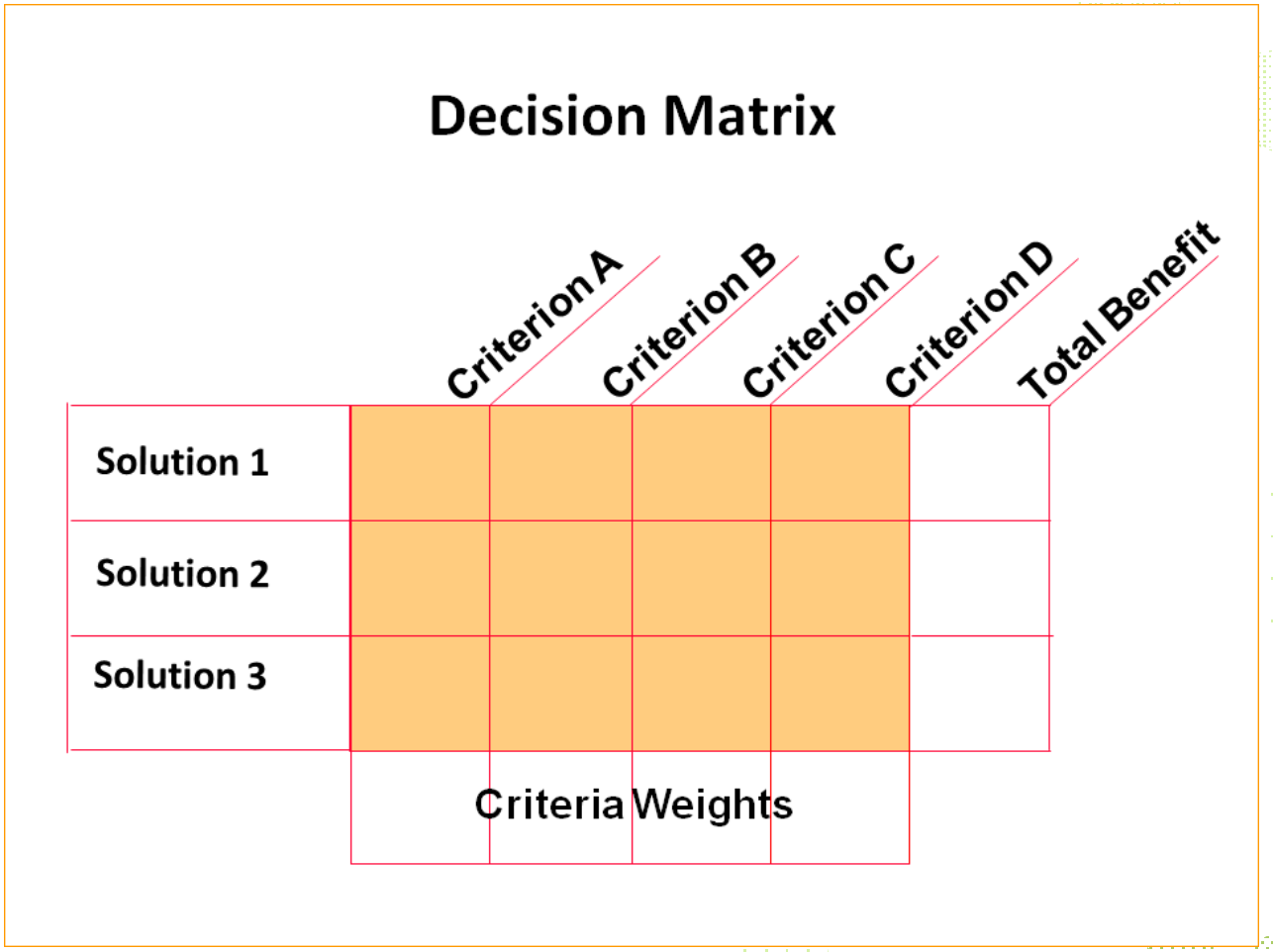
Band Chart


120
100
80
60
40
20
0
week 1
week 2
week 3
week 4
week 5
Task 1 band upper
Task 1 band lower
Task 2 band upper
Task 2 band lower
Average Task 1
Average Task 2
Chart Area

DECISION MATRIX

- A decision matrix is a chart that allows a team or individual to systematically identify, analyze, and rate the strength of relationships between sets of information. The matrix is especially useful for looking at large numbers of decision factors and assessing each factor's relative importance.
- A decision matrix is frequently used during quality planning activities to select product/service features and goals and to develop process steps and weigh alternatives. For quality improvement activities, a decision matrix can be useful in selecting a project, in evaluating alternative solutions to problems, and in designing remedies.

Decision Matrix



Decision Matrix

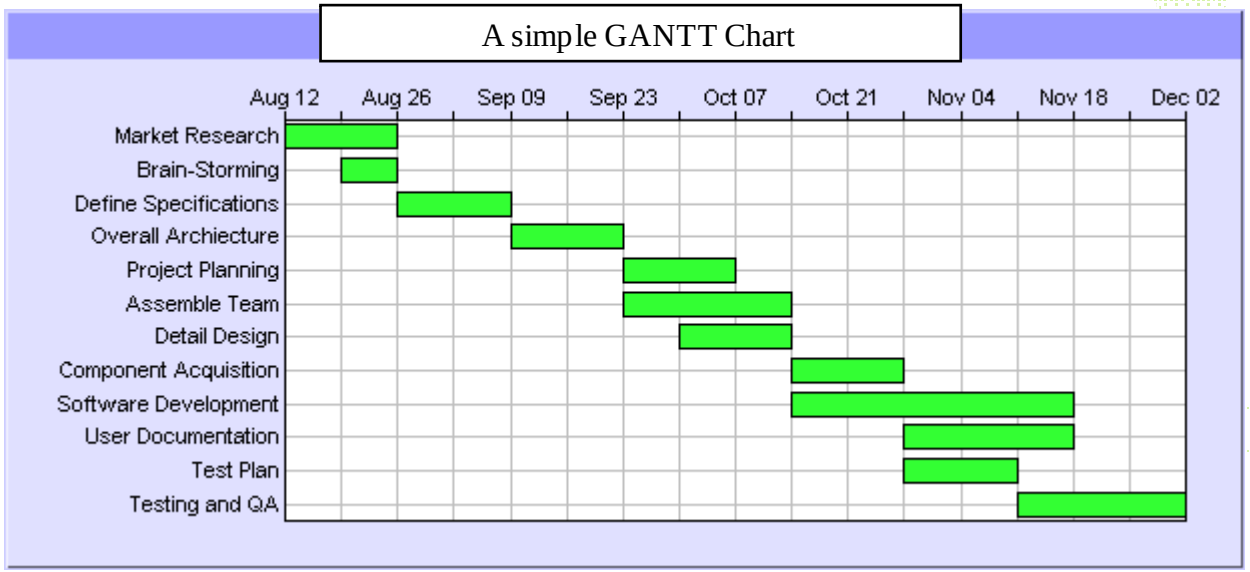
	Cost of building	Parking Space	Security	Room for expansion		Total Benefits
Facility A	5	0	2	5	1 + 0 + 0.5 + 2 = 3.5	**3.5**
Facility B	3	3	2	4	0.6 + 0.45 + 0.5 + 1.6 = 3.15	**3.15**
Facility C	3	1	1	3	0.6 + 0.15 + 0.25 + 1.2 = 2.2	**2.2**
Facility D	2	1	1	1	0.4 + 0.15 + 0.25 + 0.40 = 1.2	**1.2**
	.20	.15	.25	.40		

GANTT Chart

- Definition: A Gantt chart is used to show activities (tasks or events) displayed against time.

- On the left of the chart is a list of activities and along the top is a time scale of hours, days, months, etc,- whatever unit is most suitable.

GANTT Chart

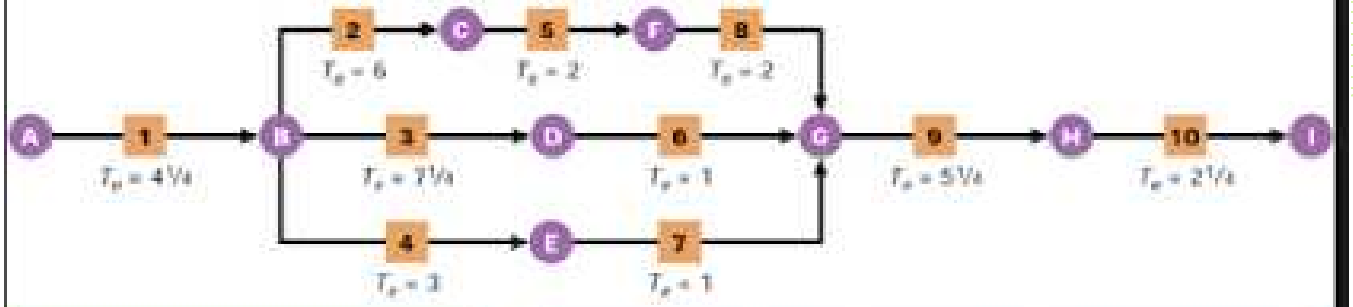

A simple GANTT Chart
Aug 12
Aug 26
Sep 09
Sep 23
Oct 07
Oct 21
Nov 04
Nov 18
Dec 02
Market Research
Brain-Storming
Define Specifications
Overall Archiecture
Project Planning
Assemble Team
Detail Design
Component Acquisition
Software Development
User Documentation
Test Plan
Testing and QA

PERT

- A PERT Chart shows the relationship among various steps in a project. It also serves as a way to calculate the critical path.
- The critical path is the longest time path through the network of steps. It identifies essential steps that must be completed on time in order to not delay completion of the total project.

PERT

TASK: Build three dozen customized golf carts for use by physically challenged adults



PERT events

A. Receive contract
B. Begin construction
C. Receive parts
D. Bodies ready for testing
E. Frames ready for testing
F. Drive trains ready for testing
G. Components ready for assembly
H. Carts assembled
I. Carts ready for shipment

PERT activities and times

Activities	T_o	T_m	T_p	T_e*
1. Prepare final design	3	4	6	4¼
2. Purchase parts	4	5	12	6
3. Fabricate bodies	5	7½	9	7¼
4. Fabricate frames	2½	3	4	3
5. Build drive trains	1½	2	3	2
6. Test bodies	½	1	1½	1
7. Test frames	½	1	1½	1
8. Test drive trains	1	1½	5	2
9. Assemble carts	3	5	9	5¼
10. Test carts	1	2	5	2¼

*Rounded to nearest ¼ workday

PERT

Enables a manager to:

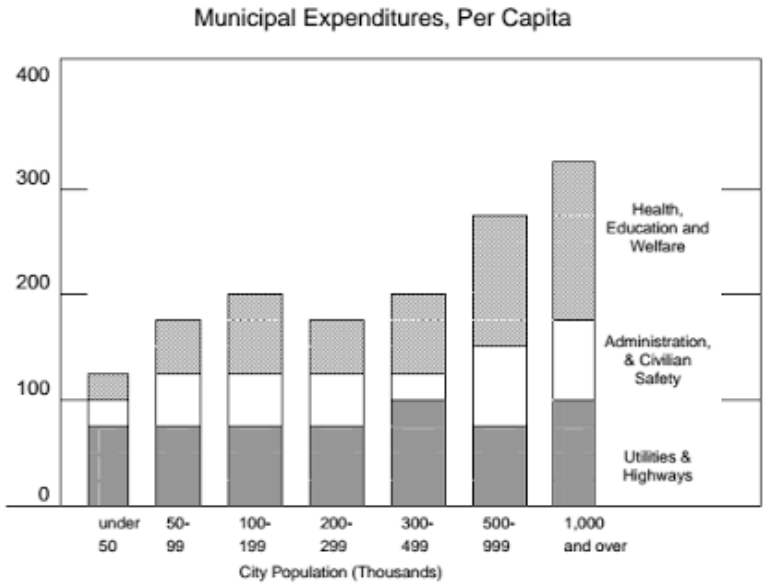
- plan the best possible use of resources to achieve a given goal within the overall time and cost limitations.

- handle one-of-a-kind programs where it is not know exactly how long things will take -- as opposed to repetitive production situations.

- utilize a so-called “time network analysis’ as a basic method of approach to determine manpower, material, and capital requirements.

REVIEW QUESTIONS

SAMPLE TEST QUESTIONS



6. Using the chart above, what is the approximate municipal expenditure per capita in cities having populations of 200,000 to 299,000?
   a. $ 125
   b. $ 175
   c. $ 200
   d. $ 300

Instructions: Read the information provided in the following passage and answer the question that follows.

8. From time to time the State makes surplus property available for sale to the public. This property consists of State property; unclaimed or abandoned personal property and valuables, except those confiscated in conjunction with drug enforcement activities; and unclaimed stolen property. The surplus property is disposed of through sale bids, auctions and donations.

   According to the passage,

   a. the State's personal property brings in the largest sales.
   b. items that are not claimed by their owner will be sold to the public.
   c. the State holds regularly scheduled sales of property to the public.
   d. property obtained by drug enforcement activities is sold through the bid process.

Question 4

The flow chart on the right is meant to show the steps for safely crossing the road. There is a decision box in this flow chart.

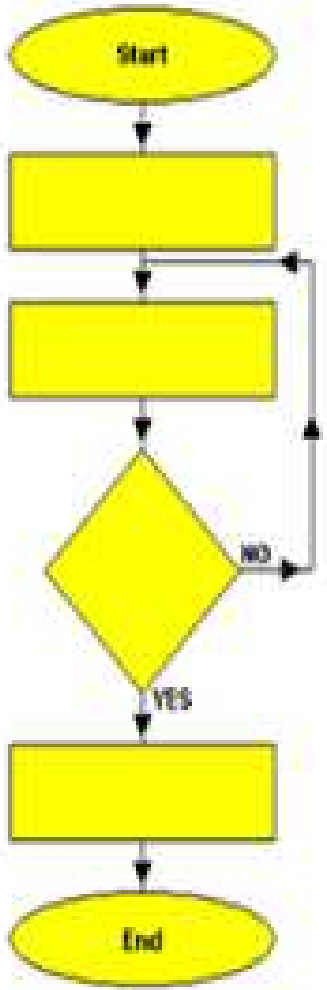
Place the boxes below in the flow chart.

Cross the road carefully

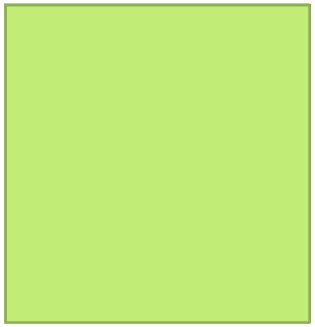
Look left and right

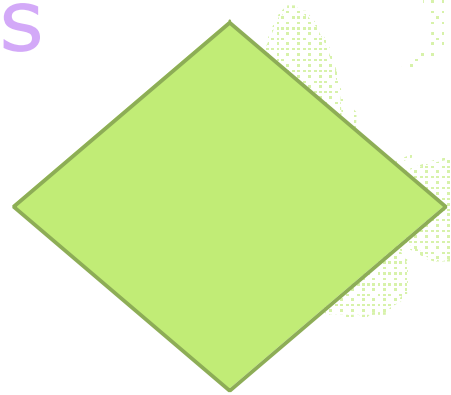
Stop at the curb

Is the road clear both ways?



Flow Charting Symbols

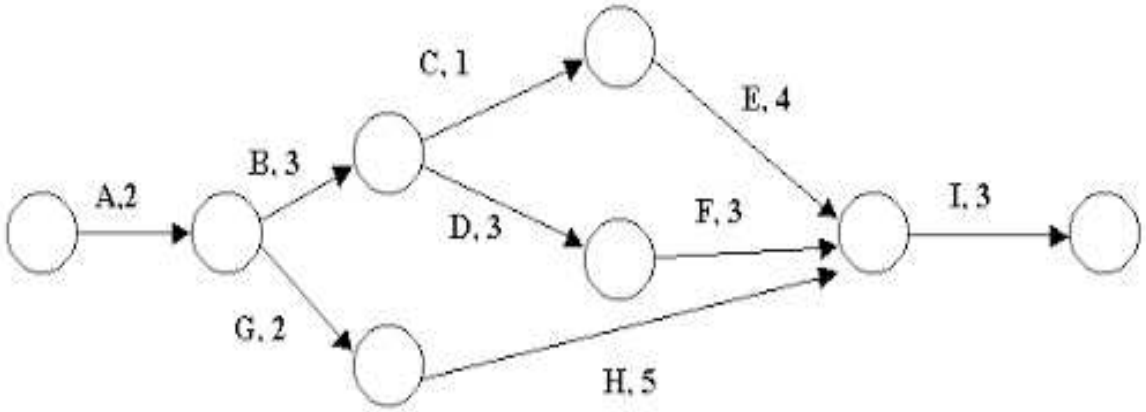




These two flowcharting symbols are

- a. Input/Output and process
- b. Decision and predefined process
- c. Process and decision
- d. Terminal and process

Below is a PERT chart drawn to show the development of a system.



EXAM QUESTION 1: Which tasks are on the critical path of the PERT chart above?

Which of the following control techniques is most useful on large, unique projects?

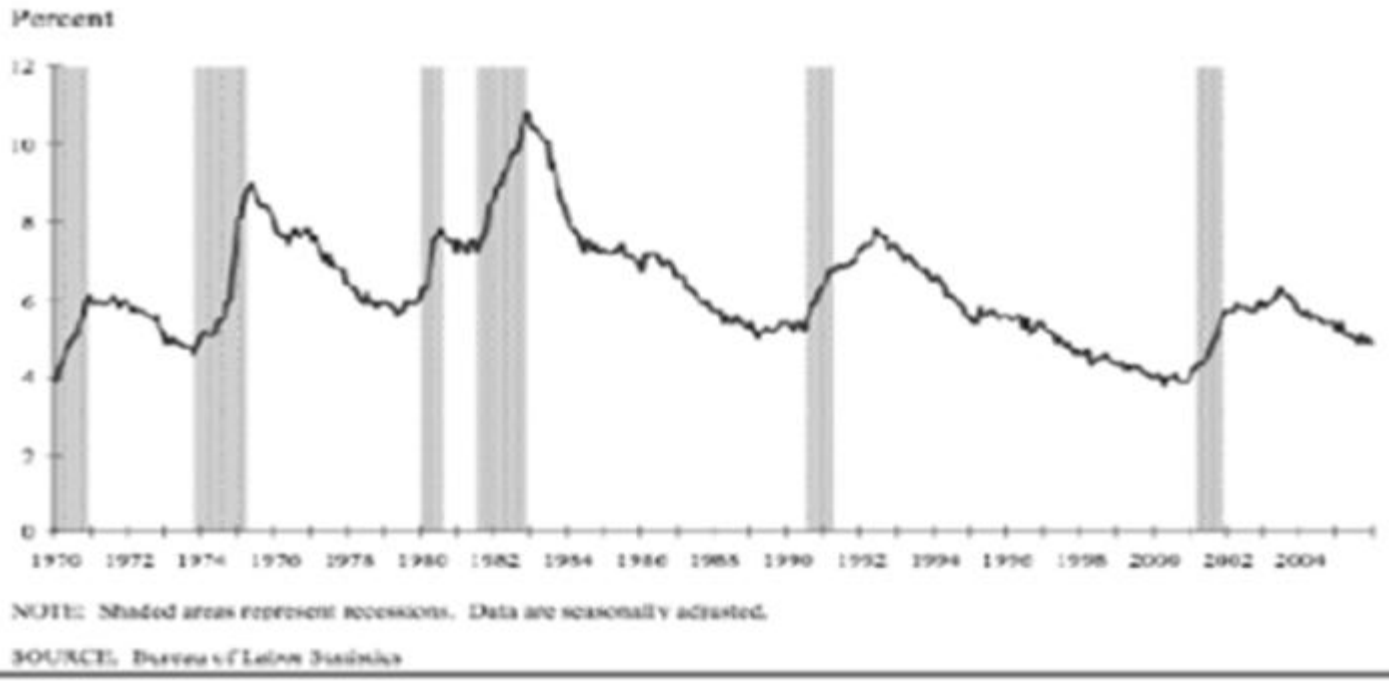
a. A general work plan

b. A Gantt chart

c. Monthly progress reports

d. PERT Chart

Chart 1-2. The unemployment rate is down from its most recent peak in June 2003



NOTE: Shaded areas represent recessions. Data are seasonally adjusted.

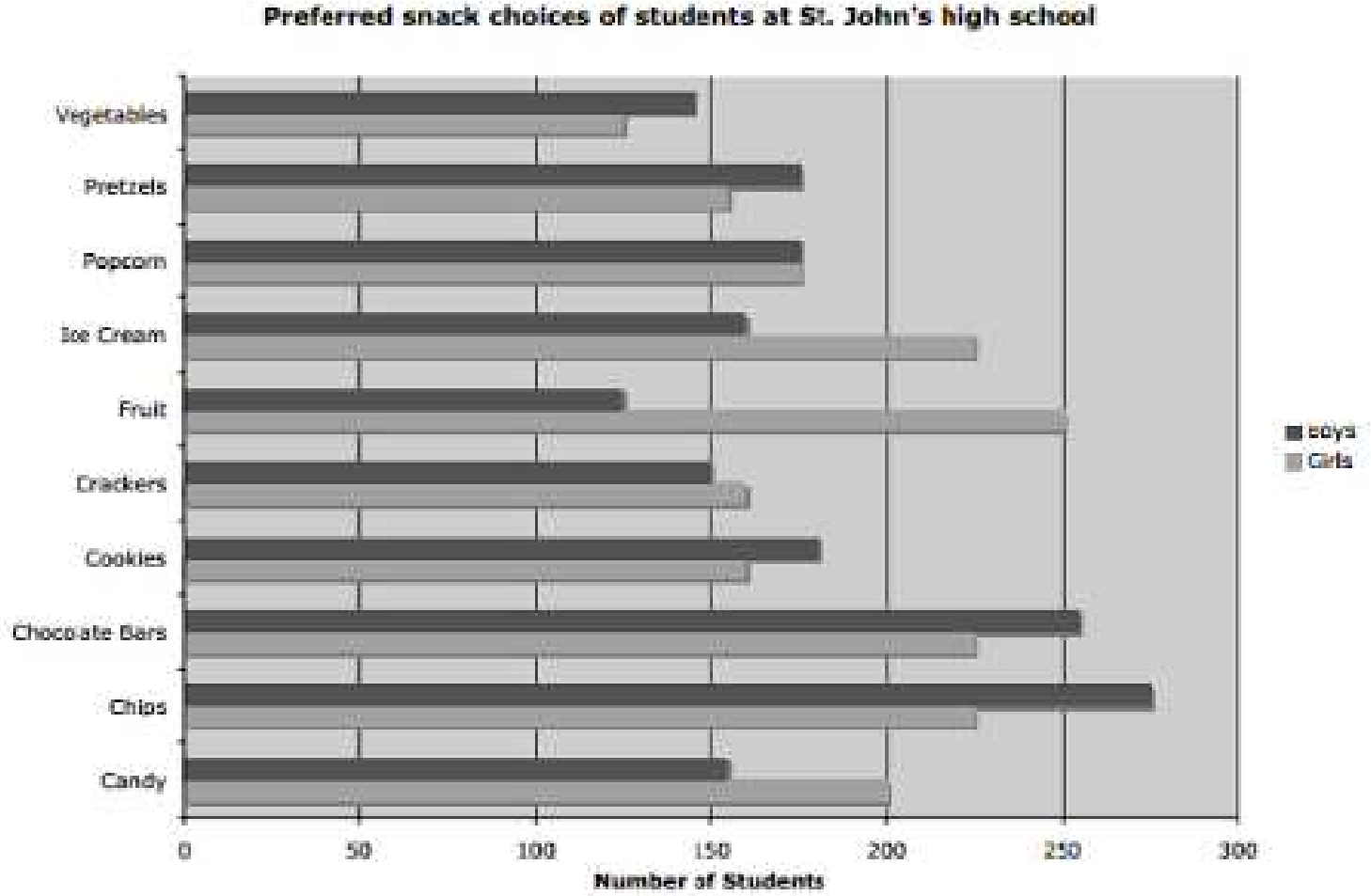
SOURCE: Bureau of Labor Statistics

Q1. What is the difference in percentage between the highest unemployment rate and the lowest unemployment rate in the given time period?

1. 10% **2.** 4% **3.** 7% **4.** 0%

Q2. What period had the lowest overall change in unemployment rates?

1. 1970 – 1980 **2.** 1980 – 1990 **3.** 1990 – 2000 **4.** 2000 – 2006



Q1. What ratio of category preferences did the boys exceed the girls in?

1. 4:5 **2.** 5:4 **3.** 1:1 **4.** 5:5

Q2. Approximately how many students had snacks at the school?

1. 3700 **2.** 1500 **3.** 600 **4.** 275

Your supervisor informs you that three of your fifteen employees have complained to her about your inconsistent methods of supervision. You should:

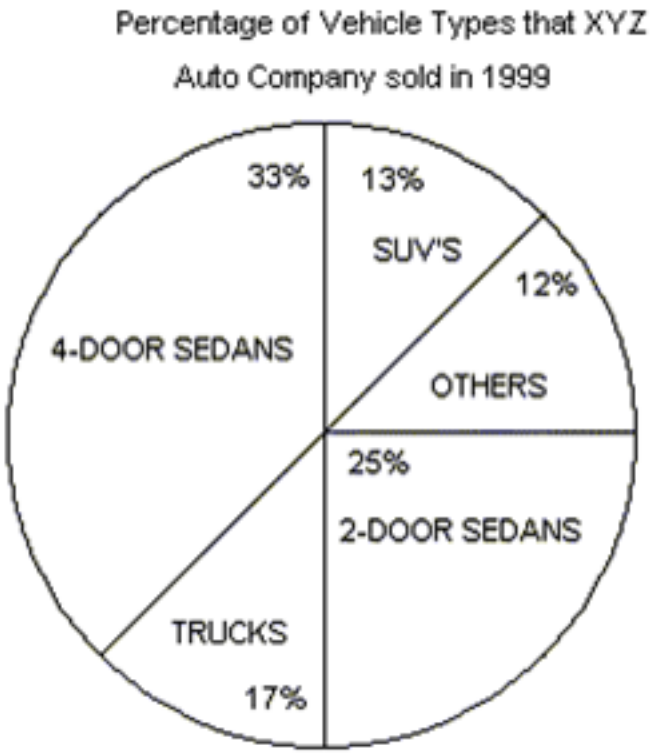
a. offer to attend a supervisory training program.

b. first ask her if it is proper for her to allow these employees to go over your head.

c. ask her what specific acts have been considered inconsistent.

d. explain that you've purposely been inconsistent because of the needs of these three employees.

If XYZ Auto Company sold 23,000 vehicles in 1999, how many were SUV's?



A. 2,990
B. 3,030
C. 3,450
D. 4,760
E. 4,775