

**ISyE 3103 Introduction to Supply Chain Modeling:
Logistics
Fall 2004
Midterm Exam
October 7, 2004**

Instructions

1. There are 7 pages and 100 points.
2. Do your own work.
3. Show all calculations.

Question 1

AutoID and Data Collection

[10 points]

1. What are 2 reasons for using automatic data collection technologies as opposed to doing data collection manually?

Answer:

- (a) Reduce errors in data entry.
- (b) Faster collection.
- (c) Cheaper in long run because save on labor costs.

2. What important step in the bar coding process needs to be done after bar code printing?

Answer: Bar code verification

3. Name 2 reasons why a company would use radio frequency identification instead of bar coding for data collection.

Answer:

- (a) No line of sight required for reading the data.
- (b) RFID chips work better in harsh environments.
- (c) RFID chips can have write capability.

Question 2

Information Systems and Database Design

[15 points]

1. Many-to-many relationships
 - (a) Give an example of a many-to-many relationship that might be found in a database storing supplier information.

- (b) Show with example tables, fields, and links between them, how the tables should be designed in a relational database to minimize the redundancy in the case of your many-to-many relationship example.

Answer:

- (a) A supplier can supply many parts, and the same part can be supplied by many suppliers, establishing a many-to-many relationship between the supplier table and the parts table.
- (b) Redundancy can be minimized by adding another table, say supplier-parts table, that contains data about which suppliers can supply which parts, what their prices and leadtimes are, etc. The supplier ID in the supplier table and supplier-parts table are linked, and the part ID in the parts table and supplier-parts table are linked.

2. Consistency

- (a) What is meant with “consistency” in database design?
- (b) Give an example of how it can easily come about that data in a database is inconsistent.
- (c) Why is inconsistency in a database undesirable?
- (d) Give an example how consistency can be enforced in a database, for example, a database in Microsoft Access.

Answer:

- (a) “Consistency” refers to representation of the same data in exactly the same way in different places in a database.
- (b) The state of Georgia in addresses may be encoded as “Georgia” or “GA” or “Ga” or “Goergia”.
- (c) Inconsistency is undesirable, because searches may not produce the desired results.
- (d) Consistency can be enforced by making a separate table that lists the allowed values for a field in the database and forcing the entries in the field to be looked up in the table. For example, a separate state table may be created with allowed values for the state field in addresses, and then making the state field in addresses a lookup field that gets its values from the state table.

Question 3

Bullwhip Effect and Vendor Managed Inventory

[18 points]

1. Give 2 reasons why the bullwhip effect leads to high costs in supply chains.

Answer: The bullwhip effect almost invariably leads to high inventory level fluctuations. This leads to high inventory carrying costs in some periods, and stockout costs in other periods. Also, highly fluctuating inventory levels may demand more physical storage space and therefore require larger fixed infrastructure investment.

2. What are 2 benefits that vendor managed inventory can have for the customer having their inventory managed?

Answer:

- (a) Less inventory.
- (b) Less frequent stock-outs.
- (c) Less resources required for inventory management.

3. What are 2 benefits that vendor managed inventory can have for the vendor managing the inventory of a customer?

Answer:

- (a) To get more freedom of when and how to deliver to their customers.
- (b) To smooth demand on production facilities.
- (c) To better coordinate deliveries to customers, saving on transportation costs.

4. Describe 3 difficulties that Barilla experienced during the execution of vendor managed inventory, after they had convinced their managers and customers, and had put in place the information systems and decision support system to support vendor managed inventory.

Answer: See the material discussed in class (part D of the case study).

Question 4

Forecasting

[16 points]

1. Forecasting by Experts

- (a) In the article on the value of experts in forecasting, it was mentioned that it was observed in studies that the quality of forecasts may actually deteriorate as the level of expertise increased. What was the explanation given for this phenomenon?
- (b) The article gives an explanation why companies continue to hire so-called experts to do their forecasting. What was the explanation?

Answer:

- (a) People who think they are experts tend to be stubborn when it comes to learning new things and admitting their errors.

- (b) Managers want to avoid responsibility for potentially bad forecasts.
2. Consider an automobile repair shop that wants a model to estimate how much paint will be used during the repair of an automobile. They want to use this model to help them decide how much paint to order from their suppliers in preparation for a paint job.
- (a) Can exponential smoothing be used to develop such a model? If so, describe the data that you would want to develop a model. If not, then explain why not.
 - (b) Can time series analysis be used to develop such a model? If so, describe the data that you would want to develop a model. If not, then explain why not.
 - (c) Can regression be used to develop such a model? If so, describe the data that you would want to develop a model. If not, then explain why not.
 - (d) To decide on the amount of paint to order from your supplier for a particular paint job, do you want to forecast the mean amount of paint used? If so, explain why. If not, explain what type of quantity you may want to forecast.

Answer:

- (a) No. Exponential smoothing extrapolation is inappropriate for such forecasting. A good forecast cannot be obtained by ordering the observed values of the amount of paint used on different jobs in a particular sequence and then extrapolating the sequence with an exponential smoothing method.
- (b) No. Time series extrapolation is inappropriate for such forecasting. A good forecast cannot be obtained by ordering the observed values of the amount of paint used on different jobs in a particular sequence and then extrapolating the sequence with a time series method.
- (c) Yes. Want data of the dependent variable, namely the amount of paint used, and data on relevant explanatory variables, such as surface area painted, type of paint used (water based or oil based), number of coats painted, whether underlying color is lighter or darker than color of paint, etc.
- (d) No. Want to forecast a slightly larger quantity, say the 80% quantile of the amount of paint used, to reduce the probability of running out of paint and having to place another order.

Question 5

Motor Freight Questions

[16 points]

1. Explain why it often happens that the trucks of a truckload carrier are emptier than the trucks of a less-than-truckload carrier.

Answer: A truckload carrier carries a single shipment directly from origin to destination on a vehicle at a time, and the shipment size may be significantly less than the

capacity of the vehicle, for example, it may be only half the capacity of the vehicle. A less-than-truckload carrier consolidates and carries multiple shipments on a vehicle at a time, thereby often getting the vehicle load to be close to the capacity of the vehicle.

2. What are 2 primary operational problems faced by truckload trucking firms?

Answer:

- (a) Driver management
- (b) Empty vehicle repositioning

3. Give an example of a benefit of good demand forecasting that is specific to a truckload carrier.

Answer: If truckload carriers have better forecasts of loads to be carried in the future, it can make better assignments of drivers/trucks to loads that reduce empty distances traveled and the associated costs.

4. What is a “private carrier”?

Answer: A company, such as WalMart, that does its own transportation with its own fleet.

5. Provide 2 reasons why a company might choose to be a private carrier.

Answer:

- (a) Lower costs, for example by avoiding unionized labor
- (b) Greater level of control over fleet, availability
- (c) Special shipping considerations, such as perishable or fragile goods

Question 6

Minimum Cost Paths

[25 points]

Suppose that you operate a distribution center in Cumming, and need to serve customers each afternoon scattered around the Atlanta metro region. You want to find paths for trucks that require minimum travel time, and you have the following travel time in minutes between city pairs. Note that travel is allowed in either direction with the same travel time.

City i	City j	Time c_{ij}
Cumming (C)	Sandy Springs (S)	40
Cumming (C)	Duluth (D)	20
Sandy Springs (S)	Duluth (D)	10
Sandy Springs (S)	Atlanta (A)	40
Sandy Springs (S)	Marietta (M)	10
Duluth (D)	Atlanta (A)	30
Duluth (D)	Hartsfield (H)	60
Marietta (M)	Atlanta (A)	50
Marietta (M)	Hartsfield (H)	30
Atlanta (A)	Hartsfield (H)	50

- Use Dijkstra's algorithm to determine the minimum travel time path tree from Cumming. Show your work in the table below.

Answer:

Iteration	Cumming	Sandy Springs	Duluth	Marietta	Atlanta	Hartsfield
Init	0 [0]	∞ [-1]	∞ [-1]	∞ [-1]	∞ [-1]	∞ [-1]
1	0 [0]	40 [C]	20 [C]	∞ [-1]	∞ [-1]	∞ [-1]
2	0 [0]	30 [D]	20 [C]	∞ [-1]	50 [D]	80 [D]
3	0 [0]	30 [D]	20 [C]	40 [S]	50 [D]	80 [D]
4	0 [0]	30 [D]	20 [C]	40 [S]	50 [D]	70 [M]
5	0 [0]	30 [D]	20 [C]	40 [S]	50 [D]	70 [M]
6	0 [0]	30 [D]	20 [C]	40 [S]	50 [D]	70 [M]

- Draw the the minimum travel time path tree from Cumming to all other locations on the network below.

Answer: Draw a line connecting each node to its predecessor.

- What is the minimum travel time from Cumming to Hartsfield?

Answer: $v(H) = 70$.

- What is the minimum travel time from Sandy Springs to Hartsfield? Justify your answer.

Answer: Since Sandy Springs lies on the directed minimum cost path connecting Cumming to Hartsfield, the minimum travel time from Sandy Springs to Hartsfield is given by the optimal labels: $v(H) - v(S) = 70 - 30 = 40$.