Problems for Logistical Management

Introduction

1. Why does a push-based supply chain react more slowly to changing demand than a pull-based system?

2. Discuss the impact of product diversification (the increase in the number of product variants) on the logistics systems planning and control.

3. CalFruit is an emerging Californian distributor of high-quality fresh fruits and vegetables, and packed food. Because the company operates in a very competitive market, the crucial factor influencing sales volume is the time required to meet the orders. On the basis of historical data, the logistician of the company has estimated that the service level (expressed as the percentage of orders filled within three working days) influences annual sales volume and total cost as reported in the table. Determine the service level that maximizes revenue.

   Annual sales forecast and total cost (in millions of dollars) for different service levels

	Percentage of orders filled within three working days						
	70%	75%	80%	85%	90%	95%	100%
Annual sales	4.48	6.67	8.17	9.34	9.87	10.56	11.52
Annual cost	4.41	5.55	5.99	6.22	6.87	7.44	12.84

4. The bullwhip effect is an unwanted increase in variability of material flows over time through the supply chain as a consequence of small variations in customer demand. This phenomenon, which was first recognized by Procter and Gamble managers when examining the demand for Pampers disposal diapers, depends mainly on the fact that individuals managing the different facilities of the supply chain make decisions based on a limited amount of information. For instance, the decision to replenish a factory warehouse is usually based on its current inventory level and the orders actually issued by its immediate successors in the supply chain (e.g. the CDCs) without any knowledge of end-user demand. Traditionally, successor orders are used to develop forecasts of the average value and the standard deviation of the demand perceived by the facility. Then such estimates serve as a basis for reorder decisions. For example, in the (s,S) method, an order is issued any time the inventory levels falls below a given reorder level s; the inventory levels is increased to an order-up-to-level S. As the perceived demand varies, the parameters S and s are updated and order quantities also changed. Show that the typical bullwhip effect for a supply chain made up of a factory, a factory warehouse, a DC and a retailer occurs, if the end-user demand is increased suddenly by 10%.

5. How can the bullwhip effect be reduced by sharing information among the facilities of a supply chain?

Forcasting

6. In containerized freight transportation, empty containers have to be periodically allocated to depots in order to satisfy future customer demands. How would you forecast the demand of carrier ISO 20 refrigerated containers?

7. To what extent are the forecasting practices different in an MTS and in an MTA system?

8. Your company is planning to add extra capacity to a plant currently manufacturing 110,000 items per year. You are asked to suggest how much capacity should be added to the factory. After an accurate sales forecast over the next few years you are quite sure that the most likely value of the annual demand is 140,000 items and that the MSE is equal to 10^8. You also know that your company loses $3 for each unit of unused capacity and $7 for each unit of unsatisfied demand. How much capacity should your company buy? (Hint: suppose that the forecasting error can be assumed to be normally distributed.)

9. Hot Spot is a firm based in the USA whose core business is the maintenance of home heaters. The company usually forecasts service requests on the basis of the number of installed heaters. Make a forecast of the service requests in 2003 in New Jersy by using data in the table. To this purpose use a single regression analysis (service requests versus total installed heaters).

Year	**Total (Installed heaters)**	**Service requests**
1995	329,500	18,672
1996	339,200	19,076
1997	370,650	20,994
1998	404,300	23,249
1999	442,500	25,025
2000	485,000	28,111
2001	528,500	30,985
2002	576,100	33,397
2003	625,750	

10. Mare Nostrum, a canned tuna manufacturer based in Sicily (Italy), has marketed a new spiced food line in June 2002. Now the management wishes to project sales for improved planning of production and logistics operations. Sales data for two and a half years are reported in the table

Month	**Sales (in hundreds of kilogram)**	**Month**	**Sales (in hundreds of kilogram)**	**Month**	**Sales (in hundreds of kilogram)**
Jän.01	130,000.00	Jän.02	141,988.00	Jän.03	156,467.00
Feb.01	129,720.00	Feb.02	142,376.00	Feb.03	158,137.00
Mär.01	129,703.00	Mär.02	143,636.00	Mär.03	159,140.00
Apr.01	129,633.00	Apr.02	144,543.00	Apr.03	161,156.00
Mai.01	129,632.00	Mai.02	147,534.00	Mai.03	162,835.00
Jun.01	129,854.00	Jun.02	148,919.00	Jun.03	165,479.00
Jul.01	130,436.00	Jul.02	150,961.00		
Aug.01	132,751.00	Aug.02	152,748.00		
Sep.01	133,334.00	Sep.02	152,977.00		
Okt.01	133,761.00	Okt.02	154,387.00		
Nov.01	135,286.00	Nov.02	156,856.00		
Dez.01	136,800.00	Dez.02	157,349.00		

a) Plot the data on a graph. What important observations can you make about the demand pattern? Which data are relevant and should be used for forecasting purpose?

b) Using the classical time series decomposition analysis, predict the expected sales over the next six months.

c) Repeat the forecast by applying the Holt method.

d) Estimate the MAPD of both methods using the last six months. Which approach seems to work best?

11. The Belgian Trucking Company needs to determine the number of refrigerated trucks to satisfy the transportation demand between Antwerp and Brussels on a daily basis. The volume of the demand for the last weeks is given in the table.

	Week									
Day	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Monday	67	68	76	75	75	82	77	88	84	84
Tuesday	54	57	59	57	58	69	65	57	72	56
Wednesday	47	49	49	52	57	59	52	54	68	59
Thursday	40	45	46	43	48	49	55	50	59	52
Friday	60	63	68	69	72	69	68	66	63	69

a) Using the Winters method, predict the expected number of pallets to be transported for the next week.

b) Estimate the error in the above forecast using the last three weeks.

12. Suppose that the preceding forecast was 2083, the actual value of the variable of interest for the last period was 1975 and the oldest value of the variable of interest was 1945. Using the moving-average technique based upon the most recent four observations, what is the new forecast for the next period?

13. Suppose that the preceding forecast was 2083, the actual value of the variable of interest for the last period was 1975 and α=0.3. Using the exponential smoothing, what is the new forecast for the next period?

14. If α is 0 or 1 in the exponential smoothing technique, what happens to the forecast?

15. The U.S. unemployment rate are as follows:

Date	Rate	Date	Rate	Date	Rate	Date	Rate	Date	Rate
1/80	6.9%	1/81	8.2%	1/82	9.4%	1/83	11.4%	1/84	8.8%
2/80	6.7%	2/81	7.0%	2/82	9.2%	2/83	10.0%	2/84	7.6%
3/80	7.9%	3/81	7.3%	3/82	9.8%	3/83	9.4%	3/84	7.5%
4/80	7.1%	4/81	7.5%	4/82	9.9%	4/83	8.4%	4/84	-

Forecast the rate for 4/84 using:

a) moving-average technique with r=3

b) exponential smoothing with α=0.1

c) linear regression with r=6

d) double-moving-average with r=3

e) Holt method with α=0.2, β=0.3

f) revised exponential smoothing with α=0.3, β=0.1

g) Winters method with α=0.3, β=0.2, η=0.1

h) Which method is the appropriate one?

Inventory Management

16. Modify the EOQ formula for the case where the stocking point has a finite capacity Q.

17. Modify the EOQ formula for the case where the order size q is delivered by a number of vehicles of capacity q_v each having a fixed cost k_v.

18. Modify the Wagner-Within model for the case where the stocking point is capacitated. Does the ZIO property still hold?

19. Al-Bufeira Motors manufactures spare parts for aircraft engines in Saudi Arabia. Its component Y02PN, produced in a plant located in Jiddah, has a demand of 220 units per year and a unit production cost of $1200. Manufacturing this product requires a time-consuming set-up that costs $800. The current annual interest rate is 18%, including warehousing costs. Shortages are allowed and the shortage cost per unit per week is $20. Calculate the optimal order quantity, the maximal shortage, and the total costs.

20. A specialty coffeehouse sells Colombian coffee at a fairly steady rate of 280 pounds annually. The beans are purchased from a local supplier for $2.40 per pound. The coffeehouse estimates that it costs $45 in paperwork and labour to place an order for the coffee, and holding costs are based on a 20 percent annual interest rate.

    a) Determine the optimal quantity for Colombian coffee

    b) What is the time between placements of orders?

    c) What is the average annual cost of holding and setup due to this item?

    d) If replenishment lead time is three weeks, determine the reorder level based on the on-hand inventory.

21. Your local grocery store stocks rolls of bathroom tissue in single packages and in more economical 12-packs. You are trying to decide which to buy. The single package costs 45 cents the 12-pack costs $5.00. You consume bathroom tissue at a fairly steady state of one roll every three months. Your opportunity cost of money is computed assuming an interest rate of 25 percent and a fixed cost of $1 for the additional time it takes you to buy bathroom tissues when you go shopping.

    a) How many single rolls should you be buying in order to minimize the annual hold and setup costs of purchasing bathroom tissue?

    b) Determine if it is more economical to purchase the bathroom tissue in 12-packs.

22. Parasol System sells motherboards for personal computers. For quantities up to 25, the firm charges $350.00 per board; for quantities between 26 and 50, it charges $315.00 for each board purchased beyond 25; and it charges $285 each for the additional quantities over 50. A large communications firm expects to require these motherboards for the next 10 years at a rate of at least 140 per year. Order setup costs are $30.00 and holding costs are based on an 18 percent annual interest rate. What should be the size of the standing order?

23. A purchasing agent for a particular type of silicon wafer used in the production of semiconductors must decide among three sources. Source A will sell the silicon wafers for $2.50 per wafer independent of the number of wafers ordered. Source B will sell the wafers for $2.40 each but will not consider an order for less than 3,000 wafers, and Source C will sell the wafers for $2.30 each but will not accept an order for less than 4,000 wafers. Assume an order setup cost of $100 and an annual requirement of 20,000 wafers. Assume a 20 percent annual interest rate for holding cost calculation.

   a) Which source should be used, and what is the size of the standing order?

   b) What is the optimal value of the holding and setup costs for wafers when the optimal source is used?

   c) If the replenishment lead time for wafers is three months, determine the reorder point based on the on-hand level of inventory of wafers.

24. Consider a company that designs swimsuits. They have to decide which quantity should be produced for the next season. To start production, they have to invest €120,000.00 independent of the amount produced. The variable production cost per unit equals €65. During summer a swimsuit will be sold for €105. At the end of the season any swimsuit not sold during summer is sold to a discount store for €15, but the discount store accepts not more than 2000 swimsuits. The remaining swimsuits have to be disposed at a cost of €5 for each. The demand forecast is as follows:

demand of 7000	9%
demand of 8000	12%
demand of 9000	26%
demand of 10000	25%
demand of 11000	16%
demand of 12000	12%

How many swimsuits should be produced 7000, 8000, 9000, 10000, 11000, or 12000?

25. Billy's Bakery bakes fresh bagels each morning. The daily demand for bagels is a random variable with a distribution estimated from prior experience given by

# of bagels sold in one day	probability
0	.05
5	.10
10	.10
15	.20
20	.25
25	.15
30	.10
35	.05

The bagels cost Billy's 8 cents to make, and they are sold for 35 cents each. Bagels unsold at the end of the day are purchased by a nearby charity soup kitchen for 3 cents each

a) Based on the discrete distribution above, how many bagels should Billy's bake at the start of each day?

b) Determine the optimal number of bagels to bake each day using a normal distribution approximation. (Hint: You must compute the mean and the variance of the demand from the discrete distribution above.)

26. Weiss's paint store uses a reorder point inventory system to control its stock levels. For a particularly popular white latex paint, historical data show that the distribution of monthly demand is approximately normal, with mean 28 and standard deviation 8. Replenishment lead time for this paint is about 14 weeks. Each can of paint costs the store $6. Although excess demands are back-ordered, the store owner estimates that unfilled demands cost about $10 each in bookkeeping and loss-of-goodwill costs. Fixed costs for replenishment are $15 per order, and holding costs are based on a 30 percent annual rate of interest.

a) What are the optimal lot sizes and reorder points for this brand of paint?

b) What is the optimal safety stock for this paint?

27. For the previous problem of Weiss's paint store, suppose that the paint is reordered on a monthly basis rather than on a continuous basis.

a) Using the solution you obtained in part (a) of Problem B8, determine appropriate values of (s,S).

b) Suppose that the demand during the months of January to June were

Month	Demand
January	37
February	33
March	26
April	31
May	14
June	40

If the starting inventory in January was 26 cans of paint, determine the number of units of paint ordered in each of the months January to June following the (s,S) policy you found in (a).

28. Bobbi's Restaurant in Boise, Idaho, is a popular place for weekend brunch. The restaurant serves real maple syrup with French toast and pancakes. Bobbi buys the maple syrup from a company in Maine that requires three weeks for delivery. The syrup costs Bobbi $4.00 a bottle and may be purchased in any quantity. Fixed costs of ordering amount to about $75.00 for bookkeeping expenses and holding costs are based on a 20 percent annual rate. Bobbi estimates that the loss of customer goodwill for not being able to serve the syrup when requested amounts to $25.00. Based on past experience, the weekly demand for the syrup if normal with mean 12 and variance 16 (in bottles). For the purpose of your calculations, you may assume 52 weeks in a year and that all excess demand is back-ordered.

a) How large an order should Bobbi be placing with her supplier of the maple syrup, and when should those orders be placed?

b) What level of Type 1 service is being provided by the policy you found in part (a)?

c) What level of Type 2 service is being provided by the policy you found in part (a)?

d) What policy should Bobbi use if the stock-out cost is replaced with a Type 1 service objective of 95 percent?

e) What policy should Bobbi use if the stock-out cost is replaced with a Type 2 service objective of 95 percent? (You may assume an EOQ lot size.)

29. Consider a two-stage serial process where the second stage is a rather minor operation adding little extra value to the product. To be more specific, suppose we have an item with these characteristics (borrowing the notation of "W" for warehouse, or primary stage and "R" for retailer, or finishing stage).

d = 1000 units/year c_w = \$5/unit
c_R = \$6 /unit p = 0.24 /year
k_w = \$20 k_R = \$10

Obtain Q_w and Q_r and n. Do your results make intuitive sense?

30. A plant produces 25-by-30-cm lithographic film. The basic unit of the product is a box of fifty sheets of film. Suppose that the production process actually involves two stages (call the primary and finishing, or warehouse and retailer). The relevant cost parameters are k_W = \$24, k_R = \$30, c_W = \$15/box, c_R = \$20/box, and p = 0.02 \$/\$/month. The requirement pattern for 8 months is:

Month	1	2	3	4	5	6	7	8
Requirement	10	62	12	130	154	129	88	52

Use the sequential, unmodified, Silver-Meal heuristic to determine the pattern of replenishment. To be more specific, first use the Silver-Meal at the finishing stage with appropriate costs and use the resulting replenishments as requirement pattern for the primary stage. Finally, give the costs of the overall solution.

31. Consider a warehouse that serves five retailers that face nearly identical costs and demands. The warehouse holds no stock, and therefore serves as a break-bulk facility. They order from their supplier, receive the products, and immediately distribute them to the five retailers. Find the order-up-to level for the warehouse assuming the following data.

a) R = 2 weeks J = 5 retailers
$\hat{v}$ = 0.35 \$/\$/year p = 0.24 \$/\$/year
L_W = 2.5 weeks L_R = 2 weeks
Weekly demand:
$\bar{d}_j = 45$ units for each retailers
$\sigma_j = 12$ units for each retailers

b) If three retailers have an inventory position of 160 units each, while the other two have 200 units each, what amount should be allocated to each?

32. A warehouse supplies a single retailer with a product. The warehouse's purchasing lead time is three weeks and the lead time for the retailer (from the warehouse) is one week. Assume that forecast errors are normally distributed with the for one week being 70 units. The annual demand rate is 12,000 units, and the following data have been gathered: c_W=\$32/unit, c_R=\$38/unit, p=0.22 \$/\$/yr. n=2, or the warehouse orders two batches of the retailer's order quantity at one time. The retailer's order quantity is q_R=500 units. Finally, suppose that the charge per unit short, u is set at \$24.7. Find the reorder point for both locations.

33. With electronic data interchange (EDI) it is possible for customers and their suppliers to have direct on-line communication. In some cases, the customer is shown the inventory status of the supplier prior to possibly placing an order. Discuss briefly the possible advantages and disadvantages of such a situation from the standpoint of the supplier.

Designing Logistics Networks

34. Your company has to close 20 of its 125 warehouses. Suppose the CPL hypotheses hold. How would you define V_1? What is the value of p?

35. Modify the CPL model to take into account that a subset of already existing facilities $V_1' \subseteq V_1$ cannot be closed (but can be upgraded). Indicate the current fixed cost and capacity of facility $i \in V_1'$ as f_i' and q_i', respectively. Moreover let f_i'' and q_i'' be the fixed cost and capacity if facility $i \in V_1'$ is upgraded, respectively.

36. Borachera is a major Spanish wine wholesaler currently operating two CDCs in Salamca nd Albacete, and a number of RDCs all over the Iberian peninsula. In order to reduce the overall logistics cost, the company wishes to redesign its distribution network by replacing its current RDCs with three (possibly new) RDCs. Based on a preliminary qualitative analysis, an RDC should be located in the Castilla-Leo region, either in Vallalolid, Burgos or Soria. A second RDC should be located in the Extremadura region, either in Badajoz, Plasencia or Caceres. Finally, the third RDC should be located in the Argon region, either in Barbastro, Saragossa or Teruel. Transportation costs from the RDCs to retailers are charged to retailers. Formulate the Borachera problem as a modified CPL model.

37. When designing a distribution network it is customary to remove excessively long transportation links from the model in order to avoid a timely delivery to customers. How should the CPL Lagrangian heuristic be modified in this case?

38. A company supplies 5 major customers. There are 4 potential locations for plants. Demand of customers and capacity limitations are:

customer	demand	plant	capacity
1	100	1	250
2	90	2	350
3	110	3	350
4	120	4	250
5	50		

The transportation costs per unit are:

plant \ customer	1	2	3	4	5
1	342	500	612	94	219
2	119	390	745	324	467
3	631	687	277	313	145
4	827	639	195	630	443

For each plant the fixed costs are 50000.
Formulate an optimization model for this problem.
Decide which customer will be supplied by which plant if only plants 2 and 3 are realized.

39. The following capacitated warehouse location problem is given. Calculate 2 iterations of the Lagrange heuristic with γ=1.

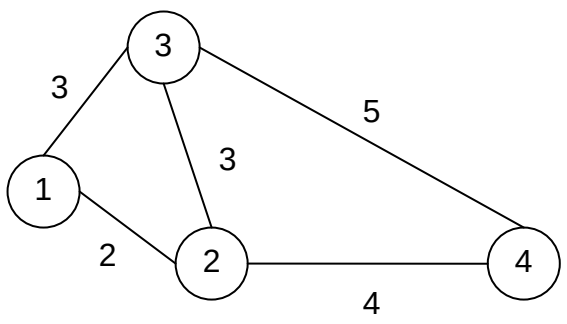
i \ j	1	2	3	4	a_i	f_i
1	0	3	2	0	25	20
2	1	0	2	1	25	20
3	3	1	0	1	25	25
b_j	10	10	10	20		

40. The following capacitated warehouse location problem is given. Calculate 2 iterations of the Lagrange heuristic with γ=1.

i \ j	1	2	3	4	a_i	f_i
1	5	2	1	0	20	15
2	2	4	6	1	25	20
3	2	1	8	2	25	20
4	1	3	4	9	20	10
b_j	10	20	10	10		

41. Complete the example on finding a **single absolute center** in a **graph** started in class (page 120 - 122)

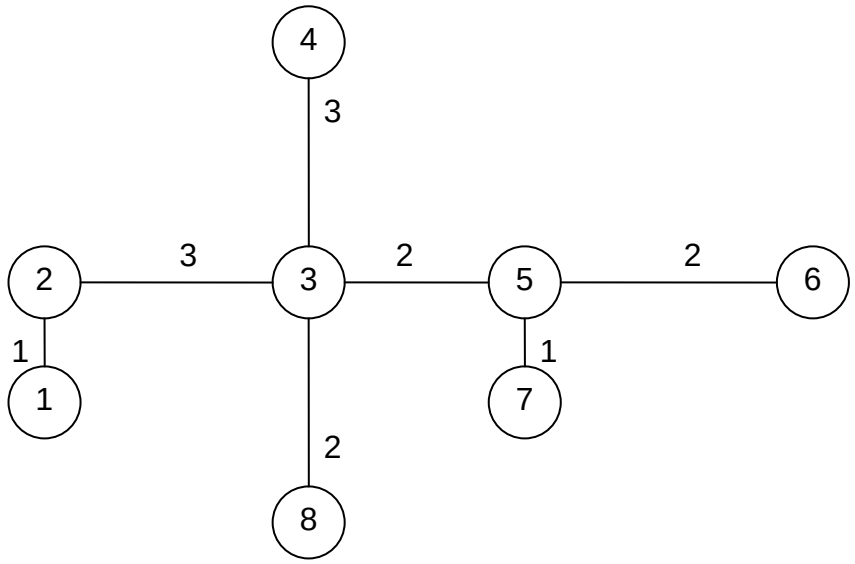
42. Consider the following graph and determine the **absolute single** center using **Hakimi's** method



43. Consider the graph from 2.) and determine the absolute single center using the **complete method**.

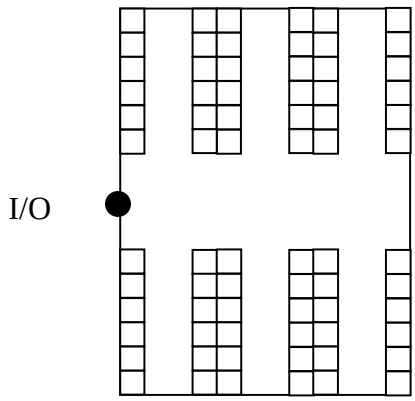
44. Complete the example on solving **the r-covering** problem started in class (page 133 – 137)

45. Consider the following **tree** and determine the **absolute 2-center**



Warehouse Design

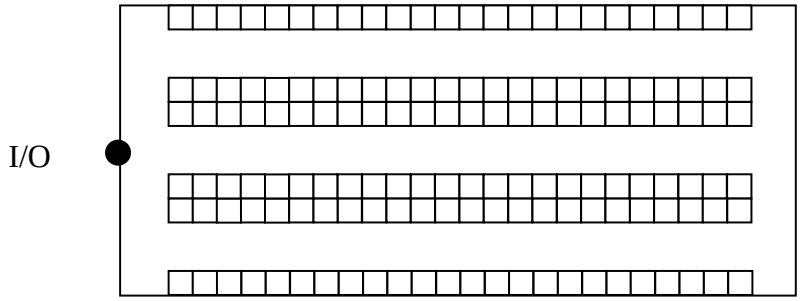
46. A warehouse is being designed to hold up to 4000 unit loads at a time. Storage locations will be 1.2 x 1.2 meter, the side aisles are 2.3 meters and the central aisle is 5.8 meters. The layout scheme is below. Find warehouse dimensions and average trip distance for single-cycle trips if



a) Loads are placed three locations high on the rack

b) Loads are placed five locations high on the rack

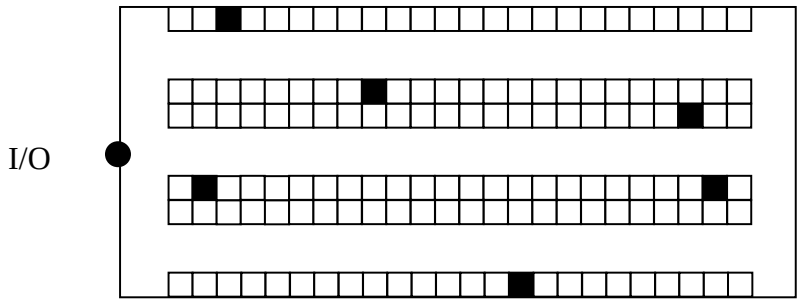
47. Suppose you have a warehouse with one I/O port at the middle of one side and aisles along the length of the warehouse as shown below. Find a general formula for the average travel distance per one-way trip and solve for the optimal dimensions of this warehouse.



48. Six product types will be stored in a 50 x 50 meter warehouse. Each part will have dedicated space. The table below contains space and flow volume considerations for the warehouse. Each square grid occupies 25 square meters of warehouse footprint. Products are received at the north-west corner and shipped at the north-east corner. All products make 3 times as many trips to the shipping port as from the receiving port. Assign products to grids.

Product	Grids required	Total Loads Moved per Day
1	15	60
2	20	100
3	10	75
4	40	25
5	5	25
6	10	400

49. Assume a warehouse as given below with storage locations of 1x1 meter and an aisle width of 2.5 meters. The black boxes mark positions which have to be visited.



a) Use the S-shape heuristic to determine the order picker route. Give the length of the route.

b) Use the Largest-Gap heuristic to determine the order picker route. Give the length of the route.

50. Modify the heuristics for the 1-BP problem for the case where each bin j, j=1,…,n, has a capacity qj and a cost fj. Apply the modified version of the BFD algorithm to the following problem. Brocard is a road carrier operating mainly in France and in the Benelux. The vehicle fleet comprises 14 vans of capacity equal to 800 kg and 22 vans of capacity equal to 500 kg. The company has to deliver on behalf of the EU 34 parcels of different sizes from Paris to Frankfurt (the distance between these cities is 592 km). The characteristics of the parcels are reported in the table below. As only five company owned vans (all having capacity 800 kg) will be available on the day of the delivery, Brocard has decided to hire additional vehicles from a third party company. The following additional vehicles will be available:

- two trucks with a capacity of 3 tons each, whose hiring total cost (incl. of drivers) is €1.4 per kilometre;
- one truck with trailer, with a capacity of 3.5 tons, whose hiring total cost (incl. of drivers) is € 1.6 kilometre.

Parcel	Weight
1-3	228
4-7	217
8-11	210
12-14	195
15-21	170
22-25	95
26-31	75
32-34	55

Which trucks should Brocard hire?

Standard Normal Distribution F(z)

Z	0,00	0,02	0,04	0,06	0,08
0,00	0,5000	0,5080	0,5160	0,5239	0,5319
0,10	0,5398	0,5478	0,5557	0,5636	0,5714
0,20	0,5793	0,5871	0,5948	0,6026	0,6103
0,30	0,6179	0,6255	0,6331	0,6406	0,6480
0,40	0,6554	0,6628	0,6700	0,6772	0,6844
0,50	0,6915	0,6985	0,7054	0,7123	0,7190
0,60	0,7257	0,7324	0,7389	0,7454	0,7517
0,70	0,7580	0,7642	0,7704	0,7764	0,7823
0,80	0,7881	0,7939	0,7995	0,8051	0,8106
0,90	0,8159	0,8212	0,8264	0,8315	0,8365
1,00	0,8413	0,8461	0,8508	0,8554	0,8599
1,10	0,8643	0,8686	0,8729	0,8770	0,8810
1,20	0,8849	0,8888	0,8925	0,8962	0,8997
1,30	0,9032	0,9066	0,9099	0,9131	0,9162
1,40	0,9192	0,9222	0,9251	0,9279	0,9306
1,50	0,9332	0,9357	0,9382	0,9406	0,9429
1,60	0,9452	0,9474	0,9495	0,9515	0,9535
1,70	0,9554	0,9573	0,9591	0,9608	0,9625
1,80	0,9641	0,9656	0,9671	0,9686	0,9699
1,90	0,9713	0,9726	0,9738	0,9750	0,9761
2,00	0,9772	0,9783	0,9793	0,9803	0,9812
2,10	0,9821	0,9830	0,9838	0,9846	0,9854
2,20	0,9861	0,9868	0,9875	0,9881	0,9887
2,30	0,9893	0,9898	0,9904	0,9909	0,9913
2,40	0,9918	0,9922	0,9927	0,9931	0,9934
2,50	0,9938	0,9941	0,9945	0,9948	0,9951
2,60	0,9953	0,9956	0,9959	0,9961	0,9963
2,70	0,9965	0,9967	0,9969	0,9971	0,9973
2,80	0,9974	0,9976	0,9977	0,9979	0,9980
2,90	0,9981	0,9982	0,9984	0,9985	0,9986
3,00	0,9987	0,9987	0,9988	0,9989	0,9990

Unit Normal Linear Loss Integral L(Z)

Z	.00	.02	.04	.06	.08
0.00	.3989	.3890	.3793	.3697	.3602
0.10	.3509	.3418	.3329	.3240	.3154
0.20	.3069	.2986	.2904	.2824	.2745
0.30	.2668	.2592	.2518	.2445	.2374
0.40	.2304	.2236	.2170	.2104	.2040
0.50	.1978	.1917	.1857	.1799	.1742
0.60	.1687	.1633	.1580	.1528	.1478
0.70	.1429	.1381	.1335	.1289	.1245
0.80	.1202	.1160	.1120	.1080	.1042
0.90	.1004	.0968	.0933	.0899	.0866
1.00	.0833	.0802	.0772	.0742	.0714
1.10	.0686	.0660	.0634	.0609	.0585
1.20	.0561	.0539	.0517	.0496	.0475
1.30	.0456	.0437	.0418	.0401	.0383
1.40	.0367	.0351	.0336	.0321	.0307
1.50	.0293	.0280	.0268	.0256	.0244
1.60	.0233	.0222	.0212	.0202	.0192
1.70	.0183	.0174	.0166	.0158	.0150
1.80	.0143	0..0136	.0129	.0122	.0116
1.90	.0110	.0104	.0099	.0094	.0089
2.00	.0084	.0080	.0075	.0071	.0067
2.10	.0063	.0060	.0056	.0053	.0050
2.20	.0047	.0044	.0042	.0039	.0037
2.30	.0036	.0034	.0032	.0030	.0028
2.40	.0027	.0026	.0024	.0023	.0022
2.50	.0021	.0018	.0017	.0016	.0016