Otto-von-Guericke-University Magdeburg
Faculty of Economics and Management
- Management Science -
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Management VII (5074)
Production Management & Operations Research
February 7, 2005

Last name: .... **First name: ....** **Matriculation No.: ....**

Examination:	Production Management & Operations Research	WS 2004/2005
Examiner:	Prof. Dr. G. Wäscher	

General remarks:

1. Write your name and matriculation number on this cover sheet and on every other sheet that has been issued to you.
2. Leave a minimum of 4 cm as correction space on the outside margin of each page.
3. Make sure that you have a complete copy of the test. The test consists of **4 assignments**, all of which have to be dealt with. It is not permitted to remove the retaining clip; doing so will be treated as fraudulent behaviour.
4. Please write legibly and number the pages which have been used. For each assignment, put down your answers on a separate sheet. Only pens with permanent ink may be used, while correction pens or ink erasers are not permitted. Make sure that you don't write in red.
5. Always make clear how you have determined your solution (solution path). Isolated solutions without traceable origin will not be accepted.
6. The following aids may be used: writing utensils, non-programmable pocket calculators without communicating and/or data processing functions, dictionaries (without any added remarks only).

Assignment # 1 (20 points)

The classic EOQ model, among others, provides information about the optimal lot-size of a single product type.

a) The classic EOQ model is based on several assumptions under which the optimal lot-size can be derived. Give three of these assumptions regarding the production process and another three assumptions regarding the inventory!

b) Plot a graph, which represents the relationship between time and inventory level for the product type under consideration!

c) In another diagram, plot the relationship between the order lot-size on one hand and the (decision-relevant) partial and total costs on the other! Where exactly do we find the optimal lot-size? Give a formal proof for that condition!

Assignment # 2 (27 points)

A furniture manufacturer produces and sells five types of furniture (F1, F2, F3, F4 and F5). For each furniture type a set of information is available, which might be valuable for production planning. This information is listed in the table below:

	F1	F2	F3	F4	F5
contribution margin [€ / product unit]	-2	0	2	4	6
processing time per unit [time units / product unit]	1	2	1	1	2
minimum sales quantity [product units / period]	20	0	0	10	0
maximum sales quantity [product units / period]	20	100	40	30	20
time per set-up [time units / set-up]	10	10	20	30	40
(variable) costs per set-up [€ / set-up]	10	30	50	20	40

During the period under discussion, a total time capacity of 150 time units will be available. The company management wants to determine the product mix which maximises the profit of this period.

a) Develop a model from which an optimal product mix can be determined! Do not forget to define the symbols used!

b) In this simple numerical example, an optimal solution can be determined without the application of linear programming. Do so, but do not forget to document your solution approach. Make clear why the solution you are suggesting must be an optimal one!

Assignment # 3 (23 points)

In a standardised production process, a company produces small, medium-size and large types of stereo receivers (SR). Three kinds of electronic components are needed in production – component A, B and C. Per day, 840 units of A, 720 units of B, and 510 units of C can be made available from a supplier. The small stereo receivers provide a profit contribution of 15 Euros, the medium ones of 5 Euros, and the large ones of 6 Euros per unit. The following table gives information about how many units of each component are used for each of the stereo receivers:

	small SR	medium-size SR	large SR
A	2	15	20
B	1	15	100
C	5	10	40

In order to determine an optimal product mix for the above-given problem, the Simplex Method is applied, which provides the following optimal tableau:

x_0	x_s	x_m	x_l	s_A	s_B	s_C	RHS
1	0	25	114	0	0	3	1530
0	0	11	4	1	0	-2/5	636
0	0	13	92	0	1	-1/5	618
0	1	2	8	0	0	1/5	102

x_0 : profit contribution per day;

x_j : number of stereo receivers to be produced of receiver type j (j = s, m, l);

s_i : slack variable assigned to component i (i =A, B, C) ; number of units of component i which could be made available beyond the actual demand.

a) What is the optimal product mix and the corresponding profit contribution per day? How many pieces of A, B and C will be used (demanded from the supplier) per day?

b) If you were the production manager of that company, how much you would pay at most if someone offered you one additional unit of A? Explain how you determine that result from the optimal tableau! What would be your answers if – ceteris paribus – one additional unit of B or C could be made available?

c) Assume that the supplier of component C increases his production by a considerable amount and can therefore provide as many units of C as you may want to buy from him. How many units of C would you buy in addition to the ones you already buy regularly? (Give reasons!) What impact would that have on the company's daily profit contribution?

Assignment # 4 (30 points)

A car retailer has the following prediction of the demand for his high-price model for the forthcoming 6 months and wants to determine the number of cars he has to order from the manufacturer.

month	t	1	2	3	4	5	6
demand	n_t	12	6	4	4	2	10

The (decision-relevant) ordering costs amount to 5 monetary units (MU) per order. Keeping cars as inventory results in holding costs of one MU per car and month. There are no cars in stock at the beginning of the first month and there should also be no cars left in stock at the end of month 6. No other inventory restrictions have to be considered.

a) Represent the problem as a shortest-path problem in a directed graph! Determine an optimal ordering policy and the corresponding holding, ordering and total costs per month.

b) In a second scenario, an additional inventory restriction is given. There is no inventory allowed at the end of period 4, but all the other information remains unchanged. Again, your task is to represent the problem as a shortest-path problem in a directed graph and to determine an optimal ordering policy and the corresponding costs.