Otto-von-Guericke-University Magdeburg
Faculty of Economics and Management
- Management Science -
Prof. Dr. Gerhard Wäscher

Test
Production Management & Operations Research (5074)
February 06, 2008

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

Examination: Production Management & Operations Research WS 2007/ 2008
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 **6 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 (14 points)

Part A – Multiple Choice (questions 1-4): Which is the correct answer to the following questions? Indicate your answer by marking the respective box! Only one answer per question is correct. (One point for each correct answer, one point will be deducted for every wrong answer – the minimum total number for this part of assignment 1 is zero!)

1) Considering the classification of planning situations for production program planning in the single period case. For which situation is linear programming the method of choice?

   (1a) ☐ single product with a single internal bottleneck
   (1b) ☐ single product with multiple internal bottlenecks
   (1c) ☐ multiple products with neglectable set-up processes and with multiple internal bottlenecks
   (1d) ☐ multiple products with non-neglectable set-up processes and a single internal bottleneck

2) The free slack of an activity is defined as the time period for a possible delay or extension of the activity, if its predecessors and successors are in the following positions:

   (2a) ☐ all predecessors are in earliest position and all successors are in earliest position
   (2b) ☐ all predecessors are in earliest position and all successors are in latest position
   (2c) ☐ all predecessors are in latest position and all successors are in earliest position
   (2d) ☐ all predecessors are in latest position and all successors are in latest position

3) If the independent slack of an activity has the value of four, you can conclude that

   (3a) ☐ the activity is on the critical path
   (3b) ☐ the free slack must be zero
   (3c) ☐ the free slack is greater than four
   (3d) ☐ the total slack is equal or greater than four

4) In order sequencing for a given set of orders, the minimization of the average order processing time is equivalent to

   (4a) ☐ minimization of the total idle time
   (4b) ☐ minimization of the total waiting time
   (4c) ☐ maximization of the capacity utilization
   (4d) ☐ maximization of the makespan

Part B – Short Questions (questions 5-9): Answer the questions in short! You do not need to write complete sentences – keywords are sufficient. (Two points for each completed question.)

5) Give a definition of the opportunity costs of a restriction!

6) Sketch the graph of the experience curve and explain in a few words the relationship between the corresponding factors!

7) In general, capacity supply and demand may be balanced either by increasing the capacity supply or by reduction of the capacity demand.
Name three short-term means for the reduction of capacity demand!

8) Given the following activities and their predecessors, construct an activity-on-arc network!

Activity	Predecessor
A	-
B	-
C	-
D	A
E	A, B
F	A, B, C
G	D, E, F

9) The Helgeson and Bernie method for production line balancing starts with certain assumptions. Name five of them!

Assignment 2 (12 points)

A company produces and sells three variants V1, V2, and V3 of a specific product. Their contribution margins are 400 € (V1), 300 € (V2), and 200 € (V3), respectively. For the planning period under discussion the sales department has already contracted a volume of 700 units, however, without being committed to a special variant or combination of variants. They also believe that up to 500 units can be sold of each variant (including the ones already contracted).

Production of V1 requires an extensive set-up process which causes (variable) set-up costs of 8,000 €. Capacities are abundant, such that no bottlenecks in production have to be considered. However, each variant will be produced at most once during each planning period. The company seeks to maximise its profits for the period under discussion.

Develop a model for the above-stated product-mix problem!
Do not forget to define the symbols used!

Assignment 3 (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 requires several assumptions under which the optimal lot-size can be derived. Name 3 assumptions regarding the production and 3 assumptions regarding the inventory.

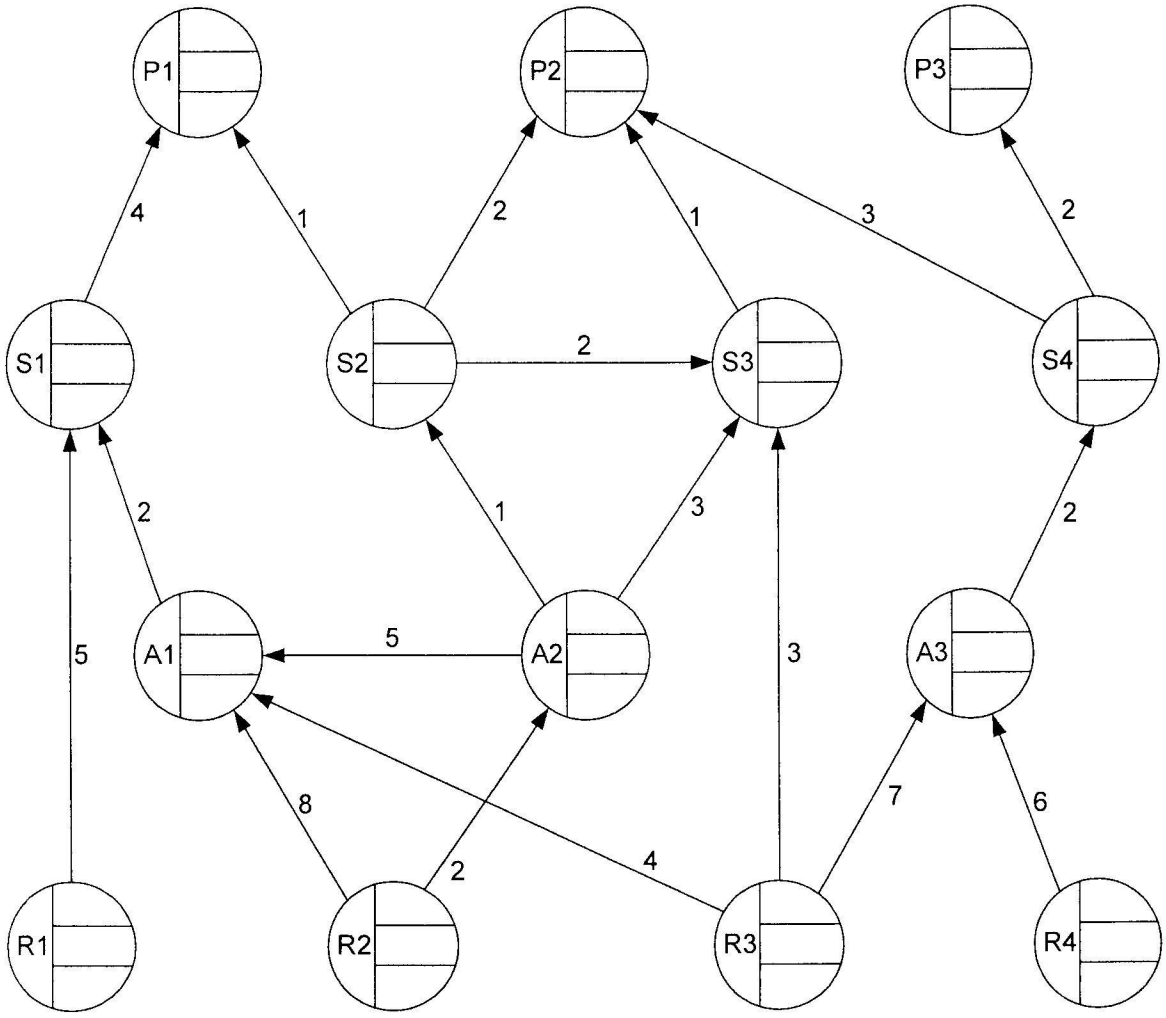
b) Plot a graph, which represents the relationship between time and inventory level for the product type under consideration!

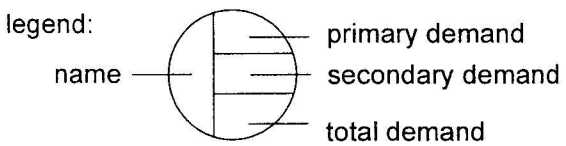
c) In another diagram, plot the relationship between the order lot-size on one hand and the (decision-relevant) partial and total costs on the other! Where exactly do we find the optimal lot-size? Give a formal proof for that condition! Also give a formal proof that for the optimal lot-size the total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

Assignment 4 (14 points)

A company produces three products P1, P2, P3 using sub-assemblies S1, S2, S3, S4, pre-assemblies A1, A2, A3 and raw materials R1, R2, R3, R4.

The values on the arcs of the following Gozinto-graph give the direct demands between all these items.





a) The company intends to sell 20 units of P1, 10 units of P2 and 30 units of P3. Also they intend to sell 10 units of the sub-assemblies S1 and S4 to an other company. Use the Gozinto-graph to calculate – for each item – the secondary and total demand! Use the graph given above for your calculations!

b) The company knows that R1 costs 1 € per unit, R2 costs 2 €, R3 costs 2 € and R4 costs 3 €. Determine the raw material costs for one unit of P2!

Assignment 5 (26 points)

A company buys a particular component from a supplier. The corresponding demand for the forthcoming six months (planning period) has been forecasted as follows:

month t	1	2	3	4	5	6
demand n_t	50	40	60	80	100	10

The costs of placing one order (ordering costs) are 600 Euro, the holding costs amount to 2 Euro per month for each stored product unit.

The following assumptions can be made:

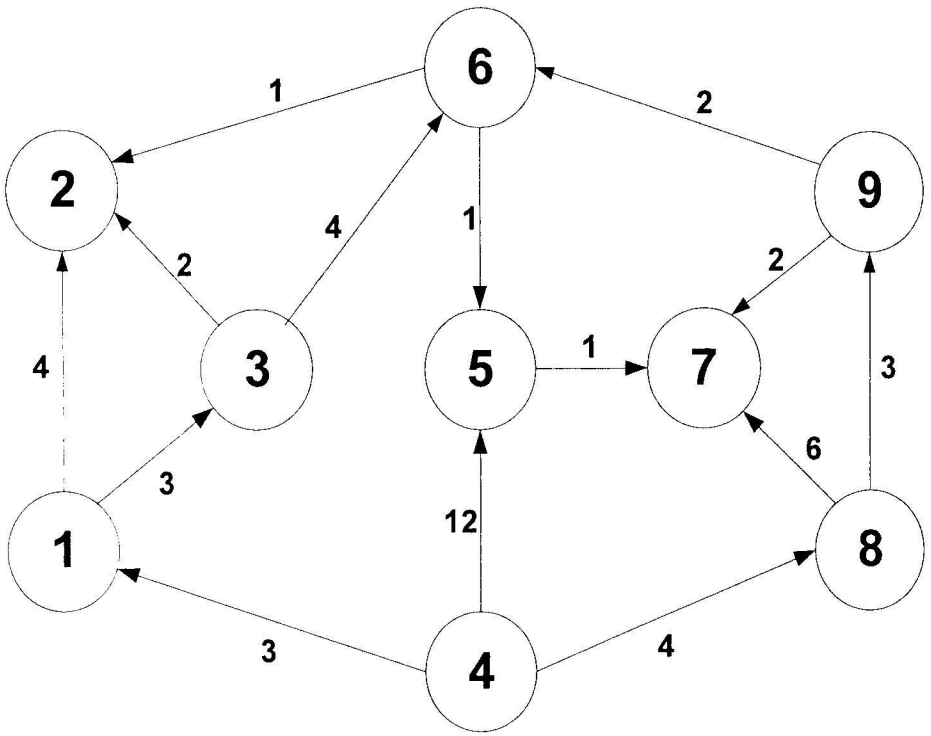
- Ordered products are received at the beginning of the month and can be processed without delays. Likewise, stored products can only be retrieved from the warehouse at the beginning of each month.
- Inventory at the beginning of the total planning period is zero. Inventory at the end of the planning period is required to be zero. No other inventory restrictions apply.

a) Determine an ordering policy by means of the Least-Unit-Cost-heuristic! Also give the ordering, holding and total costs of this policy!

b) In a second scenario, due to storage-space limitations, the maximal inventory is limited to 170 units. How could this additional constraint be included in the above-mentioned methods? What would be the solution provided by the modified method?

Assignment 6 (14 points)

Let the following graph be given:



Determine – if possible – the shortest paths from node 4 to all other nodes by means of Dijkstra's Algorithm! Also determine the corresponding distances!