Scheduling Exercises

SCH_1:

The following set of seven jobs is to be processed through two working centers at Paul's printing company. The sequence is first printing (Machine 1), and then binding (Machine 2). Processing time at each of the work centers is shown in the following table:

	A	B	C	D	E	F	G
Printing (hours)	2	3	10	6	7	9	17
Binding (hous)	1	4	6	12	10	7	5

The cost of processing for printing and binding is 10 and 11 per hour respectively. The cost of idle time for printing and binding is 5 and 6, per hour respectively. The total cost of idle time for each machine is allocated to each job in proportion to their processing time on their machine.

a) What is the optimal sequence for these jobs to be scheduled?

b) For each job, draw a table showing the waiting times and the processing times on each machine, and the total time in the system.

c) What is the average number of jobs in the system?

d) Determine the utilization of each work center.

e) Determine the total cost of each job by nature and the total cost of the seven jobs.

SCH_2:

AUTOPARTS produces various types of automobile parts. The process for the production of these parts involves two phases – during the 1st Phase the parts are moulded, and, during the 2nd Phase, they are chromed. When these phases are completed, the parts are delivered straight to the assembly line. The following table presents the processing times, in hours, of each work station, for each of the six types of parts:

	Type of part					
	A	B	C	D	E	F
Mold (WS1)	22	14	24	16	12	16
Chroming (WS2)	20	18	22	28	22	12

The production director decided to start the processing of the six parts on Wednesday, July 5, 2017, at the beginning of the first shift. Each day AUTOPARTS operates two shifts of 8 hours, 7 days a week. If the processing of a part is not completed on a certain day, it is continued on the following day.

The hourly processing costs are 30 and 20 euros respectively for the molding and chroming machines, and the idle costs are 15 and 10 euros. AUTOPARTS establishes that the total cost of idle time for each work station is allocated to each part in proportion to their processing time on their work station.

a) Which sequence minimizes the total processing time of the two operations?

b) Assume that the sequence followed by the production director was F-B-D-A-C-E. According to the production plan parts F, B and D need to be delivered to the assembly line before July 9 and A, C, and E before July 14. In your opinion, is it possible to accomplish the production plan?

c) Determine the total cost of part F.

d) What would be the waiting time for the A type part at the chroming work station?

(Adapted from resit exam 4 July 2017)

SCH_3:

The HOUSE OF ANTIQUE, a wood furniture restoration company, receives this Friday six pieces of furniture to restoration. The furniture restoration is a two-stage process in which the pieces are first processed on an abrasion machine and then lacquered on a second machine. The table below describes the processing hours on each machine:

	Pieces of furniture (processing hours)					
	A	B	C	D	E	F
Abrasing (M1)	11	10	3	8	14	5
Lacquering (M2)	3	11	6	4	5	6

The operations manager decided to start the restoration of the pieces of furniture on Monday, June 26, 2017, at the beginning of the day. The HOUSE OF ANTIQUE operates 8 hours a day, from Monday to Friday. If a part is not completed on a certain day, it is continued on the following day.

a)   The processing sequence followed by the operations manager was B-C-F-E-D-A, do you agree with this sequence? Justify your answer.

b)   Assuming that the sequence followed was B-C-F-E-D-A, how many pieces of furniture are restored on June 29 at the end of the day?

c)   Assuming that the sequence followed was B-C-F-E-D-A, what is the non-utilization rate of the lacquering machine (M2)?

(Adapted from Exam for the Normal Exam Period, 23 June 2017)

SCH_4:

METALCUBA is a metallurgic company which produces steel vats for fermenting wine. Each vat is sequentially processed by two machines: a sheet metal cutter, and a welding machine. The company works from Monday to Friday, from 8.00 to 17.00, with a lunch break from 12.00 to 13.00. The processing times for each machine for producing the last 6 vats ordered, is shown in the following table, in hours:

	Duration (in hours)					
	Vat 1	Vat 2	Vat 3	Vat 4	Vat 5	Vat 6
Metal cutter	3	10	4	8	6	3
Welding	2	3	7	11	4	5

The start of processing (of the last 6 vats ordered) is planned for Monday, July 4, 2016, at 8 in the morning. If a job is not completed on a certain day, it is continued on the following day.

a) What sequence minimizes the total processing time of the two operations?
b) How many vats are ready at the end of the afternoon on July 6?
c) The cost accounting policy of METALCUBA states that the idle costs of each machine are allocated to each vat in direct proportion to the waiting time of each vat in the respective machine. Knowing that the hourly processing costs of are 40 and 50 Euros respectively for the cutting and welding machines, and that the idle costs are 20 and 60 euros, what is the total cost of Vat 5?

(Adapted from Resit Exam, 30 June 2016)

SCH_5:

The following table describes the client orders received in the preceding weeks by a home furniture factory. The Operations Manager decided to start the processing of the orders on day 260 according to the following sequence: SD-SA-SB-SE-SF-SC.

Order of arrival of the order	Due date	Processing time (days)
SA	310	18
SB	350	28
SC	380	25
SD	300	15
SE	375	26
SF	378	22

a) Which sequencing rule did the Operations Manager use? Determine the average job lateness, average completion time, average number of jobs in the system and utilization for this sequencing rule.

b) The Quality Manager intends to satisfy the demands of its customers with minimal delay and state that the appropriate sequence to accomplish it is: SD-SA-SF-SC-SE-SB. Do you agree with the Quality Manager? Justify your answer.

(Adapted from quiz 2013/2014)

SCH_6:

Five orders are scheduled to be processed sequentially on machine M1 and then machine M2. The processing times (hours) are shown in the table below. Latin letters A through E are codes assigned to orders as they are placed "A" denotes the first order and "E" the last.

	A	B	C	D	E
M1	5	4	6	12	3
M2	7	11	14	2	13

In the absence of the production manager, the production assistant decided to process the orders in the sequence they were placed. Nonetheless, the production manager wanted to determine the amount of time it would be required to finish the processing in less time.

a)   Compare the number of hours the production assistant needed to finish all orders against the number of hours it would be needed based on a more appropriated method developed for this type of scheduling.

b)   To process all orders, the management rented a temporary warehouse at a cost of €1500. This cost is to be allocated to the orders proportionally to the order total waiting time. Find the amount to be allocated to each order. [Draw a table to show the amount allocated to each order under both method used by the production assistant and the appropriated method for this type of scheduling problem].

SCH_7:

The president of the BC consulting firm wants to minimize the total number of hours it will take to complete four projects for a new client. Accordingly, he has estimated the time it should take for each of her top consultants — Marie, Paul, Johnny, and Sara—to complete any of the four projects, as follows:

Project Hours				
Consultant	A	B	C	D
Marie	17	13	18	13
Paul	16	14	16	15
Johnny	17	17	16	19
Sara	18	16	17	14

(a) What is the optimal assignment of consultants to projects? (Use the assignment method.)

(b) For the optimal schedule, what is the total number of hours it will take these consultants to complete these projects?

SCH_8:

The Director of the College of San Marc's business department, needs to assign professors to courses next semester. As a criterion for judging who should teach each course, Professor John reviews the past 2 years' teaching evaluations. Since each of the four professors taught each of the four courses at one time or another during 2- year period, John is able to record a course rating for each instructor. These ratings are shown in the following table:

	Operations Management	Human Resources	Finance	Marketing
Chris	90	65	95	40
Steve	70	60	80	75
Juana	85	40	80	60
Rebeca	55	80	65	55

a) Find the assignment of professors to courses to maximize the overall teaching rating.

b) Assign the professors to the courses with the exception that Professor Chris cannot teach operations management.

SCH_9:

The production director of METALINOX needs to decide how to assign 4 jobs to 4 available machines. From his past experience, the director estimated the following table depicting job-processing times (in hours) on each machine:

Job	Machine			
	SOLD	PIC	PENT	LAS
T1	27	25	28	23
T2	27	24	26	25
T3	30	30	26	29
T4	28	25	27	24

a) What is the optimal assignment of jobs to machines?
b) Assume the production manager decided for the following assignment: T1- PENT, T2- PIC, T3-LAS, and T4- SOLD. How does this assignment vary from the optimal?

(Adapted from quiz 2013/2014)

SCH_10:

The manager of operations for FASTCARGO has six trucks to be unloaded at the warehouse dock. The cargo is first unloaded and, second, stored in the warehouse of the company. The truck driver helps out in the unloading and storing activities and thus leaves the warehouse dock when the cargo is stored. The following table depicts the minute duration of unloading and storing for trucks A through F:

	Truck						Idle cost/minute
	A	B	C	D	E	F	
Unloading (minutes)	30	20	35	40	25	14	2 euros
Storing (minutes)	10	40	25	18	36	22	3 euros

The idle cost of the two activities (unloading and storing) is proportionally allocated to each truck according to its time in the system.

a) Determine the order according to which the trucks should be unloaded. Please justify your answer.

b) Draw a diagram with a truck-by-truck hourly depiction of the time it leaves the warehouse dock.

c) Considering that the warehouse closes at 5 p.m., and that the requirement is that all the goods are stored on the shelves by this time, what is the latest time that the trucks can start to be unloaded?

d) Compute the inactivity cost allocated to each truck.

(Adapted from Normal examination period June 11, 2013)

Multiple choice questions

1. The data below has been retrieved from the processing centres of JumboTron. Work centre 1 packages the order while work centre 2 adds a decorative ribbon to the package.

	Jobs (processing time in hours)					
	A	B	C	D	E	F
Packaging	6	8	3	5	12	2
Adding ribbon	3	2	4	1	6	6

Which of the following minimises total processing time?		
1		F-B-C-E-D-A
2		A-F-E-C-B-D
3		F-C-E-A-B-D
4		D-B-C-F-A-E

Assuming JumboTron follows the sequence A-F-E-C-B-D, how many jobs are completed after 21 processing hours?		
1		2 jobs
2		3 jobs
3		4 jobs
4		5 jobs

2. Consider the following data concerning the orders received from clients by ICEFLAVORS in the previous week:

Orders sorted by arrival date	Due date (day)	Processing Time (days)
Apple	145	30
Banana	135	25
Cherry	305	70
Apricot	230	55
Raspberry	170	40

	a) Assuming the orders were processed according to their arrival order, how long does an order for Cherry ice cream spend in the system?	
1		25 days
2		55 days
3		70 days
4		125 days
5		220 days

	b) Assuming the orders started being processed in the beginning of day 100 and that the followed scheduling was SPT, what is the average completion time?	
1		220 days
2		545 days
3		109 days
4		70 days
5		13.2 days

(Adapted from resit exam, june 25 2015)

3. AUDIOSOND is a media content managing firm. The program's director wishes to schedule 4 shows in 4 time-slots. The goal is to maximise the overall number of viewers. The next table shows historical data for the number of shows per viewer at the different time slots:

	Viewers (in thousands)			
	PROG1	PROG2	PROG3	PROG4
14h00	150	120	130	120
17h00	140	125	140	135
19h00	150	145	140	170
21h00	160	140	150	125

a) The Program Director asked a trainee to find the optimal assignment and report back to him the next day. To do this, the trainee decided to follow the steps suggested in the assignment method. The first matrix obtained by the trainee was as follows:

1				PROG1	PROG2	PROG3	PROG4
			14h00	20	50	40	50
			17h00	30	45	30	35
			19h00	20	25	30	0
			21h00	10	30	20	45
2				PROG1	PROG2	PROG3	PROG4
			14h00	30	0	10	0
			17h00	15	0	15	10
			19h00	10	5	0	30
			21h00	35	15	25	0
3				PROG1	PROG2	PROG3	PROG4
			14h00	10	0	0	0
			17h00	0	5	10	15
			19h00	10	25	10	50
			21h00	20	20	20	5
4				PROG1	PROG2	PROG3	PROG4
			14h00	30	0	10	0
			17h00	20	5	20	15
			19h00	30	25	20	50
			21h00	40	20	30	5

b) After applying all the steps of the assignment method, the trainee obtained the following matrix:

	PROG 1	PROG 2	PROG 3	PROG 4
14h00	0	10	15	25
17h00	5	0	0	5
19h00	25	10	30	0
21h00	0	0	5	30

The director opted for the following assignment: PROG1-19H00; PROG2-14h00; PROG3-21h00; and PROG4-17h00. What is the impact on the number of viewers, relative to the optimal assignment?

1		a gain of 65 thousand viewers
2		a loss of 45 thousand viewers
3		a gain of 50 thousand viewers
4		a loss of 60 thousand viewers

(Adapted from quiz 2 2014/2015)

4. SOLATAS received 5 orders in the previous week. The manager decided to start processing the orders in the **beginning of day 151** of the production cycle.

Orders (by arrival time)	Due date	Processing time (days)
OA	210	40
OB	301	25
OC	160	5
OD	169	15
OE	225	20

a) If the manager uses EDD scheduling, what is the delay of order OA?		
1		1 day
2		0 day
3		20 day
4		45 day

b) What is the average number of orders in the system if the manager schedules the processing as OC-OD-OE-OB-OA?		
1		5 orders
2		10 orders
3		2.2 orders
4		2.6 orders

(Adapted from quiz 2 2014/2015)

5. RESTAURARBEM, an antique renovation company has received six orders last week. Antique renovation is a two-stage process in which the antiques are first processed on an abrasing machine and then lacquered on a second machine. The table below describes the processing hours on each machine:

	Jobs (processing hours)					
	A	B	C	D	E	F
Abrasing (M1)	2	5	8	1	5	7
Lacquering (M2)	6	2	4	4	9	3

Which of the following sequences minimises the total processing time?		
1		D-B-A-F-E-C
2		D-C-A-B-F-E
3		D-A-B-E-F-C
4		D-A-E-C-F-B

If the followed processing sequence was: F-E-D-C-A-B, what is the waiting time for job C on machine 2 (lacquering)?		
1		25 hours
2		4 hours
3		21 hours
4		0 hours

Assuming the processing sequence was: F-E-D-C-A-B, what is the inactivity time on machine 2 after 15 hours?		
1		9 hours
2		2 hours
3		7 hours
4		4 hours

(Adapted from quiz 2013/2014)