LISBOA SCHOOL OF ECONOMICS & MANAGEMENT

Production and Operations

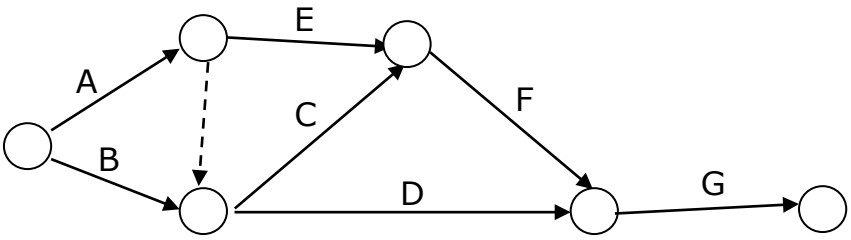
Quiz 1: Version A

THIS QUIZ HAS DURATION OF EXACTLY ONE HOUR AND THIRTY MINUTES.

Clearly mark your answer with the symbol "X" in the designated column. Wrong or misplaced answers receive 0 points. Pages 9 and 10 have been intentionally left blank and are to be used for ancillary computations.

Group I

1. Consider the project ISEGNL with network diagram, expected activity durations and standard deviations presented below:



Activities	A	B	C	D	E	F	G
Expected duration (days)	5	4	3	4	3	6	2
Standard deviation (days)	2	1	2	3	1	3	2

[2 val.] Identify the critical path of project ISEGNL.		
1		A – E – F – G
2		A – C – F – G
3		B – C – F – G
4		B – D – G

Name_____ [2]

[2 val.] If the late start (LS) time for activity D is 10, its Slack (S) is:		
1		5 days
2		4 days
3		1 days
4		6 days

[1 val.] Please consider a new project with expected activity durations and standard deviations identical to those displayed in the previous table. Assume now precedencies are different from before. If the new critical path is ACDG what is the probability that the project duration is lesser than 12 days?		
1		0.7486
2		0.3300
3		0.5432
4		0.2514

Consider the following data from project NOW:

Activities	A	B	C	D	E	F	G	H
Normal time (weeks)	6	5	4	3	5	4	3	3
Crash time (weeks)	5	4	2	2	2	4	3	2
Normal cost (euros)	1200	600	1000	500	600	800	500	800
Crash cost (euros)	1600	700	2100	950	1200	800	500	1100

After a network diagram was drawn the following paths were identified:

ACH
BCDE
BFGH
ACDH

Name_____ [3]

[1 val.] Estimate the impact of crashing activity **E** by three weeks on the total duration of the project.		
1		Project duration is shortened by one week
2		Project duration is shortened by two weeks
3		Project duration is shortened by three weeks
4		Project duration remains unaltered

[2 val.] If the duration of the NOW project is crashed by two weeks what is the minimum total project cost?		
1		6550
2		6450
3		6300
4		6000

Group II

For the purposes of Group II please consider companies to work 50 weeks per year, and 5 days per week.

[1 val.] Annual demand for TVPLUS television sets at ELECTRICA store is of 10 000 units. The order cost is of 30 euros and the weekly holding cost per unit is 0.50 euros. How many orders should ELECTRICA make in a year?		
1		65 orders
2		9 orders
3		10 orders
4		24 orders

VIGILANTE manufactures surveillance systems, namely the VG1 model, which has an yearly demand of 40000 units. Currently, VIGILANTE has a production capacity of 1000 VG1 units per week, a set-up cost of 100 euros and an yearly holding cost of 10 euros per unit.

[2 val.] Please identify the correct production order quantity:		
1		894 units
2		2000 units
3		1000 units
4		800 units

[2 val.] Assuming ELECTRICA produces a lot size of 3000 units what is the duration of the production phase in which only inventory consumption takes place?		
1		3.75 weeks
2		0.75 weeks
3		2.5 weeks
4		0.5 weeks

Name_____ [4]

Weekly demand for wholegrain flour at GOODBUY supermarket follows a Normal distribution with mean of 60 packages and standard deviation of 10 packages. The yearly holding cost of each package is 2 euros. The lead time is 8 weeks. Currently the supermarket owner orders batches of 500 packages.

[2 val.] Assuming the GOODBUY supermarket owner follows a safety stock of 70 packages, what is the service level provided to the customers?		
1		99.32%
2		95.0%
3		81.06%
4		85%

[2 val.] Assuming the GOODBUY supermarket owner follows a safety stock of 70 packages, what is the yearly holding cost associated with this inventory policy?		
1		640 euros/year
2		500 euros/ year
3		1140 euros/ year
4		140 euros/ year

Name_____ [5]

Group III

The following data was retrieved from the aggregate production plan of ELECTRICA washing machines for the months of May through July:

		Capacity		
Month	Demand (machines)	Regular time production (machines)	Overtime production (machines)	Subcontracting
May	1000	800	100	50
June	800	700	100	50
July	1300	1300	100	50

Initial Inventory: 200 machines

Costs:

Regular time Cost	200€ /machine
Overtime Cost	220€/machine
Subcontracting Cost	250€/machine
Holding Cost	10€/machine/month
Backorder Cost	25€/machine/month

Consider the following production plan:

		May		June		July		**a**	
Initial Inventory		200	0		10		20		200
May	**RT1**	800	200		210		220		800
	OT1		220	50	230		240		100
	SUB1		250		260		270		50
June	**RT2**		225	700	200		210		700
	OT2		245		220		230		100
	SUB2		275		250		260		50
July	**RT3**		250	50	225	1250	200		1300
	OT3		270		245	50	220		100

Name_____ [6]

	SUB3	300	275	250		50
Demand		1000	800	1300	**b**	

[1 val.] Please choose the text/values of cells **a** and **b** (respectively):		
1		Ending Inventory; 350
2		Ending Inventory; 0
3		Unsatisfied Demand; 350
4		Unused Capacity; 350

For mul as

[2 val.] What are the regular time costs, holding costs, and backorder costs for the given production plan in the month June?		
1		140000;11500;11250
2		150000;500;1250
3		150000;0;11250
4		22750; 500; 1250

Inventory Management

EOQ

$Q = \sqrt{\frac{2DS}{H}}$; N = D/Q ; ROP = d × L ; $TC = \frac{Q}{2} \times H + \frac{D}{Q} \times S + P \times D$

POQ

$Q = \sqrt{\frac{2DS}{H(1-\frac{d}{p})}}$ $TC = \frac{Q}{2}(1-\frac{d}{p}) \times H + \frac{D}{Q} \times S + P \times D$

$t_p = t_1 = \frac{Q}{p}$ $T = \frac{Q}{D}$ $I_{máx} = M = Q(1-\frac{d}{p})$

Probabilistic Models

$$SS = Z\sigma_{dLT}$$

$$ROP = \mu_{LT} \times \mu_d + SS$$

$$ROP = LT \times \mu_d + SS$$

$$ROP = \mu_{LT} \times d + SS$$

$$\sigma_{dLT} = \sqrt{\mu_d^2 \times \sigma_{LT}^2 + \mu_{LT} \times \sigma_d^2}$$

$$\sigma_{dLT} = \sqrt{LT} \times \sigma_d$$

$$\sigma_{dLT} = \sqrt{d^2 \times \sigma_{LT}^2}$$

$\alpha = P(X > ROP) =$ probability of stockout

$$TC = \left(\frac{Q}{2} + SS\right) \times H + \frac{D}{Q} \times S + P \times D$$

Project Management

EF = ES + Activity time

LS = LF – Activity time

Slack = LS – ES or Slack = LF– EF

Expected activity time = t = $\frac{a + 4m + b}{6}$

Variance of activity completion time = $\left[\frac{(b-a)}{6}\right]^2$

Name_____ [8]

Crash cost per period = $\frac{CC - NC}{NT - CT}$

Name_____ [9]

The Normal Distribution

Cumulative Standard Table

$$P(Z \leq z) = \Phi(z)$$

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990

α	0.400	0.300	0.200	0.100	0.050	0.025	0.020	0.010	0.005	0.001
Z_{α}	0.253	0.524	0.842	1.282	1.645	1.960	2.054	2.326	2.576	3.090
$Z_{\alpha/2}$	0.842	1.036	1.282	1.645	1.960	2.240	2.326	2.576	2.807	3.291

ANCILLARY COMPUTATIONS

Name_____ [10]

Name_____ [11]