LISBON SCHOOL OF ECONOMICS & MANAGEMENT
UNIVERSIDADE DE LISBOA

Production and Operations

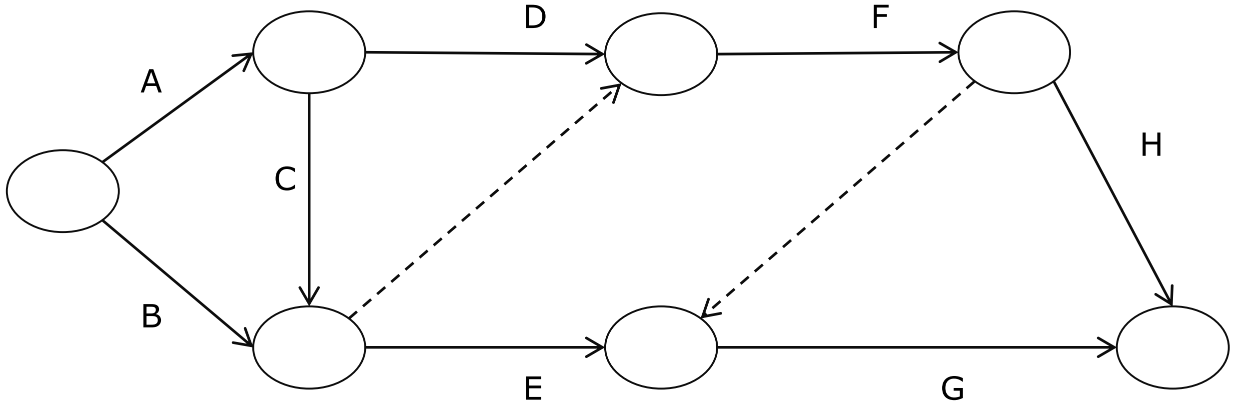
Quiz 1: Version A

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. The following network diagram describes the activities of project SODA. The table below refers to the expected durations and standard-deviations of the project activities:



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

[2 val.] Identify the critical activities for project SODA		
1		A, C, E, and G
2	x	A, D, F, and G
3		A, C, D, E, F, and G
4		A, C, F, and G

[2 val.] Which of the following is the late start (LS) of activity H?		
1	x	12 days
2		10 days
3		13 days
4		11 days

[1 val.] If the optimistic duration of activity G is 2 days and its pessimistic duration is 14 days, then the most likely duration of activity G is:		
1	x	5 days
2		4 days
3		6 days
4		3 days

2. The duration of project NEOX follows a Normal distribution. Its expected duration is 13 days and variance 15 days. It was agreed that should the project be completed before day 12, the contractor receives a 20% bonus over the value of the project. Should the project be concluded after day 15, the contractor faces a penalty of 10% of the value of the project. The value of the project is 150,000 euros.

[2 val.] What is the expected value of the project NEOX?		
1		157,601 euros
2		152,766 euros
3	x	157,400 euros
4		165,000 euros

Group (II)

Please consider the following data for the TORO project

Activities	A	B	C	D	E	F	G	H
Normal Time (weeks)	2	3	4	5	4	3	5	6
Crash time (weeks)	1	2	1	1	2	1	1	2
Normal Cost (euros)	1,000	1,200	800	600	1,000	800	900	800
Crash cost (euros)	1,130	1,350	995	1,080	1,400	920	1500	1200

A graphical representation of the network activities produced the paths identified below:

ACEG
ADFG
ADFH
BEG

[1 val.] If the value of the project is of 8,500 euros, then the contractor will:		
1		earn a 4,070 euro profit
2		face a 1,075 euro loss
3	x	earn a 1,400 euro profit
4		face a 3,745 euro loss

[2 val.] By how would the total cost increase if the duration of the TORO was reduced by two weeks?		
1	x	185 euros
2		190 euros
3		120 euros
4		125 euros

[1.0 val.] How would a reduction of the duration of activity H to 2 weeks (via crashing) impact on the total project duration?		
1		13 weeks
2		14 weeks
3	x	15 weeks
4		16 weeks

Group (III)

For the questions of the present group please consider that firms operate 50 weeks per year and 5 days per week.

1. Weekly demand for tea bags at Mrs Amélia's tea store equals 125 bags. Ordering costs are 10 euros and Mrs Amélia estimates the yearly holding cost per tea bag to be of 0.50 euros.

[1 val.] Calculate the periodicity between tea bag orders.		
1	x	20 days
2		12.5 days
3		10 days
4		25 days

[1 val.] If the lead-time is 4 days, which of the following is the re-order point?		
1	x	100 units
2		20 days
3		500 units
4		2500 units

2. NOTMOBSTER Industries, Inc. manufactures olive oil for which there is an annual demand of 60,000 litres. NOTMOBSTER currently produces 400 litres of olive oil every day. Each litre costs a staggering 20 euros to produce with set-up costs estimated at 24 euros per batch. The opportunity cost incurred in the production of the olive oil corresponds to 25% of its cost per litre.

[2 val.] Calculate the production order quantity.		
1		600 litres
2		980 litres
3		759 litres
4	x	1,200 litres

[2 val.] Assuming NOTMOBSTER manufactures 1,000 litres during each production run, what is the inventory level of olive oil one day after the conclusion of the production stage?		
1	x	160 litres
2		240 litres
3		760 litres
4		600 litres

3. LIGHTCORP manufactures light bulbs that have an annual demand of 40,000 units. Deliveries by its supplier are normally distributed and take on average 6 days with a standard-deviation of 2 days.

[1 val.] If LIGHTCORP's service level is 90%, which of the following is the recommended safety stock?		
1		33 units
2	x	411 units
3		1,051 units
4		160 units

[1 val.] Assume now that the safety stock is of 260 units. What is the inventory level when an order is made?		
1		960 units
2		160 units
3	x	1220 units
4		160 units

4. The reputed CHEZBLAG restaurant serves its signature lunch dish of oysters for 104 euros (per individual, very tiny portion). Each portion costs 29 euros to prepare and the skilled chef is able to turn the leftovers into an elegant canapé, with a value of 4 euros, which is served at dinnertime. The expected number of sales for the oyster dish at lunchtime is 10. There is usually 3 dishes of oysters left after each lunch period.

[0.5 val.] What are the odds of a late lunch client not being able to order a dish of oysters because they're all sold out?		
1	x	25.00%
2		42.86%
3		75.00%
4		54.00%

[0.5 val.] Compute CHEZBLAG's expected profit with this dish during lunchtime.		
1	x	675 €
2		790€
3		825€
4		750€

FORMULAE

Inventory Management

Newspaper Model

$F(Q) = \frac{C_S}{C_S + C_o}$

Expected lost sales =$L(Z)\times\sigma$; where $L(Z)$ is the loss function for Normal distribution

Expected leftover inventory = Q - Expected sales

Q = expected sales + expected leftover inventory

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

$$Q = \sqrt{\frac{2DS}{H(1-\frac{d}{p})}}$$

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

$$I_{máx} = M = Q(1 - \frac{d}{p})$$

$$t_p = t_1 = \frac{Q}{p}$$

$$T = \frac{Q}{D}$$

Probabilistic Models

$$SS = Z_\alpha \sigma_{dLT}$$

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

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

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

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

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

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

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

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

Project Management

EF = ES + Activity time

LS = LF – Activity time

Slack = LS – ES or Slack = LF– EF

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

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

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

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

ANCILIARY COMPUTATIONS

[10]