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DEPARTMENT OF CIVIL ENGINEERING: IIT DELHI
CEL 362: CONSTRUCTION MANAGEMENT MAJOR TEST
DURATION: 2 hours Second Semester 2006-07 Maximum mark: 40
DATE:-9-5-07 TIME:-10.30A.M-12.30P.M Venue: Exhibition Hall

1. A contractor wants to hire some equipment for large earth moving job. Two types of excavators are available and each requires the following manpower.

Machine	Skilled Operators	Unskilled laborer
Excavator 1	1	5
Excavator 2	2	4

Total number of skilled operators and unskilled laborer available are 6 and 20 respectively. The expeeted profits are same for both the excavators. The optimal number of excavators has to be integer, however, the construction manager obtained following information from the non integer solution. The optimal profit is 4.33. The optimal values of the dual variables corresponding to both constraints are same and 0.167. The optimal number of excavators as per above non integer solution are 2.67 and 1.67 for exeavators 1 and 2 respectively. It is observed that by making one more skilled labor available (i.e., 7 instead of 6) the optimal (non-integer) number of excavators 1 and 2 changes to 2.00 and 2.5 respectively. Similarly by making one more unskilled labor available, (that is changing 20 to 21), the optimal (non-integer) number of excavators 1 and 2 change to 3.00 and 1.50 respectively. *Using only these information* obtain the complete final non-integer solution table and hence obtain all possible cutting planes for determining the integer solution. (Final all integer solution is not necessary)
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2. An old building is being purchased by a company for new functional use and the engineer is concerned about the grade of concrete in a floor slab. Not much information or design drawings are available, but, from information about the prevailing design practices, it is known that the conercte may be of M15, M20 or M25 grades with prior probabilities of 0.3, 0.6 and 0.1 respectively. The alternative possible actions are: (i) Dcmolish and reconstruct the slab at a cost of 10 lakhs (ii) Assess the condition through Ultra sonic pulse velocity (USPV) test and a) make use of the floor slab for a reduced imposed load or (ii) use it for full design imposed load. In case of grade of concrete being M15, even lowered imposed load can cause damages and reetification cost would be 15 lakhs. M20 and M25 grade eonerete in the slab can sustain the lowered imposed load. Full functional imposed load can only be sustained by M25 grade eonerete in the slab and results in revenue of 5 lakhs. On the other hand if the grade of eoncrete is M20 or M15 the losses due damages are estimated to be 5 lakhs and 30 lakhs respectively. There are three possible out eomes of USPV test namely; (1) v <3 km/s; (2) 3≤v≤4 km/s and (3) 4 < v km/s following known sample likely-hoods are summarized in the table below: Obtain the eourse of decision.
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USPV indication (v km/sec)	Conditional Probability p(USPV indication v /grade)		
	M15	M20	M25
<3	0.7	0.2	0
3≤v≤4	0.3	0.6	0.3
4 < v	0	0.2	0.7
Sum	1.0	1.0	1.0

3. In bulk cement supply to silo it was observed that 117 special trucks made deliveries in a 5 day week with 8 working hours a day. With two men employed for mechanized unloading, on an average 15 minutes were required to unload a truck to silo. Determine the a) probability of a vehicle not having to wait. The average time the vehicle is waiting to be unloaded? 4

4. A small maintenanee project consists of the jobs on the following table. The erash duration, normal duration and eost of crashing are also listed in the table.

Job	Normal duration (days)	Crash duration (days)	Cost of crashing / day
1-2	9	6	200
1-3	8	5	250
1-4	15	10	300
2-4	5	3	100
3-4	10	6	150
4-5	2	1	400

a) What is the normal project length?
b) If the over-head eosts of the Rs. 600/- per day, what is the optimum project duration. 7

5. A eonstruetion company wants purehase a erane on wheels and three models M1, M2 and M3 are available. The deeiding faetors are the relative ease of proeurements (EP), maintenance (M) and ease of operation in qualitative terms. These relative performanees of three maehines are given in following table. The relative importanee of EP with respect M is 6 and that with respeet O is 4. Relative importance M with respect to O is 7.

Model	EP	M	O
M1	6	8	4.5
M2	8	1.2	2.25
M3	10	0.6	1.125

Use the data to develop the comparison matrices. Assess the consistency of the matriees if required and determine the choice of the model.

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