56:171 Operations Research
Quiz #6 Solutions – Fall 2002

Part I: ***True***(+) or ***False***(o)?

_+__ 1. The critical path in a project network is the *longest* path from a specified source node (beginning of project) to a specified destination node (end of project).

_o__ 2. There is at most one critical path in a project network.

_o__ 3. The latest times of the events in a project schedule must be computed before the earliest times of those events.

_+__ 4. In PERT, the total completion time of the project is assumed to have a normal distribution.

_+__ 5. All tasks on the critical path of a project schedule have their latest finish time equal to their earliest finish time.

_+__ 6. In the LP formulation of the project scheduling problem, the constraints include
$Y_B - Y_A \geq d_A$ if activity A must precede activity B, where d_A = duration of activity A.

_o__ 7. In CPM, the "forward pass" is used to determine the latest time (LT) for each event (node).

_+__ 8. The A-O-N project network does not require any "dummy" activities (except for the "begin" and "end" activities).

_o__ 9. The PERT method assumes that the completion time of the project has a *beta* distribution.

_o__ 10. A "dummy" activity in an A-O-A project network always has duration zero and cannot be a “critical” activity.

_o(?) 11.The Hungarian algorithm can be used to solve a transportation problem. *(If the supplies & demands are integers, one could, however, replace each source i with Si rows and each destination j with Dj columns, and apply the Hungarian algorithm.)*

_o__ 12.The number of basic variables in a n×n assignment problem is n.

_+__ 13. At each iteration of the Hungarian method, the original cost matrix is replaced with a new cost matrix having the same optimal assignment.

_+__ 14. Every basic feasible solution of an assignment problem must be degenerate.

_+__ 15. In order to apply the Hungarian algorithm, the assignment cost matrix must be square.

_+__ 16. The transportation problem is a special case of a linear programming problem.

_o__ 17. The PERT method assumes that the completion time of the project has a *beta* distribution.

_o__ 18. If the current basic solution of a transportation problem is degenerate, no improvement of the objective function will occur in the next iteration of the (transportation) simplex method.

_o__ 19. The PERT method assumes that the duration of each activity has a *normal* distribution.

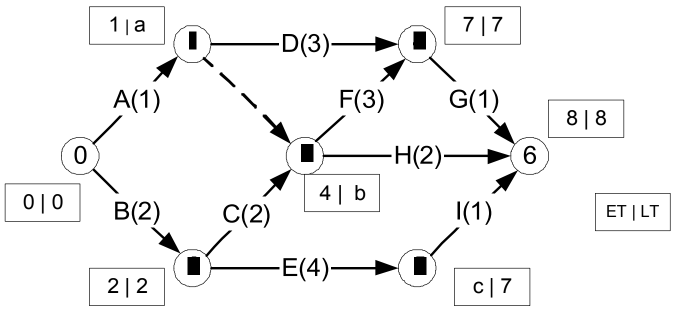
_+__ 20. A "dummy" activity in an A-O-A project network always has duration zero.

_o__ 21. At each iteration of the Hungarian method, the number of zeroes in the cost matrix will increase.

_+__ 22. If at some iteration of the Hungarian method, the zeroes of a n×n assignment cost matrix cannot be covered with fewer than n lines, this cost matrix must have a zero-cost assignment.

_+__ 23. Every A-O-A project network has at least one critical path.

Part II: Project Scheduling. Consider the project with the A-O-A (activity-on-arrow) network below. The activity durations are given on the arrows. The Earliest (event) Times (ET) and Latest (event) Times (LT) for each node are written in the box beside each node. Note: There are three different versions, each having different durations of activity A:



1. Complete the labeling of the nodes on the network.
Note: *The labeling above is one of several such that an arrow always goes from lower-numbered node to a higher-numbered node.*

_c_ 2. The number of activities (i.e., tasks), not including "dummies", which are required to complete this project is

a. six	c. eight	e. ten	g.
b. seven	d. nine	f. eleven	h. *NOTA*

_d_ 3. The latest event time (LT) indicated by **a** in the network above is:

a. one	c. three	e. five	g. seven
b. two	d. four	f. six	h. *NOTA*

_d_ 4. The latest event time (LT) indicated by **b** in the network above is:

a. one	c. three	e. five	g. seven
b. two	d. four	f. six	h. *NOTA*

_f_ 5. The earliest event time (ET) indicated by **c** in the network above is:

a. one	c. three	e. five	g. seven
b. two	d. four	f. six	h. *NOTA*

_d_ 6. The slack ("total float") for activity D is: *solution: depends upon ET(1) which depends upon duration of A. For network shown above, answer is 3.*

a. zero	c. two	e. four	g. six
b. one	d. three	f. five	h. *NOTA*

7. Which activities are critical? (*circle:* A B C D E F G H I)

Suppose that the non-zero durations are *random*, with each value in the above network being the *expected* values and each *standard deviation* equal to 1.00. Then...

_c_ 8. The expected earliest completion time for the project is

a. six	c. eight	e. ten	g. twelve
b. seven	d. nine	f. eleven	h. *NOTA*

_e_ 9. The *variance* σ^2 of the earliest completion time for the project is

a. zero	c. two	e. four	g. six
b. one	d. three	f. five	h. *NOTA*

Note: variance of sum of durations of four activities along critical path is sum of variances of those activities.