

UNIVERSITY OF SWAZILAND

DEPARTMENT OF STATISTICS AND DEMOGRAPHY

SUPPLEMENTARY EXAMINATION PAPER, 2007

| | |
|----------------|--|
| TITLE OF PAPER | OPERATIONS RESEARCH |
| COURSE CODE | ST 408 |
| TIME ALLOWED | 2 HOURS |
| REQUIREMENTS | CALCULATOR |
| INSTRUCTIONS | ANSWER ANY THREE QUESTIONS. ALL QUESTIONS CARRY EQUAL MARKS |

THIS PAPER IS NOT TO BE OPENED UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR

1. The activities and expected times of activities in a project are given below:

| <u>Activity</u> | <u>Optimistic time</u> | <u>Most likely time</u> | <u>Pessimistic time</u> |
|-----------------|------------------------|-------------------------|-------------------------|
| 1-2 | 3 | 3 | 3 |
| 2-3 | 3 | 6 | 9 |
| 2-4 | 2 | 4 | 6 |
| 3-5 | 4 | 6 | 8 |
| 4-6 | 4 | 6 | 8 |
| 5-6 | 0 | 0 | 0 |
| 5-7 | 3 | 4 | 5 |
| 6-7 | 2 | 5 | 8 |

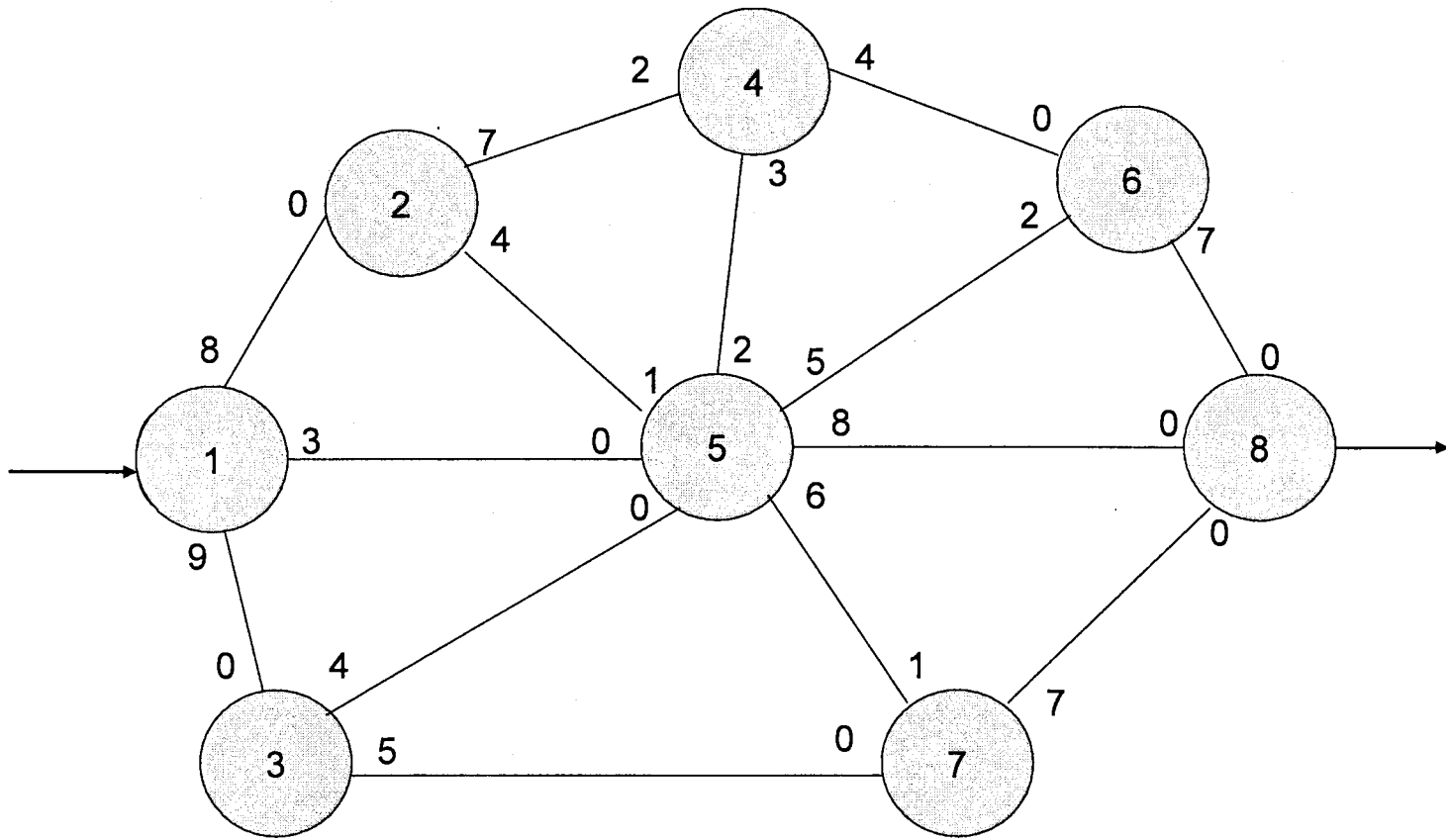
- Draw the PERT network for this project, with the activities and time estimates (in weeks) along the arrows.
- Identify the critical path.
- If the scheduled completion time is 23 weeks, what is the probability that the project will be completed on the scheduled date?

2. You have a chance to invest in three mutual funds: utility, aggressive growth and global. The value of your investment will change depending on the market conditions. There is a 10% chance that the market will go down, 50% chance that it will remain moderate, and 40% chance it will perform well. The following table provides the percentage change in the investment value under the three conditions:

| <u>Alternative</u> | <u>Percentage return on investment</u> | | |
|--------------------|--|----------------------------|----------------------|
| | <u>Market Down (%)</u> | <u>Market Moderate (%)</u> | <u>Market Up (%)</u> |
| Utility | +5 | +7 | +8 |
| Aggressive growth | -10 | +5 | +30 |
| Global | +2 | +7 | +20 |

- Represent the problem as a decision tree.
- Which mutual fund should you select?

3. Using the augmenting path algorithm, find the flow pattern giving the maximum flow from supply node (the left most node) to the demand node (the right most node), given that the arc capacity from node 'i' to node 'j' is the number nearest node 'i' along the link between these nodes



4. The parts department of a large firm has a counter used exclusively for mechanics' requests for parts. The time between requests can be modeled by a negative exponential distribution that has a mean of five minutes. A clerk can handle requests at a rate of 15 per hour, and this can be modeled by a Poisson distribution with a mean of 15. Suppose that there are two clerks at the counter.

- a) On average, how mechanics would be at the counter, including those being served?
- b) What is the probability that a mechanic would have to wait for service?
- c) If a mechanic has to wait, how long will that wait be?
- d) What percentage of time are the clerks idle?

5. An automobile manufacturer uses about 60,000 pairs of bumpers (front bumper and rear bumper) per year, which it orders from a supplier. The bumpers are used at a reasonably steady rate during the 240 working days per year. It costs E3.00 to keep one pair of bumpers in inventory for one month, and it costs E25.00 to place an order. A pair of bumpers costs E150.00.

- a) Write the annual carrying cost function and the annual ordering cost function
- b) Write the annual total cost function
- c) What is the EOQ and what is its significance?
- d) What is the total annual expense for ordering the EOQ every time?
- e) How many orders will be placed per year
- f) What is the total annual expense of ordering 600 pairs of bumpers each time? How much is saved per year by ordering the EOQ?

END OF EXAM