MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Civil and Environmental Engineering

1.017/1.010 Computing and Data Analysis for Environmental Applications/Uncertainty in Engineering

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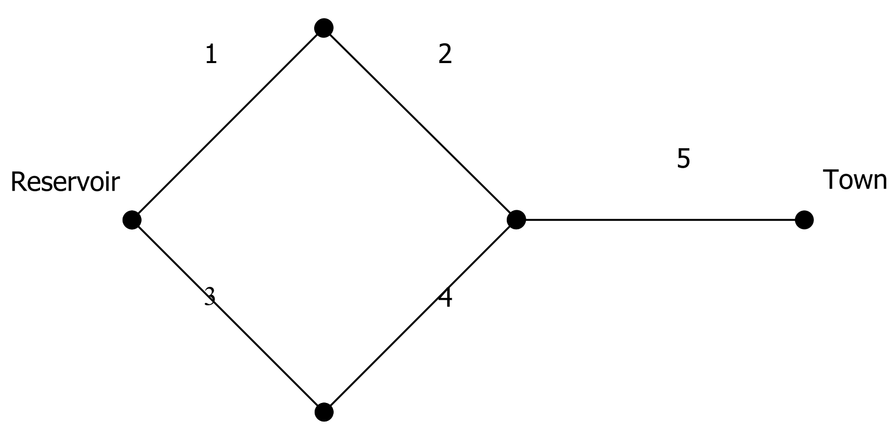
Problem Set 2: Combinatorial Methods for Deriving Probabilities
Due: Thursday, September 25, 2003

Problem 1

This is a classic combinatorial probability problem that can be solved by applying the counting and combinatorial principles from Lecture 4. Suppose that three balls are drawn successively and randomly from a box containing 6 red balls, 4 white balls, and 5 blue balls that are identical except for their colors. Determine the probability that these balls are drawn **in the order** red, white, blue if 1) each ball **is replaced** after it is drawn 2) each ball **is not replaced** after it is drawn. Note that since order is important you need to consider permutations rather than combinations when evaluating the number of outcomes for each event.

Problem 2

The figure provided below shows a simple (five pipe) water distribution network designed to deliver water from a reservoir to a town. Suppose that the probability of any single pipe failing during an 7.0 Richter earthquake is p. What is the probability that some water will still get through after such an earthquake? Evaluate for p=0.3.



Problem 3

In the game of poker five cards are drawn from a pack of 52 well shuffled cards. Find the probability of drawing 3 tens and 2 jacks.

Problem 4

Suppose that cracks are present in 8 out of 20 bridges in a particular city. If a sample of 5 bridges is inspected at random what is the probability that exactly 4 will these will have cracks? At least 4?

Problem 5 (another classic)

What is the probability that at least two students in a class of 30 students (e.g. 1.017/1.010) will have the same birthday? This problem requires the computation of very large factorials, which is best done on MATLAB or a calculator.

Problem 6

Write a MATLAB program that duplicates one of the 5 experiments described in the above problems (your choice). Use a virtual experiment/relative frequency approach to compute all probabilities. Use at least 10,000 replicates to obtain a reasonable estimate of the exact probabilities. Please contact us if you need help with the required MATLAB programming. Also, feel free to do more than one program if you like (it's optional but we will check your codes for you).