

### Armed Forces Day

**INTRODUCTION:** The management of the New Jersey Meadowlands and Giants' Stadium were so impressed with the United States Military Academy and the Corps of Cadets during the Army-Navy game last fall that they asked for our help in planning the up coming Armed Forces Day Celebration at the Meadowlands, May 18, 1998. They contacted the S-3, USCC to request assistance. S-3, USCC is a little short handed at the moment, but knows that students taking MA104 can assist in the planning.

#### **SITUATION # 1:**

You and a classmate are tasked to go down to the Meadowlands to do the planning for the air portion of the program. Your mission is to ensure the Navy F/A-18s and Army Attack Helicopters participating in the program fly over the stadium between 1510 and 1530 on 18 May 1998. The air units must maintain a minimum safe separation distance of 2 nautical miles and must pass over the stadium within 90 seconds of each other. The OIC provides you with the following plan.

**At 18 1430 May 1998 hours, the Army Attack Helicopters begin their run from a distance of \_\_\_\_\_ nautical miles from the stadium, approaching at \_\_\_\_\_ knots on a heading of \_\_\_\_\_ degrees.**

**At the same time, the Navy F/A-18s begin their run from a distance of \_\_\_\_\_ miles from the stadium approaching at \_\_\_\_\_ knots on a heading of \_\_\_\_\_ degrees.**

Determine how fast the distance between the two air units is changing when they begin their run at 18 1430 May 1998?

Determine if the plan will result in the air units meeting the requirements of the mission.

#### **SITUATION #2:**

While at Giants' Stadium, the stadium personnel discover the water at Giant's Stadium is contaminated with a new strain of bacteria, Z-Coli, which could be very similar to E-Coli as a health hazard. Z-Coli is potentially lethal if the level of bacterium grows too high. The Meadowland's management decides to contract the Army to supply fresh water to the stadium until the bacteria problem can be resolved. The Army activates a Reserve unit to operate their Reverse Osmosis Water Purification Unit (ROWPU). The system will process the contaminated water, filter out the Z-Coli bacteria, and pump the clean water to Giant's Stadium. S-3, USCC is asked to be overall responsible for the operation of the Army units in the area, which includes management of the budget.

S-3, USCC informs you and your partner that the cost associated with processing water through a ROWPU is modeled by the function:  $c(x) = \_\_\_ x^3 + \_\_\_ x^2 + \_\_\_ x + \_\_\_$  where  $x$  is measured in thousands of gallons of water and  $c(x)$  is dollars.

After doing some research, the local water utility informs you and your partner that the revenue gained from selling water is modeled by the function:  $r(x) = \_\_\_ \sqrt{x} + \_\_\_ x^2$  again,  $x$  is measured in thousands of gallons of water and  $r(x)$  is dollars.

Investigate the range of values for which the Army should operate the ROWPU.

If the Army could profit from the sale of water, what is the maximum profit?

The OIC of the reserve unit operating the ROWPU informs you that the volume of water a ROWPU can produce, without regard to cost, is modeled by the function:  $G(s) = \text{---} s\sqrt{\text{---} - s^2} - \text{---} \sqrt{s}$  where  $s$  is the size of the adjustable intake valve, *measured in square inches*, and  $G(s)$  is measured in thousands of gallons. The personnel who operate the ROWPU can adjust the intake valve in order to meet a necessary production level. Where is the optimal valve setting in this situation (without regard to cost)?

### SITUATION # 3:

The Veterinary Services, Preventive Medicine personnel inform you and your partner of the following information:

It will take approximately        days to develop an anti-toxin for the Z-Coli bacteria. At that time, they can begin treatment of the water supply.

They warn that if the level of bacteria reaches a level of        PPM, the water supply may become deadly.

They also predict that the anti-toxin treatment on the bacteria should reduce the Z-Coli levels by        % a day.

The initial reading taken by the Preventive Medicine personnel on 04 Feb 98 showed     PPM of Z-Coli in the water. A second reading taken     days later showed        PPM of the bacteria.

Develop a continuous model to predict the level of Z-Coli in Giant's Stadium's water supply.

Investigate the highest bacteria level obtained according to your model.

Investigate if the proposed antitoxin will arrive in time to prevent the water from becoming deadly. Will the water be at a safe level of        PPM before the program on 18 May? Explain.

### FINAL REQUIREMENT:

*Complete and submit your findings no later than the beginning of class, 9 Mar 98. Prepare a one page (single-spaced, 12 CPI) memorandum to the S-3, USCC that summarizes your findings and recommendations. Provide Analytical and Mathematical Support (discussion, explanations, graphs, tables, and calculations) as enclosures for each requirement where appropriate.*