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RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B. Sc. General Degree
Third Year - Semester II Examination – September / October 2013

MAT 3217 – NON LINEAR PROGRAMMING

Answer ~~all~~ 4 questions. **Time: 2 hours**

Use of a calculator is permitted.

01. a). Geometric programming deals with problems in which the objective and constraint functions are of the following type.

$$Z = \sum_{j=1}^{N} U_j \quad where \quad U_j = C_j \prod_{i=1}^{n} x_i^{a_{ij}} \qquad j = 1, 2, \ldots, N.$$

Define a posynomial.

Let Z^* be the minimum value of Z and $y_j^* = \frac{U_j^*}{Z^*}$

Show that $$Z^* = \prod_{j=1}^{N} \left(\frac{C_j}{y_j^*}\right)^{y_j^*}$$

b). Treatment of water is accomplished by chemical treatment and dilution to meet efficient conditions. The total cost is the sum of the treatment plants, pumping power requirements and piping cost. This cost is given by the following equation.

$$C = 150\,D + \frac{972 \times 10^3 Q^2}{D^5} + \frac{432}{Q}$$

Where C is in dollars, D in inches, Q in cfs. find the minimum cost and best value of D and Q.

02. a). Briefly explain the initialization, iteration steps and stopping rule of the gradient search procedure.

b). Using gradient search procedure, maximize the following function ,

$f(x) = 4x_1 + 6x_2 - 2{x_1}^2 - 2x_1x_2 - 2{x_2}^2$

Take error tolerance $\varepsilon = 0.05$ and initial solution $x_0 = (1,1)$

Contn...

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03. a). Explain each step and obtain the Lagrange multiplier equation $\nabla f = \lambda \nabla g$ to find the extreme value of $f(x, y)$, subject to the constraint $g(x, y) = c$, where c is a constant.

b). Use Lagrange multiplier method to find the greatest and least distances from the point (2, 1, -2) to the sphere with the equation $x^2 + y^2 + z^2 = 1$.

04. Using simplex method, solve the following quadratic programming problem.

$$Maximize\ z = 2x_1 - {x_1}^2 + 3x_2 - 2{x_2}^2$$

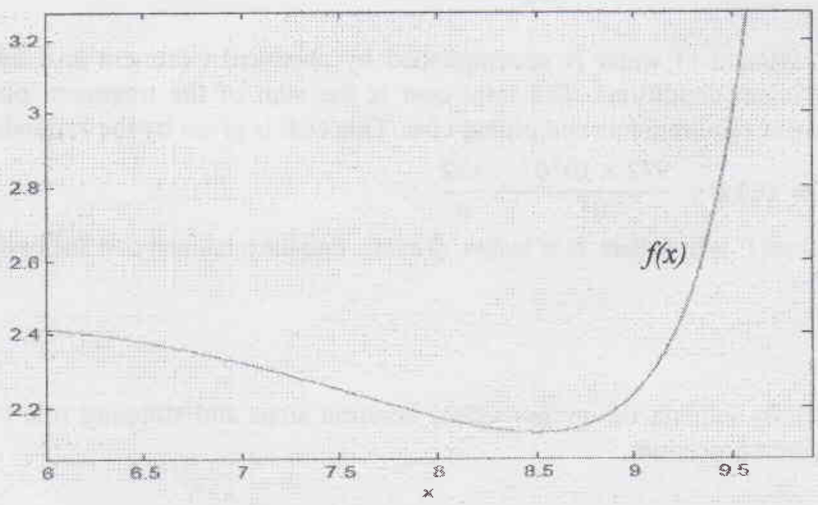
$$Subject\ to \qquad x_1 + x_2 \leq 3$$

$$x_1, x_2 \geq 0$$

05. a). Briefly explain the initialization, iteration steps and stopping rule of the one dimensional search procedure.

b). $f(x) = ln^2(x-2) + ln^2(10-x) - x^{0.2}$ is known to be a unimodal function on [6, 9.9]. Use the one dimensional search procedure to minimize the function $f(x)$. Take error tolerance $\varepsilon = 0.05$.

(Perform maximum 3 iterations).



[Hint : $ln^2(x-2) = [ln(x-2)]^2$]

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