Engineering Systems Analysis for Design

Quiz on Deterministic part of course **October 22, 2002**

This is a closed book exercise. You may use calculators

Grade Tables

There are 90 points possible for the regular test, or 1 point per minute. Points associated with each question correspond to the estimated time it might take to answer them. There are also a possible 10 points of extra credit. Final scores will be based on 90 possible points.

Item	Score	
	Max	**Yours**
Your Name (provided we can read it)	1	
Concepts	36	
What's the best design?	20	
Money, Money, Money	13	
Ship it out!	20	
Extra Credit	10	
Total	100	
Percentage grade on basis of 90 maximum:		

I have completed this test fairly, without copying from others or from a textbook

Please sign your name legibly _____

Concepts (36 points -- 2 points per part)

Write a short definition or description explaining the following:

Production Function

Technical Efficiency

Economic Efficiency

Marginal Product

Isoquant

Returns to Scale

Economies of Scale

How are the previous two related (or not)?

Shadow Prices

Opportunity Costs

Lagrangean Multipliers

Optimality Criteria in Marginal Analysis

Complementary Slackness

Expansion Path

Cost Function

Activities

Fixed Charge Problem

Data Tables

What's the best design? (20 points)

You are given a production function: $3R^{0.6}S^{0.3}$

And the cost of the resources as: $6R^{0.8}+10S^{1.2}$

a) What can you say by immediately, by inspection, about the returns to scale? About the economies of scale? Justify your answer. (4 points)

b) What is the optimal relationship between the resources R and S? (10 points)

c) What is the associated cost function? (6 points)

Money, Money, Money (13 points)

What is Net present value? (3 Points)

What are the major advantages and disadvantages of the Benefit/Cost ratio as a criterion of evaluation? (6 Points)

Why might the rank order of projects change when you calculate their benefit-cost ratios using different discount rates? (4 Points)

Ship it out! (20 points)

A plant manager wants to minimize the cost of shipments from plants A and B (capacity of 1000 and 500) to markets K, L, M (requirements of 300, 800, 200, respectively).

The shipping costs are as in the table

From	To		
	K	L	M
A	30	40	20
B	10	50	80

a) Set up the Linear Program. You may use a vector notation if convenient. (7 points)

b) Suppose the results gave the following results: (9 points)

Requirement at	Shadow Price	Range
A	0	(0. 800)
B	30	(300, 600)
K	20	(200, 400)
L	a	…
M	40	(250, 450)

What is the meaning of the shadow price on production at B?

What can you say about the shadow price on requirements at K if these rise to 450 units?

What can you say about the shadow price at L?

c) The manager thinks it might be a good idea to set up a facility between B and M at a cost of

$$20 + 0.02 \times throughput \, .$$

The object would be to reduce the shipping costs on this route. How does the LP handle such an extension to the basic formulation? (4 points)

For 10 points extra credit:

d) Suppose that the actual cost of shipping between B and M is not

$$80 \times (volume\_on\_route) \, ,$$

but

$$(volume\_on\_route)^{a} \, .$$

Under what conditions could you incorporate this feature into the LP? (4 points)

How would including this feature change the LP? Show specific equations. (6 points)