Engineering Systems Analysis for Design

Mid-Semester Quiz **October 22, 2009**

This is a closed book exercise.

Computers and other wireless enabled devices for communication with web and outside are not allowed.

You may use old-fashioned, non-communicating calculators that are not miniature computers with extensive memory (if you have them! And if so, show me first…)

In any case, you should not need any mechanical aid.

Organization of Quiz
It has 4 parts:

1. Concepts concerning Flexibility in General
2. Concepts of Evaluation and Production Functions
3. Mechanics of Deterministic Evaluation
4. Mechanics of Production Functions

Grade Table
There are 90 points possible. Points associated with each question correspond to the estimated time it might take to answer them.

Item	Score	
	Max	**Yours**
Your Name (provided we can read it)	1	
Concepts concerning Flexibility	25	
Concepts of Evaluation and Production Functions	32	
Mechanics of Deterministic Evaluation	11	
Mechanics of Production Functions	21	
Total	90	

I have completed this test fairly, without copying from others, a book, or the web.

Please sign your name legibly _____ **(1 point)**

1. Concepts Concerning Flexibility (25 points)

Respond to these questions:

"The forecasting methods on technology and market are established"
Discuss: Is it true? What are its implications for our ability to forecast accurately? **(3 points)**

Discuss our current ability to forecast future conditions for our designs: what kind of accuracy do you think is possible in your field (plus or minus what percent in how many years)? Justify your response. **(4 points)**

To what extent will better statistical techniques enable us to improve predictions? **(2 points)**

Why might we need flexibility in design? **(3 points)**

How can flexibility add value to design? **(3 points)**

Why is Expected Value an important concept for the discussion of flexible design **(2 points)**

"Flexibility is nice to have, but it's always an extra cost"
"Flexibility can provide win-win solutions, better performance at lower cost"
Discuss these contrasting statements. Which is true? **(8 points)**

2. Concepts Concerning Production Functions (32 points)

Write short definitions or explanations of the following.
Full marks only for conceptually precise responses.

Production Function **(2 points)**

Technical Efficiency **(2 points)**

Isoquant **(2 points)**

In light of the above, to what extent is it possible to justify a statement that "This is the optimal technical design" **(2 points)**

Returns to Scale **(2 points)**

Increasing returns to scale: define, give reasons for their occurrence in practice, and give examples of industries that have this feature **(2 points)**

Economic Efficiency: define and contrast with Technical Efficiency **(2 points)**

Optimality conditions for Economic Efficiency **(2 points)**

Meaning and Significance of "Balanced Design" **(2 points)**

Expansion Path **(2 points)**

Why might the expansion path be non-linear? What are the design implications of this possibility? **(3 points)**

Output Cost Function: define and compare with input cost function **(3 points)**

Discount Rate: define and compare with interest rate **(3 points)**

WACC: define concept and discuss advantages and disadvantages for use as discount rate **(3 points)**

3. Deterministic Evaluation of Projects (11 points)

Consider the project with the following revenues and costs:

	Year				
	0	1	2	3	4
Revenues		250	400	520	360
Costs	1000	30	40	55	70
Net Cash Flow					
$(1+r)^N$					
Present value					

Assume a discount rate of r = 10%. Use no more than 3 significant figures

Define Net Present Value and calculate it for this case **(5 Points**)

According to conventional practice, how would you calculate the benefit/cost ratio? What are the major advantages and disadvantages of the benefit/cost ratio as a criterion of evaluation? **(3 points)**

Define and Calculate the Pay Back Period. What are the major advantages and disadvantages of this criterion of evaluation? **(3 points)**

4. What's the best design? (21 points)

Your production function is: $Z = R^{0.3} S^{0.8}$

And the cost of the resources is: $C = R^3 + 5 S^2$

Note: In calculating answers, you may leave exponents in fractional form rather than estimating numbers in decimal form. For example, $0.4^{2/3}$ would be acceptable.

What can you say immediately, by inspection, about the returns to scale? The economies of scale? Explain answers **(3 points)**

What is the economically efficient relationship between the resources R and S? **(6 points)**

What is the associated cost function? **(8 points)**

What can you now say about the economies of scale? Explain why this is so **(4 points)**