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GRADUATE MICROECONOMICS I
PROBLEM SET 4
Fall 2013

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1. There are three goods. Goods 1 and 2 are inputs. The third, with amount q , is the output. Output can be produced by two techniques that can be operated simultaneously or separately. The techniques are not necessarily linear: The first (respectively, second) technique uses only the first (respectively, second) input. Thus the first (respectively, the second) technique is completely specified by $\alpha_1(\alpha_2)$ [respectively, $\alpha_2(\alpha_1)$], the minimal amount of input one (respectively, two) sufficient to produce the amount of output q (respectively, q_2). The two functions $\alpha_1(\cdot)$ and $\alpha_2(\cdot)$ are increasing and $\alpha_1(0) = \alpha_2(0) = 0$.

- Describe the three-dimensional production set associated with these two techniques. Assume free disposal.
- Give sufficient conditions on $\alpha_1(\cdot)$, $\alpha_2(\cdot)$ for the production set to display additivity.
- Suppose that input prices are w_1 and w_2 . Write the first order conditions for profit maximization and interpret. Under which conditions on $\alpha_1(\cdot)$, $\alpha_2(\cdot)$ will the necessary conditions be sufficient?
- Show that if $\alpha_1(\cdot)$ and $\alpha_2(\cdot)$ are strictly concave, then a cost-minimizing plan cannot involve the simultaneous use of the two techniques. Interpret the meaning of the concavity requirement. Show the isocosts in the two-dimensional space of input usage.

2. A price-taking firm producing a single product according to the technology $q = f(x_1, \dots, x_{L-1})$ faces prices p for its output and w_1, \dots, w_{L-1} for each of its inputs. Assume that $f(\cdot)$ is strictly concave and increasing, and that $\partial^2 f(x_1)/\partial x_1^2 < 0$ for

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