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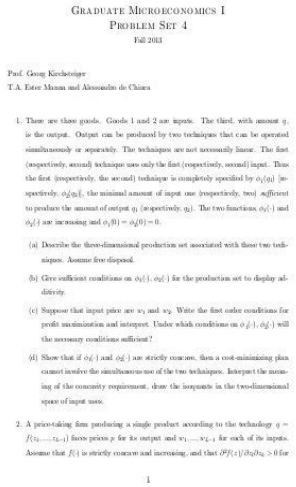

GRADUATE MICROECONOMICS I
PROBLEM SET 4
Fall 2013

Prof. Georg Kirchsteiger
T.A. Ester Manna and Alessandro de Chiara

1. There are three goods. Goods 1 and 2 are inputs. The third, with amount q_3 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 $\phi_1(q_3)$ (respectively, $\phi_2(q_3)$), the minimal amount of input one (respectively, two) sufficient to produce the amount of output q_3 (respectively, q_3). The two functions, $\phi_1(\cdot)$ and $\phi_2(\cdot)$ are increasing and $\phi_1(0) = \phi_2(0) = 0$.
   (a) Describe the three-dimensional production set associated with these two techniques. Assume free disposal.
   (b) Give sufficient conditions on $\phi_1(\cdot)$, $\phi_2(\cdot)$ for the production set to display additivity.
   (c) Suppose that input price are w_1 and w_2. Write the first order conditions for profit maximization and interpret. Under which conditions on $\phi_1(\cdot)$, $\phi_2(\cdot)$ will the necessary conditions sufficient?
   (d) Show that if $\phi_1(\cdot)$ and $\phi_2(\cdot)$ are strictly concave, then a cost-minimizing plan cannot involve the simultaneous use of the two techniques. Interpret the meaning of the convexity requirement, draw the isoquants in the two-dimensional space of input uses.
2. A price-taking firm producing a single product according to the technology $y = f(z_1, ..., z_{L-1})$ faces prices p for its output and $w_1, ..., w_{L-1}$ for each of its inputs. Assume that $f(\cdot)$ is strictly concave and increasing, and that $\partial^2 f(z)/\partial z_l \partial z_k > 0$ for

1

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