Math 105—Project 3
Profitable Production...

by Gavin LaRose (glarose@NebrWesleyan.edu), Nebraska Wesleyan University, August 1998

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Chemproc, Inc.

20000 Ryan-ears Blvd.
Lonlinc, SK
04685

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Independent Mathematical Contractors, Inc.
Suite 2, Strawmarket Business Plaza
Lonlinc, SK 04685

Dear IMC:

As you know, Chemproc, Inc. is a premier manufacturer and reprocessor of chemicals and chemical waste. Further, as has been recently highlighted on the local news, we are in the process of expanding our Lonlinc, Skanebra chemical manufacturing plant to add two or three new products to our elegantly packaged and painstakingly marketed product line—which will result in our hiring at least *four* local workers. Our engineers have, however, determined that for these products to be successful in the competitive market into which we are making our foray we must be careful to obtain the absolute highest profit possible from our overall production.

We are for reasons of corporate secrecy unable to reveal the exact names of the products that we will be producing, and therefore refer to them herein as products X and Y (for the case in which two products are produced), respectively. We will be manufacturing x and y units of these per day, and expect to realize a profit of a and b dollars per unit on each of the products (again, we are unable to divulge the actual values determined by our marketing department).

The actual number of units of these that we are able to produce is, however, limited by the number of person-hours that the *four* local workers have available for this production process on any given day. This will be L person-hours. To manufacture one unit of X requires c person-hours, and the hours required increases proportional to the number of units of X produced. For the second product, however, economies of scale are much more pronounced, so that the number of person-hours required to produce y units of it is proportional to y^p, with constant of proportionality d, where $0 < p < 1$.

It is imperative that we determine the best production strategy for the manufacture of these two products. We are additionally interested in the case in which we manufacture three products, X, Y, and Z, and hope that you will find it possible to also investigate this possibility. In this case the economy of scale indicated above is only applicable to the third product, while the time required per unit of other two is linear in the number of units produced. The profit on these is a_1, a_2, and a_3 dollars per unit. Additionally, both of X and Y require a primary reagent of which we are only able to allocate M units per day—and to manufacture one unit of X requires c_1 units for this reagent, while manufacture of Y requires c_2 units thereof. We would be very interested in your determination of the optimum production strategy in this case as well.

As specified in your contract, we need to receive your final 3–6 page report by the 11th of December. If you should find in the course of your investigation that you have questions regarding this project, you are to contact the most estimable Dr. Gavin LaRose, our consulting scientist (whose services we recently obtained by tripling to four figures his previous salary in the public sector). We regret, however, that owing to other responsibilities he will be unavailable to assist on this project between the 9th and 11th of December, inclusive.

It is difficult to indicate the eagerness with which we await your results.

Your most sincerely,

E. Idu Pont
President, Chemproc, In.

eip:glr