Environmentally Responsible Design and Manufacturing

Homework #7

Part A. (Due for oral presentation on-campus Monday April 26, 2004 -- hard copy due with Part B).

Develop THREE initiatives that could be feasibly undertaken at Michigan Tech (for off-campus students, answer the question for your work site). They must be economically viable, environmentally responsible, and socially acceptable.

Part B. (Due at Final Exam -- 5:15 pm, Tuesday, May 4, 2004)

1. Using Economic Input-Output Life Cycle Assessment results (www.eiolca.net), estimate the impact of a $1 Million increase in economic activity in a.) “Motor vehicles and passenger car bodies” and b.) “Electronic computers” for all possible data types.

i.) Report the results for the top 5 sectors and the total for all sectors.

ii.) What conclusions can you draw from the results?

2. The number-crunchers of the chimerical country of Sutherlandia have reported the following economic data (currency unit is SDU-Sutherland Dollar Units) for the Service and Manufacturing Sectors:

<table>
<thead>
<tr>
<th>Table 1: Sutherlandia Economic Data (Thousands of SDUs)</th>
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<tr>
<td>X Service</td>
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<tr>
<td>Manufacturing</td>
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<td>Total Input</td>
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i.) If matrix $X = \begin{bmatrix} 33 \\ 55 \end{bmatrix}$ and matrix $Y = \begin{bmatrix} 15 \\ 27 \end{bmatrix}$, find all the unknown values in the table (quantities a-g).
ii.) Using $Y_m = a_{m1}X_1 + a_{m2}X_2 + b_{m1}Y_1 + b_{m2}Y_2$, $m = 1, 2$

Find (a) matrix $A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$ and (b) matrix $B = \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix}$, Be careful!

iii.) Due to the Princess’s move to Lansinia for studies next year, **Exports** are expected to increase by **13k** SDUs and **Government Demand** is expected to decrease by **5k** SDUs.

As the Industry Advisor to the King of Sutherlandia, what is your recommendation to the Service and Manufacturing Sectors in changing their outputs to meet next year’s demands?

As a competent advisor, you know that you can model next year’s economic input/output numbers using the model developed for this year. Looking at your crib sheet from when you took the ERDM Class you see:

(a) New $Y$ matrix

(b) $(I - A)^{-1}B$ matrix

(c) New $X$ matrix (the key to your recommendations!)

(d) Recommendations

3. The King has decided to test your technical abilities. He has given you two pieces of annealed 304 stainless steel rods (0.500 inch diameter, 6 inches long). He wants you to reduce the diameter of each rod to 0.480 inches by (a) pulling one in tension and (b) machining it in one pass. He wants you to calculate the respective amounts of work involved (**and to report it in in.-lb. of all things!**) and he wants you to explain the causes of the difference in the energies dissipated.

After a little head scratching, you have found for this material that the strength coefficient ($K$) is **1275 MPa** and the strain-hardening exponent ($n$) is **0.45**. You also have found that the average value for the specific energy in machining stainless steels is **1.5 hp-min./in.$^3$**.

i.) Work (in.-lb.) resulting from (a) Pulling in tension and (b) Machining

ii.) Explanation of causes