IE 251 – Fall 2021

Case Study 1 - CHARY

CHARY –an electronics company at METU Technopolis– is ready to make its annual purchasing plan of computer chips for 2022. Due the scarcity of chips all over the world during the pandemic period, CHARY's industrial engineers have already completed their aggregate production plan based on which they have determined their materials requirement plan for 2022 as well. In the same vein, they have increased the number of chip suppliers that they are working with in order to alleviate the chip supply risk in the global supply chains.

CHARY uses chips of different quality grades in their prototypes and products manufacturing, and thus grade the chips rated as being of excellent, good, or mediocre quality. CHARY IEs requirements plan for the chips during two 6-month periods in 2022 are given in Table 1. It should be noted that Periods 1 and 2 correspond to the periods covering the six months from January 1 to June 30, and from July 1 to December 31, 2022, respectively.

Table 1. Requirements for chips

	Requirements for chips of quality grade		
Period	**Excellent**	**Good**	**Mediocre**
1	2000	1500	400
2	5000	1500	600

Each supplier sells the chips in boxes (lots) of 100 chips and each lot consists of a mix of different quality grades. Moreover, based on the contracts made with the suppliers, they will supply <u>at most</u> the amounts uniformly over the year at the prices as listed in Table 2. For example, Supplier 1 will provide up to 30 boxes (lots) during the year, but at most 15 lots in Period 1 and 15 lots in Period 2. The mixes in the boxes are also provided in Table 2.

Table 2. Suppliers and chip mixes & prices per lot

	Number of chips in a lot of 100 chips			**Prices per lot, $**		**Supply Limit,**
supplier	**excellent**	**good**	**mediocre**	**Period 1**	**Period 2**	**Lots/year**
1	60	30	10	400	440	30
2	50	35	15	300	330	20
3	40	20	40	250	250	30
4	50	25	25	275	300	50

CHARY can carry inventory of chips from Period 1 to Period 2, but this costs CHARY an inventory holding cost of $ 0.1 per any chip per period.

CHARY also has the option of purchasing chips on a unit-by-unit basis (not in lots of 100 units) from other sources (like retailers) that they call as special-orders, but with somehow higher prices as $10 per excellent chip, $6 per good chip, and $4 per mediocre chip over the year. CHARY does not have any limit for these special orders.

CHARY top managers has recently budgeted $25,000 to spend on chip purchases in 2022 (inventory holding costs not included). CHARY assesses a penalty of $1 for each dollar by which the total amount paid to suppliers 1–4 and retailers exceeds the annual budget.

a) Formulate this problem as an LP that CHARY IEs can benefit from so as to minimize the total cost associated with meeting all annual chip requirements on time (with no shortages in the periods) in 2022.
b) Using Excel Solver only, solve the LP.
c) Perform sensitivity analyses and prepare suggestions to present to CHARY managers.