Non-Linear Financial Modeling

Managers at Industrial Supply, Inc. are planning a sales campaign for the coming year in which they must determine how many sales representatives they will assign to seven product lines. S-shaped sales response functions of the form

$$\%Sales = b + (a- b) (\%Reps^c)/(d+ Reps^c)$$

have been fitted to subjective data provided by a group of experienced managers. (Both variables Sales and Reps have been measured relative to base levels. Thus %Reps represents the ratio between proposed reps and base reps, while %Sales represents the ratio between proposed sales and base sales.) The fitted values for the four parameters for each product are given in the following table:

	Response Parameters			
	a	b	c	d
Product A	1.6574	0.4722	2.0322	1.1954
Product B	1.3792	0.1493	2.5622	0.4562
Product C	1.2798	0.3101	2.3345	0.4033
Product D	1.0971	0.4497	3.0420	0.1910
Product E	1.2527	0.5603	1.7734	0.5576
Product F	1.1152	0.5899	2.8685	0.2851
Product G	2.0276	0.1575	1.7337	1.0381

The following table gives the current number of reps assigned to each product and current sales, along with the contribution margin on each product. The cost of each rep is $63,000 per year.

	Current Reps	Current Sales	Contribution Margin
Product A	96.8	214,400	0.70
Product B	142.4	36,500	0.55
Product C	52.7	21,200	0.72
Product D	24.1	37,200	0.72
Product E	27.3	38,000	0.62
Product F	29.7	14,600	0.53
Product G	56.8	11,200	0.52

a. Build a financial model to calculate the total net profit over all seven product lines for any proposed allocation of reps. What is the optimal allocation of reps and resulting optimal profit if we use no more reps than we currently have?
b. What is the optimal allocation of reps and the resulting optimal profit if we can hire an unlimited number of reps?

Source of this problem: Question 12 of Chapter 8 “Optimization of Network Models” of book ``Business Analytics: The Art of Modeling with Spreadsheets'', by Stephen G. Powell and Kenneth R. Baker, 5 th Edition, 2017, John Wiley and Sons.