#### Exercise 7.1

## Question

# 7.1. Engulf and Devour

The safety engineer for Engulf and Devour's Lakeside factory has estimated the number of employee disabilities (measured in sick days/year) that can be avoided by various measures: covering dangerous machinery (CDM), providing protective clothing (PPC), improving ventilation (IV), and/or lowering noise levels (LNL). The information is summarized in the following table.

	Measures				
Investment (10 <sup>3</sup> \$)	CDM	PPC	IV	LNL	
0	0	0	0	0	
10	5	15	2	5	
20	10	22	12	7	
30	15	25	15	15	
40	20	25	17	25	
50	22	30	25	26	

- (a) Use dynamic programming to determine how a \$70,000 budget could be most effectively employed to reduce disabilities.
- (b) How much of a difference would it make if management cut back the safety budget to \$60,000? How much money would be saved for each additional sick day the budget cut would cause?
- (c) Could this problem be solved by linear programming? Why or why not?

### **Solution from Manual**

#### Chapter 7

#### 7.1 Engulf and Devour

a) Best investment gives a savings of 52 days via two possible investment schemes: (0,10,20,40) or (10,20,0,40). See Table:

f 1(K)	f <sub>2</sub> (K)	f <sub>3</sub> (K)	f <sub>4</sub> (K)	
0	0	0	0	
5	15	15		
10	22	22		
15	27	27		
20	32	34		
22	37	39		
22	42	44	47	
22	45	49	52	
	0 5 10 15 20 22 22	0 0 5 15 10 22 15 27 20 32 22 37 22 42	0 0 0 0 5 15 15 15 10 22 22 15 27 27 20 32 34 22 37 39 22 42 44	0 0 0 0 0 0 5 15 15 15 15 15 15 15 15 27 27 27 20 32 34 22 37 39 22 42 44 47

b) Five less days would be saved (52 - 47 = 5) at a savings of \$10,000 which is \$2,000 per sick day.

c) This problem could not be solved by LP since the return functions for PPC, IV, Z LNL all present non-convex feasible regions.

# **Additional Notes**

7.1.	1			file)=Max g; K; +fix (k-Ki)
Budget	f,(k)	f2/k)	f3(K)	fully_
10	05	15 (0,10)	15 (0,190)	9
20	10	22 (0,20)	22 (0,20,0)	
30 40	15	27 (P)20) 32 (20,20)	27 (10,20,0) 34 (0,20,30)	
50	22	37 (30,20)	39 (1920,20)	12/0 20042
20	22	42 (40,20)	49 (30,20,20)	52 (10,20,0,40); (0,19,20,10)
				(a) 70x: f(x)=52
				(b) 604: f(0,20,0,40)=47 2 budget = 104
				A such days = 52-47 = 5 days
				#2 18/ sick day
				( NO!
	P +5 +3			Retnew this are now large
			=	Dapa-waver feasible reprov.
				- Ment-waver Jeasnote regrow-