

Innis has identified eight potential locations to construct new single-family dwellings, but he cannot put up homes on all of the sites because he has only \$300,000 to invest in all projects. The accompanying table shows the cost of constructing homes in each area and the expected profit to be made from the sale of each home. Note that the home-building costs differ considerably due to lot costs, site preparation, and differences in the models to be built. Note also that a fraction of a home cannot be built.

LOCATION	COST OF BUILDING AT THIS SITE (\$)	EXPECTED PROFIT (\$)
Clifton	60,000	5,000
Mt. Auburn	50,000	6,000
Mt. Adams	82,000	10,000
Amberly	103,000	12,000
Norwood	50,000	8,000
Covington	41,000	3,000
Roselawn	80,000	9,000
Eden Park	69,000	10,000

- (a) Formulate Innis's problem using 0-1 integer programming.
 (b) Solve with QM for Windows or Excel.

A real estate developer is considering three possible projects: a small apartment complex, a small shopping center, and a mini-warehouse. Each of these requires different funding over the next two years, and the net present value of the investments also varies. The following table provides the required investment amounts (in \$1,000s) and the net present value (NPV) of each (also expressed in \$1,000s):

INVESTMENT	NPV		YEAR 1	YEAR 2
	Apartment	Shopping center	Mini-warehouse	
	18	15	14	20
	40	30	20	20
	30			

The company has \$80,000 to invest in year 1 and \$50,000 to invest in year 2.

- (a) Develop an integer programming model to maximize the NPV in this situation.
 (b) Solve the problem in part (a) using computer software. Which of the three projects would be undertaken if NPV is maximized? How much money would be used each year?

- 10-18 Refer to the real estate investment situation in Problem 10-17.
 (a) Suppose that the shopping center and the apartment would be on adjacent properties, and the

finance up to \$1.6 billion in purchases; (2) each Boeing 757 will cost \$80 million, and each Boeing 767 will cost \$110 million; (3) at least one-third of the planes purchased should be the longer-range 757; (4) the annual maintenance budget is to be no more than \$8 million; (5) the annual maintenance cost per 757 is estimated to be \$800,000, and it is \$500,000 for each 767 purchased; and (6) each 757 can carry 125,000 passengers per year, whereas each 767 can fly 81,000 passengers annually. Formulate this as an integer programming problem to maximize the annual passenger-carrying capability. What category of integer programming problem is this?

- 10-14 Trapeze Investments is a venture capital firm that is currently evaluating six different investment opportunities. There is not sufficient capital to invest in all of these, but more than one will be selected. A 0-1 integer programming model is planned to help determine which of the six opportunities to choose. Variables X_1 , X_2 , X_3 , X_4 , X_5 , and X_6 represent the six choices. For each of the following situations, write a constraint (or several constraints) that would be used.
 (a) At least 3 of these choices are to be selected.
 (b) Either investment 1 or investment 4 must be undertaken, but not both.
 (c) If investment 4 is selected, then investment 6 must also be selected. However, if investment 4 is not selected, it is still possible to select number 6.
 (d) Investment 5 cannot be selected unless both investments 2 and 3 are also selected.
 (e) Investment 5 must be selected if both investments 2 and 3 are also selected.

Horizon Wireless, a cellular telephone company, is expanding into a new era. Relay towers are necessary to provide wireless telephone coverage to the different areas of the city. A grid is superimposed on a map of the city to help determine where the towers should be located. The grid consists of 8 areas labeled A through H. Six possible tower locations (numbered 1-6) have been identified, and each location could serve several areas. The table below indicates the areas served by each of the towers.

TOWER LOCATION	AREAS SERVED
1	A, B, D, B, C, G
2	C, D, E, F, E, F, H, E, G, H
3	A, D, F
4	
5	
6	

- 10-16 Innis Construction Company specializes in building moderately priced homes in Cincinnati, Ohio. Tom Formulate this as a 0-1 programming model to minimize the total number of towers required to cover all the areas. Solve this using a computer.