Mod 6:

Integer programming (integer solution is the only solution)

Total integer programming: all decision variables are integers

Binary programming: decision variables are binary

Mixed programming: decision variables some integer, binary, real

Example: urban development, building four new facilities, city wants to construct facilities that would maximize the total expected daily usage by residents and subjected to the budgetary and land requirements

|  |  |  |  |
| --- | --- | --- | --- |
| Recreation Facility | Expected Usage (People Per Day) | Cost (Dollars) | Land Requirement (Acres) |
| Swimming pool | 320 | 96000 | 3 |
| Tennis Courts | 100 | 70000 | 2 |
| Athletic field | 400 | 94000 | 6 |
| Gymnasium | 180 | 190000 | 4 |

Constraints:

* Available budget: $ 340000
* Available land: 12 acres
* Either swimming pool or tennis center, not both

Decision variable:

X1: construction of swimming pool

X2: construction of tennis courts

X3: athletic field

X4: gymnasium

Objective: maximize daily usage

Z = 320X1+100X2+ 400X3+180X4

Constraints expressed in formulas:

Budget <= 340K: 96X1 + 70X2 + 94X3+ 190X4 <= 340

Available land <= 12 acres: 3X1 + 2X2 + 6X32 + 4X4 <= 12

X1 and X2 cannot be selected together: X1 + X2 <= 1

Contingency constraints: divided into several types (in this example the third constraints)

* Mutually exclusive constraints: (if x1 is selected, then x2 cannot be selected)—x1 +x2<= 1
* Multiple choice constraints (exactly one of x1 or x2 but not both) : x1 + x2 = 1 ; eg. Exactly two of the facilities should be selected—x1 + x2 + x3 + x4 = 2 ; at least two should be selected -- x1 + x2 +x3 +x4 >= 2; at most two facilities may be selected out of four -- x1 + x2 +x3 +x4 <= 2;
* Conditional constraints: if x1 is not selected, then x2 cannot be selected either: x2 <= x1
* Co-requisite constraints: if x1 is selecte4d, then x2 should also be selected: x1 = x2

Transshipment

Example of Transportation problem: transportation problem is always a minimization problem