Integer Programming with LINGO

LINDO Systems

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Integer Programming

Example with general integer variables

```
MAX = 20 * A + 30 * C;
          A          <= 60;
                   C <= 50;
          A  + 2 * C <= 119;
```

Variable	Value	Reduced Cost
A	60.00000	0.0000000
C	29.50000	0.0000000

Row	Slack or Surplus	Dual Price
1	2085.000000	1.000000
2	0.000000	5.000000
3	20.500000	0.0000000
4	0.000000	15.00000

That fractional value for C may not useful, so use @GIN...

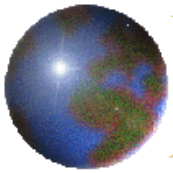
```
1]MAX = 20 * A + 30 * C;
2]            A           <= 60;
3]                      C <= 50;
4]            A  + 2 * C <= 119;
5]! Require C to be General INteger;
6]  @GIN( C);
```

Now we get the more useful solution:

Variable	Value	Reduced Cost
A	59.000000	0.000000
C	30.000000	10.000000

Row	Slack or Surplus	Dual Price
1	2080.000000	1.000000
2	1.000000	0.000000
3	20.000000	0.000000
4	0.000000	20.000000

Note, dual prices and reduce costs have limited interpretation with integer variables.



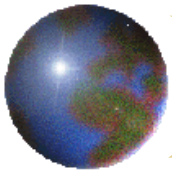
Go/No-Go Decisions and Binary Variables


```
 1]! Make or buy decisions:
 2]    Case 1) Minimum batch size;
 3]! If we do any C, must do at least 40;
 4]MAX = 20 * A + 30 * C;
 5]           A          <= 60;
 6]                    C <= 50;
 7]           A  + 2 * C <= 120;
 8]! Define YC = 1 if we make any C, else 0;
 9]!  Make YC a BINary variable;
10]   @BIN( YC);
11]! If YC = 1, then C >= 40;
12]    C >= 40 * YC;
13]! If YC = 0, then C <= 0;
14]    C <= 50 * YC;
```

The solution says its worth “taking the plunge” with C:

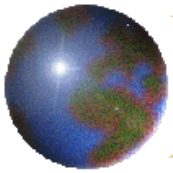
Variable	Value	Reduced Cost
A	40.00000	0.000000
C	40.00000	0.000000
YC	1.000000	400.000000

Row	Slack or Surplus	Dual Price
1	2000.000000	1.000000
2	20.000000	0.000000
3	10.000000	0.000000
4	0.000000	20.000000
5	0.000000	-10.000000
6	10.00000	0.0000000



A Second Common Use of Binary Variables: LSL4-6

```
 1]! Make or buy decisions:
 2]    Case 2) Fixed cost;
 3]! If we do any A, must pay $700 fixed cost;
 4]! Define YA = 1 if we make any A, else 0;
 5]MAX = 20 * A + 30 * C - 700 * YA;
 6]            A           <= 60;
 7]                      C <= 50;
 8]            A  + 2 * C <= 120;
 9]!  Make YA a BINary variable;
10]@BIN( YA);
11]! If YA = 0, then A <= 0;
12]    A <= 60 * YA;
```



Solution says it is not worth “paying the entry fee” for A:


```
Optimal solution found at step:          8
Objective value:                  1500.000
Branch count:                            1

 Variable           Value        Reduced Cost
        A        0.000000           0.0000000
        C       50.000000           0.0000000
       YA        0.000000        -500.0000

      Row    Slack or Surplus      Dual Price
        1      1500.000000           1.000000
        2        60.000000           0.000000
        3         0.000000          30.000000
        4        20.000000           0.000000
        5         0.000000          20.000000
```

Thank you for your attention.

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