56:134 Process Engineering
GETTING STARTED WITH LINDO

The main purpose of LINDO (Linear INteractive Discrete Optmizer) is to allow a user to quickly input a linear programming (LP formulation); solve it; assess the correctness or appropriateness of the formulation based on the solution and then quickly make minor modifications to the formulation and repeat the process.

You may run LINDO on a Unix workstation or a Windows computer.

To invoke LINDO on a Unix workstation, the following steps are to be taken.
(1) Log in on a Unix node.
(2) Type LINDO after the $(OK) prompt. A ":" prompt will show up on the screen. Now you are in LINDO.

There is a help menu available in LINDO. The following four commands may be used to obtain information about LINDO.

HELP	Gives help in various situations
COM	Lists commands by category
LOCAL	Gives info specific to your local installation
CAT	Lists categories of commands.

Most commonly used commands are:

1. Input

MAX	Start *natural* input
MIN	Start *natural* input
RETR	Retrieve old problem from file
TAKE	Take terminal input from a file
LEAVE	Undo the previous TAKE

2. Display

LOOK	Print (part of) problem in natural format
SOLUTION	Print standard solution report

3. File output

SAVE	Save current problem to file
DIVERT	Divert output to file
RVRT	Revert output to terminal

4. Solution

GO	Go solve the problem
PIVOT	Do the next simplex pivot

5. Problem editing

ALTER	Alter some element of current problem
EXT	Extend problem by adding constraints
DEL	Delete a specified constraints

6. Integer programs

INT	Identify integer variables (0/1)

7. Quit

QUIT	Quit LINDO

Integer variables in LINDO can be either 0/1 or continuous. Variables which are restricted to the values 0 or 1 are identified with the INTEGER (or INT) command. It is used in one of two forms:

INTEGER *variable-name* or INTEGER n

The first form identifies variable *variable-name* as being 0/1. The second identifies the first n variables in the current formulation as being 0/1. The order of the variables is determined by their order encountered in the input. This order can be observed in the solution report.

Most of the problems considered in this course will be formulated as mixed integer programming problems.

Other details of LINDO are available in the manual "Linear, Integer, and Quadratic Programming with LINDO" (Schrage, Scientific Press). Copies of this manual are available in the Engineering Library.

There are two ways of using LINDO:

1. Without file I/O
2. With file I/O

Option 2 is more preferable, and is illustrated below.

Example

Solve the following problem with LINDO.

Objective: Maximize X + Y

Constraints: $(X-1) + 2(Y-2) \leq 10$

$2X + Y \leq 13$

$X = 0, 1$

Step 1. Prepare a problem specification ("TAKE") input file in your directory.

```
MAX x + y
 s.t.
```

```
x + 2y <= 15
2x + y <= 13
END
INT x
LEAVE
```

Note that all the variables are on the left-hand of each constraint, while the constants are on the opposite side. In the above example only one variable, namely x is an integer variable.

The input file name is

example.in.

Step 2. Solve the problem using LINDO and create output file (**example.out**).

```
$ lindo
 *** LINDO (Linear, Interactive, and Discrete Optimizer) ***
  LINDO (UC 30 APRIL 82)
: take
Enter file name: example.in


: look all

 MAX      X +  Y
 SUBJECT TO
   2)     X + 2 Y <=   15
   3)    2 X +  Y <=   13
 END
 INTEGER-VARIABLES=       1


: divert
Enter file name:example.out
: look all
: go
    LP OPTIMUM FOUND  AT STEP     2

         OBJECTIVE FUNCTION VALUE

  1)        8.00000000

 LP OPTIMUM IS IP OPTIMUM

 NEW INTEGER SOLUTION OF   8.00000   AT BRANCH  0 PIVOT 2

         OBJECTIVE FUNCTION VALUE
```

```
 1)        8.00000000
 BOUND ON OPTIMUM:  8.000000
   ENUMERATION COMPLETE. BRANCHES=     0  PIVOTS=     2

 LAST INTEGER SOLUTION IS THE BEST FOUND
: quit
Fortran STOP
$ prf example.out
```