# ΠΑΡΑΔΕΙΓΜΑΤΑ ΕΠΙΧΕΙΡΗΣΙΑΚΗΣ ΕΡΕΥΝΑΣ ΜΕ ΤΗ ΧΡΗΣΗ Η/Υ

***ΙΩΑΝΝΗΣ ΝΤΖΟΥΦΡΑΣ***





ΙΩΑΝΝΗΣ ΝΤΖΟΥΦΡΑΣ: ΠΑΡΑΔΕΙΓΜΑΤΑ ΕΠΙΧΕΙΡΗΣΙΑΚΗΣ ΕΡΕΥΝΑΣ ΜΕ ΤΗ ΧΡΗΣΗ ΗΥ
**ΜΕΤΑΠΤΥΧΙΑΚΟ ΔΙΠΛΩΜΑ ΔΙΟΙΚΗΣΗΣ ΕΠΙΧΕΙΡΗΣΕΩΝ – ΜΕ.ΔΙ.Δ.Ε.**
**ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΙΓΑΙΟΥ**

## ΠΕΡΙΕΧΟΜΕΝΑ

# 1 ΓΕΝΙΚΕΣ ΟΔΗΓΙΕΣ – ΕΝΤΟΛΕΣ

## *1.1 LINDO*

### 1.1.1 ΔΟΜΗ ΠΡΟΓΡΑΜΜΑΤΟΣ

```
MAX/MIN [FUNTION]
SUBJECT TO
[CONSTRAINTS]
END
```

### 1.1.2 ΕΙΔΙΚΕΣ ΕΝΤΟΛΕΣ

```
TITLE [TEXT]      :    ΤΙΤΛΟΣ ΠΡΟΒΛΗΜΑΤΟΣ
FREE [VARS]       :    ΟΡΙΣΜΟΣ ΜΗ ΘΕΤΙΚΩΝ ΜΕΤΑΒΛΗΤΩΝ
GIN [VARS]        :    ΟΡΙΣΜΟΣ ΑΚΕΡΑΙΩΝ ΜΕΤΑΒΛΗΤΩΝ
SLB [VAR][#BOUND]:    ΠΕΡΙΟΡΙΣΜΟΣ VAR>BOUND
                       SLB = LOWER BOUND
SUB [VAR][#BOUND]:    ΠΕΡΙΟΡΙΣΜΟΣ VAR<BOUND
                       SUB = UPPER BOUND
```





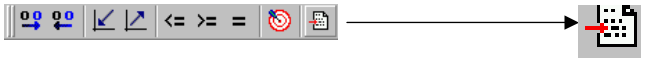
## *1.2 EXCEL WHAT'S BEST*

### 1.2.1 ΕΙΚΟΝΙΔΙΑ

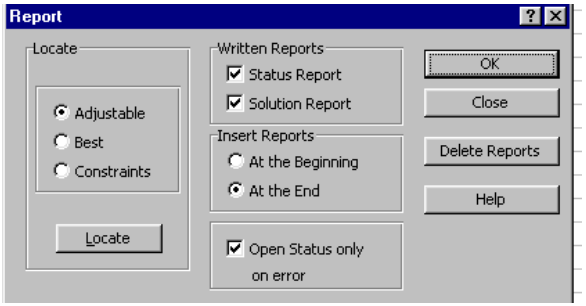
| | |
|---|---|
| | ΟΡΙΣΜΟΣ ΜΕΤΑΒΛΗΤΩΝ ΑΠΟΦΑΣΗΣ |
| | ΑΚΥΡΩΣΗ ΟΡΙΣΜΟΥ ΜΕΤΑΒΛΗΤΩΝ ΑΠΟΦΑΣΗΣ |
| | ΟΡΙΣΜΟΣ ΚΕΛΙΟΥ ΕΛΑΧΙΣΤΟΠΟΙΗΣΗΣ |
| | ΟΡΙΣΜΟΣ ΚΕΛΙΟΥ ΜΕΓΙΣΤΟΠΟΙΗΣΗΣ |
| <= >= = | ΟΡΙΣΜΟΣ ΠΕΡΙΟΡΙΣΜΩΝ |
| | ΕΠΙΛΥΣΗ ΠΡΟΒΛΗΜΑΤΟΣ |
| | ΕΠΙΛΟΓΕΣ |

### 1.2.2 ΛΥΣΗ – REPORT

*1… ΕΠΙΛΕΞΤΕ ΤΟ ΕΙΚΟΝΙΔΙΟ ΤΩΝ ΕΠΙΛΟΓΩΝ*

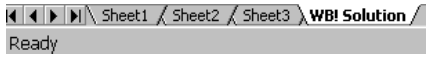


*2… ΕΠΙΛΕΞΤΕ ΤΗΝ ΕΚΘΕΣΗ ΛΥΣΗΣ (SOLUTION REPORT)*




*3… ΕΠΙΛΕΞΤΕ ΤΟ ΕΙΚΟΝΙΔΙΟ ΤΗΣ ΕΠΙΛΥΣΗΣ ΤΟΥ ΠΡΟΒΛΗΜΑΤΟΣ*

*4… ΕΠΙΛΕΞΤΕ ΤΟ ΕΙΚΟΝΙΔΙΟ ΤΗΝ ΕΤΙΚΕΤΑ ΤΗΣ ΛΥΣΗΣ (WB!SOLUTION) ΣΤΟ ΚΑΤΩ ΑΡΙΣΤΕΡΑ ΤΗΣ ΟΘΟΝΗΣ*



# 2 ΠΑΡΑΔΕΙΓΜΑ 1: GALAXY INDUSTRIES (Chap 3: Applied Management Science)

## *2.1 LINDO*

### 2.1.1 ΜΟΝΤΕΛΟ

```
max 8x1+5x2
st
 2x1+  x2 <=1200
 3x1+ 4x2 <=2400
  x1+  x2 <= 800
  x1-  x2 <= 450
end
```

### 2.1.2 ΛΥΣΗ

```
 LP OPTIMUM FOUND AT STEP      2

        OBJECTIVE FUNCTION VALUE

        1)      5040.000

  VARIABLE        VALUE          REDUCED COST
        X1       480.000000          0.000000
        X2       240.000000          0.000000


       ROW   SLACK OR SURPLUS     DUAL PRICES
        2)         0.000000          3.400000
        3)         0.000000          0.400000
        4)        80.000000          0.000000
        5)       210.000000          0.000000

 NO. ITERATIONS=       2
```

### 2.1.3 ΑΝΑΛΥΣΗ ΕΥΑΙΣΘΗΣΙΑΣ

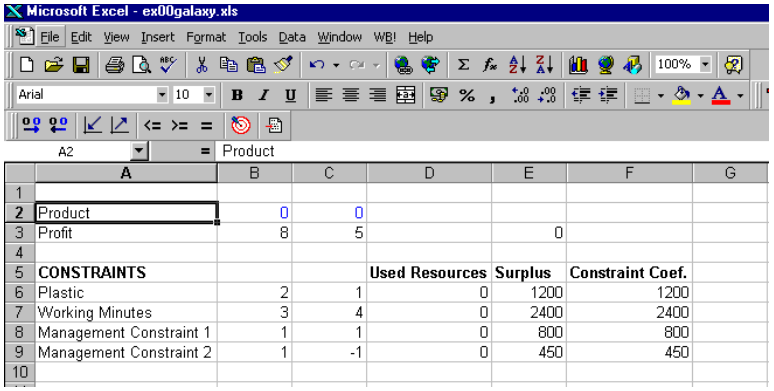
```
 RANGES IN WHICH THE BASIS IS UNCHANGED:
                         OBJ COEFFICIENT RANGES
 VARIABLE         CURRENT        ALLOWABLE        ALLOWABLE
                   COEF          INCREASE         DECREASE
       X1        8.000000         2.000000         4.250000
       X2        5.000000         5.666667         1.000000

                         RIGHTHAND SIDE RANGES
      ROW         CURRENT        ALLOWABLE        ALLOWABLE
                    RHS          INCREASE         DECREASE
        2     1200.000000       150.000000       600.000000
        3     2400.000000       400.000000       350.000000
        4      800.000000         INFINITY        80.000000
    5   450.000000      INFINITY     210.000000
```





## *2.2 EXCEL WHAT'S BEST*

### 2.2.1 ΜΟΝΤΕΛΟ


Microsoft Excel - ex00galaxy.xls

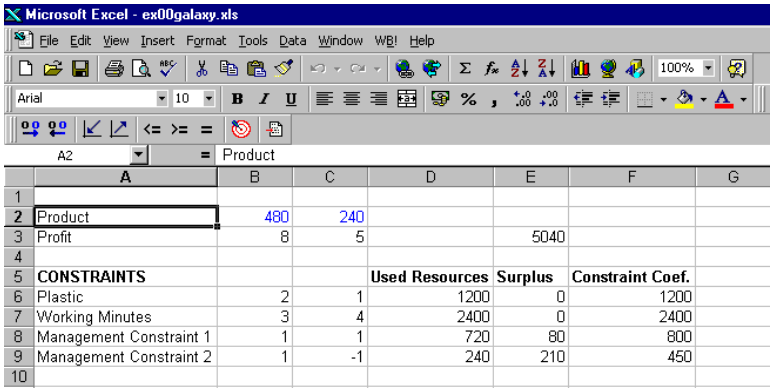
File Edit View Insert Format Tools Data Window WB! Help

Arial 10 100%

A2 = Product

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | Product | 0 | 0 | | | | |
| 3 | Profit | 8 | 5 | | 0 | | |
| 4 | | | | | | | |
| 5 | **CONSTRAINTS** | | | **Used Resources** | **Surplus** | **Constraint Coef.** | |
| 6 | Plastic | 2 | 1 | 0 | 1200 | 1200 | |
| 7 | Working Minutes | 3 | 4 | 0 | 2400 | 2400 | |
| 8 | Management Constraint 1 | 1 | 1 | 0 | 800 | 800 | |
| 9 | Management Constraint 2 | 1 | -1 | 0 | 450 | 450 | |
| 10 | | | | | | | |

### 2.2.2 ΛΥΣΗ (  )


Microsoft Excel - ex00galaxy.xls

File Edit View Insert Format Tools Data Window WB! Help

Arial 10 100%

A2 = Product

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | Product | 480 | 240 | | | | |
| 3 | Profit | 8 | 5 | | 5040 | | |
| 4 | | | | | | | |
| 5 | **CONSTRAINTS** | | | **Used Resources** | **Surplus** | **Constraint Coef.** | |
| 6 | Plastic | 2 | 1 | 1200 | 0 | 1200 | |
| 7 | Working Minutes | 3 | 4 | 2400 | 0 | 2400 | |
| 8 | Management Constraint 1 | 1 | 1 | 720 | 80 | 800 | |
| 9 | Management Constraint 2 | 1 | -1 | 240 | 210 | 450 | |
| 10 | | | | | | | |

### 2.2.3 ΛΥΣΗ – REPORT

What'sBest! Solution Report
29-Οκτ-02 7:54 PM

OBJECTIVE CELL:

| CELL ADDRESS | VALUE | INITIAL VALUE | TYPE |
|---|---|---|---|
| Sheet1!E3 | 5040 | 0 | MAX |

ADJUSTABLE CELLS:

| CELL ADDRESS | VALUE | INITIAL VALUE | TYPE | DUAL VALUE | UPPER RANGE | LOWER RANGE |
|---|---|---|---|---|---|---|
| Sheet1!B2 | 480 | 0 | >=0 | 0 | 480 | +Inf |
| Sheet1!C2 | 240 | 0 | >=0 | 0 | 240 | +Inf |

CONSTRAINT CELLS:

| CELL ADDRESS | VALUE | TYPE | DUAL VALUE | UPPER RANGE | LOWER RANGE | FORMULA |
|---|---|---|---|---|---|---|
| Sheet1!E6 | 0 | <= | 3.4 | 150 | 600 | D6 <= F6 |
| Sheet1!E7 | 0 | <= | 0.4 | 400 | 350 | D7 <= F7 |
| Sheet1!E8 | 80 | <= | 0 | +Inf | 80 | D8 <= F8 |
| Sheet1!E9 | 210 | <= | 0 | +Inf | 210 | D9 <= F9 |





## *2.3 WINQSB*

### 2.3.1 ΜΟΝΤΕΛΟ

| Variable --> | X1 | X2 | Direction | R. H. S. |
|---|---|---|---|---|
| Maximize | 8 | 5 | | |
| C1 | 2 | 1 | <= | 1200 |
| C2 | 3 | 4 | <= | 2400 |
| C3 | 1 | 1 | <= | 800 |
| C4 | 1 | -1 | <= | 450 |
| LowerBound | 0 | 0 | | |
| UpperBound | M | M | | |
| VariableType | Continuous | Continuous | | |

### 2.3.2 ΛΥΣΗ & ΑΝΑΛΥΣΗ ΕΥΑΙΣΘΗΣΙΑΣ

Combined Report for Galaxy Industries Problem

| | 14:22:36 | | Tuesday | October | 29 | 2002 | | |
|---|---|---|---|---|---|---|---|---|
| | Decision Variable | Solution Value | Unit Cost or Profit c(j) | Total Contribution | Reduced Cost | Basis Status | Allowable Min. c(j) | Allowable Max. c(j) |
| 1 | X1 | 480.0000 | 8.0000 | 3 840.0000 | 0 | basic | 3.7500 | 10.0000 |
| 2 | X2 | 240.0000 | 5.0000 | 1 200.0000 | 0 | basic | 4.0000 | 10.6667 |
| | Objective | Function | (Max.) = | 5 040.0000 | | | | |

| | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
|---|---|---|---|---|---|---|---|---|
| 1 | C1 | 1 200.0000 | <= | 1 200.0000 | 0 | 3.4000 | 600.0000 | 1 350.0000 |
| 2 | C2 | 2 400.0000 | <= | 2 400.0000 | 0 | 0.4000 | 2 050.0000 | 2 800.0000 |
| 3 | C3 | 720.0000 | <= | 800.0000 | 80.0000 | 0 | 720.0000 | M |
| 4 | C4 | 240.0000 | <= | 450.0000 | 210.0000 | 0 | 240.0000 | M |

# 3 ΠΑΡΑΔΕΙΓΜΑ 2: ΠΑΡΑΔΕΙΓΜΑ ΣΗΜΕΙΩΣΕΩΝ

## *3.1 LINDO*

### 3.1.1 ΜΟΝΤΕΛΟ

```
max 3 x1 + 8 x2
subject to
2 x1 + 4 x2 <=1600
6 x1 + 2 x2 <=1800
 x2 <=350
end
```

### 3.1.2 ΛΥΣΗ

```
 LP OPTIMUM FOUND AT STEP      2

        OBJECTIVE FUNCTION VALUE

        1)      3100.000

  VARIABLE        VALUE          REDUCED COST
        X1       100.000000          0.000000
        X2       350.000000          0.000000


       ROW   SLACK OR SURPLUS     DUAL PRICES
        2)         0.000000          1.500000
        3)       500.000000          0.000000
        4)         0.000000          2.000000

 NO. ITERATIONS=       2
```

### 3.1.3 ΑΝΑΛΥΣΗ ΕΥΑΙΣΘΗΣΙΑΣ

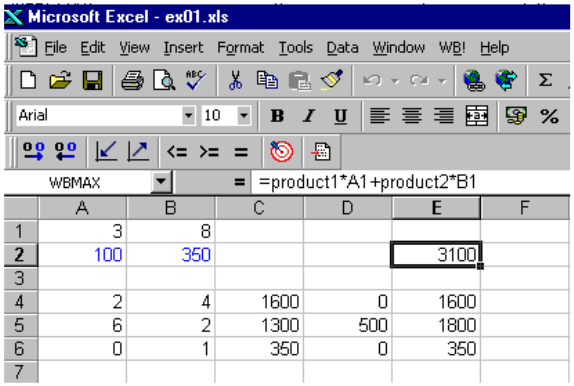
```
 RANGES IN WHICH THE BASIS IS UNCHANGED:

                        OBJ COEFFICIENT RANGES
 VARIABLE         CURRENT        ALLOWABLE         ALLOWABLE
                   COEF          INCREASE          DECREASE
       X1        3.000000         1.000000          3.000000
       X2        8.000000          INFINITY         2.000000

                        RIGHTHAND SIDE RANGES
      ROW         CURRENT        ALLOWABLE         ALLOWABLE
                    RHS          INCREASE          DECREASE
        2     1600.000000       166.666672        200.000000
        3     1800.000000          INFINITY       500.000000
        4      350.000000        50.000000         50.000000
```





## *3.2 EXCEL WHAT'S BEST*

### 3.2.1 ΜΟΝΤΕΛΟ & ΛΥΣΗ (  )




| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | 3 | 8 | | | | |
| 2 | 100 | 350 | | | 3100 | |
| 3 | | | | | | |
| 4 | 2 | 4 | 1600 | 0 | 1600 | |
| 5 | 6 | 2 | 1300 | 500 | 1800 | |
| 6 | 0 | 1 | 350 | 0 | 350 | |
| 7 | | | | | | |

### 3.2.2 ΛΥΣΗ – REPORT

```
What'sBest! Solution Report
    19-Μαρ-02 7:29 μμ

OBJECTIVE CELL:

CELL                        INITIAL
ADDRESS              VALUE    VALUE  TYPE
-----------------------------------------
Sheet1!E2             3100     3100   MAX


ADJUSTABLE CELLS:

CELL                        INITIAL        DUAL        UPPER  LOWER
ADDRESS              VALUE    VALUE  TYPE VALUE        RANGE  RANGE
-------------------------------------------------------------------------
Sheet1!A2              100      100  >=0     0          100           +Inf
Sheet1!B2              350      350  >=0     0          350           +Inf


CONSTRAINT CELLS:

CELL                                    DUAL        UPPER  LOWER
ADDRESS              VALUE          TYPE VALUE        RANGE  RANGE FORMULA
-------------------------------------------------------------------------------
Sheet1!D4                0          <=    1.5    166.6667    200 C4 <= E4
Sheet1!D5              500          <=      0        +Inf    500 C5 <= E5
Sheet1!D6                0          <=      2          50     50 C6 <= E6
```

## *3.3 WINQSB*

### 3.3.1 ΜΟΝΤΕΛΟ

| Variable --> | X1 | X2 | Direction | R. H. S. |
|---|---|---|---|---|
| Maximize | 3 | 8 | | |
| C1 | 2 | 4 | <= | 1600 |
| C2 | 6 | 2 | <= | 1800 |
| C3 | | 1 | <= | 350 |
| LowerBound | 0 | 0 | | |
| UpperBound | M | M | | |
| VariableType | Continuous | Continuous | | |

### 3.3.2 ΛΥΣΗ

| | 19:39:19 | | Tuesday | October | 29 | 2002 | | |
|---|---|---|---|---|---|---|---|---|
| | Decision Variable | Solution Value | Unit Cost or Profit c(j) | Total Contribution | Reduced Cost | Basis Status | Allowable Min. c(j) | Allowable Max. c(j) |
| 1 | X1 | 100.0000 | 3.0000 | 300.0000 | 0 | basic | 0 | 4.0000 |
| 2 | X2 | 350.0000 | 8.0000 | 2 800.0000 | 0 | basic | 6.0000 | M |
| | Objective | Function | (Max.) = | 3 100.0000 | | | | |
| | | | | | | | | |
| | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1 | C1 | 1 600.0000 | <= | 1 600.0000 | 0 | 1.5000 | 1 400.0000 | 1 766.6670 |
| 2 | C2 | 1 300.0000 | <= | 1 800.0000 | 500.0000 | 0 | 1 300.0000 | M |
| 3 | C3 | 350.0000 | <= | 350.0000 | 0 | 2.0000 | 300.0000 | 400.0000 |





# 4 ΠΑΡΑΔΕΙΓΜΑ 3: THE DAKOTA FURNITURE PROBLEM (Roe, 1998, User's Guide for Lindo and Lingo, example 1, σελιδες 12–15)

## *4.1 LINDO*

### 4.1.1 ΜΟΝΤΕΛΟ

```
max 60d+30t+20c
subject to
8d+  6t+1c  <=48
4d+  2t+1.5c<=20
2d+1.5t+0.5c<=8
      t     <=5
end
```

### 4.1.2 ΛΥΣΗ

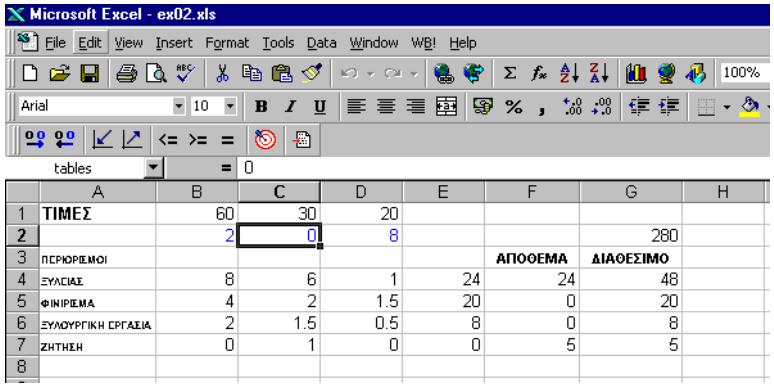
```
 LP OPTIMUM FOUND AT STEP      1

        OBJECTIVE FUNCTION VALUE

        1)      280.0000

  VARIABLE        VALUE          REDUCED COST
         D         2.000000          0.000000
         T         0.000000          5.000000
         C         8.000000          0.000000

       ROW   SLACK OR SURPLUS      DUAL PRICES
         2)        24.000000          0.000000
         3)         0.000000         10.000000
         4)         0.000000         10.000000
         5)         5.000000          0.000000
 NO. ITERATIONS=       1
```

### 4.1.3 ΑΝΑΛΥΣΗ ΕΥΑΙΣΘΗΣΙΑΣ

```
 RANGES IN WHICH THE BASIS IS UNCHANGED:
                            OBJ COEFFICIENT RANGES
 VARIABLE         CURRENT        ALLOWABLE        ALLOWABLE
                   COEF          INCREASE         DECREASE
        D        60.000000        20.000000         4.000000
        T        30.000000         5.000000         INFINITY
        C        20.000000         2.500000         5.000000

                            RIGHTHAND SIDE RANGES
      ROW         CURRENT        ALLOWABLE        ALLOWABLE
                    RHS          INCREASE         DECREASE
        2        48.000000         INFINITY        24.000000
        3        20.000000         4.000000         4.000000
        4         8.000000         2.000000         1.333333
        5         5.000000         INFINITY         5.000000
```

## *4.2 EXCEL WHAT'S BEST*

### 4.2.1 ΜΟΝΤΕΛΟ & ΛΥΣΗ ( )




| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | ΤΙΜΕΣ | 60 | 30 | 20 | | | | |
| 2 | | 2 | 0 | 8 | | | 280 | |
| 3 | ΠΕΡΙΟΡΙΣΜΟΙ | | | | | ΑΠΟΘΕΜΑ | ΔΙΑΘΕΣΙΜΟ | |
| 4 | ΕΥΛΑΙΑΣ | 8 | 6 | 1 | 24 | 24 | 48 | |
| 5 | ΦΙΝΙΡΙΣΜΑ | 4 | 2 | 1.5 | 20 | 0 | 20 | |
| 6 | ΞΥΛΟΥΡΓΙΚΗ ΕΡΓΑΣΙΑ | 2 | 1.5 | 0.5 | 8 | 0 | 8 | |
| 7 | ΖΗΤΗΣΗ | 0 | 1 | 0 | 0 | 5 | 5 | |
| 8 | | | | | | | | |

### 4.2.2 ΛΥΣΗ – REPORT

```
What'sBest! Solution Report
     29-•••-02 8:13 PM

OBJECTIVE CELL:

CELL                          INITIAL
ADDRESS                VALUE    VALUE  TYPE
-----------------------------------------------
Sheet1!G2                280      280   MAX


ADJUSTABLE CELLS:

CELL                          INITIAL         DUAL        UPPER     LOWER
ADDRESS                VALUE    VALUE  TYPE  VALUE        RANGE     RANGE
-------------------------------------------------------------------------------
Sheet1!B2                  2        2   >=0       0            2              +Inf
Sheet1!C2                  0        0   >=0       5          1.6         4
Sheet1!D2                  8        8   >=0       0            8              +Inf


CONSTRAINT CELLS:

CELL                                    DUAL        UPPER     LOWER
ADDRESS                VALUE          TYPE  VALUE        RANGE     RANGE FORMULA
-------------------------------------------------------------------------------
Sheet1!F4                 24            <=       0         +Inf        24 E4 <= G4
Sheet1!F5                  0            <=      10            4         4 E5 <= G5
Sheet1!F6                  0            <=      10            2  1.333333 E6 <= G6
Sheet1!F7                  5            <=       0         +Inf         5 E7 <= G7
```





## *4.3 WINQSB*

### 4.3.1 ΜΟΝΤΕΛΟ

| Variable --> | X1 | X2 | X3 | Direction | R. H. S. |
|---|---|---|---|---|---|
| Maximize | 60 | 30 | 20 | | |
| C1 | 8 | 6 | 1 | <= | 48 |
| C2 | 4 | 2 | 1.5 | <= | 20 |
| C3 | 2 | 1.5 | 0.5 | <= | 8 |
| C4 | | 1 | | <= | 5 |
| LowerBound | 0 | 0 | 0 | | |
| UpperBound | M | M | M | | |
| VariableType | Continuous | Continuous | Continuous | | |

### 4.3.2 ΛΥΣΗ

| | 19:48:59 | | Tuesday | October | 29 | 2002 | | |
|---|---|---|---|---|---|---|---|---|
| | Decision Variable | Solution Value | Unit Cost or Profit c[j] | Total Contribution | Reduced Cost | Basis Status | Allowable Min. c[j] | Allowable Max. c[j] |
| 1 | X1 | 2.0000 | 60.0000 | 120.0000 | 0 | basic | 56.0000 | 80.0000 |
| 2 | X2 | 0 | 30.0000 | 0 | -5.0000 | at bound | -M | 35.0000 |
| 3 | X3 | 8.0000 | 20.0000 | 160.0000 | 0 | basic | 15.0000 | 22.5000 |
| | Objective | Function | (Max.) = | 280.0000 | | | | |
| | Constraint | Left Hand Side | Direction | Right Hand Side | Slack or Surplus | Shadow Price | Allowable Min. RHS | Allowable Max. RHS |
| 1 | C1 | 24.0000 | <= | 48.0000 | 24.0000 | 0 | 24.0000 | M |
| 2 | C2 | 20.0000 | <= | 20.0000 | 0 | 10.0000 | 16.0000 | 24.0000 |
| 3 | C3 | 8.0000 | <= | 8.0000 | 0 | 10.0000 | 6.6667 | 10.0000 |
| 4 | C4 | 0 | <= | 5.0000 | 5.0000 | 0 | 0 | M |