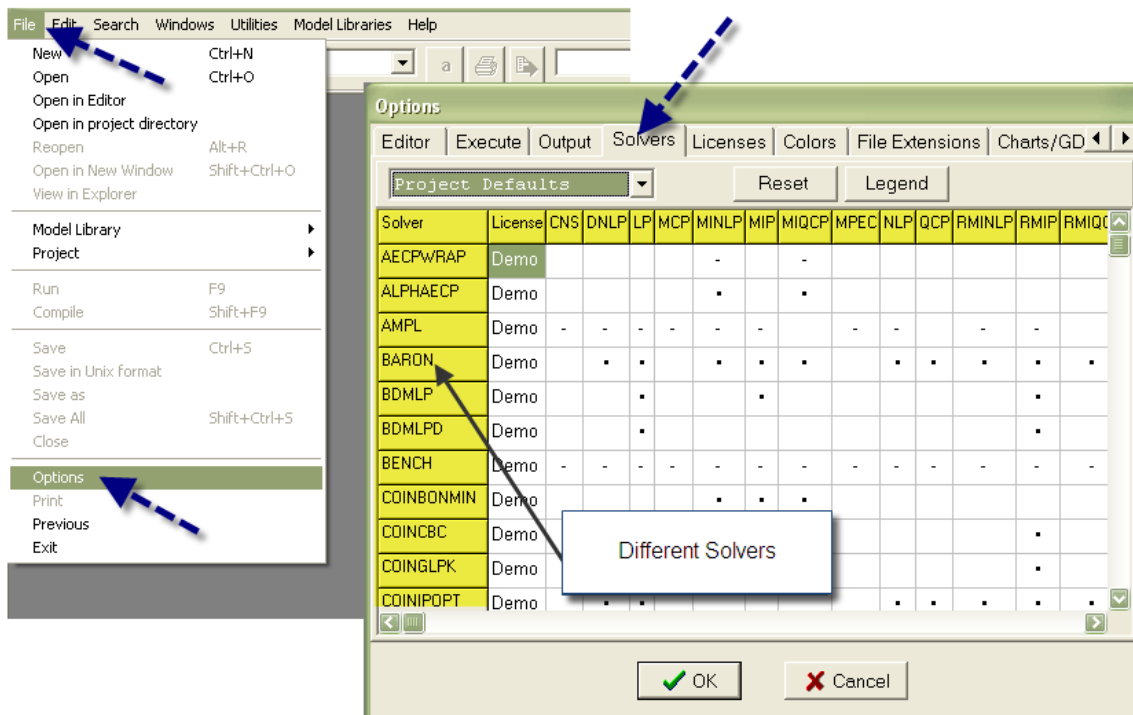




**Objectives**

- Introduce different types of variables.
- How to use different types of solvers for (NLP – LP).

**Remember**



Variable Type	Allowed Range of Variable
Free	$-\infty$ to $+\infty$
Positive	0 to $+\infty$
Negative	$-\infty$ to 0
Binary	0 or 1
Integer	0,1,....., 100

- lp for linear programming
- nlp for nonlinear programming
- =l= less than or equal to
- =g= greater than or equal to
- =e= equal to
- .lo lower bound
- .l level or primal value
- .up upper bound

Perform the following exercise: (Note: Use BARON-NLP solver)

$$\text{Min } (x + 3)^2 * y^2$$

Subject to

$$2x + y \leq 30$$

$$x + y = 20$$

$$x, y \geq 0$$

```

variable f;
positive variables x, y;

equations obj, c1, c2;
obj.. f =e= (x+3)*(x+3)* y * y;
c1.. 2*x + y =l= 30;
c2.. x + y =e= 20;

model ex1 /all/;

solve ex1 using nlp minimizing f;

display x.l, y.l, f.l;
  
```

Annotations in the screenshot:

- Callout: f can carry values from  $-\infty$  to  $\infty$  (points to 'variable f;')
- Callout: x and y can carry values from 0 to  $\infty$  (points to 'positive variables x, y;')
- Callout: These are the results when BARON-NLP is used (points to the solution report)

Solution Report		SOLVE e	
SoIEQU		14 VARIABLE x.L	= 0.000
SoIVAR		VARIABLE y.L	= 20.000
Execution		VARIABLE f.L	= 3600.000
Display			
x			
y			
f			
		ION TIME	= 0.015 SECONDS

## Assignment

Solve the following NLP models using three different solvers and compare the results

$$\text{Min } (x + 3)^2 * y^2 * z^2$$

Subject to

$$2x + y \leq 30$$

$$x + y = 20$$

$$z \geq 4$$

$$x, y, z \geq 0$$

$$\text{Max } x^3 * (y + 1)^3$$

Subject to

$$3x + 5y \leq 100$$

$$2y \leq 30$$

$$x, y \geq 0$$

Due to **Next Lab** (Cover Page – Print Screen the model – Print Screen the results with your comment and conclusion)