



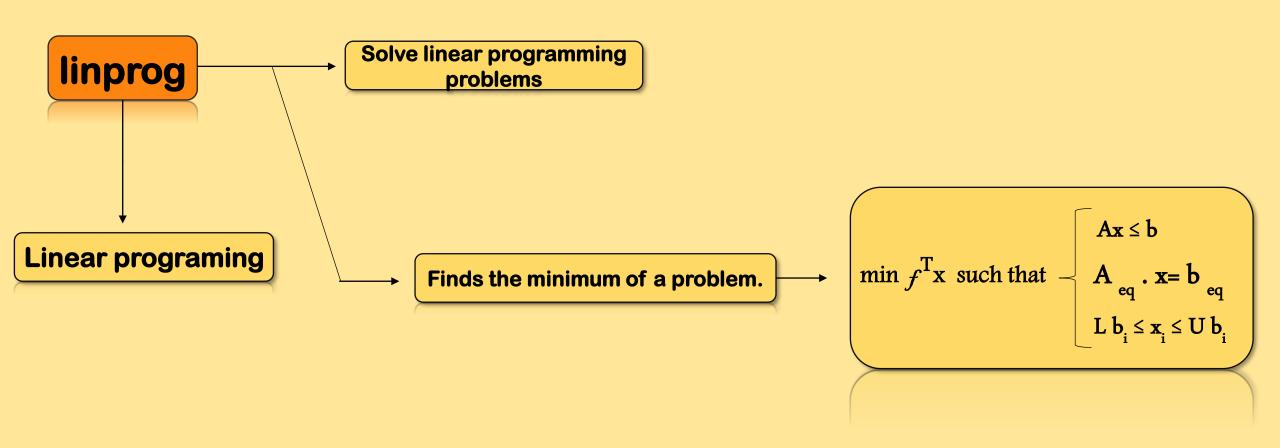
#### What you'll learn



Output Arguments

**Input Arguments** 

#### **Function Name**



```
X=linprog(f, A, b)
X=linprog(f, A, b, A<sub>eq</sub>, b<sub>eq</sub>, lb, ub)
X= linprog(f, A, b, A<sub>eq</sub>, b<sub>eq</sub>, lb, ub, options)
[X, fval]=linprog(__)
                                              input
[X, fval, exitflag, output] = linprog(__)
[X, fval, exitflag, output, lambda] = linprog(__)
```

#### **Objective Function & Constraints**

$$\min Z = \sum_{i=1}^{n} f_{i} x_{i} \xrightarrow{\text{vector notation}} f^{T} x \qquad \text{Objective Function}$$

$$Ax \leq b$$

$$A_{eq} = b_{eq}$$

$$L b_i \le x_i \le U b_i$$

#### Example

$$\begin{aligned} & \min & \mathbf{Z} = -\mathbf{5x}_1 - \mathbf{4x}_2 - \mathbf{6x}_3 \\ & \mathbf{S} \cdot \mathbf{t} \cdot \\ & \mathbf{x}_1 - \mathbf{x}_2 + \mathbf{x}_3 \leq 20 \\ & 3\mathbf{x}_1 + 2\mathbf{x}_2 + 4\mathbf{x}_3 \leq 42 \\ & 3\mathbf{x}_1 + 2\mathbf{x}_2 & \leq 30 \\ & x_1, x_2, x_3 \geq 0 \end{aligned}$$

X=linprog( f A b A<sub>eq</sub> b<sub>eq</sub> lb ub)

min 
$$Z = -5x_1 - 4x_2 - 6x_3$$

$$\begin{bmatrix} -5, -4, -6 \end{bmatrix} \cdot \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} \qquad f = \begin{bmatrix} -5 \\ -4 \\ -6 \end{bmatrix}$$

# A & b

S.t

t. 
$$x_{1} - x_{2} + x_{3} \le 20$$

$$3x_{1} + 2x_{2} + 4x_{3} \le 42$$

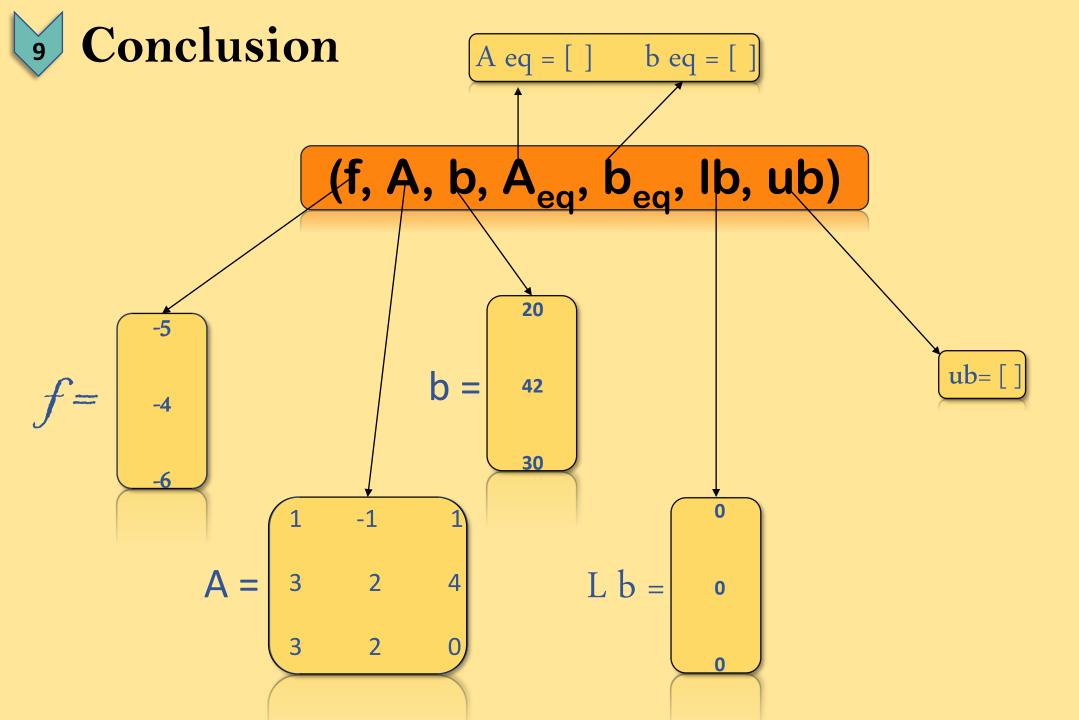
$$3x_{1} + 2x_{2} \le 30 \quad A \qquad \qquad X \ge b$$

$$1 \quad -1 \quad 1 \quad X_{1} \qquad 20$$

$$3 \quad 2 \quad 4 \quad X_{2} \ge 42$$

$$3 \quad 2 \quad 0 \quad X_{3} \qquad 30$$

## 8 lb & ub





## exitflag

**v** 

exitflag — Reason linprog stopped integer

Reason linprog stopped, returned as an integer.

3	The solution is feasible with respect to the relative ConstraintTolerance tolerance, but is not feasible with respect to the absolute tolerance.		
1	Function converged to a solution x.		
0	Number of iterations exceeded options.MaxIterations or solution time in seconds exceeded options.MaxTime.		
-2	No feasible point was found.		
-3	Problem is unbounded.		
-4	NaN value was encountered during execution of the algorithm.		
-5	Both primal and dual problems are infeasible.		
-7	Search direction became too small. No further progress could be made.		
-9	Solver lost feasibility.		

Exitflags 3 and -9 relate to solutions that have large infeasibilities. These usually arise from linear constraint matrices that have large condition number, or problems that have large solution components. To correct these issues, try to scale the coefficient matrices, eliminate redundant linear constraints, or give tighter bounds on the variables.

output — Information about the optimization process structure

Information about the optimization process, returned as a structure with these fields.

iterations	Number of iterations
algorithm	Optimization algorithm used
cgiterations	0 (interior-point algorithm only, included for backward compatibility)
message	Exit message
constrviolation	Maximum of constraint functions
firstorderopt	First-order optimality measure



1ambda — Lagrange multipliers at the solution structure

Lagrange multipliers at the solution, returned as a structure with these fields.

lower	Lower bounds corresponding to 1b
upper	Upper bounds corresponding to ub
ineqlin	Linear inequalities corresponding to A and b
eqlin	Linear equalities corresponding to Aeq and beq

# **Options**



#### options — Optimization options

output of optimoptions | structure as optimset returns

Optimization options, specified as the output of optimoptions or a structure as optimset returns.

Some options apply to all algorithms, and others are relevant for particular algorithms. See Optimization Options Reference for detailed information.

Some options are absent from the optimoptions display. These options appear in italics in the following table. For details, see View Options.

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Algorithm	Choose the optimization algorithm:
	'dual-simplex' (default)
	'interior-point-legacy'
	• 'interior-point'
	For information on choosing the algorithm, see Linear Programming Algorithms.
Diagnostics	Display diagnostic information about the function to be minimized or solved. Choose 'off' (default) or 'on'.
Display	Level of display (see Iterative Display):  'final' (default) displays just the final output.
	'off' or 'none' displays no output.
	'iter' displays output at each iteration.
MaxIterations	Maximum number of iterations allowed, a positive integer. The default is:  • 85 for the 'interior-point-legacy' algorithm
	200 for the 'interior-point' algorithm
	• 10*(numberOfEqualities + numberOfInequalities + numberOfVariables) for the 'dual-simplex' algorithm
	See Tolerances and Stopping Criteria and Iterations and Function Counts.
	For optimset, the name is MaxIter. See Current and Legacy Option Name Tables.

# Example of the feasible region

#### max Z = 143x + 60y

S.t.

 $110x + 30y \le 4000$ 

 $120x + 210y \le 15000$ 

$$f = \begin{pmatrix} 143 \\ 60 \end{pmatrix}$$

$$A = \begin{pmatrix} 1 & 1 \\ 110 & 30 \\ 120 & 210 \end{pmatrix}$$

$$b = \begin{pmatrix} 75 \\ 4000 \\ 15000 \end{pmatrix}$$

$$L b = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

