Lineáris programozási megoldások

Grafikus megoldások

```
Needs["OptimizationToolbox`GraphicalSolution`"]
```

```
?GraphicalSolution
```

```
GraphicalSolution[f,{x,xmin,xmax}, {y,ymin,ymax}, options]. The function draws contours
  of the objective function (f) and optionally those for constraint functions.
  All contours are labelled. The function returns a graphics object. See Options[
  GraphicalSolution] for a description of different options for this function.
```

$f = e^{x_1} - x_1 x_2 + x_2^2$

$g = 2 x_1 + x_2 - 2 \leq 0$

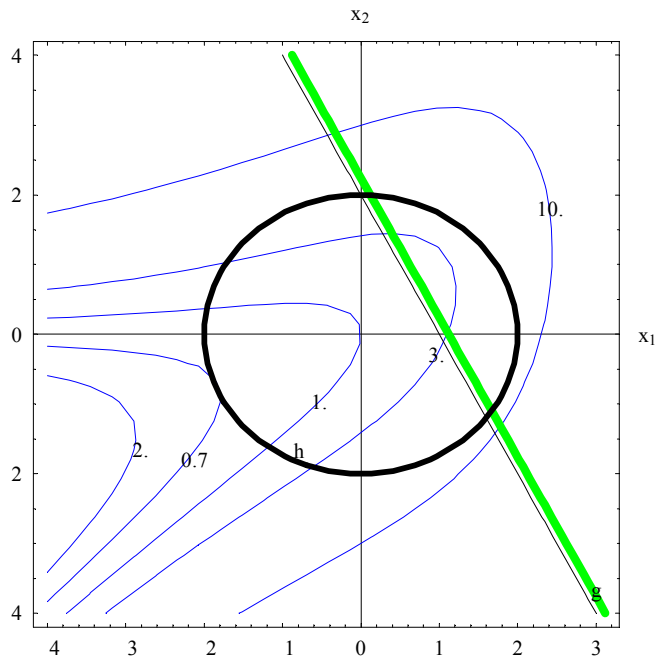
$h = x_1^2 + x_2^2 - 4 == 0$

$e^{x_1} - x_1 x_2 + x_2^2$

$-2 + 2 x_1 + x_2 \leq 0$

$-4 + x_1^2 + x_2^2 == 0$

```
GraphicalSolution[f, {x1, -4, 4}, {x2, -4, 4}, Constraints → {g, h},
 ObjectiveContours → {-2, -0.6347, 1, 3, 10}, PlotPoints → 30, ShadingOffset → 0.1]
```



- Graphics -

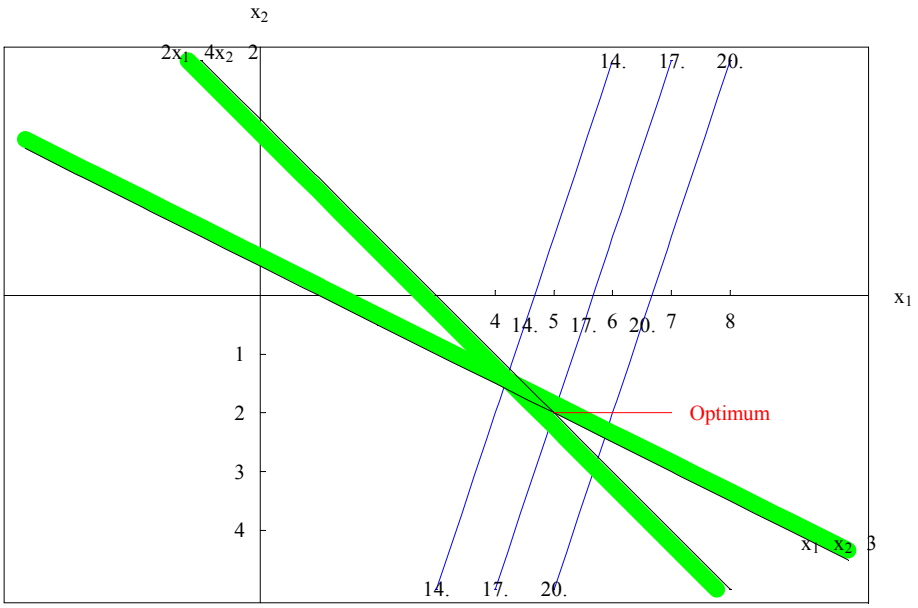
```
f = 3 x1 - x2
g1 = x1 + x2 ≥ 3
g2 = 2 x1 + 4 x2 ≤ 2
```

$3 x_1 - x_2$

$x_1 + x_2 \geq 3$

$2 x_1 + 4 x_2 \leq 2$

```
GraphicalSolution[f, {x1, -4, 10}, {x2, -5, 4}, Constraints → {g1, g2},
 ConstraintLabels -> {"   x1+x2=3   ", "2x1+4x2=2"}, ShadingThickness → 0.02,
 ShadingOffset → 0.1, ObjectiveContours → {14, 17, 20}, AspectRatio → Automatic,
 FrameTicks → None, Ticks → {{4, 5, 6, 7, 8}, {-4, -3, -2, -1}},
 Epilog → {RGBColor[1, 0, 0], Line[{{5, -2}, {7, -2}}], Text[Optimum, {8, -2}]}]
```



- Graphics -

```
sol = Solve[{x1 + x2 == 3, 2 x1 + 4 x2 == 2}, {x1, x2}]
```

$\{\{x_1 \to 5, x_2 \to -2\}\}$

```
f /. sol[[1]]
```

17

```
f = 6 x1 - 9 x2
g1 = x1 - x2 ≥ 2
g2 = 3 x1 + x2 ≥ 1
g3 = 2 x1 - 3 x2 ≥ 3
```

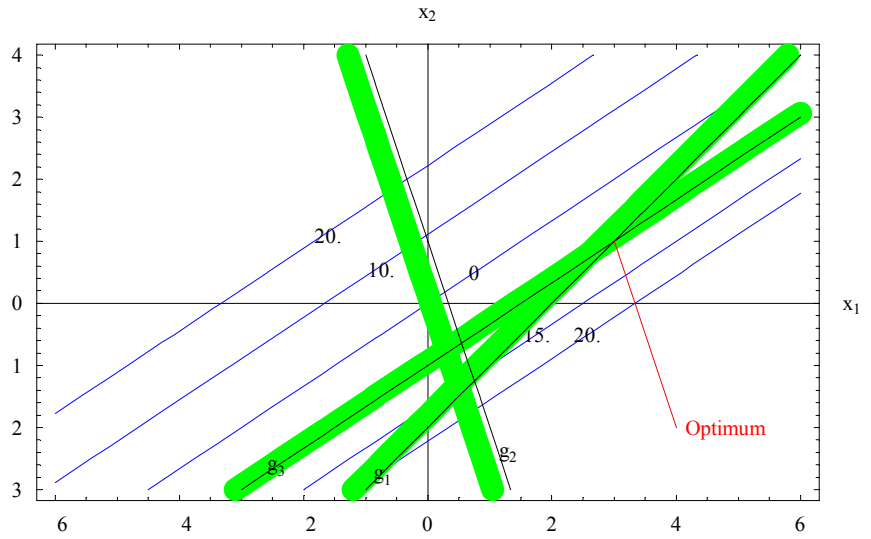
$6 x_1 - 9 x_2$

$x_1 - x_2 \geq 2$

$3 x_1 + x_2 \geq 1$

$2 x_1 - 3 x_2 \geq 3$

```
GraphicalSolution[f, {x1, -6, 6}, {x2, -3, 4},
 Constraints → {g1, g2, g3}, ObjectiveContours → {-20, -10, 0, 15, 20},
 AspectRatio → Automatic, ShadingThickness → 0.03, ShadingOffset → 0.2,
 Epilog → {RGBColor[1, 0, 0], Line[{{3, 1}, {4, -2}}], Text[Optimum, {4.8, -2}]}]
```




```
- Graphics -
```

```
ConstrainedMin[f, {g1, g2, g3}, {x1, x2}]
```

```
{9, {x1 → 3, x2 → 1}}
```

```
ConstrainedMax[-f, {g1, g2, g3}, {x1, x2}]
```

```
{-9, {x1 → 3, x2 → 1}}
```

Numerikus megoldások

```
D1 = "arany";
D2 = "civil ipar";
D3 = "olaj";
D4 = "informatika";
D5 = "gabona";
D6 = "szén";
D7 = "kereskedelem";
D8 = "turizmus";
S1 = "várható \nnyereség %-ban";
S2 = "megbízhatóság";
S3 = "megtérülési idő";
S4 = "kockázat";
payoff = {{4, "A", "rövid", 15}, {6.1, "B", "hosszú", 15},
   {8, "A", "rövid", 20}, {20, "A", "rövid", 30}, {3, "C", "hosszú", 30},
   {3.5, "A", "hosszú", 20}, {7.2, "B", "rövid", 15}, {10, "C", "rövid", 15}};
```

```
TableForm[payoff,
 TableHeadings -> {{D1, D2, D3, D4, D5, D6, D7, D8}, {S1, S2, S3, S4}},
 TableSpacing -> {2, 2}, TableAlignments → Right]
```

	várható nyereség %-ban	megbízhatóság	megtérülési idő	kockázat
arany	4	A	rövid	15
civil ipar	6.1	B	hosszú	15
olaj	8	A	rövid	20
informatika	20	A	rövid	30
gabona	3	C	hosszú	30
szén	3.5	A	hosszú	20
kereskedelem	7.2	B	rövid	15
turizmus	10	C	rövid	15

```
befektetes = x1 + x2 + x3 + x4 + x5 + x6 + x7 + x8
nyereseg = 0.04 x1 + 0.061 x2 + 0.08 x3 + 0.20 x4 + 0.03 x5 + 0.035 x6 + 0.072 x7 + 0.10 x8
megbizhatosag = x1 + x3 + x4 + x6
megterules = x1 + x3 + x4 + x7 + x8
banyaszat = x1 + x6
kockazat = 15 x1 + 15 x2 + 20 x3 + 30 x4 + 30 x5 + 20 x6 + 15 x7 + 15 x8
eredmeny = ConstrainedMin[kockazat,
  {befektetes == 100000, nyereseg ≥ 7000, megbizhatosag ≥ 60000,
   megterules ≥ 20000, banyaszat ≤ 40000}, {x1, x2, x3, x4, x5, x6, x7, x8}]
```

$$x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8$$

$$0.04\, x_1 + 0.061\, x_2 + 0.08\, x_3 + 0.2\, x_4 + 0.03\, x_5 + 0.035\, x_6 + 0.072\, x_7 + 0.1\, x_8$$

$$x_1 + x_3 + x_4 + x_6$$

$$x_1 + x_3 + x_4 + x_7 + x_8$$

$$x_1 + x_6$$

$$15\, x_1 + 15\, x_2 + 20\, x_3 + 30\, x_4 + 30\, x_5 + 20\, x_6 + 15\, x_7 + 15\, x_8$$

$$\{1.6 \times 10^6,\ \{x_1 \to 40000.,\ x_2 \to 5128.21,\ x_3 \to 20000.,\ x_4 \to 0.,\ x_5 \to 0.,\ x_6 \to 0.,\ x_7 \to 0.,\ x_8 \to 34871.8\}\}$$

```
kockazat /. eredmeny[[2]]
```

$$1.6 \times 10^6$$

```
befektetes /. eredmeny[[2]]
```

```
100000.
```

```
nyereseg /. eredmeny[[2]]
```

```
7000.
```

```
megbizhatosag /. eredmeny[[2]]
```

```
60000.
```

```
megterules /. eredmeny[[2]]
```

```
94871.8
```

```
banyaszat /. eredmeny[[2]]
```

```
40000.
```

Átlagos kockázat befektetési egységenként: 1600000 / 100000 = 16

```
befektetes = x1 + x2 + x3 + x4 + x5 + x6 + x7 + x8
nyereseg = 0.04 x1 + 0.061 x2 + 0.08 x3 + 0.20 x4 + 0.03 x5 + 0.035 x6 + 0.072 x7 + 0.10 x8
megbizhatosag = x1 + x3 + x4 + x6
megterules = x1 + x3 + x4 + x7 + x8
banyaszat = x1 + x6
kockazat = 15 x1 + 15 x2 + 20 x3 + 30 x4 + 30 x5 + 20 x6 + 15 x7 + 15 x8
ConstrainedMin[kockazat,
 {befektetes == 100000, nyereseg ≥ 7500, megbizhatosag ≥ 60000,
  megterules ≥ 20000, banyaszat ≤ 40000}, {x1, x2, x3, x4, x5, x6, x7, x8}]
```

$$x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 == 100000$$

$$0.04\, x_1 + 0.061\, x_2 + 0.08\, x_3 + 0.2\, x_4 + 0.03\, x_5 + 0.035\, x_6 + 0.072\, x_7 + 0.1\, x_8 \geq 7500$$

$$x_1 + x_3 + x_4 + x_6 \geq 60000$$

$$x_1 + x_3 + x_4 + x_7 + x_8 \geq 20000$$

$$x_1 + x_6 \leq 40000$$

$$15\, x_1 + 15\, x_2 + 20\, x_3 + 30\, x_4 + 30\, x_5 + 20\, x_6 + 15\, x_7 + 15\, x_8$$

$$\{1.625 \times 10^6,\ \{x_1 \to 40000.,\ x_2 \to 0.,\ x_3 \to 17500.,\ x_4 \to 2500.,\ x_5 \to 0.,\ x_6 \to 0.,\ x_7 \to 0.,\ x_8 \to 40000.\}\}$$

Átlagos kockázat befektetési egységenként: 1625000 / 100000 = 16.25