

```

> # Example: Advertising with HIM/LIP/HIW and Budget constraints
#
with(LinearAlgebra):
interface(rtablesize=11);

```

10 (1)

```

> # Vars: x1 x2 s1 e1 s2 e2 s3 e3 s4 (and rhs)
A:=<<0,7,10,5,100>|<0,3,5,4,60>|<50,1,0,0,0>|<0,-1,0,0,0>|<100,0,
1,0,0>|<0,0,-1,0,0>|<200,0,0,1,0>|<0,0,0,-1,0>|<0,0,0,0,1>|<1,0,
0,0,-1>|<0,40,60,35,600>>;

```

$$A := \begin{bmatrix} 0 & 0 & 50 & 0 & 100 & 0 & 200 & 0 & 0 & 1 & 0 \\ 7 & 3 & 1 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 40 \\ 10 & 5 & 0 & 0 & 1 & -1 & 0 & 0 & 0 & 0 & 60 \\ 5 & 4 & 0 & 0 & 0 & 0 & 1 & -1 & 0 & 0 & 35 \\ 100 & 60 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & -1 & 600 \end{bmatrix}$$

(2)

```

> # Clear the values above the identity columns for an initial BFS:
A2:=RowOperation(A,[1,2],-50):
A3:=RowOperation(A2,[1,3],-100):
A4:=RowOperation(A3,[1,4],-200):

```

$$A4 := \begin{bmatrix} -2350 & -1450 & 0 & 50 & 0 & 100 & 0 & 200 & 0 & 1 & -15000 \\ 7 & 3 & 1 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 40 \\ 10 & 5 & 0 & 0 & 1 & -1 & 0 & 0 & 0 & 0 & 60 \\ 5 & 4 & 0 & 0 & 0 & 0 & 1 & -1 & 0 & 0 & 35 \\ 100 & 60 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & -1 & 600 \end{bmatrix}$$

(3)

```

> # Pivot in Column 1, and perform Ratio Test:
evalf([40/7, 60/10, 35/5, 600/100]);

```

[5.714285714, 6., 7., 6.] (4)

```

> #Pivot in Column 1, Row 2:
A5:=RowOperation(A4,2,1/7):
A6:=RowOperation(A5,[1,2],2350):
A7:=RowOperation(A6,[3,2],-10):
A8:=RowOperation(A7,[4,2],-5):
A9:=RowOperation(A8,[5,2],-100);

```

(5)

$$A9 := \begin{bmatrix} 0 & -\frac{3100}{7} & \frac{2350}{7} & -\frac{2000}{7} & 0 & 100 & 0 & 200 & 0 & 1 & -\frac{11000}{7} \\ 1 & \frac{3}{7} & \frac{1}{7} & -\frac{1}{7} & 0 & 0 & 0 & 0 & 0 & 0 & \frac{40}{7} \\ 0 & \frac{5}{7} & -\frac{10}{7} & \frac{10}{7} & 1 & -1 & 0 & 0 & 0 & 0 & \frac{20}{7} \\ 0 & \frac{13}{7} & -\frac{5}{7} & \frac{5}{7} & 0 & 0 & 1 & -1 & 0 & 0 & \frac{45}{7} \\ 0 & \frac{120}{7} & -\frac{100}{7} & \frac{100}{7} & 0 & 0 & 0 & 0 & 1 & -1 & \frac{200}{7} \end{bmatrix} \quad (5)$$

> # Pivot in Column 2, and perform Ratio Test: Last row
 evalf([(40/7)/(3/7), (20/7)/(5/7), (45/7)/(13/7), (200/7)/(120/7)]);

$$[13.33333333, 4., 3.461538462, 1.666666667] \quad (6)$$

> A10:=RowOperation(A9,5,7/120):
 A11:=RowOperation(A10,[1,5],3100/7):
 A12:=RowOperation(A11,[2,5],-3/7):
 A13:=RowOperation(A12,[3,5],-5/7):
 A14:=RowOperation(A13,[4,5],-13/7):

$$A14 := \begin{bmatrix} 0 & 0 & -\frac{100}{3} & \frac{250}{3} & 0 & 100 & 0 & 200 & \frac{155}{6} & -\frac{149}{6} & -\frac{2500}{3} \\ 1 & 0 & \frac{1}{2} & -\frac{1}{2} & 0 & 0 & 0 & 0 & -\frac{1}{40} & \frac{1}{40} & 5 \\ 0 & 0 & -\frac{5}{6} & \frac{5}{6} & 1 & -1 & 0 & 0 & -\frac{1}{24} & \frac{1}{24} & \frac{5}{3} \\ 0 & 0 & \frac{5}{6} & -\frac{5}{6} & 0 & 0 & 1 & -1 & -\frac{13}{120} & \frac{13}{120} & \frac{10}{3} \\ 0 & 1 & -\frac{5}{6} & \frac{5}{6} & 0 & 0 & 0 & 0 & \frac{7}{120} & -\frac{7}{120} & \frac{5}{3} \end{bmatrix} \quad (7)$$

> evalf([A14[2,11]/A14[2,3], A14[4,11]/A14[4,3]]);
 [10., 4.]

(8)

> # Pivot in Column 3, Row 4:
 A15:=RowOperation(A14,4,6/5):
 A16:=RowOperation(A15,[1,4],100/3):
 A17:=RowOperation(A16,[2,4],-1/2):
 A18:=RowOperation(A17,[3,4],5/6):
 A19:=RowOperation(A18,[5,4],5/6):

$$A19 := \begin{bmatrix} 0 & 0 & 0 & 50 & 0 & 100 & 40 & 160 & \frac{43}{2} & -\frac{41}{2} & -700 \\ 1 & 0 & 0 & 0 & 0 & 0 & -\frac{3}{5} & \frac{3}{5} & \frac{1}{25} & -\frac{1}{25} & 3 \\ 0 & 0 & 0 & 0 & 1 & -1 & 1 & -1 & -\frac{3}{20} & \frac{3}{20} & 5 \\ 0 & 0 & 1 & -1 & 0 & 0 & \frac{6}{5} & -\frac{6}{5} & -\frac{13}{100} & \frac{13}{100} & 4 \\ 0 & 1 & 0 & 0 & 0 & 0 & 1 & -1 & -\frac{1}{20} & \frac{1}{20} & 5 \end{bmatrix} \quad (9)$$

> evalf([A19[3,11]/A19[3,10], A19[4,11]/A19[4,10], A19[5,11]/A19[5,10]]);
 [33.33333333, 30.76923077, 100.] (10)

> # Pivot in Column 10, Row 4
 A20:=RowOperation(A19,4,100/13):
 A21:=RowOperation(A20,[1,4],41/2):
 A22:=RowOperation(A21,[2,4],1/25):
 A23:=RowOperation(A22,[3,4],-3/20):
 A24:=RowOperation(A23,[5,4],-1/20):

$$A24 := \begin{bmatrix} 0 & 0 & \frac{2050}{13} & -\frac{1400}{13} & 0 & 100 & \frac{2980}{13} & -\frac{380}{13} & 1 & 0 & -\frac{900}{13} \\ 1 & 0 & \frac{4}{13} & -\frac{4}{13} & 0 & 0 & -\frac{3}{13} & \frac{3}{13} & 0 & 0 & \frac{55}{13} \\ 0 & 0 & -\frac{15}{13} & \frac{15}{13} & 1 & -1 & -\frac{5}{13} & \frac{5}{13} & 0 & 0 & \frac{5}{13} \\ 0 & 0 & \frac{100}{13} & -\frac{100}{13} & 0 & 0 & \frac{120}{13} & -\frac{120}{13} & -1 & 1 & \frac{400}{13} \\ 0 & 1 & -\frac{5}{13} & \frac{5}{13} & 0 & 0 & \frac{7}{13} & -\frac{7}{13} & 0 & 0 & \frac{45}{13} \end{bmatrix} \quad (11)$$

> evalf([A24[3,11]/A24[3,4], A24[5,11]/A24[5,4]]);
 [0.3333333333, 9.] (12)

> # Pivot in Column 4, Row 3
 A25:=RowOperation(A24,3,13/15):
 A26:=RowOperation(A25,[1,3],1400/13):
 A27:=RowOperation(A26,[2,3],4/13):
 A28:=RowOperation(A27,[4,3],100/13):
 A29:=RowOperation(A28,[5,3],-5/13):

$$A_{29} := \begin{bmatrix} 0 & 0 & 50 & 0 & \frac{280}{3} & \frac{20}{3} & \frac{580}{3} & \frac{20}{3} & 1 & 0 & -\frac{100}{3} \\ 1 & 0 & 0 & 0 & \frac{4}{15} & -\frac{4}{15} & -\frac{1}{3} & \frac{1}{3} & 0 & 0 & \frac{13}{3} \\ 0 & 0 & -1 & 1 & \frac{13}{15} & -\frac{13}{15} & -\frac{1}{3} & \frac{1}{3} & 0 & 0 & \frac{1}{3} \\ 0 & 0 & 0 & 0 & \frac{20}{3} & -\frac{20}{3} & \frac{20}{3} & -\frac{20}{3} & -1 & 1 & \frac{100}{3} \\ 0 & 1 & 0 & 0 & -\frac{1}{3} & \frac{1}{3} & \frac{2}{3} & -\frac{2}{3} & 0 & 0 & \frac{10}{3} \end{bmatrix} \quad (13)$$