We solve E2010A Opg 5 and E2010 Opg 5 in maple.

> $with(LinearAlgebra) : with(plots) :$

>

E0210A Opg 5

> $A := Matrix(3, 4, [-1, 5, 2, 5, 0, 3, 0, 1, -1, 0, 1, 2]);$

$$A := \begin{bmatrix} -1 & 5 & 2 & 5 \\ 0 & 3 & 0 & 1 \\ -1 & 0 & 1 & 2 \end{bmatrix} \quad (1)$$

> $xv := Vector(4, [x_1, x_2, x_3, x_4]);$

$$xv := \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} \quad (2)$$

> $Ax := A.xv;$

$$Ax := \begin{bmatrix} -x_1 + 5\,x_2 + 2\,x_3 + 5\,x_4 \\ 3\,x_2 + x_4 \\ -x_1 + x_3 + 2\,x_4 \end{bmatrix} \quad (3)$$

> $b := Vector(3, [5, 2, 1]);$

$$b := \begin{bmatrix} 5 \\ 2 \\ 1 \end{bmatrix} \quad (4)$$

> $c := Vector(4, [0, 5, 1, 4]);$

$$c := \begin{bmatrix} 0 \\ 5 \\ 1 \\ 4 \end{bmatrix} \quad (5)$$

> $yv := Vector(3, [y_1, y_2, y_3]);$

$$yv := \begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} \quad (6)$$

(1) Det duale program

> $DotProduct(b, yv);$

(7)

$$5\,y_1 + 2\,y_2 + y_3 \quad \textbf{(7)}$$

> $ytA := Vector[row](yv).A;$

$$ytA := \begin{bmatrix} -y_1 - y_3 & 5\,y_1 + 3\,y_2 & 2\,y_1 + y_3 & 5\,y_1 + y_2 + 2\,y_3 \end{bmatrix} \quad \textbf{(8)}$$

Substitute y_3=1-2y_1

> $subs(y_3 = 1 - 2\cdot y_1, ytA);$

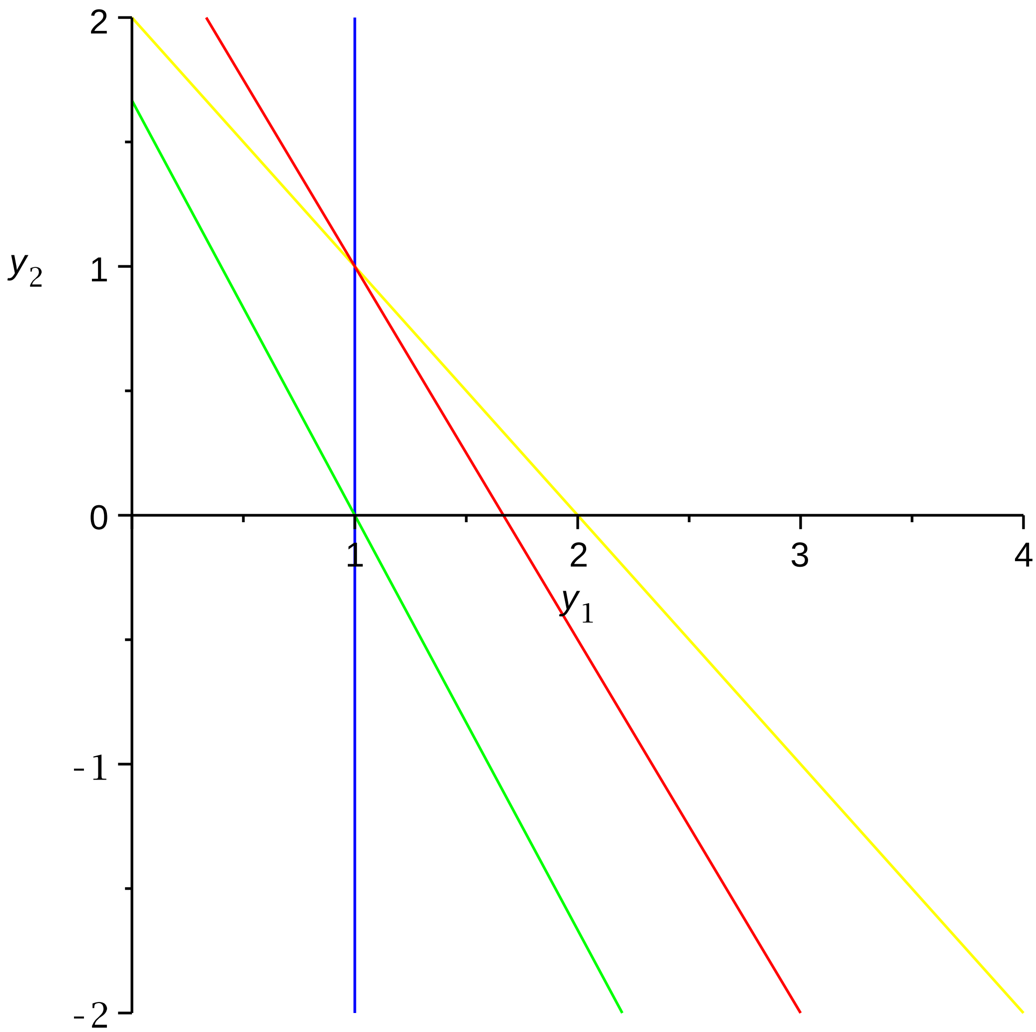
$$\begin{bmatrix} y_1 - 1 & 5\,y_1 + 3\,y_2 & 1 & y_1 + y_2 + 2 \end{bmatrix} \quad \textbf{(9)}$$

> $subs(y_3 = 1 - 2\cdot y_1, DotProduct(b, yv));$

$$3\,y_1 + 2\,y_2 + 1 \quad \textbf{(10)}$$

Now we have a program in just two variables (y_1,y_2) - we can find a solution from a drawing

> $implicitplot([y_1 - 1 = 0, 5\cdot y_1 + 3\cdot y_2 = 5, y_1 + y_2 + 2 = 4, 3\,y_1 + 2\cdot y_2 + 1 = 6], y_1 = 0..5, y_2 = -2..2, color = [blue, green, yellow, red]);$



An optimal solution and the optimal value for (P')

> $ystar := Vector(3, [1, 1, -1]);$

$$ystar := \begin{bmatrix} 1 \\ 1 \\ -1 \end{bmatrix} \quad (11)$$

> $DotProduct(ystar, b);$

$$6 \quad (12)$$

By Duality, the first condition is active, and the object function has value 6 at an optimal solution for (P). This determines an optimal solution

> $solve([Ax[1] = 5, Ax[2] = 2, Ax[3] = 1, DotProduct(xv, c) = 6], [x_1, x_2, x_3, x_4]);$

$$[[x_1 = 1, x_2 = 0, x_3 = -2, x_4 = 2]] \quad (13)$$

>

E2010B Opg 5

> $A := Matrix(3, 4, [2, 3, -1, 1, -3, -1, -4, 2, -1, -1, 2, 1]);$

$$A := \begin{bmatrix} 2 & 3 & -1 & 1 \\ -3 & -1 & -4 & 2 \\ -1 & -1 & 2 & 1 \end{bmatrix} \quad (14)$$

> $xv := Vector(4, [x_1, x_2, x_3, x_4]);$

$$xv := \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} \quad (15)$$

> $Ax := A.xv;$

$$Ax := \begin{bmatrix} 2 x_1 + 3 x_2 - x_3 + x_4 \\ -3 x_1 - x_2 - 4 x_3 + 2 x_4 \\ -x_1 - x_2 + 2 x_3 + x_4 \end{bmatrix} \quad (16)$$

> $yv := Vector(3, [y_1, y_2, y_3]);$

$$yv := \begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} \quad (17)$$

> $ytA := Vector[row](yv).A;$

$$ytA := \begin{bmatrix} 2 y_1 - 3 y_2 - y_3 & 3 y_1 - y_2 - y_3 & -y_1 - 4 y_2 + 2 y_3 & y_1 + 2 y_2 + y_3 \end{bmatrix} \quad (18)$$

> $b := Vector(3, [0, -3, 1]);$

$$b := \begin{bmatrix} 0 \\ -3 \\ 1 \end{bmatrix} \quad (19)$$

> $c := Vector(4, [1, -1, 0, 0]);$

$$c := \begin{bmatrix} 1 \\ -1 \\ 0 \\ 0 \end{bmatrix} \quad (20)$$

> $solve([ytA[1] = 1, ytA[4] = 0], [y_2, y_3]);$

$$[[y_2 = 3\,y_1 - 1, y_3 = -7\,y_1 + 2]] \quad (21)$$

> $subs([y_2 = 3 \cdot y_1 - 1, y_3 = -7 \cdot y_1 + 2], [ytA[2] \geq -1, ytA[3] \geq 0]);$

$$[0 \leq 7\,y_1, 0 \leq -27\,y_1 + 8] \quad (22)$$

> $solve([3 \cdot y_1 - 1 \geq 0, 0 \leq -27 \cdot y_1 + 8], [y_1]);$

$$[\,] \quad (23)$$

M(P') is empty, inf(P')=∞
Since there are feasible solutions to (P), the primal program is unbounded: sup(P)=∞.
There are no optimal solutions to (P).