HW #5 EE/Econ 458, Solutions
Due Friday, October 7, 2011
Construct the dual problem for the primal problem given below. Report your primal and dual problems. Solve both the primal and the dual problems using CPLEX. In both cases, use CPLEX commands to get the values of the slack variables and the dual variables. And so, for both problems (primal and dual), you should report, at the optimum:

- Value of objective
- Values of all decision variables
- Values of all dual variables
- Values of all slack variables

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\begin{aligned}
&\max F = 4x_1 + x_2 + 5x_3 + 3x_4 \\
&\text{s.t.} \\
&x_1 \quad - x_2 \quad - x_3 \quad + 3x_4 \quad \le 1 \\
&5x_1 \quad + x_2 \quad + 3x_3 \quad + 8x_4 \quad \le 55 \\
&- x_1 \quad + 2x_2 \quad + 3x_3 \quad - 5x_4 \quad \le 3 \\
&x_1 \ge 0, x_2 \ge 0, x_3 \ge 0, x_4 \ge 0
\end{aligned}
$$

Solution:
We refer to the above problem as the primal.
The dual of the above problem follows:

Minimize G(y) = y1 + 55 y2 + 3y3
Subject to

$y_1+5y_2-y_3\ge 4$
$-y_1+ y_2+2y_3\ge 1$
$-y_1+3y_2+3y_3\ge 5$
$3y_1+8y_2-5y_3\ge 3$

$y_1, y_2, y_3, y_4\ge 0$

For the primal problem, CPLEX reports:

- Value of the objective is F*=29.
- Values of decision variables at the optimum are:
  x_1*=0, x_2*=14, x_3*=0, x_4*=5
- Values of dual variables are:
  y_1=11, y_2=0, y_3=6
- Values of slack variables are:
  x_5=0, x_6=1, x_7=0

For the dual problem, CPLEX reports:

- Value of the objective is G*=29
- Values of the decision variables at the optimum are:
  y_1*=11, y_2*=0, y_3*=6
- Values of the dual variables at the optimum are:
  x_1*=0 , x_2*=14 , x_3*=0 , x_4*=5
- Values of slack variables are:
  y_4=-1, y_5=0, y_6=-2, y_7=0