

Project for Operations Research 1

February 27, 2017

- Marks for project: 30%.
- Project due date: 23:55 Friday 21 April (Week 12).

1 Project Description

A file has been placed at <http://jkcray.maths.ul.ie/ms4303/Projectdata.pdf> containing a list of LP's, a different one for every student in the class.

The LP's are in Standard Form, so z is to be **minimised**.

2 Solution to Optimality

You should:

- Find and copy down “your” problem.
- Create a Matlab/Octave script m-file `Run.m` containing all the Matlab/Octave commands needed to solve the problem.
- Generate a Simplex tableau T_0 for your LP.
- Use the provided `Pivot.m` m-file with either Octave or Matlab to transform T_0 to a canonical form tableau T_B .
- Use the provided `colsortjk` m-file with either Octave or Matlab to transform T_B to a canonical form tableau T_C which has the basic columns in standard order on the right of the tableau.
 - ★ This corresponds to re-labelling the decision variables but does not change the optimal value of the LH-column and in particular z .
- Use the `Pivot.m` m-file with either Octave or Matlab to solve T_C to optimality.
- Name the optimal tableau T^* .
- What is the optimal solution vector \mathbf{x} and the optimal z -value?

3 Sensitivity Analysis

For the remaining questions, you need to interpret your Standard Form LP (which is a **min** problem) as derived from a **max** problem with (of course) the objective coefficients reversed in sign.

- (A) First deal with some changes in the Production Requirements.
- (a) There has been a change in the Production Requirements.
 - Pick the **last non-basic** variable in T^* (I'll refer to it as x_{nbL}) and increase it up to 1 unit or to **half** its maximum value (whichever is the greater).
 - What is the new optimal solution x and optimal z -value?
 - Check your result(s) by adding the constraint $x_{nbL} = X$ to T^* where X is the chosen value of x_{nb} and pivot to optimality.
 - (b) There has been another change in the Production Requirements.
 - ★ Find the last **basic** variable in T^* (I'll refer to it as x_{bL}) and increase it from its optimal value by 1 unit or to **half** its maximum value (whichever is the greater).
 - ★ If the last basic variable cannot be increased, choose the second-last, . . . until you find a basic variable that can be increased.
 - What is the new optimal solution x and optimal z -value?
 - Check your result(s) by adding the constraint $x_{bL} = X$ to T^* where X is the chosen value of x_{bL} and pivot to optimality.
 - (c) There has been another change in the Production Requirements.
 - Find the **first non-basic** variable in T^* (I'll refer to it as x_{nbF}) and increase it by one unit **above** its maximum value, the minimum row ratio (**mrr**) for the variable. If x_{nbF} cannot be increased by one unit above its mrr, increase it by the maximum amount possible. (Use the two-phase method explained in Section 4.2.4 “When a Nonbasic Variable becomes Basic and Exceeds its Minimum Row Ratio” in the Notes.)
 - What is the new optimal solution x and optimal z -value?
 - Check your result(s) by adding the constraint $x_{nbF} = X$ to T^* where X is the chosen value of x_{nbF} and pivot to optimality.

- (B) There has been a change in the availability of resources.
- The availability of the resource corresponding to the last non-basic slack variable of your **optimal form tableau** T^* has changed.
 - Work out (using the technique explained in Ch4 of the Notes) the maximal amount by which the availability of this resource may be **reduced** while maintaining the optimality of your optimal solution T_{opt} .
 - Use the technique explained in Ch4 of the Notes to **reduce** the availability of this resource by **half** this maximum amount and find the new optimal solution x and optimal z -value.
 - Check your result(s) by altering the availability of the resource in T_C and pivoting to optimality.
- (C) A change in the price of the first variable that is **basic** in your optimal tableau is required. (I'll call it x_{bF} .)
- Use the technique explained in Ch4 of the Notes to find the range of price-changes q for that product in the canonical form tableau T_C that keeps the current set of basis variables basic in your optimal tableau.
 - If possible, **Increase** (otherwise **Decrease**) the price in the real LP (decrease/increase the price in the canonical form tableau T_C) for the selected basic variable by **half** the maximum amount possible that keeps the current set of basis variables basic in your optimal tableau.
 - Find the new optimal z -value (the optimal x -vector will not change).
 - Check your result(s) by altering the price in T_C and pivoting to optimality.

4 Report

- Write a report in PDF format using \LaTeX explaining your steps and your interpretation of the results.
- Your report should include the succession of tableaux that you created when solving the problem, copy/pasted from the **diary** file.
- Use the \LaTeX `verbatim` environment to enclose the successive tableaux.
- Use `\tiny` if necessary to allow your tableaux to fit on a page.
- You should submit a zip file containing your working folder, including your \LaTeX files and your Matlab/Octave m-files.
- Email attachments (other than a single zip file) will not be accepted.
- Marks will be awarded for correct results and also for clear explanations of your steps.