Feedback — Examination #1 (Weeks 1 - 4)

Help Center

You submitted this exam on **Sun 10 Nov 2013 1:04 PM PST**. You got a score of **47.00** out of **55.00**.

Quiz #1

This quiz will be timed: you have one hour to answer the nine questions. If you have been following the material, this should be quite conceptual and we do not expect any calculation aids will be needed. We advise you to have a pen and paper with you.

Question 1

Select all the correct choices for the entering and leaving variables in the following dictionary:

$$\begin{array}{c|ccccc} x_1 & 1 & & & -1x_5 & -2x_7 \\ x_4 & 3 & -1x_6 & -1x_3 & -2x_5 & -1x_7 \\ x_2 & 0 & -1x_6 & & -2x_5 & \\ \hline z & 7 & +1x_6 & -2x_3 & +1x_5 & -1x_7 \end{array}$$

Your Answer		Score	Explanation
☐ x_5 enters and x_4 leaves	✔	1.00	
☐ The dictionary is final	✔	1.00	
☑ x_5 enters and x_2 leaves	✔	1.00	

☐ x_5 enters and x_1 leaves	✔	1.00	
☑ x_6 enters and x_2 leaves	✔	1.00	
Total		5.00 / 5.00	

Question 2

Consider the dictionary below:

$$\begin{array}{r|rrrrr} x_1 & 1 & & & -1x_5 & -2x_7 \\ x_4 & 3 & -1x_6 & -1x_3 & -2x_5 & -1x_7 \\ x_2 & 0 & -1x_6 & & -2x_5 & \\ z & 7 & +1x_6 & -2x_3 & +1x_5 & -1x_7 \end{array}$$

Which of the statements concerning the subsequent dictionary after pivoting will be valid, no matter what entering/leaving variable combinations we choose?

Your Answer		Score	Explanation
☐ The value of the objective will be strictly greater than 7	✔	1.25	
☑ The subsequent dictionary will be degenerate.	✔	1.25	
☐ The value of the objective will be less than 7	✔	1.25	
☑ The value of the objective will be 7	✔	1.25	
Total		5.00 / 5.00	

Question Explanation

The entering variables are x_6, x_5 and corr. leaving variable is x_2 in both cases. The solution does not change for either option since max increase in the value of entering variable is 0 for both options.

Question 3

Consider the dictionary below:

$$\begin{array}{c|cccccc} x_1 & 1 & & & -1x_5 & -2x_7 \\ x_4 & 3 & -1x_6 & -1x_3 & -2x_5 & -1x_7 \\ x_2 & 0 & -1x_6 & & -2x_5 & \\ \hline z & 7 & +1x_6 & -2x_3 & +1x_5 & -1x_7 \end{array}$$

We consider the dual variables $y_1, \ldots, y_7$ with the following complementary pairs:

x_1	x_2	x_3	x_4	x_5	x_6	x_7
y_4	y_5	y_6	y_7	y_1	y_2	y_3

Select all the basic variables in the complement dual dictionary.

Your Answer		Score	Explanation
☑ y_1	✔	1.00	
☑ y_2	✔	1.00	
☑ y_3	✔	1.00	
☑ y_6	✔	1.00	
☐ y_4	✔	1.00	

y_5	✔	1.00
y_7	✔	1.00
Total		7.00 / 7.00

Question Explanation

They will be the complements of the nonbasic variables in the primal dictionary: y_2, y_6, y_1, y_3

Question 4

Consider the dictionary below:

$$\begin{array}{r|llllll} x_1 & 1 & & & -1x_5 & -2x_7 \\ x_4 & 3 & -1x_6 & -1x_3 & -2x_5 & -1x_7 \\ x_2 & 0 & -1x_6 & & -2x_5 & \\ z & 7 & +1x_6 & -2x_3 & +1x_5 & -1x_7 \end{array}$$

We consider the dual variables $y_1, \ldots, y_7$ with the following complementary pairs:

x_1	x_2	x_3	x_4	x_5	x_6	x_7
y_4	y_5	y_6	y_7	y_1	y_2	y_3

If x_6 enters and x_2 leaves the basis, what are the entering and leaving variables in the complementary dual dictionary?

Your Answer	Score	Explanation
○ y_5 enters and y_2 leaves the dual dictionary basis.		
○ y_1 enters and y_4 leaves the dual dictionary basis.		

○ y_2 enters and y_5 leaves the dual dictionary basis.		
◉ The dual dictionary is final and therefore already optimal. No entering variable exists.	✖	0.00
Total		0.00 / 5.00

Question Explanation

If x_6 enters and x_2 leaves the primal basis then x_2^c enters and x_6^c leaves the dual basis. This leads to the answer: y_5 enters and y_2 leaves the dual dictionary basis.

Question 5

The initialization phase of the Simplex algorithm presented in this course used a special rule:

whenever x_0 is one of the valid options for a leaving variable, it must be chosen to leave.

Which of the following facts is guaranteed by this rule?

Your Answer		Score	Explanation
○ None of the above. The rule was made up primarily to confuse coursera students.			
○ The initialization phase final dictionary always has x_0 as a basic variable			
◉ If the original problem is feasible, the final dictionary for the initialization phase will have x_0 as a non-basic variable.	✔	5.00	This is correct.
○ The initialization phase final dictionary always has x_0 as a non-basic variable			
○ If the original problem is infeasible, the final dictionary for the initialization phase will have x_0 as a non-basic variable.			

Total	5.00 / 5.00

Question 6

If instead of using Bland's rule, Simplex is modified to choose the entering and leaving variable at each pivoting step uniformly at random:

- Entering variable is chosen uniformly from all non-basic variables with positive coefficients.
- Fixing the choice of the entering variables, leaving variable is chosen at random from the set of correct choices for the leaving variable.

What can we say about the resulting algorithm? Select the correct answer

Your Answer		Score	Explanation
○ If a final dictionary is arrived at through this algorithm, it may not be optimal.			
◉ We can come up with examples where non-termination will occur regardless of what random choices are made.	✖	0.00	This is not possible. There is a very small but still non zero chance that the random set of pivots will discover the same series of entering/leaving variables as Bland's rule long enough to ensure non-termination.
○ It will terminate with probability 1.			
○ Such a variant can cause the objective function to decrease at some iterations.			
○ Nothing can be said about the behavior since it behaves			

randomly.

Total	0.00 / 1.00

Question Explanation

Randomness ensures that the algorithm cannot cycle forever. Since there is a path out of the cycle through bland's rule, eventually the random sequence will simulate Bland's rule and exit.

Question 7

Which of the following statements about an unbounded primal LP are true? Select all the true statements.

Your Answer		Score	Explanation
☑ Its dual is infeasible.	✔	1.00	
☑ Its feasible region is unbounded as well.	✔	1.00	
☑ When solving using Simplex, we conclude unboundedness when we cannot find a leaving variable at a pivoting step.	✔	1.00	
☐ It's dual can be unbounded as well.	✔	1.00	No. Primal and dual cannot be unbounded at the same time.
☐ When solving Simplex, we will encounter unboundedness during the initialization phase.	✔	1.00	No: this will never happen.
☐ Negating the objective function can always make the problem bounded.	✔	1.00	No, it need not.

Total	6.00 / 6.00

Question 8

Which of the following statements are true about an infeasible primal LP?

Your Answer		Score	Explanation
☑ The feasible region is the empty set.	✔	1.00	
☐ Changing the objective function can make the problem feasible in all cases.	✔	1.00	No. Feasibility concerns the constraints.
☐ The auxiliary problem is also infeasible	✔	1.00	Note: the auxilary problem is always feasible.
☑ The auxiliary LP ($\max\ -x_0\ \mathtt{s.t.} \ldots$) has optimal solutions with a strictly negative objective.	✔	1.00	
☑ The constraints are contradictory.	✔	1.00	
☐ The auxiliary problem is unbounded	✔	1.00	This cannot happen.
☐ The dual is always unbounded.	✔	1.00	It may be infeasible as well.
☑ The dual may either be infeasible or unbounded.	✔	1.00	
Total		8.00 / 8.00	

Question 9

Which of the following statements about the Simplex algorithm are true? Assume we are maximizing a standard form problem.

Your Answer		Score	Explanation
☐ Simplex runs in polynomial time in the worst case.	✔	0.83	No. Klee-Minty Examples
☑ Its worst case complexity can be exponential in the problem size depending on the pivoting rule used.	✔	0.83	Yes, we talked about the Klee-Minty cubes.
☑ It can fail to terminate by cycling between a series of dictionaries.	✔	0.83	Yes. We talked about this.
☐ It is a hill climbing search: the objective strictly increases in each step.	✔	0.83	Not necessarily: it can be the same due to a degenerate dictionary.
☑ At each pivoting step, the objective function increases or remains the same	✔	0.83	Correct, we proved this.
☐ The Simplex algorithm can move from a primal feasible dictionary to a primal infeasible dictionary.	✔	0.83	No. We proved that it cannot
Total		5.00 / 5.00	

Question 10

We solved an LP in the standard form and found the following optimal solution for the primal and dual problems:

Primal	$x_1 : 10$	$x_2 : ?$	$x_3 : ?$	$x_4 : 5$	$x_5 : 4$	$x_6 : ?$
Dual	$y_4 : ?$	$y_5 : 5$	$y_6 : ?$	$y_1 : 0$	$y_2 : 0$	$y_3 : 2$

The primal objective is given by x_3 and the dual objective by $y_1 + y_2 + 2y_3$.

For your convenience, we have listed complementary pairs next to each other. But for your inconvenience, we have left out the solution for some of the variables marked by "?". Select all the correct statements regarding the missing parts below.

Your Answer		Score	Explanation
☑ $y_4 = 0$	✔	1.00	Because $x_1 = 10$
☑ $x_2 = 0$	✔	1.00	Because $y_5 \neq 0$
☐ x_3 may or may not be zero. We do not have enough data.	✔	1.00	We do have enough data through strong duality
☑ $x_3 \neq 0$	✔	1.00	Yes. In fact $x_3 = y_1 + y_2 + 2y_3 = 4$
☐ $x_6 = 0$	✘	0.00	Because $y_3 \neq 0$
☑ $x_3 = 4$	✔	1.00	$x_3 = y_1 + y_2 + 2y_3 = 4$ by strong duality.
☐ $x_3 = 0$	✔	1.00	$x_3 = y_1 + y_2 + 2y_3 = 4$ by strong duality.
☐ $y_6 = 0$	✘	0.00	Because $x_3 \neq 0$
Total		6.00 / 8.00	