

56:171 Operations Research
 Quiz #2 (version A) Solution—Fall 2002

Part I. For each statement, indicate "+"=true or "o"=false.

- + 1. A "pivot" in a nonbasic column of a tableau will make it a basic column.
- O 2. If a zero appears on the right-hand-side of row i of an LP tableau, then at the next iteration you *cannot* pivot in row i .
- O 3. A "pivot" in row i of the column for variable X_j will increase the number of basic variables.
- + 4. A basic solution of the problem "maximize cx subject to $Ax \leq b, x \geq 0$ " corresponds to a corner of the feasible region.
- + 5. In a basic LP solution, the nonbasic variables equal zero.

Part II. Below are several simplex tableaus. Assume that the objective in each case is to be **maximized**. Classify each tableau by writing to the right of the tableau a letter **A** through **F**, according to the descriptions below. *Also circle the pivot element when specified.*

(A) Nonoptimal, nondegenerate tableau with bounded solution. *Circle a pivot element which would improve the objective.*

(B) Nonoptimal, degenerate tableau with bounded solution. *Circle an appropriate pivot element.*

(C) Unique optimum.

(D) Optimal tableau, with alternate optimum. *Circle a pivot element which would lead to another optimal basic solution.*

(E) Objective unbounded (above).

(F) Tableau with infeasible basic solution.

(1)	-z	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	RHS	
max	1	0	0	1	3	0	0	2	2	-36	
	0	3	0	4	0	0	1	3	0	9	__B__
	0	-1	1	-2	5	0	0	-2	1	4	(4 correct pivots)
	0	6	0	3	-2	1	0	-4	3	0	

(2)	-z	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	RHS	
max	1	-3	0	-1	-3	0	0	0	-2	-36	
	0	3	0	4	0	0	1	3	0	9	__D__
	0	6	0	3	-2	1	0	-4	3	5	
	0	-1	1	-2	-5	0	0	-2	1	4	

(3)	-z	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	RHS	
max	1	-3	0	1	3	0	0	-2	-2	-36	
	0	3	0	4	0	0	1	3	0	9	__E__
	0	-1	1	-2	-5	0	0	-2	1	4	(variable $X_4 \rightarrow \infty$)
	0	6	0	3	-2	1	0	-4	3	5	

(4)	-z	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	RHS	
max	1	3	0	-1	3	0	0	2	-2	-36	
	0	3	0	4	1	0	1	3	0	9	__A__
	0	-1	1	2	5	0	0	-2	1	2	(3 correct pivots)
	0	6	0	3	-2	1	0	-4	3	5	

(5)	-z	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	RHS	
max	1	-3	0	-1	-3	0	0	-2	-2	-36	
	0	3	0	4	1	0	1	3	0	9	__F__
	0	-1	1	-2	-5	0	0	-2	1	-4	
	0	6	0	3	2	1	0	-4	3	5	

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 Quiz #2 (version B) Solution—Fall 2002

Part I. For each statement, indicate "+"=true or "o"=false.

- O 1. It may happen that an LP problem has (exactly) two optimal solutions.
 O 2. If a zero appears on the right-hand-side of row i of an LP tableau, then at the next iteration you *must* pivot in row i .
 + 3. A "pivot" in the simplex method corresponds to a move from one corner point of the feasible region to another.
 + 4. In the simplex method, every variable of the LP is either basic or nonbasic.
 + 5. If there is a tie in the "minimum-ratio test" of the simplex method, the next basic solution will be degenerate, i.e., one of the basic variables will be zero.

Part II. Below are several simplex tableaus. Assume that the objective in each case is to be **maximized**. Classify each tableau by writing to the right of the tableau a letter **A** through **F**, according to the descriptions below. *Also circle the pivot element when specified.*

(A) Optimal tableau, with alternate optimum. *Circle a pivot element which would lead to another optimal basic solution.*

(B) Objective unbounded (above).

(C) Nonoptimal, nondegenerate tableau with bounded solution. *Circle a pivot element which would improve the objective.*

(D) Nonoptimal, degenerate tableau with bounded solution. *Circle an appropriate pivot element.*

(E) Unique optimum.

(F) Tableau with infeasible basic solution.

(1)	-z	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	RHS	
max	1	-3	0	-1	-3	0	0	-2	-2	-36	
	0	3	0	4	1	0	1	3	0	9	___F___
	0	-1	1	-2	-5	0	0	-2	1	-4	
	0	6	0	3	2	1	0	-4	3	5	

(2)	-z	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	RHS	
max	1	0	0	1	3	0	0	2	2	-36	
	0	3	0	4	0	0	1	3	0	9	___D___
	0	-1	1	-2	5	0	0	-2	1	4	
	0	6	0	3	-2	1	0	-4	3	0	

(3)	-z	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	RHS	
max	1	-3	0	-1	-3	0	0	0	-2	-36	
	0	3	0	4	0	0	1	3	0	9	___A___
	0	6	0	3	-2	1	0	-4	3	5	
	0	-1	1	-2	-5	0	0	-2	1	4	

(4)	-z	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	RHS	
max	1	-3	0	1	3	0	0	-2	-2	-36	
	0	3	0	4	0	0	1	3	0	9	___B___
	0	-1	1	-2	-5	0	0	-2	1	4	(X ₄ →∞)
	0	6	0	3	-2	1	0	-4	3	5	

(5)	-z	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	RHS	
max	1	3	0	-1	3	0	0	2	-2	-36	
	0	3	0	4	1	0	1	3	0	9	___C___
	0	-1	1	2	5	0	0	-2	1	2	
	0	6	0	3	-2	1	0	-4	3	5	

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 Quiz #2 (version C) Solution –Fall 2002

Part I. For each statement, indicate "+"=true or "o"=false.

- O 1. If a zero appears on the right-hand-side of row i of an LP tableau, then at the next iteration you *cannot* pivot in row i .
- + 2. A basic solution of the problem "maximize cx subject to $Ax \leq b, x \geq 0$ " corresponds to a corner of the feasible region.
- + 3. In a basic LP solution, the nonbasic variables equal zero.
- O 4. The "minimum ratio test" is used to select the pivot column in the simplex method for linear programming.
- + 5. In the simplex tableau, all rows, including the objective row, are written in the form of equations.

Part II. Below are several simplex tableaus. Assume that the objective in each case is to be **maximized**. Classify each tableau by writing to the right of the tableau a letter **A** through **F**, according to the descriptions below. *Also circle the pivot element when specified.*

(A) Nonoptimal, nondegenerate tableau with bounded solution. *Circle a pivot element which would improve the objective.*

(B) Nonoptimal, degenerate tableau with bounded solution. *Circle an appropriate pivot element.*

(C) Unique optimum.

(D) Optimal tableau, with alternate optimum. *Circle a pivot element which would lead to another optimal basic solution.*

(E) Objective unbounded (above).

(F) Tableau with infeasible basic solution.

(1)	-z	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	RHS	
max	1	-3	0	1	3	0	0	-2	-2	-36	
	0	3	0	4	0	0	1	3	0	9	_E _____
	0	-1	1	-2	-5	0	0	-2	1	4	(variable X ₄ → ∞)
	0	6	0	3	-2	1	0	-4	3	5	
(2)	-z	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	RHS	
max	1	3	0	-1	3	0	0	2	-2	-36	
	0	3	0	4	1	0	1	3	0	9	_A _____
	0	-1	1	2	5	0	0	-2	1	2	(3 correct pivots)
	0	6	0	3	-2	1	0	-4	3	5	
(3)	-z	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	RHS	
max	1	0	0	1	3	0	0	2	2	-36	
	0	3	0	4	0	0	1	3	0	9	_B _____
	0	-1	1	-2	5	0	0	-2	1	4	(4 correct pivots)
	0	6	0	3	-2	1	0	-4	3	0	
(4)	-z	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	RHS	
max	1	-3	0	-1	-3	0	0	-2	-2	-36	
	0	3	0	4	1	0	1	3	0	9	_F _____
	0	-1	1	-2	-5	0	0	-2	1	-4	
	0	6	0	3	2	1	0	-4	3	5	
(5)	-z	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	RHS	
max	1	-3	0	-1	-3	0	0	0	-2	-36	
	0	3	0	4	0	0	1	3	0	9	_D _____
	0	6	0	3	-2	1	0	-4	3	5	
	0	-1	1	-2	-5	0	0	-2	1	4	