Home Exercise 5: True or false?

a) The dual of the dual problem yields the original primal.

b) If the primal constraint is originally in an equality (=) form, the corresponding dual variable is necessarily unrestricted.

c) If the primal constraint is of the type ≤, the corresponding dual variable will be nonnegative (nonpositive) if the primal objective is maximization (minimization).

d) If the dual constraint is of the type ≥, the corresponding primal variable will be nonnegative (nonpositive) if the primal objective is minimization (maximization).

e) An unrestricted primal variable will result in an ≥ dual constraint.

a) The dual of the dual problem yields the original primal.
Answer: True
As the simplex method progresses, the solutions determined for the dual problem are all infeasible until the optimal solution is attained for the primal problem. The dual solution corresponding to the optimal primal solution is both optimal and feasible
Theorem 3 (Strong duality)
If an LP has a finite optimal solution, then its dual problem also have a finite optimal solution, and the optimal objective function value of both problem are the same

For question (b) to (e), we can verify using this table.

Primal (dual)	Dual (primal)
maximise	minimise
Independent terms (b)	Obj. function coef. (c)
Obj. function coef. (c)	Independent terms (b)
i-th row of constraint coef.	i-th column of constraint coef.
i-th column of constraint coef.	i-th row of constraint coef.
Constraints	**Variables**
$\leq$	≥ 0
$\geq$	≤ 0
$=$	$\in \mathbb{R}$
Variables	**Constraints**
≥ 0	$\geq$
≤ 0	$\leq$
$\in \mathbb{R}$	$=$

Minimization Problem	Maximization Problem
If the Constraint is	The Associated Variable is
>=	>=0
<=	<=0
=	Unrestricted
If the Variable is	The corresponding Constraint is
>=0	<=
<=0	>=
Unrestricted	=

b) If the primal constraint is originally in an equality (=) form, the corresponding dual variable is necessarily unrestricted.
Answer: True

c) If the primal constraint is of the type ≤, the corresponding dual variable will be nonnegative (nonpositive) if the primal objective is maximization (minimization).
Answer: True

d) If the dual constraint is of the type ≥, the corresponding primal variable will be nonnegative (nonpositive) if the primal objective is minimization (maximization).
Answer: True

e) An unrestricted primal variable will result in an ≥ dual constraint.
Answer: False
 An unrestricted primal variable will result in an equality = dual constraint for both maximization and minimization of the primal objective