1

(a) -min z = 2x\_1 + x\_2

s.t.

x\_1 – 4x\_2 + x\_3 = 1

x\_1 + 5x\_2 + x\_4 = 3

all x >= 0

(b) <- feasibility

 <- reduced costs

we find that with I\_1 {1,4} it is not optimal as reduced cost < 0

Others are ok.

(Recap: r>=0 for optimality)

(c) 4 (17/9, 2/9)

(d) We note that it is a <= constraint so the shadow price can be read off the simplex, and is \beta\_3 as x\_3 is the slack used (for the first constraint). As in the simplex we are doing minimisation, the optimal value becomes -4+2(-1) = -6. So the final value is 6.

2

(a) z = 4, x\_1 = 4/3, x\_2 = 0, x\_3 = 0, x\_4 = 8

(ii)

⅔ x\_2 + ⅓ x\_3 >= ⅓

I think this wants *in words*, we insert artificial variable etc in to the tableau to solve.

(b)

Min c^T x

S.t. Ax <= b

X >= 0

See notes for proof. Proof by contradiction.

3

(a) (i)

Let x\_{iL} be number of laptops L made by factory i; L in {A,B,C};i in {1,2,3}

max 100 (sum x\_{iA} over all i) + 150 (sum x\_{iB} over all i) + 200 (sum x\_{iC} over all i)

sum x\_{1L} over all L <= 600

x\_{2B} = 0

x\_{2A} + x\_{2C} <= 400

sum x\_{3L} <= 600 over all L

//no more than 2 produce A == at least 1 doesn’t produce A

x\_{1A} <= M(1 – d\_1)

x\_{2A} <= M(1 – d\_2)

x\_{3A} <= M(1 – d\_3)

sum d\_i over all i >= 1

M is large number, all d\_i in {0, 1}

//x\_{1A} > 0 implies d\_1 == 0.

x\_{3B} <= 100 + M(d\_1)

All x >= 0 and int except x\_{2B}

(ii) sum x\_{1L} over all L = 200e, e in N\_0

(b) Max 10y\_1 + 20y\_2

-2y\_1 + 3y\_2 <= -1

y\_1 + 7y\_2 <= 1

y\_1 >= 0

y\_1 <= 0, y\_2 >= 0

4

(a) Last row

(b) No

(c) No (if RP chooses R1, CP will switch to C3 if known)

(d) Yes, minimax theorem & strong duality. See slides for more complete answer.

(e) See tutorial and extra game theory problems, lots of examples.