1 (a)

min y\_0 = 10y\_1 + 10y\_2

y\_1 + 3y\_2 >= 2

2y\_1 + 3y\_2 >= 7

y\_1 + 2y\_2 >= 4

y1, y2 >= 0

Strong duality YADA YADA so x\_0 = y\_0 if there exists feasible optimal in either. (Weak duality works too)

Set y\_0 = 40 and find any y\_1 y\_2 feasible. This means that primal <= 40 QED (You can actually show a better bound, let C\_i be constraint i. C\_2 – C\_3 gives y\_1 + y\_2 >= 3, and then you can find valid y\_1 y\_2 that gives a “better” bound of 30)

(b) 23+1/3 (0, 2+1/3)

2 (a) P\_0: -18, (1.5, 2.5)

P\_1: x\_1 <= 1, -16 (1, 2) stop, integer soln

P\_2: x\_1 >= 2, -12 (2, 7/3) stop, integer soln

Hence answer is -16

(b) let the sum term be S

S <= b + M (1 - \delta)

condition: M larger than the abs value of (sum + b)

(c) x = 1 + d\_1 + d\_2 + d\_3, all d in {0, 1} (many alternatives, e.g. x = d\_1 + 2d\_2 + 3d\_3 + 4d\_4, sum of all d = 1)

(d) x <= 2 => y <= 3 is equiv to x > 2 or y <= 3 (a => b is not a or b)

x > 2 + M(d)

y <= 3 - M(1 – d)

d in {0, 1}. M large.

alternatively, from tutorial, d\_1 is LHS holds, d\_2 is RHS holds.

x <= 2 – M(1 – d\_1)

y <= 3 – M(1 – d\_2)

d\_2 >= d\_1

All d in {0, 1}, M large

3 (a) make the table for finding nash eqlbm (which I think is what saddle pt refers to) and prove that there is no such pt.

(b) this should be mixed LP. Find primal then find its dual.

(c) Because A is square and nonsingular (and full row rank, otherwise it won’t be a valid LP)

we have Ax <= b and (multiply both sides by A^{-1}) x <= A^{-1} b.

multiplying both sides by c^T from the LHS gives **c^T x <= c^T A^{-1} b**.

Now the second constraint can be written as (c^T A^{-1}) <= 0 (apply T both sides)

Because A is square and full row + col rank, this means this is at optimal, there cannot exist any other basis (as the basis requires n variables). This means we can rewrite the inequality as equality.

4 (a) 2017-2018

(b) (i) (Using elimination)

Max 4 – x\_3

-x\_2 + 2x\_3 – x\_3 = 4

all x >= 0

(ii) Rank is 2, and if we take x+ and x- as basis, we have

B =

[2 -2

4 -4]

which is singular, and the RHS vals render it unsolvable.