*Some solutions to forming linear programs have used shortcut algebraic notation, if you don't feel comfortable with it you can use explicit constructs in your solutions.*

1. a)& b) Unbounded solution (check page 26)
2. a) max z'=-3\*x1-5\*x2

2\*x1+x2≤10

-6\*x1+2\*x2≤ -9

2\*x1+x2≤4

-2\*x1-x2≤-4

-3\*x1+4x2≤3

x1≥0,x2≥0

b)(check page 41)

min z''=10\*y1-9\*y2+4\*y3-4\*y4+3\*y5

2\*y1-6\*y2+2\*y3-2\*y4-3\*y5≥-3

y1+2\*y2+y3-y4+4\*y5≥-5

y1≥0,y2≥0,y3≥0,y4≥0,y5≥0

1. Dual decision variables y1=0, y2=1, y3=2; z=15(accounting for all substitutions)

We can also read the values of primal decision variables from the final iteration's table.

1. (check pages 137-143)

Initial feasible basic solution(NW corner)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | Available |
| A | 20 | 10 |  |  |  | 30 |
| B |  | 40 | ε |  |  | 40+ ε |
| C |  |  | 60 | 20 |  | 80 |
| D |  |  |  | 30 | 20 | 50 |
| Reqs. | 20 | 50 | 60+ ε | 50 | 20 |  |

Final solution: A1=20, A5=10, B3=40, C3=20, C4=50, C5=10, D2=50

1. min z=10\*S1+15\*S1

A+B ≥ 0.1\*(S1+S2)

C ≥ 2\*D

D+E ≤ A+B+C+D

A+B+C+D+E≥0.5\*(S1+S2)

A=0.03\*S1+0.16\*S2 //and 4 constraints for rest of the ingredients, using specification table (in the exam you have to write down everything)

S1,S2,A,B,C,D,E≥0

//need to add some constraint that excludes (0,0) as a possible solution, for example

S1+S2≥1 //or S1+S2=1 as shown in the lecture, but anything that excludes (0,0) would do

1. a)(mij is the maximum number of points for component i of course j)

min z=X1+X2+X3

b) same constraints as in a) part, but replacing objective function and adding few constraints:

max L

X1+X2+X3≤200

1. max z=3\*x1+4\*x2+5\*x3+2\*x4

0.5\*x1+1\*x2≤10

2\*x3+0.25\*x4≤20

4\*x1+10\*x2+5\*x3+x4≤5

xi≥0.1\*(x1+x2+x3+x4) , i=1,...,4

FAQ

1. **Q:** Why did we transform = constraints to ≥ & ≤? And ≥ to ≤?

**A:** That was a part of procedure to adapt a model to the form to which we can apply dual simplex method. There are other ways of coping with = and ≥ constraints more directly - used in M-method and two-phase method(for further details check pages 19-26).

Basic simplex method is constructed to work with input models in canonical form so we can't directly use = and ≥ constraints, we have to deal with them in a specific way prescribed by used solving method(dual simplex, M-method, two-phase method).

1. **Q:** Optimal values of objective functions for the primal and dual have to be identical? I got that these values differ in sign, but are identical in absolute value.

**A:** In the process of solving the dual manually, you probably did something along this line(dropping intermediate steps):

min p(y) **-**> (-1)\*(-1) min p(y) -> -1\*max –p(y)

You solved the max –p(y) and forgot about the minus sign in front.

Try out solving two versions of the same program in the solver, one with min p(y), the other with max –p(y) to verify. Both versions should, however, yield identical values for the decision variables.