Written Report

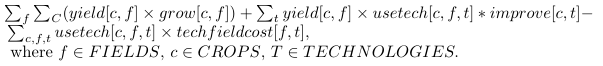
The model file contains five major components: sets, objective function, variables, parameters, and constraints.

There are three sets in the model file, representing a set of crops (containing six types of crops), a set of fields (containing 20 distinctive fields), and a set of technologies (containing five different technologies). The sets are set up in the aim of taking the data from the data file and doing the further calculation with the rest of the components.

There are six parameters in the model file. The parameter of yield is the revenue of certain crops in certain fields and each yield is nonnegative. The parameter of availability is the non-negative maximum budget availability of each technology. The parameter of technology costs is the total amount of technology used on a field. The parameter of improvement on crops is the nonnegative proportion of boost in expected revenue from using the technology on certain crops. The parameter upper bound states the revenue from each crop cannot exceed 50% of the total expected revenue, while the parameter lower bound states the revenue from each crop takes at least 10% of the total expected revenue.

There are two variables: grow variable is set up for each proportion of a single yield with a single crop, and usetechnology variable is set up for each proportion of a single yield in a single crop with a single technology.

The objective function is to maximize the difference between expected revenue and expected cost (Technologies). The expected profit in this case equals to



Since it is possible to have multiple crops in each field and to have different technologies covered in each field, we set up two variables ‘grow’ and ‘usetech’. ‘grow’ represents the proportion of each crop in each field, and ‘usetech’ represents proportion of field j in crop i with technology k. ‘grow’ and ‘usetech’ variables make it more convenient when setting up the constraints.

There are five constraints in the model file. The first constraint restricts the spending of each technology, which limits the use of each tech. The second constraint clarifies the limits of variables. By our definition of the two variables, the constraint applies. The third constraint specifies aggregation of proportion of all the crops in each field cannot exceed 1, which is logically true. The fourth and fifth constraints apply the requirement of diversity.

The following gives the AMPL output.

ampl: reset;model farmparam.mod;data farm.dat;solve;

CPLEX 12.10.0.0: optimal solution; objective 8619.6444

241 dual simplex iterations (0 in phase I)

ampl: display grow;

: endive romaine sorghum soybeans strawberries wheat

1 0 0.945491 0.0545089 0 0 0

2 0 1 0 0 0 0

3 0 0 0 0 0 1

4 0 0 0 0 0 1

5 1 0 0 0 0 0

6 1 0 0 0 0 0

7 0 1 0 0 0 0

8 0 0 1 0 0 0

9 0 0 0.229979 0 0.770021 0

10 0 0 0 0 1 0

11 0 1 0 0 0 0

12 0 1 0 0 0 0

13 1 0 0 0 0 0

14 0 0 0 1 0 0

15 0 0 0 1 0 0

16 0 0 0 1 0 0

17 0 1 0 0 0 0

18 0 0 1 0 0 0

19 0 0 0 1 0 0

20 0 0 0 1 0 0

;

ampl: display usetech;

usetech [\*,\*,fertilizer] (tr)

: endive romaine sorghum soybeans strawberries wheat

1 0 0 0 0 0 0

2 0 0 0 0 0 0

3 0 0 0 0 0 1

4 0 0 0 0 0 1

5 1 0 0 0 0 0

6 1 0 0 0 0 0

7 0 0 0 0 0 0

8 0 0 0 0 0 0

9 0 0 0 0 0.770021 0

10 0 0 0 0 1 0

11 0 0 0 0 0 0

12 0 0 0 0 0 0

13 1 0 0 0 0 0

14 0 0 0 0 0 0

15 0 0 0 0 0 0

16 0 0 0 0 0 0

17 0 0 0 0 0 0

18 0 0 0 0 0 0

19 0 0 0 0 0 0

20 0 0 0 0 0 0

[\*,\*,labor] (tr)

: endive romaine sorghum soybeans strawberries wheat :=

1 0 0 0 0 0 0

2 0 0 0 0 0 0

3 0 0 0 0 0 0

4 0 0 0 0 0 0

5 0 0 0 0 0 0

6 0 0 0 0 0 0

7 0 0 0 0 0 0

8 0 0 0 0 0 0

9 0 0 0 0 0.770021 0

10 0 0 0 0 1 0

11 0 0 0 0 0 0

12 0 0 0 0 0 0

13 0 0 0 0 0 0

14 0 0 0 0 0 0

15 0 0 0 0 0 0

16 0 0 0 0 0 0

17 0 0 0 0 0 0

18 0 0 0 0 0 0

19 0 0 0 0 0 0

20 0 0 0 0 0 0

[\*,\*,monitoring] (tr)

: endive romaine sorghum soybeans strawberries wheat :=

1 0 0.945491 0.0545089 0 0 0

2 0 1 0 0 0 0

3 0 0 0 0 0 1

4 0 0 0 0 0 1

5 1 0 0 0 0 0

6 1 0 0 0 0 0

7 0 1 0 0 0 0

8 0 0 1 0 0 0

9 0 0 0.229979 0 0.770021 0

10 0 0 0 0 0 0

11 0 1 0 0 0 0

12 0 1 0 0 0 0

13 1 0 0 0 0 0

14 0 0 0 1 0 0

15 0 0 0 1 0 0

16 0 0 0 0.811354 0 0

17 0 1 0 0 0 0

18 0 0 1 0 0 0

19 0 0 0 1 0 0

20 0 0 0 1 0 0

[\*,\*,pollinators] (tr)

: endive romaine sorghum soybeans strawberries wheat :=

1 0 0 0 0 0 0

2 0 0 0 0 0 0

3 0 0 0 0 0 0

4 0 0 0 0 0 0

5 0 0 0 0 0 0

6 0 0 0 0 0 0

7 0 0 0 0 0 0

8 0 0 0 0 0 0

9 0 0 0 0 0.770021 0

10 0 0 0 0 0.481044 0

11 0 0 0 0 0 0

12 0 0 0 0 0 0

13 0 0 0 0 0 0

14 0 0 0 0 0 0

15 0 0 0 0 0 0

16 0 0 0 0 0 0

17 0 0 0 0 0 0

18 0 0 0 0 0 0

19 0 0 0 0 0 0

20 0 0 0 0 0 0

[\*,\*,water] (tr)

: endive romaine sorghum soybeans strawberries wheat :=

1 0 0 0 0 0 0

2 0 0 0 0 0 0

3 0 0 0 0 0 1

4 0 0 0 0 0 1

5 1 0 0 0 0 0

6 1 0 0 0 0 0

7 0 0 0 0 0 0

8 0 0 0 0 0 0

9 0 0 0 0 0.140254 0

10 0 0 0 0 1 0

11 0 0 0 0 0 0

12 0 0 0 0 0 0

13 1 0 0 0 0 0

14 0 0 0 1 0 0

15 0 0 0 1 0 0

16 0 0 0 1 0 0

17 0 0 0 0 0 0

18 0 0 0 0 0 0

19 0 0 0 1 0 0

20 0 0 0 1 0 0

;