





Handout



Discrete Optimization II

15.060: Data, Models, and Decisions

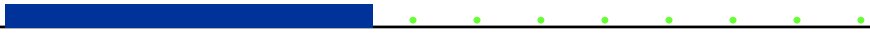
2007



Sloan Course Schedule

- You would like to determine your optimal course schedule for your first two terms at MIT.
- You have created a list of the 20 courses that most interest you, with interest levels from 3 to 5, and you want to maximize your total interest level.

2



Handout

Considerations

- You can only take a class if you have completed or are currently taking all the courses that are pre-requisite for a particular course.
- In the Fall Semester, you must take at least 3 of the following courses: **DMD, Micro-Economics, Finance Theory, Accounting, Business Communication.**
- If you take **Financial Engineering** you can't take **Options and Futures** because the two courses overlap.
- You want to take at least one course in **Marketing** and at least one in **Operations Management.**
- You can't take the same class twice.

3

The Data

Course Number	Course Title	Semester Offered	Course Prerequisites	Interest Level
1	DMD	Fall		5
2	Micro-Economics	Fall		5
3	Finance Theory	Fall and Spring		4
4	Strategy I	Fall		4
5	Strategy II	Spring	4	4
6	Accounting I	Fall		3
7	Accounting II	Spring	2, 6	3
8	Financial Engineering	Spring	1, 3	5
9	Statistics	Spring	1	4
10	Operations Management I	Fall		4
11	Operations Management II	Spring	1, 10	4
12	Marketing I	Fall		3
13	Marketing II	Spring	9, 12	3
14	Options and Futures	Spring	3	5
15	Information Technology I	Fall		4
16	Information Technology II	Spring	15	4
17	Entrepreneurship	Spring	4	4
18	New Product Development	Spring	10,12,17	3
19	Organizational Processes	Fall	4	3
20	Business Communications	Fall		5

4

Robert Freund, David Gamarnik, and Andreas Schulz, course materials for 15.060 Data, Models, and Decisions, Fall 2007. MIT OpenCourseWare (<http://ocw.mit.edu>), Massachusetts Institute of Technology. Downloaded on [DD Month YYYY].

Handout

Formulating the problem

- Let F_1, \dots, F_{20} be binary variables indicating whether or not you take any of the 20 courses during the fall term.
- Similarly, let S_1, \dots, S_{20} be binary variables indicating whether or not you take any of the 20 courses during the spring term
- Let OF_1, \dots, OF_{20} and OS_1, \dots, OS_{20} be binary constants indicating whether each of the classes is offered in the fall and spring terms, respectively
- Finally, let I_1, \dots, I_{20} be the interest level you assigned to each of the 20 courses

5

- Objective: maximize total interest

$$\text{Max } I_1(F_1 + S_1) + \dots + I_{20}(F_{20} + S_{20})$$

- Constraints:

- Cannot take a course twice: $F_1 + S_1 \leq 1, \dots, F_{20} + S_{20} \leq 1$

- Fall course offering: $F_1 \leq OF_1, \dots, F_{20} \leq OF_{20}$

- Spring course offering: $S_1 \leq OS_1, \dots, S_{20} \leq OS_{20}$

- Fall term maximum: $F_1 + \dots + F_{20} \leq 5$

- Spring term maximum: $S_1 + \dots + S_{20} \leq 5$

6

Handout

Constraints (cont.)

- Fall term requirement: $F1 + F2 + F3 + F6 + F20 \geq 3$
- Financial or Options: $S14 + S8 \leq 1$
- Marketing: $F12 + S13 \geq 1$
- O.M.: $F10 + S11 \geq 1$
- Binary: $F1, \dots, F20, S1, \dots, S20 = 0 \text{ or } 1$

7

Constraints (cont.)

- Prerequisites course 5: $S_5 \leq F_4$
- Prerequisites course 7: $S_7 \leq F_2, S_7 \leq F_6$
- Prerequisites course 8: $S_8 \leq F_1, S_8 \leq F_3 + S_3$
- Prerequisites course 9: $S_9 \leq F_1$
- Prerequisites course 11: $S_{11} \leq F_1, S_{11} \leq F_{10}$
- Prerequisites course 13: $S_{13} \leq S_9, S_{13} \leq F_{12}$
- Prerequisites course 14: $S_{14} \leq F_3 + S_3$
- Prerequisites course 16: $S_{16} \leq F_{15}$
- Prerequisites course 17: $S_{17} \leq F_4$
- Prerequisites course 18: $S_{18} \leq F_{10}, S_{18} \leq F_{12}, S_{18} \leq S_{17}$
- Prerequisites course 19: $F_{19} \leq F_4$

8

Handout

The Solution

- The optimal courses to take are **DMD, MicroEco, OM I, Marketing I, and Business Comm** in the fall and **Finance Theory, Stats, OM II, Marketing II, and Options and Futures** during the spring

Course	Value	Course	Value
F1	1	S1	0
F2	1	S2	0
F3	0	S3	1
F4	0	S4	0
F5	0	S5	0
F6	0	S6	0
F7	0	S7	0
F8	0	S8	1
F9	0	S9	1
F10	1	S10	0
F11	0	S11	1
F12	1	S12	0
F13	0	S13	1
F14	0	S14	0
F15	0	S15	0
F16	0	S16	0
F17	0	S17	0
F18	0	S18	0
F19	0	S19	0
F20	1	S20	0

9