Exercises - Section 2: Lecture 7 – Knapsack and Covering Archetypes - Questions

Write mathematical and gurobipy models corresponding to the English problem statements, and solve the gurobipy models.

1. A space launch provider would like to maximize the revenue it gets from the payloads it will carry into orbit on its next launch. However, it cannot launch more than a safe weight. Create and solve an optimization model that can help the launch provider select the set of payloads it will launch.

PAYLOAD	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
REVENUE	$15M	$12M	$9M	$17M	$23M	$3M	$8M	$4M	$10M
WEIGHT	100	80	70	130	250	10	20	30	70

Maximum allowable weight: 350

2. A home flipper (someone who buys old homes, renovates them, and sells them) has a $75,000 budget for renovations on a home, and would like to complete the set of renovations that maximizes the increase in the home's resale value minus renovation cost. Create and solve an optimization model that can help the home flipper decide which renovations to do.

RENOVATION	**COST**	**RESALE VALUE**
New roof	$10K	$12K
New kitchen	$30K	$45K
New bathrooms	$20K	$28K

RENOVATION	**COST**	**RESALE VALUE**
New HVAC	$15K	$18K
New floors	$38K	$70K
Landscaping	$6K	$10K

3. A manager is trying to decide which of eight people to put on a new project team. The manager needs the team to have at least one person with each of the key skills/knowledge, but would like to minimize the number of people on the team. Create and solve an optimization model that can help the manager select the set of team members to put on the new project.

SKILL/KNOWLEDGE	PEOPLE
Analytics/data science modeling	2,3,6
Computer vision	1,4,6
Creating presentations	2,5,8
Data wrangling	2,4,5,6,7
Deep learning	1,3,4,6,7
Giving presentations	2,3,6,8
Natural language processing	1,5,7,8
Optimization	2
Project management	4,5,8
Python coding	1,2,4,6,7,8
Software engineering	3,4,7
Visualization	3,4,5,6,7,8
Writing reports	2,5,8

4. A student at a certain university is required to take courses from nine different core areas, and would like to minimize the number of courses needed by applying some courses to more than one area (for example, a course in Mathematical Writing might count for both the Math area and the Writing area). Create and solve an optimization model that can help the student select from the course options below.

AREAS
A – Writing
B – Math
C – Computing
D – History
E – Economics
F – Ethics
G – Science
H – Civics
I – Literature
J – International

COURSE	AREAS
American History and Government	A,D,H
Ancient World History	D,J
Bioethics in Science Fiction	A,F,G,I
Calculus for Science Applications	B,G
Computational Complexity	B,C
Computational Voting Theory	C,H
Contemporary Social Issues	A,F
Economic Development of the World	A,D,E,J
Economic History of the US	D,E
History and Technology in the Works of Neal Stephenson	B,C,D,I
Impact of Bitcoin Mining Around the World	A,C,E,F,J
Mathematical Modeling of Social Issues	B,F,H
Space, Time, and Reality	A,F,G
Thomas Sowell: Writings and Biographies	A,D,E,I,J

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