1. True/False: For each of the problem, state whether it is true or false.
    a. Fixed cost problem is a common example of mixed integer programming.
    b. Mutually exclusive constraints require both variables to be included or excluded at the same time.
    c. A multiple choice constraint involves selecting k out of n alternatives where k ≥ 2.
    d. Mixed integer problems are harder to solve than the general linear programming problems with continuous variables.

2. Stacey is forming a team to develop a new product for her company. To ensure that her team incorporates a diverse range of viewpoints, she has been allowed to select team members from across three departments. After speaking with several other managers, Stacey has identified 10 potential team members:

Name	Department	Years	Gender	Commitment
Alvin	Marketing	6	Male	5
Bernie	Accounting	4	Female	9
Carlos	Engineering	5	Male	6
Drew	Marketing	10	Male	5
Elena	Engineering	3	Female	7
Fiona	Marketing	8	Female	10
Guillaume	Accounting	6	Male	8
Hilda	Accounting	7	Female	5
Isabel	Marketing	4	Female	7
Jing	Engineering	6	Female	9

The Commitment score for each person is Stacey's estimate, on a scale of 1-10, of how committed the person would be to the project. The "Years" column shows how many years of experience the person has.

Using the three steps, formulate an optimization model using binary decision variables to help Stacey form a team that will maximize the total commitment level subject to the follow constraints:

- The team must have exactly five members.
- The team must have at least one member from each of the three departments (Marketing, Engineering, and Accounting).
- The average of the number of years of experience of the team members must be at least 6.
- The team must have at least two women.
- The team must have at least two men.
- If Jing is chosen for the team, Guillaume must also be chosen.
- Bernie and Hilda can't both be chosen.
- Alvin and Drew must either both be chosen or both left off.

3. The office manager of a large New York City-based accounting firm needs to replace the aging and out-of-style office furniture in their New York offices. The firm has decided to purchase desk/chair/credenza furniture sets for all 2,000 offices in New York. The company has received bids from four different furniture companies who are willing to supply the furniture sets, as follows:
Carolina Woodworks has bid to deliver up to 1,000 furniture sets at a cost of $2,500 per set and with a one-time charge of $10,000.
Nashawtuc Millworks has bid to deliver up to 1,200 furniture sets at a cost of $2,450 per set and with a one-time charge of $20,000.
Adirondack Furnishing Designs has bid to deliver up to 800 furniture sets at a cost of $2,510 per set with no additional charges.
Lancaster Artisan Company has bid to deliver up to 1,100 furniture sets at a cost of $2,470 per set and with a one-time charge of $13,000.

   a) Formulate a mixed integer optimization model that could be used to determine how many furniture sets to purchase from each of the four potential suppliers in order to minimize cost. Make sure to follow the three steps clearly.
   b) Use Excel to find the optimal solution. Turn in your spreadsheet.
   c) In your Word/ PDF file, report how many furniture sets to order from each supplier.
   d) In your Word/ PDF file, report what the total cost will be.

4. The Marketing Department is deciding which classes to offer over the summer. The classes under consideration are:

Course	Type
Introduction to Marketing	Required
Retail Marketing Management	Elective
Marketing High Technology	Required
Business Logistics	Elective
International Marketing	Elective
Marketing Research	Required

They are using an optimization model to determine which classes to offer. They have already formulated the objective function and need your help with the constraints.
(a) Define binary decision variables to use to make the following constraints.
Formulate the following constraints:
(b) They would like to offer exactly 4 classes.
(c) They want to offer at least one required classes.
(d) They want to offer at most two electives.
(e) The same professor teaches both Retail Marketing Management and Marketing High Technology, so they can't offer both courses.
(f) If they offer Marketing Research, they must also offer International Marketing.

5. A power plant has three boilers. If a given boiler is operated, it can be used to produce a quantity of steam (in tons) between the minimum and maximum given in Table 1. The cost of producing a ton of steam on each boiler is also given. Steam from the boilers is used to produce power on three turbines. If operated, each turbine can process an amount of steam (in tons) between the minimum and maximum given in Table 2. The cost of processing a ton of steam and the power produced by each turbine is also given.

Table 1: Boilers Capacity

Boiler Number	Minimum Steam	Maximum Steam	Cost/Ton ($)
1	500	1000	10
2	300	1900	18
3	400	1800	16

Table 2: Turbines Capacity

Turbine Number	Minimum	Maximum	Kwh per ton of Steam	Processing Cost/Ton ($)
1	300	600	4	2
2	500	800	5	3
3	600	900	6	4

Formulate an IP that can be used to minimize the cost of producing 8,000 kwh of power. Make sure to follow the three steps correctly. **Hint:** Especially make sure to understand the number of variables and how to link them in the constraints.