Read the following scenario and apply the three elements (decision variables, Objective Function, Constraints) to formulate an optimization model.

**Scenario:**

Apollo Industries manufactures luxury cars. The organization targets men and women with high incomes. Apollo’s senior executives have decided to invest in a substantial marketing campaign. The campaign will have a special focus on television advertising. Apollo will purchase a currently unknown number of commercial spots for real estate and travel shows.

Apollo has the following targets and costs for the campaign:

* Fifteen million women and 8 million men are to see each real estate commercial.
* Two million women and 12 million men are to see each travel commercial.
* Real estate ad cost: $18,500.
* Travel ad cost: $29,500.

Apollo wants at least 17 million women and 20 million men to view the commercials, and management wants to use linear programming to determine how to meet its advertising targets at minimum cost. The task is to formulate an optimization model to determine the minimum cost advertising campaign. Your formulation should have the following components:

1. **Decision variables**(As a manager, what decisions do you need to make?)
2. **Objective function** (Which metric do you want to improve, and in what direction? Up or down?)
3. **Constraints** (What requirements do your decisions need to satisfy?
4. **The Decision Variables**

Decide the number of commercials to buy for each type of show.

Using the variables:

|  |  |
| --- | --- |
| x | number of **real estate** commercials |
| y | number of **travel** commercials |

1. **Objective Function**

You want to **minimize total advertising cost**.

|  |  |
| --- | --- |
| Commercial Type | Cost |
| Real estate | **18,500** |
| Each travel | **29,500** |

So, the objective function is:

**Minimize** 18,500x + 29,500y.

1. **Constraints**

Commercials must reach at least:

|  |  |
| --- | --- |
| Target Audience | Reach |
| Men | **17 million** |
| Women | **20 million** |

Based on reach per commercial:

|  |  |  |
| --- | --- | --- |
|  | Women Reached | Men Reached |
| Real Estate | 15 million | 8 million |
| Travel | 2 million | 12 million |

So, the constraints are:

|  |  |
| --- | --- |
| Women Constraint | 15x + 2y >= 17 |
| Men Constraint | 8x + 12y >= 20 |
| Non-Negativity | x >= 0, y >= 0 |

And if commercials must be whole numbers, we could add x, y ∊ Z+

**Final Model Summary**

• **Decision Variables**

|  |  |
| --- | --- |
| x | number of **real estate** commercials |
| y | number of **travel** commercials |

• **Objective Function**

Minimize 18,500x + 29,500y.

• **Constraints**:

|  |  |
| --- | --- |
| 15x + 2y | >= 17 (women reached) |
| 8x + 12y | >= 20 (men reached) |
| x, y | > 0 and integers (if needed) |