Statement of the problem:

Nurses in a hospital							
Days of the week	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Number of nurses needed	>= 17	>= 13	>= 15	>= 19	>= 14	>= 16	>= 11

- They work 5 days in row with 2 days off

Linear programming formulation

- ***Variables*** – We define seven variables, each variable coresponding to a shift. Because we are talking about people, our variables must be integers. For a maximization LP, any feasible solution gives a lower bound on the optimal value. We want the highest lower bound possible (i.e. the lower bound closest to the optimal value).
- **Constraints** – They work 5 days in row with 2 days off, and we cannot have less than a certain number of nurses at work, as fallowing:
  - "Shift one Monday to Friday", >= 17
  - "Shift two Tuesday to Saturday" ,6 >= 13
  - "Shift three Wednesday to Sunday", 7 >= 15
  - "Shift four Thursday to Monday", >= 19
  - "Shift five Friday to Tuesday", >=14
  - "Shift six Saturday to Wednesday", >= 10
  - "Shift seven Sunday to Thursday", >= 11
- ***Objective*** – our task is to minimize the number of nurses that we hire.
- The ***basic assumptions*** are:
  - There won't be missing days at work;
  - All the data/numbers given are accurate;
  - They will be eager to adopt the given shift pattern;

Now, let's understand the code step by step:

- **Line 1-2:** First import the library pulp as p.
- **Line 4-5:** Define the problem by giving a suitable name to our problem, I have chosen the name 'Nurses'. Also, I specified our aim for the objective function of Minimize.
- **Line 7-14:** Define LpVariable to hold the variables of the objective functions. The next argument specifies the lower bound of the defined variable, 0, and the upper bound is none by default.
- **Line 16-17:** Denotes the objective function in terms of defined variables.
- **Line 19-26:** These are the constraints on the variables.
- **Line 28-29:** This will show you the problem in the output screen.

- **Line 31-32:** This is the problem solver.
- **Line 34-35:** Will display the status of the problem.
- **Line 37-38:** Will print the final solution, represented by minimum number of nurses that we need.

  Results: The optimum number of nurses that we need to hire to satisfy our conditions is 21.