Case Study #2: Scheduling in Emergency Department

After evaluating the arrivals of patients to an emergency department of the Dublin Hospital, the medical director identified the number of doctors needed per each time period. Now, she needs to develop an optimal schedule of doctors assigned to the emergency department.

Time	Minimum Number of Doctors
9 am - 2 pm	8
2 pm - 6 pm	6
6 pm - 12 am	10
12 am - 9 am	5

Each time period may be covered by staff attendants (full-time doctors) and medical interns (part-time doctors) that just finished their medical programs. The attendants have three shifts of 8 hours each, starting from 8 am, 4 pm and 12 am. The interns' schedule includes two 12-hour shifts starting from 8 am and 8 pm. The hourly cost is $140 per attendant and $42 per intern. Help the medical director to identify the optimal schedule of attendants and interns in the emergency department.

Questions.

1. Formulate an integer programming model that can be used to develop a schedule that will satisfy customer service needs at a minimum total daily cost.

2. Create a spreadsheet model using the formulation from question 1. Solve the model using Excel Solver for the optimal schedule of attendants and interns. Present the optimal schedule and comment on the solution. Will this optimal solution be appropriate for the emergency department? Explain.

3. After reviewing the solution in question 2, the medical director has realized that some additional requirements must be incorporated into the schedule. Specifically, she wants to ensure that at least two attendants are working at any 8-hour shift. She also wants to hire no more than 7 interns in each of the 12-hour shift. Provide the mathematical formulation of the additional constraints and incorporate these constraints into the spreadsheet model from question 2. Solve the revised model, present and explain the new optimal schedule, and compare it with the optimal schedule in question 2.

4. For the optimal model in question 3, use SolverTable to analyze the effect of changing the minimum number of attendants (doctors) from 9 am - 2 pm (currently equal to 8) from 2 to 15 (with an increment of 1) on the minimum total cost, and number of attendants and interns in respective time shifts. Present and briefly explain the results of your sensitivity analysis.

5. For the optimal model in question 3, provide a two-way sensitivity analysis using SolverTable for parameters of your choice. Present and briefly explain the results of your sensitivity analysis.