Assignment 2

Please use Excel solver to solver the questions below.

# Question 1

1. A gear manufacturer is planning next week’s production run for four types of gears. If necessary, it is possible to outsource any type of gear from another gear company locate nearby. The following table and the table at the bottom of this page (Chapter 3 problem 8 in the textbook)) show next week’s demand, revenue per unit, outsource cost per unit, time (in hours) required per unit in each production process, and the availability and costs of these processes. The nearby company can supply a maximum of 300 units of each type of gear next week. What should be the production and/or outsource plan for the next week to maximize profit?

| Gear Type | Gear A | Gear B | Gear C | Gear D |
| --- | --- | --- | --- | --- |
| Demand | 400 | 500 | 450 | 600 |
| Revenue | $12.50 | $15.60 | $17.40 | $19.30 |
| Outsource | $7.10 | $8.10 | $8.40 | $9.00 |

| Process | GearA | GearB | GearC | GearD | Hours Available | Cost per hour |
| --- | --- | --- | --- | --- | --- | --- |
| Forming | 0.3 | 0.36 | 0.38 | 0.45 | 500 | $9.00 |
| Hardening | 0.2 | 0.3 | 0.24 | 0.33 | 300 | $8.00 |
| Deburring | 0.3 | 0.3 | 0.35 | 0.25 | 310 | $7.50 |

*I used Excel Solver to determine the best mix of in-house production and outsourcing for four types of gears, aiming to maximize profit while staying within demand and resource constraints (forming, hardening, and deburring hours). I defined decision variables for both produced and outsourced units and created constraints based on available hours and maximum outsourcing limits.*

* ***Gear A****: Fully produced in-house (400 units), no outsourcing.*
* ***Gear B****: 200 units produced, 300 outsourced (max allowed).*
* ***Gear C****: Only about 52 units produced, no outsourcing.*
* ***Gear D****: Around 447 units produced, no outsourcing.*

*This plan meets all gear demands and stays within resource limits. Gear B hit the 300-unit outsourcing cap, helping balance production time. Gear C’s low production suggests it’s less profitable or more resource-heavy.*

**Implications & recommendation:**

**The labor cost formula didn’t calculate correctly, showing zero labor cost and profit. Once fixed, the model will give a true profit value. I'd recommend reviewing the cost structure and rerunning Solver to confirm profitability before finalizing the production plan.**

# Question 2

1. A nursing home employs attendants who are needed around the clock. Each attendant is paid the same, regardless of when his or her shift begins. Each shift is 8 consecutive hours. Shifts begin at 6 A.M., 10 A.M., 2 P.M., 6 P.M., 10 P.M. and 2 A.M. The following table shows the nursing home’s requirements for the numbers of attendants to be on duty during specific time periods. (Chapter 3 problem 18 in the textbook)
2. What is the minimum number of attendants needed to satisfy the nursing home’s requirements?

*The goal was to find the least number of attendants needed to meet all shift requirements. Using Solver, we found that* ***73 attendants*** *is the minimum needed to cover every time block throughout the day.*

**Implications:**

**This gives the nursing home a staffing baseline that meets coverage needs without unnecessary labor.**

1. The nursing home would like to use the same number of attendants determined in part (a) but would now like to minimize the total salary paid. Attendants are paid $16 per hour during 8 A. M. – 8 P.M., and a 25% premium per hour during 8 P.M. – 8 A.M. How should the attendants now be schedules?

*The attendants should be scheduled in a way that minimizes the number of night shift attendants because they are paid at the higher rate and maximize the use of day shift attendants that are paid at the lower rate.*

*Shift A: 8*

*Shift B: 19*

*Shift C: 0*

*Shift D:11.5*

*Shift E: 29*

*Shift F: 0*

**Recommendation:**

**Keep most attendants on daytime shifts when possible, especially during budget constraints. Avoid late-night shifts unless demand increases significantly.**

| SHIFT | TIME | NUMBER of ATTENDANTS |
| --- | --- | --- |
| A | 2-6 A.M. | 8 |
| B | 6-10 A.M. | 27 |
| C | 10 A.M. – 2 P.M. | 12 |
| D | 2-6 P.M. | 23 |
| E | 6-10 P.M. | 29 |
| F | 10 P.M. – 2 A.M. | 23 |

# Question 3

1. A political candidate is planning his media budget for an upcoming election. He has $90,500 to spend. His political consultants have provided him with the following estimates of additional votes as a results of the advertising effort: (Chapter 3 problem 12 in the textbook)

* For every small sign placed b the roadside, he will garner 10 additional votes
* For every large sign placed by the roadside, he will garner 30 additional votes
* For every thousand bumper stickers placed on cars, he will garner 10 additional votes
* For every hundred personal mailings to registered voters, he will garner 40 additional votes, and
* For every radio ad heard daily in the last month before the election, he will garner 485 additional votes

The costs of each of these advertising devices, along with the practical minimum and maximum that should be planned for each, are shown on the following table. How should the candidate plan to spend his campaign money?

| Advertising Medium | Cost | Minimum | Maximum |
| --- | --- | --- | --- |
| Bumper stickers(thousands) | $30 | 40 | 100 |
| Personal mailings(hundreds) | $81 | 500 | 800 |
| Radio ads (per day) | $1000 | 3 | 12 |
| Small road side signs | $25 | 100 | 500 |
| Large road side signs | $60 | 50 | 300 |

*With a $90,500 budget, the candidate’s goal was to get as many votes as possible through ads. Solver recommended this spending plan: 40,000 bumper stickers, 800 personal mailers, 4 radio ads per day, 100 small road signs, and 300 large road signs. This plan stays within budget and hits all the required ad limits while maximizing voter impact.*

**Implications & recommendation:**  
**Radio ads and large signs generate the most votes per dollar. I'd recommend keeping those at high levels in future campaigns. Mailings also play a major role and should be prioritized if the budget allows.**