Based on the stated model, the Excel screen capture and the sensitivity results shown, answer the following (1.5 points per question):

1. **Explain why this problem can be modeled using the given LP. Make sure to explain the meaning of the decision variables and constraints.**

- The constraint is: *min* 200x1 + 100x2 + 40x3 based on the prices of a ton of pulp, recycled office paper, and recycled newsprint paper. We want to minimize the sum of these in order to reduce our costs.

There are four processes,

**b) What is the marginal cost of production at optimality?**

- We are producing Paper, and the shadow price of Paper is 800. Producing an additional ton of paper costs $800.

**c) How much extra amount (beyond $200) should we be willing to pay to obtain an additional ton of pulp?**

- We would be willing to pay a maximum amount of $400 for an extra ton of pulp.

**d) How much will the optimal cost change if the price of pulp is increased to $300 per pulp?**

­- The optimal solution will not change because the increase is within the Allowable range, however, the cost of an extra ton of pulp will go up 300-200 = 100 \* 80.00 = $8,000.

**e) How much will the optimal cost change if the price of recycled office paper is decreased to $40 per ton? If you cannot determine the exact value, try to find a lower bound for it.**

- We cannot tell because the change (-$60) is above the allowable decrease. The lower-bound limit is -$50 where the cost would decrease cost by 480\*50= $24,000. If the price of recycled office paper is decreased to $40, the reduction can be *at least* 480\*60 = $28,800.

**f) How much will the optimal cost change if the price of recycled office paper is increased to $150 per ton? If you cannot determine the exact value, try to find a lower and an upper bound for it.**

- We cannot tell, but if the price of recycled office paper increases to $120, price will increase by 480\*20 = $9,000. If the price of recycled office paper increases to $150, the price increase can be *at least* 480\*50 = $24,000.

**g) How much will the optimal cost change if the number of tons of paper required decreased to 60? If you cannot determine the exact value, try to find a lower and an upper bound for it.**

- We cannot tell, but if paper required drops to 80 tons, the cost would decrease 800\*20 = $16,000. If the amount of paper required dropped to 60, cost would decrease by *at least* 40\*800 = $32,000.

**h) How much will the optimal cost if the number of tons of new paper needed increased to 200?**

- The allowable increase is 1x1030, therefore, 100\*800 would be the new optimal cost = $80,000.

**i) How cheap recycled newsprint would have to become before the primal solution could change.**

-Recycled Newspaper would have to drop $6.68 for the solution to change.

**j) An experimental new process will use 6 tons of newsprint and an undetermined number α tons of recycled office paper. How low would α have to be for the new process to be competitive with existing one?**

Alpha would have to be 5.6. If we solve the linear equations where y5 ­is present for constraints 2, 3, and 4. We would arrive at the final equation: 0-100(-**α**) -40(-6) – 800(1) <= 0 . >>> 100(**α**) <= 560.

**k) Would a limit of 400 tons on recycled office paper change the optimal solution?**

- No, recycled office paper has an allowable decrease of 480. The optimal solution would not change.

**l) Would a limit of 400 tons on recycled newsprint change the optimal solution?**

- Yes, the allowable decrease for recycled newsprint is 0. Any decrease will change the optimal solution.