Midterm

Prescriptive Analytics

2024

Instruction

Grading

This midterm is optional. Please put the following letter in the top right corner of your answer sheet:

- N: the grade of the midterm will not be considered
- Y: the grade of the midterm will be considered and will substitute the attendance grade

Answers

There is one and only one correct answer.

- Each correct answer is worth 1pt.
- Each incorrect answer is worth -0.5 pts.
- Each blank answer is worth 0 pts.

Question 1:

The plot below represents a sensitivity analysis of a dependent variable `Net Profit` versus two independent variables `Proportion of Supers(%)` and `Demand`.

The sensitivity of the `Net Profit` to `Proportion of Supers(%)` is...

(a) Higher when the `Demand` is higher

(b) Lower when the `Demand` is around `150000` than when `Demand` is around `250000`

(c) Equal to the sensitivity to `Demand`

(d) Higher when the `Demand` is around `150000` than when the `Demand` is around `50000`

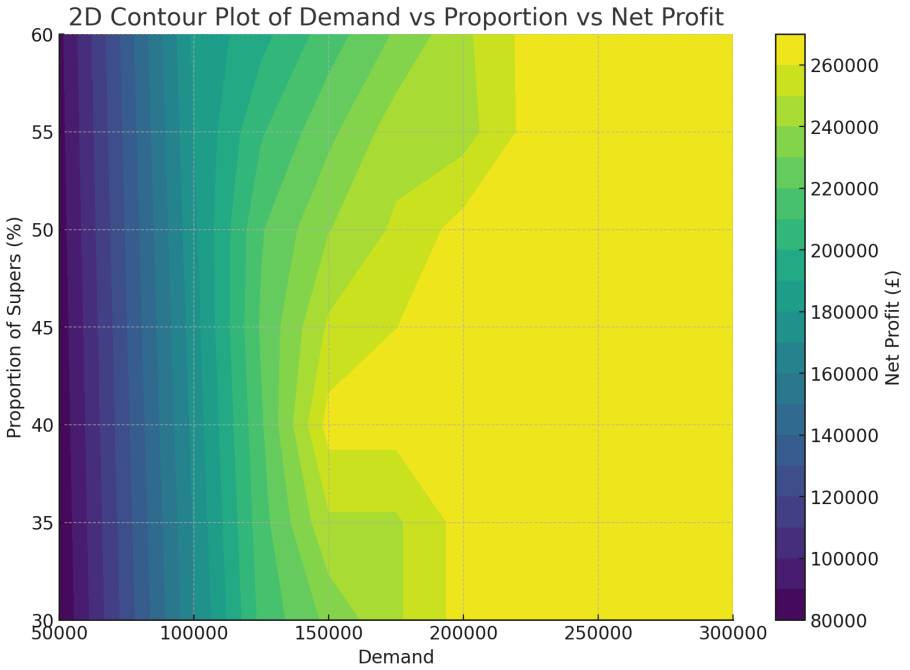

Figure 1: Question 1

Question 2

The plot below shows the cumulative distribution function of the output variable of the profit of the Wellyntoy company.

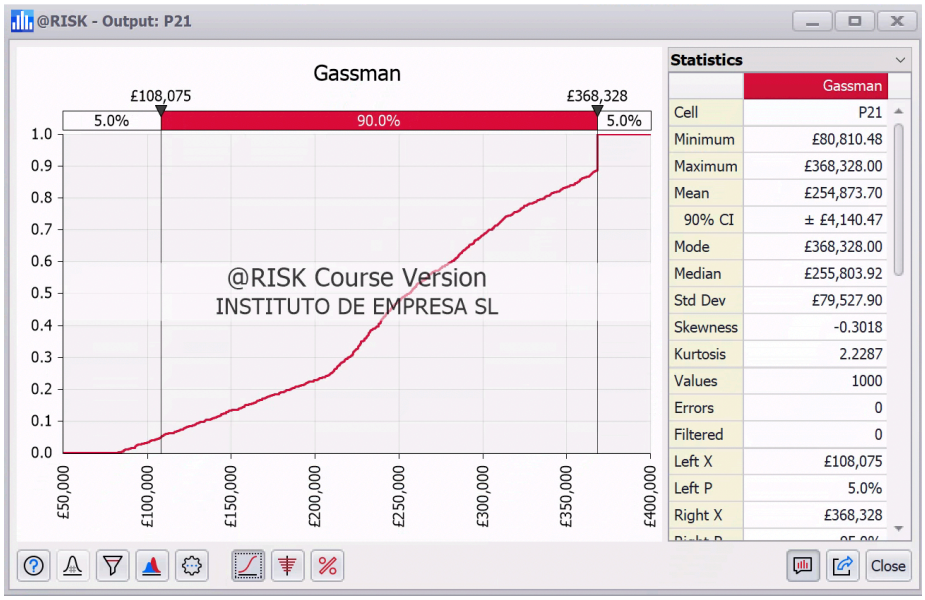

Figure 2: Question 2

Choose the correct statement:

(a) There is a 90% probability that the profit is £328,328

(b) There is a 5% probability that the profit is between 0 and £108,075

(c) There is a 5% probability that the profit is below 0.9 (approx.)

(d) There is a 30% probability that the profit is £225,000 (approx.)

Question 3

Choose the correct statement:

(a) There is a 90% probability that the profit is £357,328

(b) There is a 5% probability that the profit is £54,465

(c) There is a 90% probability that the profit is between £54,465 and £357,328

(d) There is a 5% probability that the profit is £50,000 (approx.)

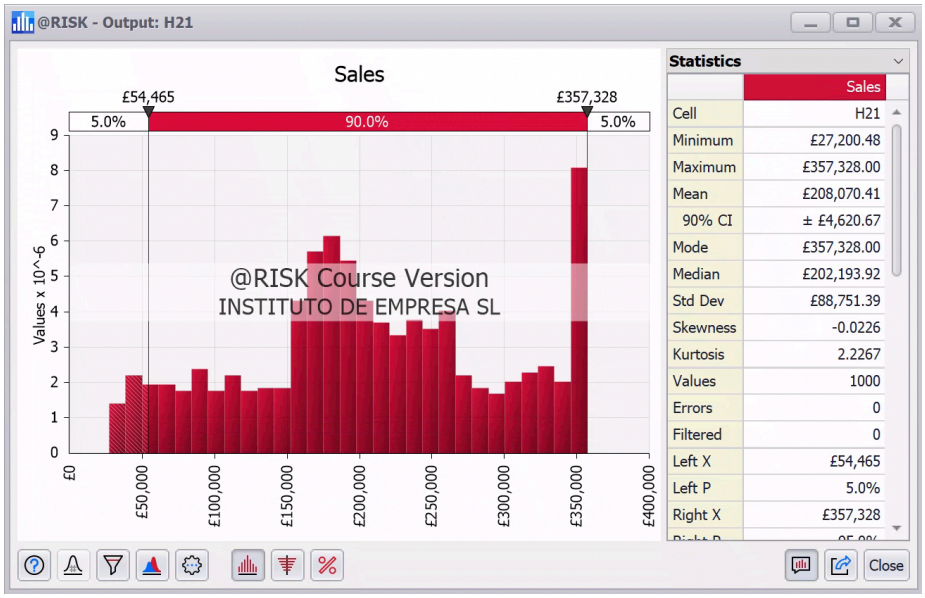

Figure 3: Question 3

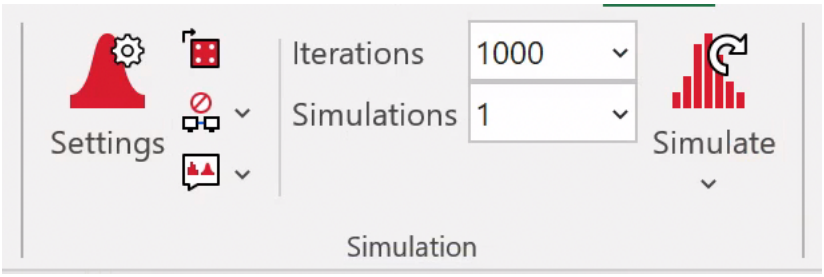

Figure 4: Question 4

Question 4

What does this represent?:

(a) 1,000 Monte Carlo simulations
(b) A Monte Carlo simulation with 1,000 draws from each input random variable
(c) 1,000 iterations of a linear programming
(d) A Monte Carlo simulation with 1,000 iterations, each with 1,000 random variables

Question 5

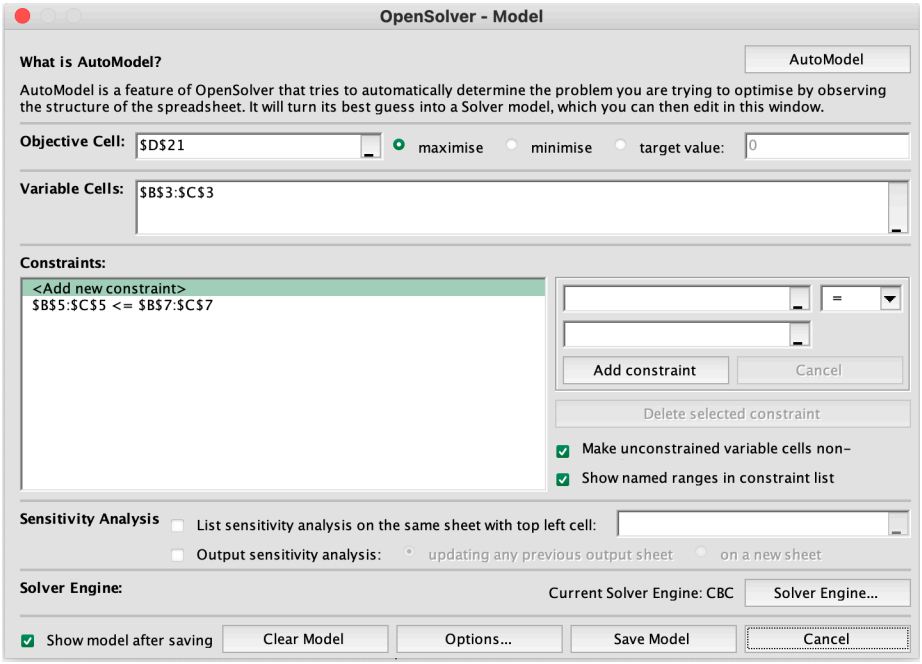

Figure 5: Question 5

Which one is correct?

(a) The model has several decision variables
(b) The model has a single constraint
(c) The model tries to maximize the error between cell D21 and the target value
(d) The model is not using Simplex as Solver

Question 6

Which one is false?

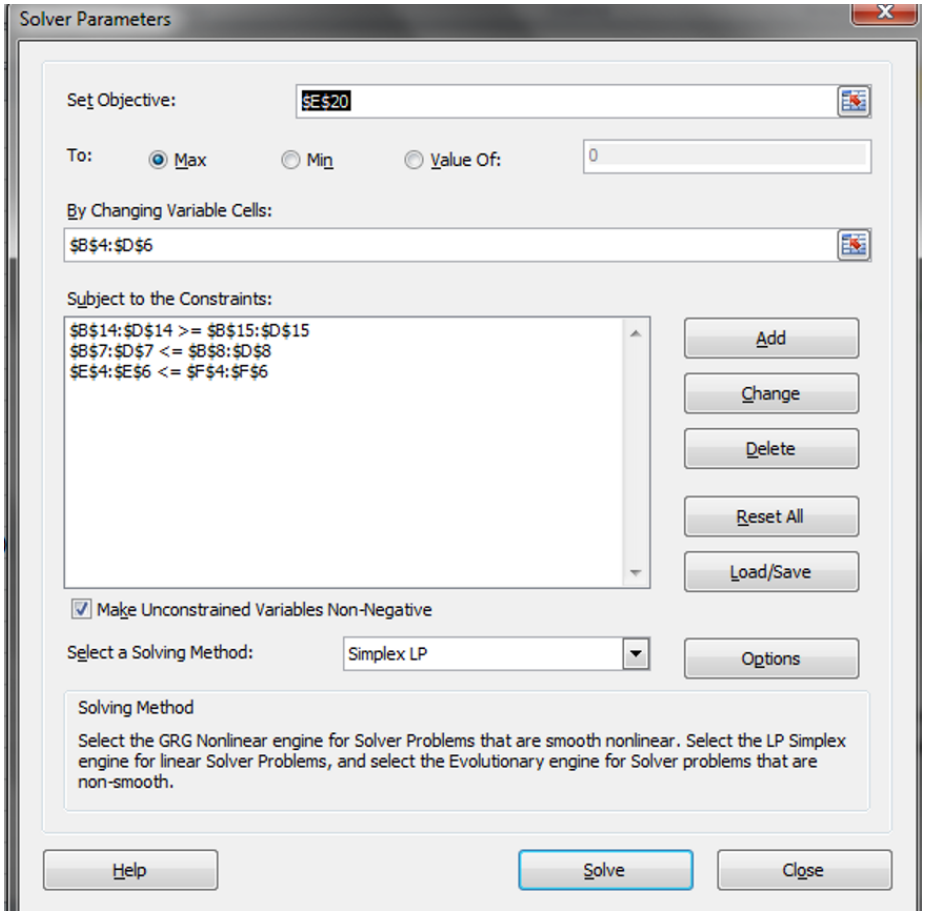

Figure 6: Question 6

(a) The model has several sets of constraints
(b) The models assumes that this is a linear programming problem
(c) The model has several objective functions
(d) The model takes six decision variables

Question 7

RED BRAND CANNERS					
MIX DECISION	**Whole**	**Juice**	**Paste**	**Total Required**	**Available**
Grade A	239	125	0	364	≤ 364
Grade B	80	375	1,000	1,455	≤ 1,455
Total Production	318	500	1,000		1,818
Demand	≤ 600	500	1,000		
QUALITY	**Whole**	**Juice**	**Paste**	**Quality**	
Grade A	2,148	1,125	0	9	
Grade B	398	1,875	5,000	5	
Total Quality	2,545	3,000	5,000		
Required Total Quality	≥ 2,545	3,000	5,000		
Average Quality	8.0	6.0	5.0		
Required Average Quality	8.0	6.0	5.0		
PROFIT	**Whole**	**Juice**	**Paste**	**Total Contribution**	**Profit**
Contribution Margin	$247	$198	$222	$399,591	max $72,318

Figure 7: Question 7 and 8

Which one is correct?

(a) The multiple-cell boxes highlight the decision variables
(b) The single-cell box highlights the decision variables
(c) The pink shades highlight the constraints
(d) The horizontal boxes highlight a constraint

Question 8

Which one is correct?

(a) The demand of juice seems to be not binding
(b) The demand of whole tomatoes seems to be not binding
(c) The available A tomatoes seems to be not binding
(d) The quality of whole tomatoes seems to be not binding

Question 9

Choose the correct one (don't worry about the units or the converstion to 1,000s):

(a) Increasing the production of grade A tomatoes would bring a benefit of 600

OpenSolver Sensitivity Report - CBC
Worksheet: [RBC Lecture.xlsx] Model Sensitivity
Report Created: 23/9/24 22:35:41

Decision Variables

Cells	Name	Final Value	Reduced Costs	Objective Value	Allowable Increase	Allowable Decrease
B4	Grade A Whole	525	0	247	462.6666669	65.3333334
C4	Grade A Juice	75	0	198	65.33333342	462.6666669
D4	Grade A Paste	0	-98	222	98	1E+100
B5	Grade B Whole	175	0	247	1388.000001	65.33333342
C5	Grade B Juice	225	0	198	43.1111112	154.2222223
D5	Grade B Paste	2000	0	222	1E+100	48.5000001

Constraints

Cells	Name	Final Value	Shadow Price	RHS Value	Allowable Increase	Allowable Decrease
B12>=B13	Total Quality Whole	0	-24.5	0	466.6666667	600
C12>=C13	Total Quality Juice	0	-24.5	0	1400	200
D12>=D13	Total Quality Paste	0	0	0	0	1E+100
B6<=B7	Total Production Whole	700	0	14400	1E+100	13700
C6<=C7	Total Production Juice	300	0	1000	1E+100	700
D6<=D7	Total Production Paste	2000	48.5	2000	200	466.6666667
E4<=F4	Grade A Total Required	600	271.5	600	600	466.6666667
E5<=F5	Grade B Total Required	2400	173.5	2400	466.6666667	200

Figure 8: Question 9

(b) Increasing the production of grade B tomatoes would bring a benefit of 2,400
(c) Increasing the production of grade A tomatoes would bring a benefit of 271.5 for at least 600 additional tomatoes
(d) Increasing the production of grade B tomatoes would bring a benefit of 173.5 for at least 200 additional tomatoes

Question 10

Which one is false?

(a) the b coefficients are the decision variables
(b) Z is the objective function
(c) the a coefficients are part of the definition of the constraints
(d) the b coefficients are the shadow prices

Maximize:

$$Z = C_1X_1 + C_2X_2 + \cdots + C_nX_n$$

Subject to:

$$\begin{aligned} a_{11}X_1 + a_{12}X_2 + \cdots + a_{1n}X_n &= b_1 \\ a_{21}X_1 + a_{22}X_2 + \cdots + a_{2n}X_n &= b_2 \\ &\vdots \\ a_{m1}X_1 + a_{m2}X_2 + \cdots + a_{mn}X_n &= b_m \end{aligned}$$

With:

$$X_1, X_2, \ldots, X_n \geq 0$$
$$b_1, b_2, \ldots, b_m \geq 0$$

Figure 9: Question 10