SOLUTION KEY

National University of Computer and Emerging Sciences, Lahore Campus



Course Name:	Operations Research	Course Code:	MT4031
Degree Program:	BS Computer Science	Semester:	Spring 2023
Exam Duration:	60 Minutes	Total Marks:	20
Paper Date:	10.04.2023	Weight	20
Section:	ALL	Page(s):	03
Exam Type:	Mid-2 Exam		

Student: Name:

Roll No.

Section:

Instruction/Notes: Attempt all questions. Programmable calculators are not allowed.

The answer sheet is NOT required, Paper must be solved in the given space on the question paper.

QUESTION # 1: Given the LP problem:

Maximize: $Z = 2X_1 + 1.5X_2$

Subject to:

 $3X_1 + 4X_2 \le 1000$ (Cast Irons Constraint)

 $6X_1 + 3X_2 \le 1200$ (Labor Hours Const.)

≤ 180 (Model-A Production Cont.)

 $X_1, X_2 \ge 0$

and the following Excel Solver output

Adjustable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
\$G\$6	Quantity Produced: Model-A	120	0	2	1	0.875
\$H\$6	Quantity Produced: Model-B	160	0	1.5	1.166666667	0.5

Constraints

		Final	Shadow	Constraint	Allowable	Allowable
Cell	Name	Value	Price	R.H. Side	Increase	Decrease
\$1\$9	Cast Irons: TOTAL	1000	0.2	1000	600	300
\$1\$10	Labor Hour: TOTAL	1200	0.233333333	1200	225	450
\$1\$11	Model-A Production: TOTAL	120	0	180	1E+30	60

Answer the following questions:

1. What is the optimal solution and optimal value for the problem?

Optimal Solution:

Z = 2*X1+1.5*XL = 2*120+1.5*160

= 240 + 240 = 480

2. What is the impact on the optimal solution and optimal value if we decrease the cost coefficient C1=2 to 1.5? Why?

As allowable decrease in C1 is 0.875, we can decrease it upto (2-0.875=1.125) 1.125. So 2 to 1.5 decrease is feasible.

1. optimum solution will be same (still producing same amount of x, & xe).

2. optimum value is changed because coefficient of X1 is decreased from 2 to 1.5. New optimal value:

Z=1.5 *120 +1.5 * 160

=180 +240 = 420

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3. What is the shadow price for the Cast Iron (RHS # 1)? How do you interpret it?

Shadow Price of Cast Iron = 0.2

Shadow price is the unit worth of resource (Constraint 1 in this case)

I we increase decrease in R.H.s by 1 unit, 2 unit increase decrease by 0.20.

4. What is the shadow price for the Model-A Production (RHS # 3)? How do you interpret it?

Snadow Price for Model-A production = 0
means resource 3 is not fully utilized, some slack amount of this resource
is available (Associated constraint is non-binding.

of we want to add some additional amount, we donot need to pay for it.
(we already have this resource

5. What is the impact on the optimal value if we decrease the right-hand side of constraint-1 (Cast Iron) by 30?

As shadow price/unit worth of resource 1 is 0-2.

If we decrease it by 30 units.

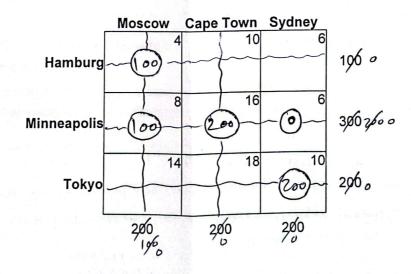
So, 30+0.2=6

New optimal value will be \$ ' Z=480 -6=474

QUESTION # 2: Consider the transportation problem shown below.

(10)

Initial Start: Use the "Northwest Corner Rule" to form an initial basis for this problem.



educed Shipping Costs:

- a. Calculate the value of v1 below.
- b. Calculate the <u>reduced cost</u> for cell Minneapolis-Cape Town.
 (Note that reduced costs for other non-basic cells are shown in brackets [] below.)

$u_1 + V_1 = 4$		Moscow	Cape Town	Sydney	
$0 + V_1 = 4$ $0 + V_1 = 4$ $\boxed{V_1 = 4}$	Hamburg	100	[0]	[4]	u ₁ = 0
$C_{22} - U_2 - V_2 = 16 - 4 - 10 = 2$	Minneapolis	100	[2]	200 ⁶	u ₂ = 4
	Tokyo	[2]	18 200	0	u ₃ = 8
	_	v ₁ = 🗆 4	v ₂ = 10	v ₃ = 2	

c. Assuming that this is a cost minimization problem, which non-basic route would you next bring into the basis (ship through) to further reduce costs? Briefly explain.

As reduced Costs of all non-basic cells are positive,

$$241 = 100$$
 optimal 2:
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