Quiz 1 (75 minutes)

Date: February 26 Instructor: Trani

Open book and notes, use of computer is allowed

Honor Code Pledge

The information provided in this exam is my own work. I have not received information from another person while doing this exam.

Your Name : A. Trani

Solution Sheet

Problem 1 (30 Points)

The data provided in the spreadsheet (see Table 1) contains the aircraft fleet information for two major airlines: Star Airlines and Challenger Airways. Both are in the process of merging into a single airline to be operated under the name Star Airline Inc.

a) Create a Pivot table that shows a summary of how many aircraft of each type the new company will own and the average ages of each aircraft type.

Row Labels	Count of Aircraft Type	Average of Age (years)
190-100AR	20	6.7
737-300	1	25.0
737-400	29	24.2
737-800	221	6.9
757-200	127	19.7
757-200EM	7	19.9
767-200EREM	24	26.5
767-300EREM	59	20.1
777-200ER	47	13.4
777-300ER	9	1.2
A319-112	58	13.6
A319-115	6	1.0
A319-132	39	13.1
A320-214	23	12.8
A320-231	14	24.7
A320-232	35	13.5
A321-211	39	10.1
A321-231	49	3.2
A330-243	10	3.6
A330-323	9	13.7
DC-9-82 (MD-82)	113	24.8
DC-9-83 (MD-83)	79	19.8
Grand Total	**1018**	**14.7**

b) Create a second Pivot Table that will display in one column, the average age of each aircraft group for the new company. A second column should show the average number of hours flown by each aircraft type.

	Values	
Row Labels	Average of Age (years)	Average of Flight Hours (hrs)
190-100AR	6.7	22,949.6
737-300	25.0	82,227.6
737-400	24.2	81,276.2
737-800	6.9	23,617.2
757-200	19.7	66,108.2
757-200EM	19.9	66,943.4
767-200EREM	26.5	88,875.5
767-300EREM	20.1	67,379.4
777-200ER	13.4	45,441.0
777-300ER	1.2	5,346.9
A319-112	13.6	45,575.7
A319-115	1.0	3,504.7
A319-132	13.1	44,153.2
A320-214	12.8	42,743.6
A320-231	24.7	82,396.6
A320-232	13.5	45,564.2
A321-211	10.1	34,397.0
A321-231	3.2	11,829.3
A330-243	3.6	12,510.4
A330-323	13.7	46,431.8
DC-9-82 (MD-82)	24.8	83,285.9
DC-9-83 (MD-83)	19.8	66,739.8
Grand Total	**14.7**	**49,646.2**

c) Find the average age and the number of Boeing 757-200 that belong to the original Star Airlines. Compare the average age of these aircraft with the Boeing 757-200 owned by Challenger Airways.

Average of Age (years)	Column Labels		
Row Labels	Challenger Airways	Star Airlines	Grand Total
190-100AR	6.65		6.65
737-300	25.00		25.00
737-400	24.24		24.24
737-800		6.90	6.90
757-200	**21.39**	**19.32**	**19.69**
757-200EM	13.00	21.00	19.86
767-200EREM	24.90	27.64	26.50
767-300EREM		20.08	20.08
777-200ER		13.45	13.45
777-300ER		1.22	1.22
A319-112	14.50	1.00	13.57
A319-115		1.00	1.00
A319-132	13.05		13.05
A320-214	12.78		12.78
A320-231	24.71		24.71
A320-232	13.46		13.46
A321-211	10.08		10.08
A321-231	3.24		3.24
A330-243	3.60		3.60
A330-323	13.67		13.67
DC-9-82 (MD-82)		24.83	24.83
DC-9-83 (MD-83)		19.82	19.82
Grand Total	**13.28**	**15.49**	**14.72**

The average age of the Boeing 757-200 for both airlines differ by around to years. Boeing 757-200 owned by Challenger Airways are 2 years older (on average) than those owned by Star Airlines.

b) Using another Pivot Table, find the average number of hours flown by Airbus A319 aircraft with engines of the type CFM56-5B6/P.

The average hours flown by Airbus A319 with CFM56-5B6/P engines is ~48,700. Notice that these aircraft are older than other types of the A319.

777-300ER	5,346.9
GE90-115BL2	5,346.9
A319-112	45,575.7
CFM56-5B6/3	3,403.7
CFM56-5B6/P	**48,699.6**
A319-115	3,504.7
CFM56-5B7/3	3,504.7

Problem 2 (35 Points)

A formula used in Coastal Engineering to estimate the transport rate of sediment for beaches exposed to waves is given below in equation (1). **The equation is dimensionally correct so there is no need to check for units in the exam**.

$$Q = K\sqrt{\frac{g}{\gamma}}\frac{H_b^{2.5}\sin 2\alpha}{16*(s-1)a^*}$$

where:

Q is the longshore transport formula (in cu. meters per second)

K = coastal coefficient

H_b = is the significant wave height (m)

s = sediment specific gravity (typically 2.65 for most sediments)

α =is the angle between the waves and the beach (degrees).

a^* = ratio of solid to total volume of sediment (dim)

g = gravity constant (m/s-s) (1)

Assume all units in equation 1 are correct.

a) Write a **function** in Visual Basic for Applications (VBA) to calculate the value of Q given the values of all six variables in the right hand side of Equation (1). The VBA function should produce a single value (Q) as output. The values of the six input variables are to be entered in the worksheet. Use the following parameters to test the function:

K = 0.32; s = 2.6; Hb = 3.0; ap = 0.6; alpha = 12, g = 9.81; gamma = 0.9.

```
Public Function ValueofQ(K, Hb, s, alpha, ap, gamma, g)

' Programmer : A. Trani
' Date: 02/17/07

' Calculates the transport rate of sediment in coastal beaches
'
' Inputs:
' K        = coastal coefficient (dim)
' Hb       = significant wake height (m)
' s        = sediment specific gravity (kg/cubic decimeter)
' alpha    = angle of waves and beach (degrees)
' astar    = ratio of solid to total volume of sediment (dim)
' g        = gravity constant (m/s-s)

' Outputs:
' Q        = coastal sediment transport rate (cu.m/second)

'Convert alpha to radians

convertDeg_to_Radians = 3.14159 / 180
alphaRad = alpha * convertDeg_to_Radians

' Calculate the value of Q (transport rate of sediment)

ValueofQ = K * Sqr(g / gamma) * Hb ^ 2.5 * Sin(2 * alphaRad) / (16 * (s - 1) * ap)
```

b) Write back the result for Q obtained in the Visual Basic code worksheet. Label all inputs and outputs appropriately.

Since the calculation of Q is a function, there is no need to write back in VBA code the value of Q. Q is calculated when we invoke the function Q programmed in Task (a) above.

c) Test your Excel/VBA function with angles ranging from 0-90 degrees at steps of 5 degrees. Write the results to the worksheet (your choice on where to place the results). Explain.

Coastal Engineering Formula			Formula Q = K * sqrt(g/gamma) * Hb^2.5 * sin(2*alpha) / (16 * (s-1) * ap	
Prorammer: A. Trani			Function	ValueofQ(K, Hb, s, alpha, astar, gamma, g)
2/28/15 21:27				
Inputs		Units		Calculation
K	0.32	dim		
g	9.81	m/s-s		
gamma	0.90	dim		
Hb	3.00			
alpha	12.00	deg		
s	2.60			
ap	0.60			
Outputs				
Q	0.4361	cu.m./s		
Wave Angle (deg)	Value of Q (cu. m/second)		Make a plot	
0	0.000			
5	0.186			
10	0.367			
15	0.536			
20	0.689			
25	0.821			
30	0.929			
35	1.008			
40	1.056			
45	1.072			
50	1.056			
55	1.008			
60	0.929			
65	0.821			
70	0.689			
75	0.536			
80	0.367			
85	0.186			
90	0.000			

Problem 3 (35 Points)

An engineer formulates a linear programming with two decision variables as follows:

$$\text{Maximize } Z = 4x_1 + 9x_2$$

Subject to:

$$x_2 \le 19$$

$$1.45x_1 + x_2 \le 45$$

$$x_2 - 1.25x_1 \le 10$$

and

$$x_1 \ge 0,\ x_2 \ge 0$$

a) Use **Excel Solver** to obtain the optimal solution. State the optimal value of the objective function.

Optimization Problem - Problem 3 in Q1 - 2015			
Decision Variables			
x1	17.93		
x2	19.00		
Objective Function			
4 x1 + 9 x2	242.72		
Constraint Equations			
	Formula		
x2 <= 19	19.00	<=	19
1.45 x1 + x2 <= 45	45.00	<=	45
x2-1.25x1<=10	-3.41	<=	10

b) Write down the **first two tables (initial table and the first iteration)** to solve the problem using the Simplex method. In the table indicate what is the Initial Basic Feasible Solution (IBFS) including the values of all variables (both original and slacks, if any).

Table 1. Initial Table. Problem Has Been Converted into Standard Form. Added Three Slack Variables.

Basic Variable	Z	x1	x2	x3	x4	x5	RHS
	1	-4	-9	0	0	0	0
x3	0	0	1	1	0	0	19
x4	0	1.45	1	0	1	0	45
x5	0	-1.25	1	0	0	1	10

Initial Basic Feasible Solution (IBFS) is: x1 = 0, x2 = 0, x3 = 19, x4 = 45 and x5 = 10.

Value of Z = 0.

Steps:

1) Select Pivot column that containing Non-Basic variable x2. The coefficient of x2 in the Z-row is the most negative and hence improves the solution the most.
2) Take the ratio test. RHS/coefficients in Pivot column.

Basic Variable	Z	x1	x2	x3	x4	x5	RHS	Ratio
	1	-4	-9	0	0	0	0	
x3	0	0	1	1	0	0	19	19
x4	0	1.45	1	0	1	0	45	45
x5	0	-1.25	1	0	0	1	10	10

3) Select the lowest ratio (variable x5 leaves the Basic Variable set and becomes zero in the next table.
4) Variable x2 enters the solution in the next table.
5) Perform row operations to eliminate all coefficients in Pivot Column.

a) Multiply row with variable x5 (3rd constraint equation) by 9 and add to Z-row

b) Multiply row with variable x5 (3rd constraint equation) by (-1) and add to second row (first constraint equation)

6 Eliminate all coefficients in the Pivot column except for the unit value in the Pivot row (see Table 2).

Table 2. Second Table.

Basic Variable	Z	x1	x2	x3	x4	x5	RHS	Ratio
	1	-15.25	0	0	0	9	90	
x3	0.0	1.3	0.0	1.0	0.0	-1.0	9.0	7.2
x4	0.0	2.7	0.0	0.0	1.0	-1.0	35.0	13.0
x2	0	-1.25	1	0	0	1	10	10

Current Solution (2nd Table) is: x1 = 0, x2 = 10, x3 = 7.2, x4 = 13 and x5 = 0.

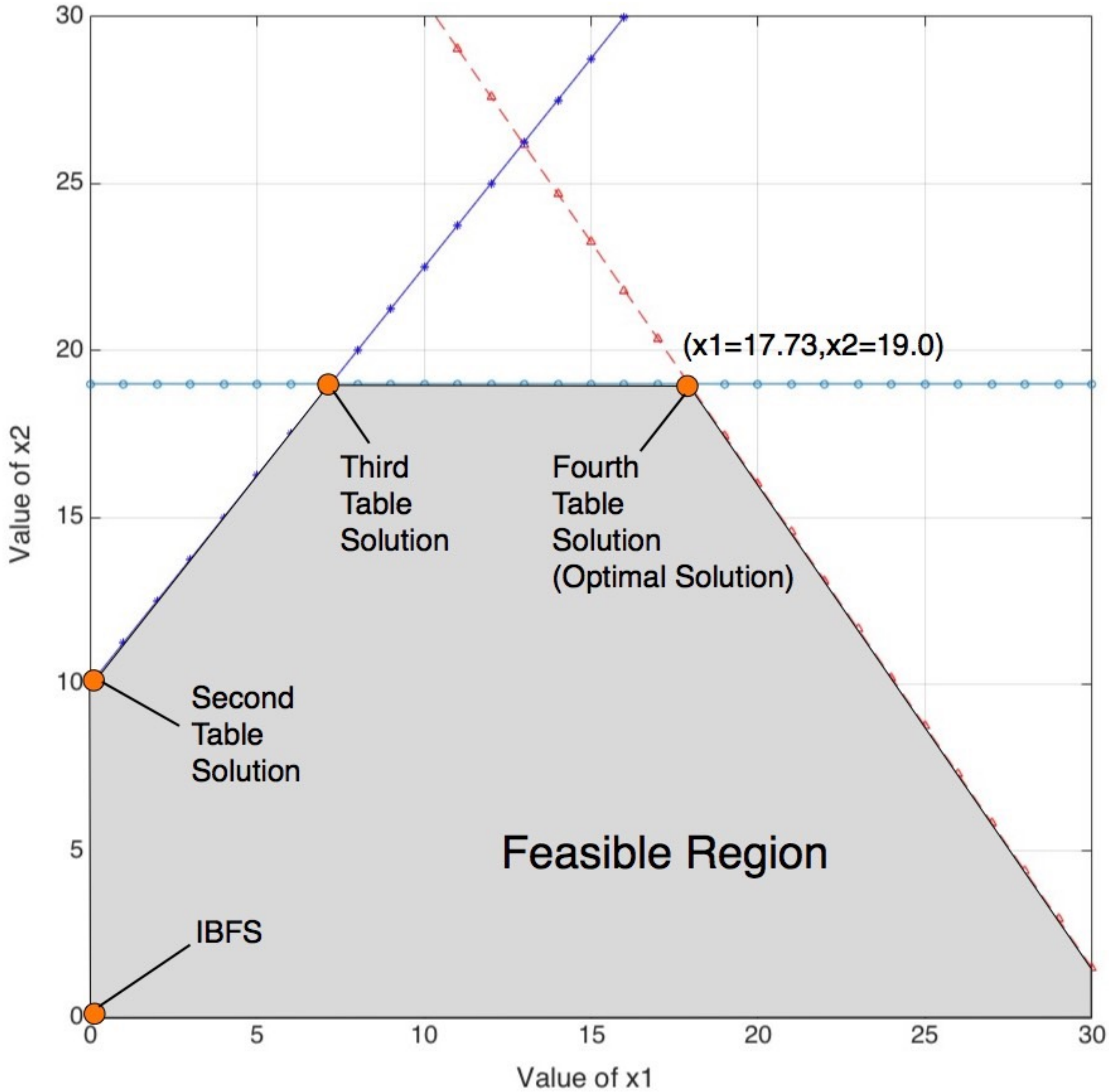

Figure 1. LP Problem Graphical Solution.