FINAL EXAMINATION
FIRST SEMESTER SESSION 2008/2009

CODE/SUBJECT NAME: QQP2013 / TEKNIK PEMBUATAN KEPUTUSAN II
DATE: 10 NOVEMBER 2008
TIME: 9.00 – 11.30 AM (2 1/2 HOURS)
VENUE: DTSO

INSTRUCTIONS:
1. This book script contains EIGHT (8) questions in NINE (9) printed pages, excluding the cover page and appendix.
2. An appendix is given on pages 10 and 11.
3. Answer ALL questions in the space provided.

MATRIC NO: ________________________________ (in words) ____________ (in digits)
I/C NO: ________________________________
NAME OF LECTURER: ________________________________
GROUP: _______ TABLE NO: _______

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QUESTION 1 (8 MARKS)

An airline owns an aging fleet of Boeing 737 jet airplanes. It is considering a major purchase of up to 17 new Boeing model 757 and 767 jets. The decision must take into account numerous cost and capability factors, including the following:

1. The airline can finance up to RM1.6 billion in purchases;
2. Each Boeing 757 will cost RM80 million, and each Boeing 767 will cost RM110 million;
3. At least one-third of the planes purchased should be the longer-range Boeing 757;
4. The annual maintenance budget is to be no more than RM8 million;
5. The annual maintenance cost per Boeing 757 is estimated to be RM800 000, and it is RM500 000 for each Boeing 767 purchased;
6. Each Boeing 757 can carry 125 000 passengers per year, whereas each Boeing 767 can fly 81 000 passengers annually.

a. State whether this problem is the total integer, mix or zero-one? (1 mark)

b. Formulate this as an integer programming problem to maximize the annual passenger-carrying capability. (7 marks)
QUESTION 2 (12 MARKS)

Solve the following Integer Programming problem using branch and bound approach. Show all the calculations.

\[ \text{Max } Z = 2x + 1.7y \]
\[ \text{subject to: } 4x + 3y \leq 7 \]
\[ x + y \leq 4 \]
\[ x, y \geq 0 \text{ and integer} \]

Relaxed solution for the above problem: \( x = 0, y = 2.33 \), \( Z = 3.97 \)
QUESTION 3 (8 MARKS)

Anis Boutique produces “baju kurung” and “baju kebaya” during the Hari Raya Celebration. All “baju kurung” and “baju kebaya” are produced in a modern sewing center. A “baju kurung” requires an average of 45 minutes and a “baju kebaya” an average of 1 hour in sewing center. The two shifts of the sewing center combine to create a normal operation period of 98 hours per week. The unit profit for “baju kurung” is RM10 and RM15 for “baju kebaya”. Puan Anis wishes to achieve the following goals, which are listed in order of importance:

1. Achieve the profit goal of RM2000 in a week.
2. Avoid any underutilization of regular operation hours of the sewing center.
3. Meet the demand for “baju kurung” of 500 units and “baju kebaya” of 300 units.
4. Limit the overtime operation of sewing center to 8 hours.

Formulate a goal programming model for this problem.
QUESTION 4 (12 MARKS)

Given the goal programming problem:

Minimize: \[ P_1 d_1^- , P_2 d_2^- , P_3 d_2^+ , P_4 d_3^- \]

Subject to:

\[ 4X_1 + 8X_2 + d_1^- - d_1^+ = 64 \]
\[ 5X_1 + 5X_2 + d_2^- - d_2^+ = 50 \]
\[ 15X_1 + 8X_2 + d_3^- - d_3^+ = 120 \]

\[ All \ X_i , \ d_i^- , \ d_i^+ \geq 0 \ \ for \ i = 1, 2 \]

Solve the problem graphically. Are all the goals met?
QUESTION 5 (8 MARKS)

A rancher faces the profit function

\[ Z = 110x - 3x^2 - 2xy - 2y^2 + 140y \]

where \( x \) = sides of beef and \( y \) = hides. Since there are two sides of beef for every hide, it follows that output must be in proportion \( \frac{x}{2} = y \). At what level of output the rancher will maximize profit? Solve this problem using Lagrange method.
QUESTION 6 (12 MARKS)

A textbook publishing company has compiled data on total annual sales (in thousands) of its business for the preceding 7 years:

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales ('000)</td>
<td>40.2</td>
<td>44.5</td>
<td>48.0</td>
<td>52.3</td>
<td>55.8</td>
<td>57.1</td>
<td>62.4</td>
</tr>
</tbody>
</table>

a. Prepare a forecast using each of these approaches:
   i. a three-period Moving Average
   ii. Simple Exponential Smoothing (α = 0.4)  

b. Compute the MAD for each set of forecast. Which forecast appears to be more accurate?
QUESTION 7 (11 MARKS)

Myrad Industry is facing with the attractive situation in which it can obtain immediate delivery of an item it stocks for retail sale. This company has therefore not bothered to order the item in any systematic way. It has recently hired a management consultant to study its inventory control. The consultant has determined that the various costs associated with making an order are approximately RM30 per order. In addition, she has determined that the costs at carrying one unit of the item in inventory for one year amount approximately RM20. Demand for the item is reasonably constant overtime; the demand forecast is 19,200 units per year. When an order is placed for the item, the entire order takes 2 days to deliver to the firm by the supplier. The company operates 320 days per year. Determine the followings:

a. Optimal order quantity per order. (2 marks)

b. Total minimum inventory cost. (2 marks)

c. Optimal number of orders per year. (2 marks)

d. Number of operating days between orders, based on the optimal ordering policy. (2 marks)

e. Reorder point. (3 marks)
QUESTION 8 (9 MARKS)

Mazra Enterprise owns four fast food restaurants and wants to determine which, if any of the restaurants are inefficient. Input measures for the restaurant include weekly hours of operations, full-time equivalent staff and weekly supply expenses. Output measures of performance include average weekly contribute to profit and average weekly customer. Data for the input and output are shown in the following tables.

<table>
<thead>
<tr>
<th>Restaurant</th>
<th>Hours of operation</th>
<th>FTE staff</th>
<th>Supplies (RM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mazra Enak (ME)</td>
<td>96</td>
<td>16</td>
<td>890</td>
</tr>
<tr>
<td>Mazra Lazat (ML)</td>
<td>90</td>
<td>15</td>
<td>1900</td>
</tr>
<tr>
<td>Mazra Jimat (MJ)</td>
<td>110</td>
<td>22</td>
<td>1400</td>
</tr>
<tr>
<td>Mazra Mesra (MM)</td>
<td>120</td>
<td>26</td>
<td>1200</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Restaurant</th>
<th>Weekly Profit (RM)</th>
<th>Weekly Customer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mazra Enak (ME)</td>
<td>4000</td>
<td>450</td>
</tr>
<tr>
<td>Mazra Lazat (ML)</td>
<td>5500</td>
<td>500</td>
</tr>
<tr>
<td>Mazra Jimat (MJ)</td>
<td>6500</td>
<td>400</td>
</tr>
<tr>
<td>Mazra Mesra (MM)</td>
<td>4900</td>
<td>390</td>
</tr>
</tbody>
</table>

a. Using DEA analysis, develop an LP model to evaluate the efficiency of Mazra Lazat Restaurant.

(7 marks)
b. The following optimal solution was obtained for the DEA problem of Mazra Lazat Restaurant:

<p>| Objective function value = 1.000 |
|-------------------------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
<th>Reduced Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>1.000</td>
<td>0.000</td>
</tr>
<tr>
<td>( w_{ME} )</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>( w_{ML} )</td>
<td>1.000</td>
<td>0.000</td>
</tr>
<tr>
<td>( w_{MJ} )</td>
<td>0.000</td>
<td>0.331</td>
</tr>
<tr>
<td>( w_{MM} )</td>
<td>0.000</td>
<td>0.215</td>
</tr>
</tbody>
</table>

i. Does the solution indicate the Mazra Lazat Restaurant is relatively inefficient?  
   (1 mark)

ii. Which restaurant(s) make up the composite unit to evaluate Mazra Lazat Restaurant?  
    (1 mark)
Forecasting

Moving Average:
\[
MA_n = \frac{\sum_{i=1}^{n} D_i}{n}
\]
Where:
\( n \) = number of periods in the MA
\( D_i \) = data in period \( i \)

Simple exponential smoothing:
\[
F_{t+1} = \alpha D_t + (1 - \alpha) F_t
\]

Adjusted exponential smoothing:
\[
AF_{t+1} = F_{t+1} + T_{t+1}
\]

Trend:
\[
T_{t+1} = \beta (F_{t+1} - F_t) + (1 - \beta) T_t
\]

Mean absolute deviation:
\[
MAD = \frac{\sum |D_t - F_t|}{n}
\]

Basic EOQ Model

1) \( Q_{opt} = \sqrt{\frac{2C_o D}{C_c}} \)

2) \( TC = \frac{C_o D}{Q_{opt}} + \frac{C_c Q_{opt}}{2} \)

3) \( R = dL \)
EOQ Model Noninstantaneous Receipt

Define: \( p = \) daily rate order is received (also known as production) \\
\( d = \) daily rate inventory is demanded

1) \( Q_{opt} = \sqrt{\frac{2C_oD}{C_c \left( 1 - \frac{d}{p} \right)}} \)

2) Maximum inventory level = \( Q - \frac{Q}{P}d = Q \left( 1 - \frac{d}{p} \right) \)

3) Average inventory level = \( \frac{1}{2} \left[ Q \left( 1 - \frac{d}{p} \right) \right] \)

4) \( TC = \frac{C_oD}{Q_{opt}} + \frac{C_cQ_{opt}}{2 \left( 1 - \frac{d}{p} \right)} \)