NOTE THE FOLLOWING

1) There are four questions and you are required to answer all of them.
2) Deadline for submission is Wednesday; 22nd July, 2015
3) The total marks is 50.
4) To get full credit do your calculations carefully.

1. This question has to be done in an EXCEL (*.xlsx/*xls) file. Pick up any 4 stocks of different sectors. Construct the efficient frontier comprising the stocks and the market. Use the latest 1 year data for each stock and the corresponding period’s BSE 100 index to proxy for the market. Use EXCEL for any calculation and graphical representation. Show your calculations clearly.
   a) Compute the historical annual mean, annual standard deviation and coefficient of variation of return for all stocks.
   b) Report the daily returns, daily deviation, variance-covariance and correlation matrices
   c) Construct the efficient frontier using annual data. Show the frontier on a scatter plot. Clearly label the axes, title of the chart, legends etc.
   d) Compute the global minimum variance portfolio. Show the weights allocated to each stock, portfolio risk and portfolio return.
   e) Risk-free rate is 4%, what is the Sharpe ratio of the tangency portfolio?
   f) Compute the beta of each stock using regression analysis and also mathematically and compare the values.

Note: Please refer the sample solution provided for this question or refer this YouTube video whose link is given below:
https://www.youtube.com/watch?v=FZyAXP4syD8
2.

(a) The NPTEL Home Tutor Solutions Pvt. Ltd. help customers to find private tuitions and coaching centers in Kanpur city as well as online tutors. This supply business is competitive, and the ability to deliver talented as well as well-educated tutors promptly is a big factor in getting new customers and maintaining old ones. The manager of the company wants to be certain that enough tutors are available at hand to meet demand promptly. Therefore, the manager wants to be able to forecast the demand for requirement of tutors during the next month. From the records of previous orders, management has accumulated the following data for the past 10 months:

<table>
<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Orders</td>
<td>120</td>
<td>90</td>
<td>100</td>
<td>75</td>
<td>110</td>
<td>50</td>
<td>75</td>
<td>130</td>
<td>110</td>
<td>90</td>
</tr>
</tbody>
</table>

(i) Compute the monthly demand forecast for February through November using the naive method.

(ii) Compute the monthly demand forecast for April through November using a 3-month moving average.

(iii) Compute the monthly demand forecast for June through November using a 5-month moving average.

(iv) Compute the monthly demand forecast for April through November using a 3-month weighted moving average. Use weights of 0.5, 0.33, and 0.17, with the heavier weights on the more recent months.

(v) Compute the mean absolute deviation for June through October for each of the methods used. Which method would you use to forecast demand for November?

(b) NPTEL Furniture Ltd. makes customized furniture. Orders are received via online request and subsequently demand is fulfilled. Formed and operated by IIT Kanpur students, the company has had steady growth since it started. Due to volatility of demand, they need a good forecast of demand for their furniture so that they will know how much raw material to purchase and stock. They have compiled demand data for the last 12 months as reported below.
(i) Use exponential smoothing with smoothing parameter $\alpha = 0.3$ to compute the demand forecast for January (Period 13).

(ii) Use exponential smoothing with smoothing parameter $\alpha = 0.5$ to compute the demand forecast for January (Period 13).

(iii) Paulette believes that there is an upward trend in the demand. Use trend-adjusted exponential smoothing with smoothing parameter $\alpha = 0.5$ and trend parameter $\beta = 0.3$ to compute the demand forecast for January (Period 13).

(iv) Compute the mean squared error for each of the methods used.

3.

(a) There may be a relationship between class attendance and number of popcorn packets sold from the nearby canteen. Data for the first six months are shown in the table. Forecast the number of popcorn packets that will be sold in month 7 if monthly class attendance is forecast as 25000 people.

<table>
<thead>
<tr>
<th>Month</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance (x) (,000)</td>
<td>8</td>
<td>12</td>
<td>14</td>
<td>18</td>
<td>19</td>
<td>22</td>
</tr>
<tr>
<td>Sales (y)</td>
<td>1500</td>
<td>2200</td>
<td>2700</td>
<td>4200</td>
<td>7800</td>
<td>5400</td>
</tr>
</tbody>
</table>

(b) The demand for popcorn packets over the past three years is shown in the table. If we expect the total yearly demand in 2002 to be 45,000 units, what will be our forecasted monthly demands in 2002?

<table>
<thead>
<tr>
<th>Month</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>1100</td>
<td>1800</td>
<td>2300</td>
<td>3800</td>
<td>4500</td>
<td>5000</td>
</tr>
<tr>
<td>2000</td>
<td>1300</td>
<td>2000</td>
<td>2500</td>
<td>4000</td>
<td>4700</td>
<td>5200</td>
</tr>
<tr>
<td>2001</td>
<td>1500</td>
<td>2200</td>
<td>2700</td>
<td>4200</td>
<td>4900</td>
<td>5400</td>
</tr>
</tbody>
</table>
The following table gives a time series $y_t$, which has been smoothed using the one parameter double exponential smoothing method. The results are reported in the table, where $a_{o,t} = 2S_{o,t} - S_{o,t-1}^2$ and $b_{t,t} = \left(\alpha/(1-\alpha)\right) (S_{o,t} - S_{o,t-1}^2)$ are the estimates of the permanent and trend components respectively, $S_{o,t} = \alpha y_t + (1-\alpha)S_{o,t-1}$ and $S_{o,t}^2 = \alpha S_{o,t} + (1-\alpha)S_{o,t-1}^2$ are respectively the first and second smoothed statistics of the series, and $\alpha$ is a smoothing parameter.

(a) What is the assumed data generating process of $y_t$ in order for double exponential smoothing to be valid?

(ii) Determine the value of $\alpha$, the smoothing parameter.
(iii) Use the equations
\[ S_{a,o} = a_{o,o} - \left( (1 - \alpha) \alpha \right) b_{1,o} \]
\[ S^2_{a,o} = a_{o,o} - 2 \left( (1 - \alpha) \alpha \right) b_{1,o} \]
to find the initial values of \( S_{a,o} \) and \( S^2_{a,o} \).

(iv) Obtain the updated estimates of \( a_{o,t} \) and \( b_{1,t} \) for period 1, and hence a forecast of \( y_2 \).

(v) What is the value of \( y_y \)?

(vi) Compute the forecasts of \( y_{12} \) and \( y_{13} \) made in time period \( t = 10 \).

(vii) Work out the Theil’s U statistic for the in-sample forecasts and interpret your finding (Hint: \( \sum_{i=2}^{10} (y_i - y_{i-1})^2 = 28071 \)).

(b)

(i) Suppose that the investigator now uses the Holt-Winter’s method on the above data series. The estimates generated for period \( t = 0 \) are \( a_{o,o} = 17.2975 \) and \( b_{1,o} = 34.6 \). The updating equations for the Holt-Winter’s method are
\[ a_{o,t} = \alpha y_t + (1 - \alpha)(a_{o,t-1} + b_{1,t-1}) \]
\[ b_{1,t} = \beta(a_{o,t} - a_{o,t-1}) + (1 - \beta)b_{1,t-1} \]. Apply the method on the first 2 observations of the series and obtain the forecasts of \( y_2 \) and \( y_3 \) made in time periods \( t = 1 \) and \( t = 2 \) respectively. Use \( \alpha = 0.2 \) and \( \beta = 0.7 \).

(ii) For the one-parameter double exponential smoothing method or the Holt-Winter’s method, how are the optimal smoothing constants chosen?

(iii) What is the main disadvantage of the one-parameter double exponential smoothing method in general and specifically relative to the Holt-Winter’s method?