NPTEL

INDUSTRIAL AND MANAGEMENT ENGINEERING DEPARTMENT, IIT KANPUR

QUANTITATIVE FINANCE

ASSIGNMENT-3 (2015 JULY-AUG ONLINE COURSE)

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 **co-efficient 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:

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
Orders	120	90	100	75	110	50	75	130	110	90

(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.

Period	Month	Demand	Period	Month	Demand
1	January	37	7	July	43
2	February	40	8	August	47
3	March	41	9	September	56
4	April	37	10	October	52
5	May	45	11	November	55
6	June	50	12	December	54

(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.

Month	1	2	3	4	5	6
Attendance (x) (,000)	8	12	14	18	19	22
Sales (y)	1500	2200	2700	4200	7800	5400

(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?

Month	1	2	3	4	5	6
1999	1100	1800	2300	3800	4500	5000
2000	1300	2000	2500	4000	4700	5200
2001	1500	2200	2700	4200	4900	5400

Month	7	8	9	10	11	12
1999	5500	4800	3000	2200	1500	1200
2000	5700	5000	3200	2400	1700	1400
2001	5900	5200	3400	2600	1900	1600

4.

(a) The following table gives a time series y_t, which has been smoothed using the one parameter double exponential smoothing method. The results are the reported in the table, where $a_{o,t} = 2S_{o,t} - S^2_{o,t}$ and $b_{1,t} = \left(\alpha/(1-\alpha)\right)(S_{o,t} - S^2_{o,t})$ are the estimates of the permanent and trend components respectively, $S_{o,t} = \alpha y_t + (1-\alpha)S_{o,t-1}$ and $S^2_{o,t} = \alpha S_{o,t} + (1-\alpha)S^2_{o,t-1}$ are respectively the first and second smoothed statistics of the series, and α is a smoothing parameter.

t	y_t	$a_{o,t}$	$b_{1,t}$	$S_{o,t}$	$S^2_{o,t}$	$\hat{y}_t(t-1)$	$\left(y_t - \hat{y}_t(t-1)\right)^2$
0		17.2975	34.6	??	??		
1	200	??	??	??	??	51.8975	21934.35
2	280	268.65	82.97563	185.6744	102.6988	??	??
3	250	275.4064	57.56922	217.8372	160.268	351.6256	10327.77
4	320	323.2439	54.32531	268.9186	214.5933	332.9756	168.3668
5	336	346.3923	43.93301	302.4593	258.5263	377.5692	1728
6	378	381.0813	40.85168	340.2296	299.378	390.3253	151.9133
7	429	427.2333	42.61843	384.6148	341.9964	421.933	49.94238
8	441	448.2129	35.40551	412.8074	377.4019	469.8517	832.4194
9	??	458.4046	27.0009	431.4037	404.4028	483.6184	??
10	555	537.6014	44.39952	493.2019	448.8023	485.4055	4843.393

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

(ii) Determine the value of α, the smoothing parameter.

(iii) Use the equations $S_{o,o} = a_{o,o} - \big((1-\alpha)/\alpha\big)b_{1,o}$ and $S^2_{o,o} = a_{o,o} - 2\big((1-\alpha)/\alpha\big)b_{1,o}$ to find the initial values of $S_{o,t}$ and $S^2_{o,t}$.

(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_9?

(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: $\sum_{t=2}^{10}(y_t - y_{t-1})^2 = 28071$).

(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 $a_{o,t} = \alpha y_t + (1-\alpha)(a_{o,t-1} + b_{1,t-1})$ and $b_{1,t} = \beta(a_{o,t} - a_{o,t-1}) + (1-\beta)b_{1,t-1}$. 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?