General Instructions:

1. The problem consists of 5 parts, each of unequal weights. The points allotted for each part are given with it.
2. The final submission will be in form of a PPT which will be evaluated.
3. The PPT must consists of a summary of the approach adopted, assumptions taken, results obtained, inferences derived, conclusions and references used.
4. The naming convention has to be adhered to for the PPT is: **<Team name>_<DSE>_<Finstats2017>**
5. The first slide of the PPT should have all the details of the participants involved in the team.
6. All the other supporting work (i.e. Spreadsheets, Code files, Output files etc.) has to be submitted along with the final submission. Use the convention **<Team name>_<Q1>_<DSE>** for naming the files.
7. In case of any ambiguity in any of the parts, make necessary assumptions and explicitly state them.
8. Partial marking would be allotted for the correct approach to the problem.
9. Plagiarism/Unfair practices of any sort will lead to straight disqualification of all the parties involved.

Problem Statement:

Two friends X and Y who wish to invest in a financial market come to CS personal banking division that offers a help in investing a wide range of asset classes. Mr. Broker carefully studies the profiles of both the friends and come to a conclusion that while X is a **"risk-averse"** investor, Y is **"risk neutral"**. Mr. Broker offers the following asset classes to each of the friends to invest in: (Current date in problem is 30th June 2017).

Asset Classes	Products
Stocks:	Stock A, Stock B, Stock C and Stock D
Bonds:	Bond P ("AA rated"), Bond Q ("BB rated") and Bond R ("CC rated")
Commodities:	Gold, Silver and Copper
Forex (Spot):	Currency pairs USD-INR, EUR-INR and INR-CNY
Funds:	Mutual Fund J, Mutual Fund K and Mutual fund L
Alternative Investments:	Mortgaged back securities NAV(A1), a Hedge Fund (A2)
Cash:	Earns 3.5% annually

Mr. X and Mr. Y clearly confused with all the jargons and the variety of offering come to you to seek advice.

You should:

a) Help them design suitable portfolios with choosing at least 5 and maximum 7 products from across the asset classes. The products chosen should be from at least 3 different asset classes that are most suitable for each of the investors according to their risk profile. Assume total corpus amount to be Rs. **1 crore**.
(Total points: 30)

Following constraints should be followed:

- You may opt to choose different products for both the investors as per their risk profile.
- Investment in any asset class shouldn't be more than 60%
- Investment in any particular asset should not be more than 35% and should not be less than 5%
- Short-selling is allowed within the above limits i.e. maximum short position per asset can be 35% and maximum short position for an asset class can be 60%.
- Investment in cash (if any) shouldn't exceed 10%. Assume that cash earns 3.5% annually and carries no risk. Short selling in cash is not allowed.

- Make adjustments in the data wherever required. Clearly state the adjustments made and explain the rationale for the adjustments. Also state the assumptions taken if any.
- Additional conditions for each instrument in given in the appendix (Applicable only if one chooses to invest in that particular instrument).

Mr. X expects a return of over 15% p.a. and Mr. Y expects the return to be at least 20% p.a.

For each of the portfolios, justify the choice of the assets based on their risk profile. Any portfolio that satisfies the above criteria is acceptable. Points will be awarded for:

1. Appropriate optimization techniques used.
2. Appropriate adjustments made in the data (if applicable).
3. Proper justification for the choices made.
4. Appropriate tabulation of results.
5. Appropriate justification for choosing date window to perform the analysis.

Deliverables: Working files for both the portfolios (i.e. Excel spreadsheets or code files with outputs) with formulae kept for verification of your work. Highlight the results obtained.

Mr. X and Y are seeking your opinion on the prices of assets they invested in on your advice 1 month post investment (i.e. on 31st July 2017).

b) Knowing the historical prices (from the data provided above here) or otherwise, forecast the daily price of all the assets chosen by both Mr. X and Y using appropriate techniques, for the entire month of July 2017.
(Predict for all the business days from 1st July 2017 to 31st July 2017)
(Total points: 20)

Points will be awarded for:

1. Proper mathematical formulation of the prediction model.
2. Stating any underlying assumptions for the models used.
3. Appropriate use of the data
4. Appropriate justification for the use of proposed model

Deliverables: Working file(s) for all the assets (i.e. Excel spreadsheets or code files with outputs) with formulae kept for verification of your work. Highlight the results obtained.

c) Post 1 month, compare your prices (predicted by your model as in part (b)) with your actual market prices (as observed in the market) and check the level of accuracy in your prediction. Draw statistical inferences.
(Total points: 10)

Points will be awarded for:

1. Appropriate statistic(s) reported as per the methods used in part (b).
2. Level of accuracy in the prediction of the model

Deliverables: Values to be reported as requested and be highlighted appropriately. This can be combined with the deliverable of part (b).

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d) Assuming that Mr. X and Mr. Y remain invested in the market for next 3 months starting from 1st July 2017 and ending at 29th September 2017 in the proportions estimated in the part (a), what would be the risk and return values for each of the portfolios. Does it meet the requirements of the investors? We assume that the composition of the portfolio remains the same for the entire period after the initial investments are made on 1st July 2017 and is finally sold off on 29th September 2017.
(Total points: 5)

Deliverables: Report the appropriate values. Show calculations.

---x---x---x---x---x---

e) Assume now that Mr. Broker "actively" manages the portfolio for both Mr. X and Mr. Y through periodic rebalancing based on the instructions given by the investors. Devise a periodic rebalancing algorithm so that Mr. Broker can trade accordingly. Consider the brokerages given in Appendix.

Write a code using C++/C/Python/R/Matlab/VBA to implement the algorithm and compute the returns, risk and other appropriate metrics at the end of the period (29th Sept 2017) for the portfolio.
Does it give a better return than that of a passive portfolio from the part (d) above?

In case of no prior experience in any of the above language, a pseudo implementation in Excel would also be accepted.

(Total points: 35)

Points will be awarded for:
1. Clearly describing the rebalancing strategy.
2. Motivation of the strategy (How did you come up with it?)
3. Correct implementation (using a code or otherwise)
4. Reporting the parameters requested.

Please keep in mind the following things while rebalancing:
- You have to rebalance within the assets chosen for the clients based on the answer to part (a)
- The restrictions for the maximum investment in the assets and the asset class remains the same as part (a) i.e. 35% maximum in an asset and 60% maximum in an asset class.
- The restriction of the minimum number of asset class (being at least 3) and the number of assets (being between 5 and 7) can be relaxed. Constraint of minimum investment in the asset being 5% is also relaxed.
- Remember, every time an asset is bought or sold, the transaction cost has to be considered.
- There is no constraint on maximum cash that could be kept in the portfolio.

Deliverables: Working files for both the portfolios (i.e. Excel spreadsheets or code files with outputs) where the implementation can be checked. Clearly outline the rule / strategy adopted and report the values requested. The code provided (if any) should be able to compile without any changes required to be made.

Hint: Actively managing the portfolio means actively buying or selling the assets based on market signals and other information that is available to the investor. In this question, you are supposed to devise a strategy (a rule of sorts) to trigger buy or sell based on price movements or any other empirical method that you find appropriate. The instructions to follow the rule have to be given to the broker at the beginning of the investment and the same has to be followed throughout.
For this question, you have to devise rules for both the portfolios.

Appendix

- Stocks can be bought in multiples of 1.
  Corporate Events: Stock C performed a 2:1 stock split on 12-Feb-2016.
  Stock D performed a 3:1 stock split on 28-March-2016

- Bonds expire on 31st Dec 2018 with a face value of 100.

- Forex:
  Minimum lot size is 5000 units and can be bought or sold thereafter in multiples of 1000.

- Commodities:
  Each lot is 10 units and can be bought or sold in multiples of 5 lots.

- Mutual Funds:
  Minimum investment in a fund is Rs. 5000.

- Alternative Investments:
  Hedge Funds: Minimum holding period = 2 months
  Minimum investment is 5 Lakhs

Transaction costs:

Instruments	**Brokerage Costs (Both buy and sell)**
Stocks, Bond	0.1%
Forex	0.1%
Commodities	0.3%
Mutual funds	Entry load = 0%, exit load = 1%(only if exited within 1 year)
Alternative Investments	Nil

Dictionary:

- Asset Class: An asset class is a group of securities that exhibits similar characteristics, behaves similarly in the marketplace and is subject to the same laws and regulations.
  Additional Reference: https://en.wikipedia.org/wiki/Asset_classes

- Risk Averse: Risk averse is a description of an investor who, when faced with two investments with a similar expected return (but different risks), will prefer the one with the lower risk.
  Additional Reference: http://www.investopedia.com/terms/r/riskaverse.asp

- Risk Neutral: Risk neutral is a mindset where an investor is indifferent to risk when making an investment decision.
  Additional Reference: http://www.investopedia.com/terms/r/riskneutral.asp

- Stock: The stock (also capital stock) of a corporation is constituted of the equity stock of its owners. A single share of the stock represents fractional ownership of the corporation in proportion to the total number of shares.
  Additional Reference: https://en.wikipedia.org/wiki/Stock

- Bond: The bond is a debt security, under which the issuer owes the holders a debt and (depending on the terms of the bond) is obliged to pay them interest (the coupon) or to repay the principal at a later date, termed the maturity date.
  Additional Reference: https://en.wikipedia.org/wiki/Bond_(finance)

- Forex: Foreign exchange is the exchange of one currency for another or the conversion of one currency into another currency.
  Additional Reference: http://www.investopedia.com/terms/f/foreign-exchange.asp

- Mutual Funds: A mutual fund is a professionally managed investment fund that pools money from many investors to purchase securities.
  Additional Reference: https://en.wikipedia.org/wiki/Mutual_fund

- Alternative Investments: These are non-traditional investment options that people choose. They usually constitute asset classes other than stocks, bonds, and cash.
  Additional Reference: https://en.wikipedia.org/wiki/Alternative_investment

- Hedge Fund: A hedge fund is an investment fund that pools capital from accredited individuals or institutional investors and invests in a variety of assets, often with complex portfolio-construction and risk-management techniques.
  Additional Reference: https://en.wikipedia.org/wiki/Hedge_fund

- MBS (Mortgage Backed Securities): A mortgage-backed security (MBS) is a type of asset-backed security that is secured by a mortgage or collection of mortgages.
  Additional Reference: https://en.wikipedia.org/wiki/Mortgage-backed_security