Class #24/25

The class consists of two parts: **10am-11am** lecture and **11am-12noon** lab.

Notes:

- the pretest will be assigned as required HW that provides 1 point on the final grade. It will be handed out and due in the beginning of the semester. The link to it will be provided on Blackboard and TopHat. In order to receive credit it must be handed in on time.
- the posttest will be assigned as required HW that provides 1 point on the final grade. It will be handed out after the required lesson must be completed and handed in the following lesson. The link to it will be provided on Blackboard and TopHat. In order to receive credit it must be handed in on time.

Lecture:

1. I will show a ten minute video discussing randomness: https://www.youtube.com/watch?v=9rIy0xY99a0. We will have a discussion as to what it means to be random and how we can verify (or not) true randomness.
2. We will discuss Independent Identically Distributed Random Variables (IIDRV) in terms of probabilities and what different distributions of such events might imply; highlighting the regular continuous distributions with examples from everyday life; mentioning the approach and complexity in modeling such events.
3. We will discuss events in terms of time-series. I.e. looking at the stock market and other FRED related time-series to understand how random events are modeled.
4. We will draw several graphs depicting typical scenarios and try our hand at graphing said events w/r/t course requirements.
5. We will then begin discussion of predicting such distributions based on a random resampling of probabilities related to data.

Lab:

1. We will discuss the “case-study” in Monte Carlo below: https://support.office.com/en-us/article/Introduction-to-Monte-Carlo-simulation-64c0ba99-752a-4fa8-bbd3-4450d8db16f1
2. We will discuss how the setup and implementation in the file and then begin to work on a new data set with predefined probabilities of past historical significance.
3. We will use random numbers (RND) to pick a probability based on the setup that assigns a range to each bin (as laid out in the above document reference) and then lookup (INDEX/MATCH) the associated value. We will fill our time-series and then do a running sum.
4. We will do this several times, including with a data table under what-if analysis, and create several time-series.
5. We will then graph our data and explore the relationship among the data.

6. We will discuss the relevant distribution that is simulated by the random numbers probabilistically assigned to our events and have a short discussion on simulation.

Following Lecture:

1. We will review the process by which we simulated our data, highlighting what n as it approaches infinity number of simulations would appear as - thus discussing the concepts of linearity, average, complexity, standard deviation, and randomness w/r//t Monte Carlo.
2. We will discuss a HW problem using FRED data to test if our modelling technique is in truth effective; asking the student to take FRED data, find the probabilities and design their own model, based on several varying charts that display the information in more relevant terms as per the data set.

The lesson will have addressed the following points:

Key points related to Monte Carlo simulation:

- *many* diverse problems can be solved (probabilistically) by analyzing random data that fits a similar distribution to the sample set.
- Simulations allow for data to be understood statically (i.e. a broader perspective on the distribution via the moment generating functions) and dynamically (i.e. as a time series).
- Sampling complexity and nonlinearity can effectively be dealt with.

Key points in modelling:

- random numbers are difficult to come by (and how to make a pseudo-random number generator)
- clarity of presentation helps provide clarity of understanding
- a very defined question is often necessary
- different charts provide different perspectives
- we're talking about "on average", on average
- Excel can do it all for you as long as you know what you're looking for

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The lesson will include the following:

Specific Quantitative Reasoning Additions/Examples:

1. Random numbers
    a. why a computer cannot be random
    b. cryptographic examples
2. Averages, Standard Deviations
    a. example with 2007 hedge fund housing market bets
    b. examples related to biological mutation
    c. examples related to small business product procurement
3. Time-Series
    a. FRED
    b. stock market returns and volatility