Important Topics to study for Final Examinaiton, Spring 2023

From Lecture note - 5 on Time series

- Describe the following time series processes: AR process, MA process, ARMA process and ARIMA process with suitable mathematical expressions.
- Study also the characteristics of ARCH and GRACH models. When we need ARCH and GRACH models to apply on time series data? What is the fundamental difference between AR/ARMA models and ARCH/GRACH models.
- Express the AR (1) process in Moving average form.
- What is autocorrelation? What is Autocovariance? What are the possible reasons to observe autocorrelation? If autocorrelation exist, what is the right method of estimation?
- Test of serial correlation: Describe DW statistics, how to estimate DW statistics. Describe DW tests and how to test positive and negative auto correlation among error terms across periods. Study the weakness of DW test and study **what are the other possible tests such as** Godfrey-Breusch LM Test, Durbin Test with P lags of error terms **which might overcome the weakness of DW test.**

From Lecture note - 6

- Define Stationarity in a time series process. Distinguish between strong stationarity and weak stationarity.
- Distinguish between Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) in the context of time series data
- Basic Characteristics of Non-stationary time series process
- Describe various types of Non-stationary process using proper mathematical expression.
- **Distinguish between stochastic Non-stationarity and Deterministic Non-stationarity**
- Describe various ways to transform a non-stationary time series process into stationary series
- Define the concept of Unit Roots in the context of time series data
- Describe various tests for Unit Roots
- Describe Dicky-Fuller Test and Augmented Dicky-Fuller test for Unit Roots.
- Define the Cointegration process for say two time series Y(t) and X(t). Under what condition we can say that the two series are cointegrated.

From Lecture – 7 : Binary Choice Models

- **Types of Discrete Choice Models and Estimation methods: Read well all related to Linear Probability model, Probit model and Logit model. Describe each type of model and derive the expression for Marginal Effects under each model type.**
- Describe the advantages and disadvantages of using each of the 3 type of Discrete choice models described above (LPM, Probit and Logit)
- State the Relationships among parameter estimates using Linear Probability and Logit and Probit model.
- What is the best estimation method to estimate Probit and Logit models?

From Lecture – 8: Multinomial Choice Models

- **Describe the ordered Probit model and derive the expression for marginal effects for a model with three response levels.**
- Describe the Random Utility model in the context of Discrete choice problems. Give some examples of Unordered Multiple-Choice model vs Ordered Multiple choice models.
- Write the expression for Multinomial Logit Model. What is the best estimation method to estimate Multinomial Logit Model?
- **Define the Nested Logit Model with some example.**

From Lecture – 9 & 10

- Distinguish the following Learning process in ML
  - **Supervised Learning**
  - **Unsupervised Learning**
  - **Reinforcement Learning**

- Distinguish **between Parametric and non-parametric** modelling methods. What are the advantages and disadvantages of two types of estimation methods?
  - Distinguish between **Classification and regression methods**. When is application of Classification method is appropriate and when regression method is appropriate?
  - Describe and distinguish between **Histogram and Kernel Density Estimation** suing proper mathematical expression for each case.
  - To estimate the Kernel Density function **which one is more important**: Choicer of specific Kernel function or Bandwidth measurement.
  - Describe **Various Approaches to Variables Subset Selections** including (Including **Ridge regression and Lasso** as a part of Shrinkage method)
  - Explain the concept of Cross Validation in ML process
  - Describe Local Linear Regression and LOESS

From Lecture – 11

- Describe what is Decision Tree? Give a simple example to show the Decision Tree Learning
- What are the two main type of Decision tree used in data mining for prediction? (Regression Tree and Classification tree) and explain their goals.
- Some techniques, often called *ensemble* methods, construct more than one decision tree. Explain some such ensemble methods and explain the primary difference among such methods

(i) (**Bootstrap aggregated (or bagged) decision trees,**

(ii) **A Random forest classifier which is a specific type of bootstrap aggregating.**

Describe the characteristics of these two types of tree methods. Explain the difference between these two methods and explain why these methods are chosen over single decision tree.