Midterm 1 Exam Topics:

Module 1

1. *Time Series Basics*:
   - Definition
   - Characteristics
   - Importance for accounting for dependence in modeling
   - Objectives in time series modeling
   - Basic decomposition
2. *Trend Estimation: Understanding and Implementation*
   - Parametric Model
   - Moving Average
   - Differencing
   - Non-parametric Model
   - Comparison of model fits
3. *Seasonality Estimation: Understanding and Implementation*
   - Means Model
   - Harmonics Model
   - Differencing
   - Comparison of model fits
   - Trend and seasonality estimation
4. *Fundamentals: Stationarity*
   - Stationarity conditions
   - White noise vs independent data
   - Random Walk: Nonstationary Process Example
   - Autocovariance/Autocorrelation of a time series
   - Autocovariance/Autocorrelation function of a stationary time series
   - Sample Autocovariance/Autocorrelation function
   - (Sample) Autocovariance/Autocorrelation function vs Stationarity
   - Evaluating stationarity using visual analytics
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5. *Fundamentals: Linear Process*
   - Definition
   - Evaluating whether a linear process
   - Autocovariance
   - Prediction
   - Best Linear Predictor
   - Mean Squared Prediction Error
   - Prediction for large sample size: Examples of Approaches

Module 2

1. *ARMA Model: Basics*
   - Definition
   - AR process & AR polynomial
   - MA process & MA polynomial
   - ARMA model vs ARMA process
   - Stationarity of ARMA model: Definition
   - Autocovariance of stationary process vs ARMA process
   - Causality and Invertibility of ARMA processes: Definition & Simple Examples
   - Causality vs Stationarity for ARMA processes
   - ACF of AR, MA and ARMA
   - PACF: Definition and Estimation
   - PACF and Prediction
   - ACF and MA(q)
   - PACF and AR(p)
   - ACF and PACF for ARMA
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2. *ARMA Model: Estimation and Inference*
   - AR Estimation via Linear Model: Approach & Properties, Order Selection, Statistical Significance
   - AR Estimation via Yule-Walker Equations*: Understanding Properties
   - MA and ARMA Estimation via Innovations Algorithm*: Understanding Properties
   - ARMA process as a Gaussian Process
   - ARMA estimation via MLE*: Understanding Approach & Properties
   - ARMA Estimation: MLE vs other approaches
   - ARMA: Order selection via model selection using AICC or BIC
   - ARMA Modeling: Evaluating assumptions via residual analysis (visual analytics and hypothesis testing)
   - ARMA Modeling: Outliers and Transformations
   - ARIMA*: Understanding and Applying Model and Prediction
   - Seasonal ARMA*: Understanding and Applying Model and Prediction
   - Evaluating Prediction: Measures and Comparison

   * *Note that for all these areas you will NOT need to memorize, and you will not need know how to derive the mathematics behind those concepts but you will need to understand the 'Why' and 'How' is connected to data analysis.*