EF 4822: Financial Econometrics
Week 1: Introduction to the Course

Ding Luo

City University of Hong Kong

What is Econometrics

- Econometrics is the application of **statistical methods** to economic data in order to give empirical content to **economic relationships**.
  - For example, how could we describe the economic relationship between unemployment growth and GDP growth using the available data for unemployment and GDP?
- A basic tool for econometrics: linear regression model

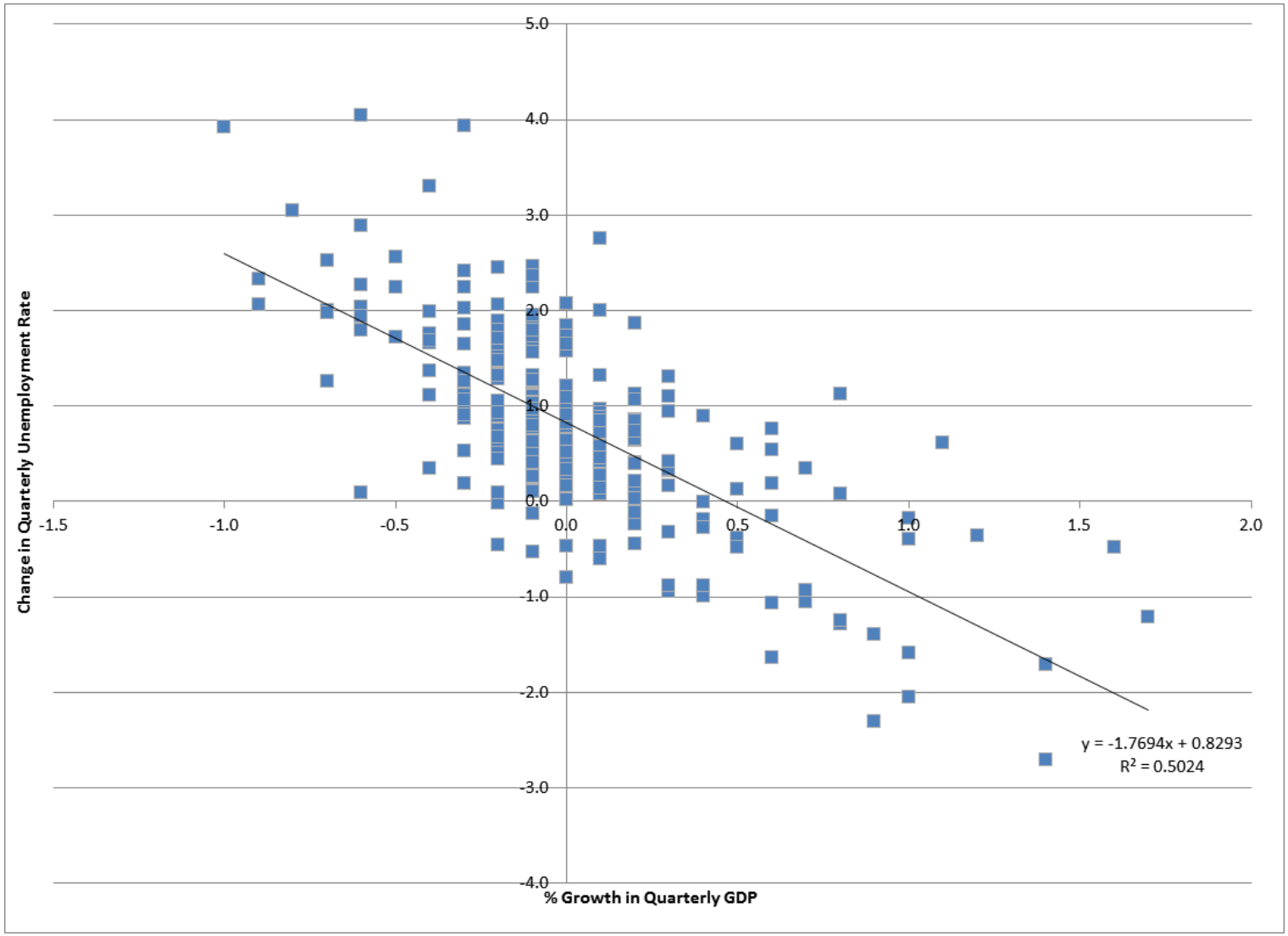
$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_k x_k + \epsilon$$

y: dependent variable; $x_1, x_2, ..., x_k$: independent variables;
ϵ: error term or disturbance term;
β_0: intercept; $\beta_1 ..., \beta_k$: slope coefficients.

  - if β_i $(i = 1, ...k)$ is significantly different from 0, there exists a significant relationship between y and x_i.
  - R^2: coefficient of determination, between 0 and 1, is the proportion of the variance in the dependent variable that is explainable by the independent variable(s).
    – higher R^2 means better fit of the linear regression model

Econometrics: An Example

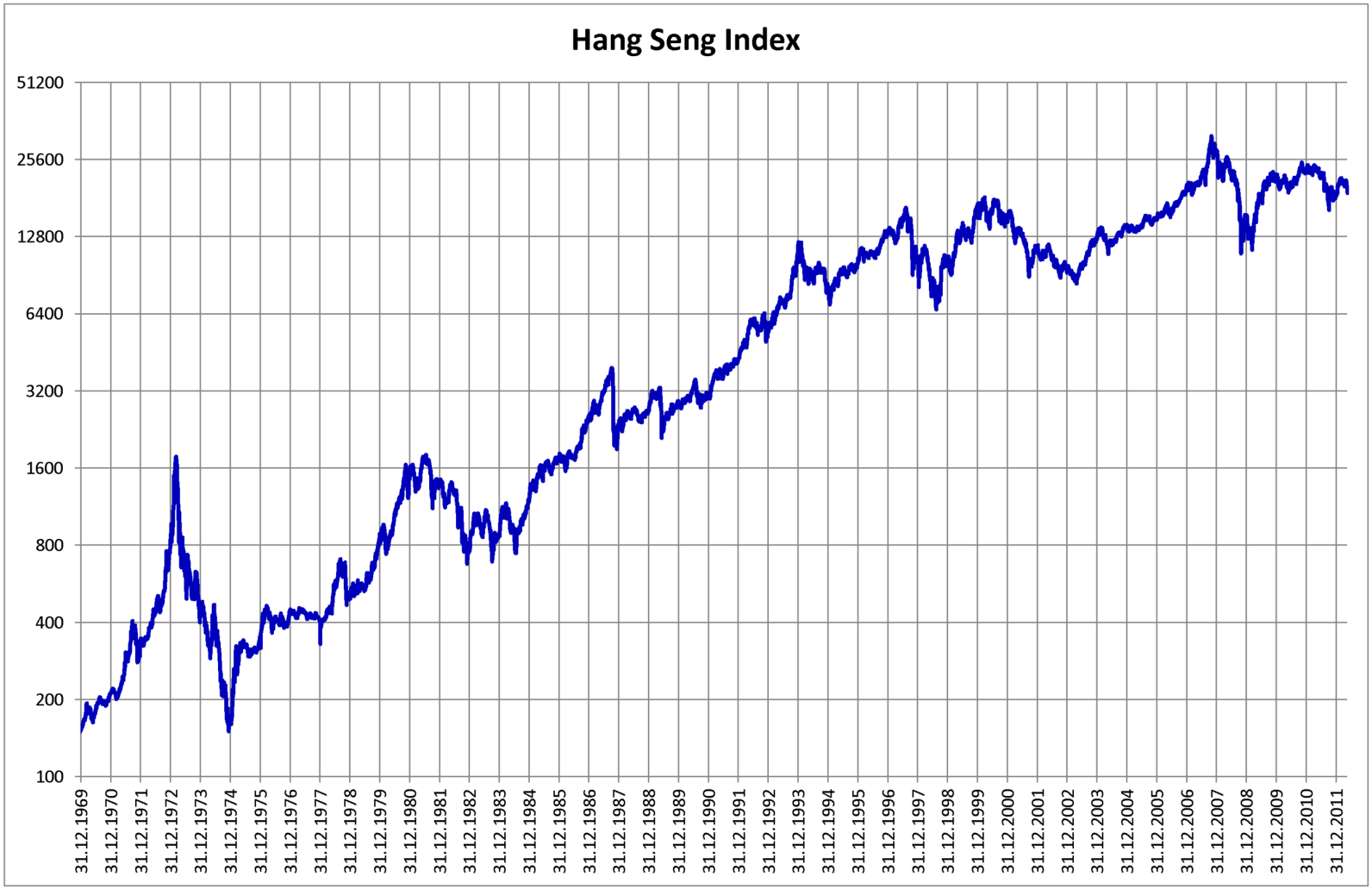
$$\text{unemployment growth} = \beta_0 + \beta_1 \times \text{GDP growth} + \epsilon$$



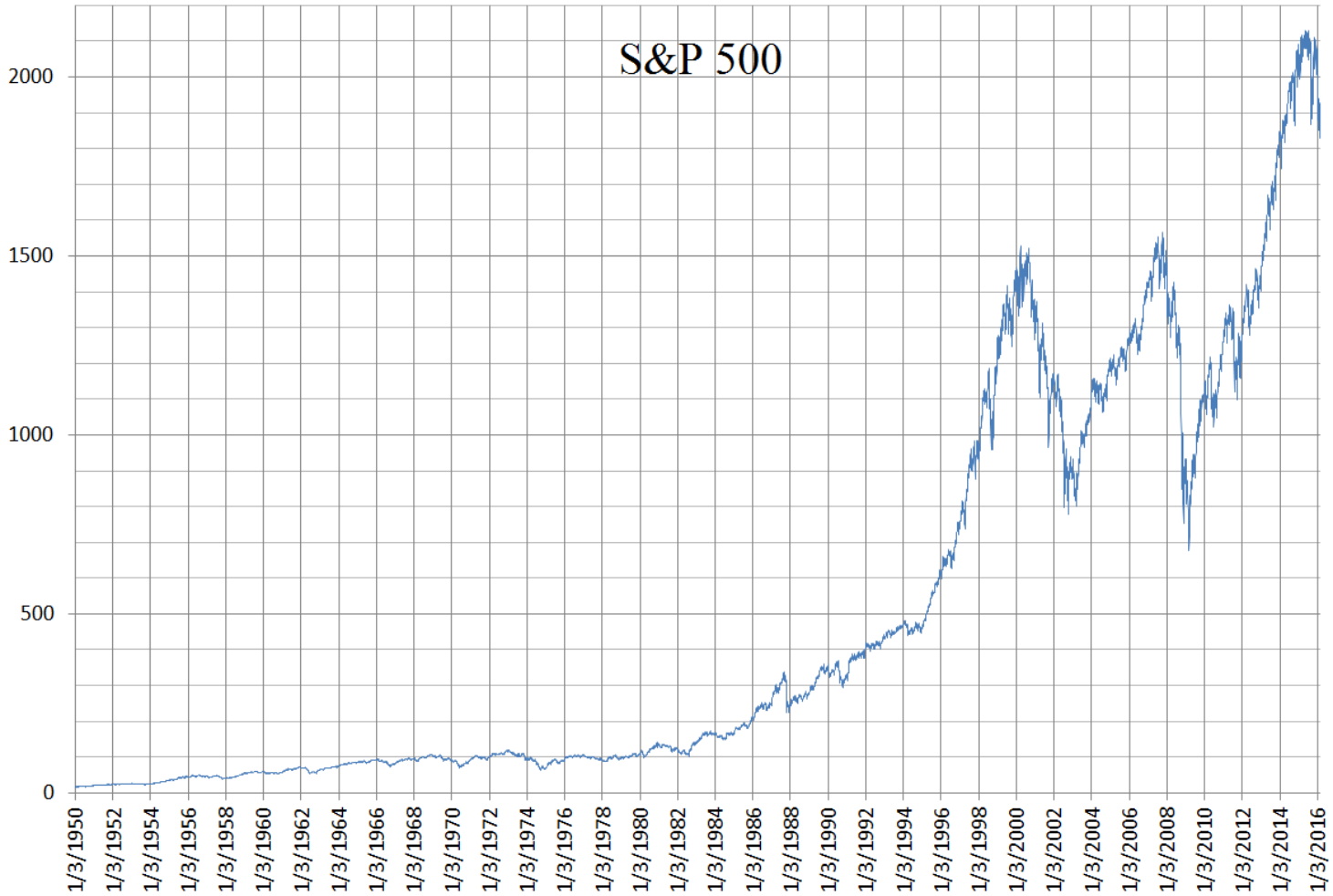
What is Financial Econometrics

- Financial econometrics is the application of **statistical methods** to **financial market data**.
- Financial market data is usually in terms of time series.
- Time series: a series of data points indexed in time order.
- Examples of financial time series
  - Hang Seng index: from December 1969 to May 2012 (daily)
  - US S&P 500 stock market index: Jan 3, 1950 - Feb 19, 2016 (daily)
  - HKD/USD exchange rate: from Jan 3, 2015 to Jan 3, 2020 (daily)
  - HK real residential property prices: 1979 Q4 - 2019 Q2 (quarterly)
  - US 1-Year Treasury Rate: from Jan 9, 2015 to Jan 9, 2020 (daily)

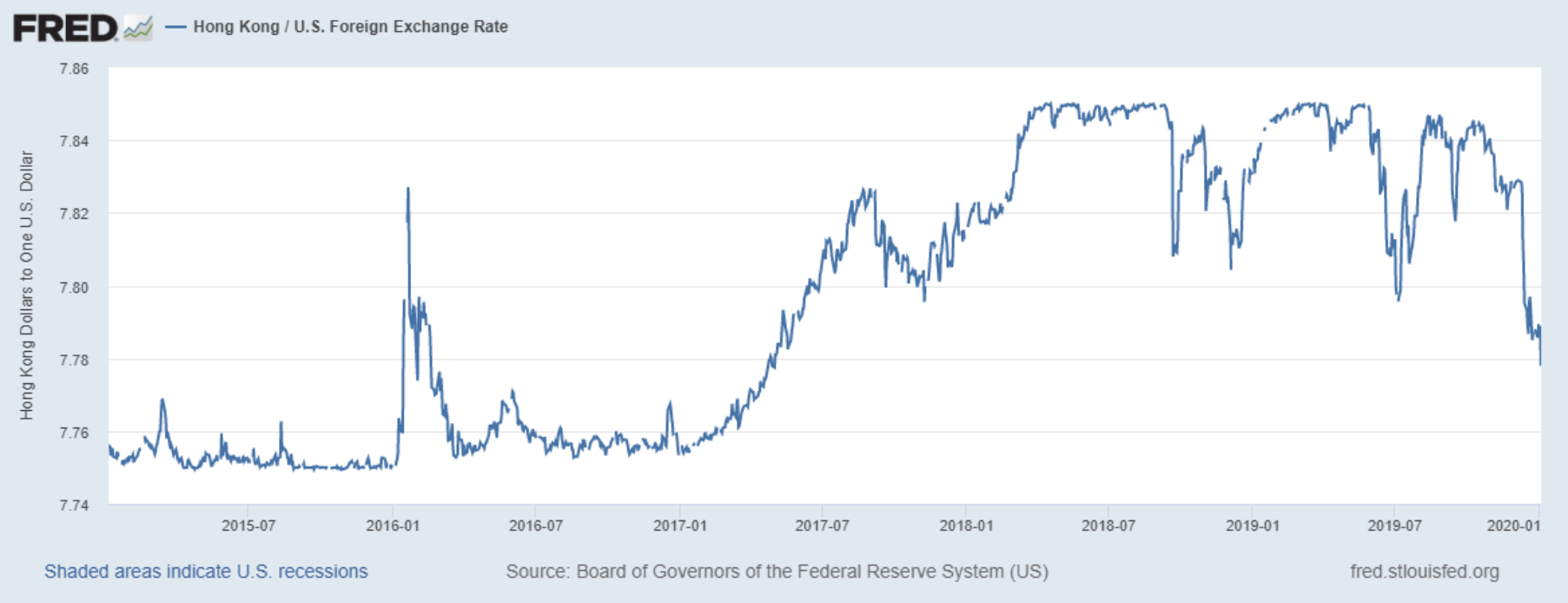
Financial Time Series: Hang Seng Index



Financial Time Series: S&P 500

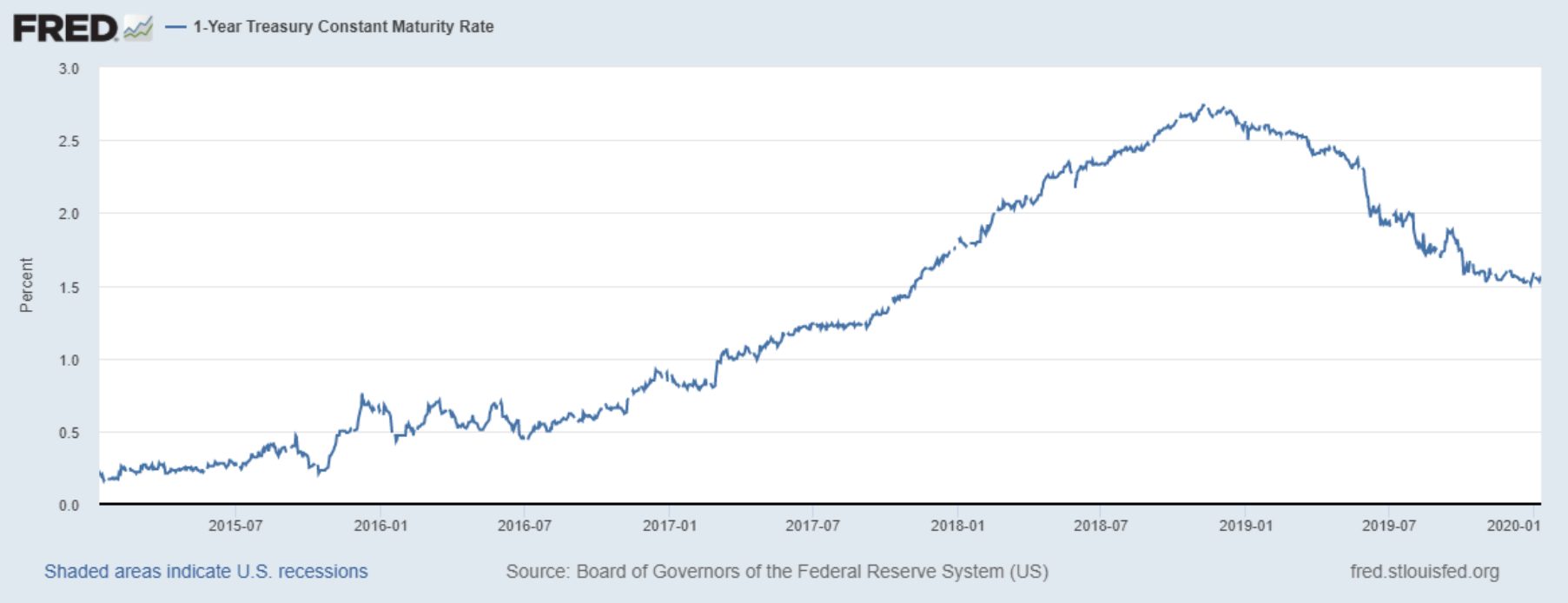


Financial Time Series: HKD/USD Exchange Rate



Financial Time Series: HK Real Residential Property Prices

Financial Time Series: US 1-Year Treasury Rate



Outline of the Course

- We will focus mostly on data on stock returns (r_t), such as Hang Seng index return, and use software R to analyze the data.
- Returns & their characteristics: empirical analysis (summary statistics, including mean, variance, skewness, and kurtosis)
- Simple linear time series models & their applications
  - AR model: $r_t = \phi_0 + \phi_1 r_{t-1} + a_t$
  - MA model: $r_t = \mu + a_t - \theta a_{t-1}$
  - ARMA model: $r_t = \phi_0 + \phi_1 r_{t-1} + a_t - \theta a_{t-1}$

  Steps in R: specify a model $\Rightarrow$ estimate the model
  $\Rightarrow$ check the estimated model $\Rightarrow$ use the model to forecast
- Regression and estimating capital asset pricing model (CAPM)
  - Regression: $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_k x_k + \epsilon$
  - CAPM: $E(r_{it} - r_{ft}) = \beta_i E(r_t^{mkt} - r_{ft}) \Rightarrow r_{it} - r_{ft} = \alpha_i + \beta_i (r_t^{mkt} - r_{ft}) + \epsilon_{it}$
  - Use R to find estimates $\hat{\alpha}_i$ and $\hat{\beta}_i$
- Time series return predictability
  - Which variables predict aggregate stock market returns?
  - $r_t = \beta_0 + \beta_1 x_{t-1} + \epsilon_t$
    Use R to find predictors x with significant non-zero $\hat{\beta}_1$ and high R^2
- Overall, study ONE time series $\Rightarrow$ TWO $\Rightarrow$ Multiple (Asset Management course)