

Statistical finance: Exam

2 hours-No document allowed

29 March 2022

- 1) State Markowitz optimization problem and solve it.
- 2) Define the Ridge estimator and provide its closed form formula with proof. What is the interest of Ridge estimator compared to ordinary least squares ? Define the Lasso estimator. What is the interest of Lasso estimator compared to Ridge ? How do we choose the regularization parameter (λ) of the Ridge and Lasso estimators ? Give one example of situation where Ridge or Lasso estimators are useful in finance.
- 3) State the Marcenko-Pastur theorem (no need to give the density of the Marcenko-Pastur law, just call it L). How can this result be used in finance ?
- 4) In the Black-Scholes model, how does the option price evolve with the drift ? Connect this with statistical estimation of the drift from historical data.
- 5) How do you assess the quality of an order book model. Give detailed explanations and examples.
- 6) How do you assess the quality of the tick value for a given asset ?
- 7) From a time series of prices (high frequency data over several years), how would you show that volatility is rough ? What are the advantages of rough models compared to classical models used for options ? What are the microstructural foundations of rough volatility ? Summarize how this can be shown mathematically.

$$\psi_{(e,1)} \times_{(e,p)}^{(s)} (p,1)$$