STA 542 – Homework 7

Due: Wednesday, November 4, at the start of class

Credit. This homework is graded for a substantive, good-faith attempt. Address every assigned part and show the reasoning behind each answer. Correct answers without supporting work do not constitute a substantive attempt.

Submission. Submit one ordered PDF. Mathematical and statistical reasoning must be written legibly by hand; tablet handwriting is welcome. R code, numerical output, tables, and plots may be printed or inserted and appended. Simple code or plots may instead be sketched when exact output is unnecessary. Label every computational exhibit, refer to it in the handwritten response, and explain what it shows.

Problem 1. An Investigation of Related Series

Choose at least two real time series and investigate one question about their relationship. Use observations at a common, regular frequency over an overlapping period. Choose readily accessible data; collecting a new dataset is not part of this homework. Keep the written discussion to about two pages, plus the computational exhibits needed to support it.

(a) **Data and goal.** Identify the source, what each series measures, its units, the sampling frequency, and the period used. State a specific inference goal (e.g. predicting one series using another, informing an inventory decision, or estimating a long-run relationship between two prices) and explain why the comparison is of interest.

(b) **Transformations and stationarity.** Show time-series plots of the original series and the series used in your analysis. Explain any transformations or filters, such as logs, detrending, or differencing. Assess which series or linear combinations can reasonably be treated as stationary, using sample ACVF/ACF plots or a KPSS test. Explain any handling of missing or unmatched observations.

(c) **Analysis.** Fit a model or estimate a relationship addressing your goal. Write the fitted equation and explain the fitting method. Pursue at least one of the following:

- *Cointegration:* assess the individual integration orders and whether a linear combination of the levels is plausibly $I(0)$.
- *Granger causality:* use a fitted VAR to assess whether one series' past adds predictive information, given the histories of the other series in the model. State the direction and lag order, assess the relevant cross-lags jointly, and check the residuals for remaining dependence.
- *Spuriousness:* compare an apparent relationship in the levels with what remains after justified detrending or differencing.

Report the estimates, confidence intervals, or tests relevant to your question. A formal cointegration test is optional.

(d) **Conclusion.** Answer the original question, making clear whether the conclusion concerns levels, changes, or another transformed series. State the assumptions needed for your inference and its main limitation. A negative or inconclusive finding is an acceptable conclusion.

Problem 2. Self-Assessment

Identify the steps in Problem 1 that you are least confident about, and briefly explain what you are unsure about.