Assignment 3

Dec 10-14: 10:00 AM, 11:00 AM

Unit 4 - Week 3

Course outline

Topic 4: Dynamic Systems Analysis

Lesson 4: Stochastic Processes

Lesson 5: Time Series Analysis

Lesson 6: Forecasting Techniques

Lesson 7: Case Studies and Applications

Lesson 8: Final Exam Review

Topic 5: Control Systems

Lesson 9: Introduction to Control Systems

Lesson 10: System Identification

Lesson 11: Control Design

Lesson 12: Case Studies and Applications

Lesson 13: Final Exam Review

Lesson 14: Examination

Lesson 15: Final Project Presentation

Lesson 16: Graduation Ceremony

Assignment 3

1. Which of the following statements are correct for the case of a 2x2 matrix? (2 points)
   - A. The determinant is equal to zero.
   - B. The eigenvalues are real and distinct.
   - C. The trace is equal to zero.
   - D. The matrix is invertible.

2. A linear time-invariant (LTI) system is described by the following state-space equations:

   \[ \dot{x} = Ax + Bu \]
   \[ y =Cx + Du \]

   where \( A \), \( B \), \( C \), and \( D \) are matrices. The goal is to find the transfer function \( G(s) \) of the system. (2 points)

3. Consider a system described by the transfer function \( G(s) = \frac{1}{s^2 + 2s + 1} \). Determine the poles and the zero of the system. (2 points)

4. A single-input single-output (SISO) system is given by the transfer function \( G(s) = \frac{1}{s + 1} \). Determine the step response and the ramp response of the system. (2 points)

5. Given the system \( G(s) = \frac{1}{s^2 + 4s + 13} \), determine the output response of the system to a unit step input. (2 points)

6. A discrete-time system is described by the difference equation \( y[n] = 0.5y[n-1] + 0.5u[n-1] \). Determine the transfer function of the system. (2 points)

7. Consider a system with the transfer function \( G(s) = \frac{1}{s^2 + 2s + 1} \). Determine the poles and zeros of the system. (2 points)

8. A control system is represented by the transfer function \( G(s) = \frac{1}{s^2 + 4s + 13} \). Determine the steady-state error for a step input. (2 points)

9. A system is described by the state-space equations:

   \[ \dot{x} = Ax + Bu \]
   \[ y = Cx + Du \]

   where \( A \), \( B \), \( C \), and \( D \) are matrices. The goal is to find the transfer function \( G(s) \) of the system. (2 points)

10. A linear time-invariant (LTI) system is described by the following state-space equations:

    \[ \dot{x} = Ax + Bu \]
    \[ y = Cx + Du \]

    where \( A \), \( B \), \( C \), and \( D \) are matrices. The goal is to find the transfer function \( G(s) \) of the system. (2 points)