Quick Guide to Synthetic Time Series Generation in Python

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March 20, 2025

1 Introduction

This document presents a quick guide to generating and plotting a synthetic time series using Python. Students can use this as an alternative to the MATLAB-based approach.

2 Python Code for Time Series Generation

Below is the Python script to construct and plot a noisy time series:

```python
import numpy as np
import matplotlib.pyplot as plt

# Define a random time series with trend
t = np.arange(0, np.pi, 0.1)      # Independent variable
n = len(t)
s = np.std(np.cos(t) * t) / np.random.rand()  # Noise
x = np.cos(t) * t + s * np.random.rand(n)     # Constructed
    time series

# Plot the Time Series
plt.figure(figsize=(8, 6))
plt.plot(t, x, color='gray', label='Noisy Time Series')
plt.title('Synthetic Time Series with Trend and Noise')
plt.xlabel('Time')
plt.ylabel('Value')
plt.legend()
plt.grid(True)
plt.show()
```

Listing 1: Python Code for Time Series Construction and Plotting

This script uses `numpy` for numerical operations and `matplotlib` for visualization. It constructs a time series with a trend altered by random noise and visualizes it in a plot. Students are encouraged to experiment with different parameters to explore various effects.