Statistics and Data Analysis
Unit 06 – Lecture 01 Notes

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Topic

Time series basics: components and autocorrelation.

Learning Outcomes

- Define time series and why order matters

- Identify trend, seasonality, and noise

- Explain autocorrelation (intuition)

- Explain why random shuffling breaks time series analysis

Detailed Notes

These notes are designed to be read alongside the slides. They expand each slide bullet into plain-language explanations, small worked examples, and common pitfalls. When a formula appears, emphasize (1) what each symbol means, (2) the assumptions needed to use it, and (3) how to interpret the final number in the problem context.

Components

- Trend: long-term movement

- Seasonality: repeating pattern

- Noise: irregular fluctuations

Autocorrelation

- Correlation with past values

- Important for AR/MA/ARIMA models

- Shows persistence of shocks

Exercises (with Solutions)

Exercise 1: Order matters

Why should train/test split be chronological for time series?

Solution

- To avoid future-to-past leakage.

Exercise 2: Seasonality example

Give one seasonal pattern in campus data.

Solution

- Weekly cafe sales (weekday vs weekend), etc.

Exercise 3: Autocorr meaning

If lag-1 autocorrelation is strong positive, what does it suggest?

Solution

- Values tend to persist from one step to next.

Exit Question

In one sentence: what is seasonality and why does it matter for forecasting?

Demo (Python)

Run from the lecture folder:

```
python demo/demo.py
```

Output files:

- `images/demo.png`
- `data/results.txt`

References

- Montgomery, D. C., & Runger, G. C. *Applied Statistics and Probability for Engineers*, Wiley.
- Devore, J. L. *Probability and Statistics for Engineering and the Sciences*, Cengage.
- McKinney, W. *Python for Data Analysis*, O'Reilly.