Statistics and Data Analysis
Unit 06 – Lecture 06 Notes

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Topic

ADF test (unit root) and interpretation.

Learning Outcomes

- State null and alternative of ADF test (unit root)
- Interpret ADF p-value for stationarity decision
- Apply ADF to original and differenced series (idea)
- Explain why tests are not the only evidence (plots matter)

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.

ADF Test

- H0: unit root (non-stationary)
- H1: stationary
- Small p-value -> reject H0

Interpretation

- If non-stationary, difference and test again
- Seasonality can require seasonal differencing
- Use ACF/PACF + diagnostics too

Exercises (with Solutions)

Exercise 1: ADF null

What is H0 in ADF?

Solution

- Unit root; non-stationary.

Exercise 2: Decision

If p=0.02 at alpha=0.05, what do you conclude?

Solution

- Reject H0; evidence of stationarity.

Exercise 3: Next step

If p=0.6, what next step?

Solution

- Difference and test again; consider seasonal differencing.

Exit Question

Why should we not rely on only one test to decide stationarity?

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.