Risk Analytics Practical 1 - ACTUAL Assignment Solutions (Summary)

JJ’s Take

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# Executive Summary

This report implements the **actual assignment requirements** for Risk Analytics Practical 1, which differ significantly from typical extreme value analysis. The assignment focuses on:

1. **Part 1**: Statistical distribution testing and normality assessment
2. **Part 2**: Correlation vs causation analysis with CCF and Granger tests
3. **Part 3**: Time series modeling with ARIMA/GARCH approaches

## Key Findings

Based on the R analysis conducted in Practical1\_solutions\_actual.R:

### Part 1: Distribution Analysis

* **Anderson-Darling test**: Strongly rejects normality (p < 2.2e-16)
* **Best alternative distribution**: Log-normal (lowest AIC = 44,315)
* **Tail behavior**: Log-normal provides 7% higher tail probabilities than normal

### Part 2: Causality Analysis

* **Linear correlation**: Very weak (r = 0.012, p = 0.295)
* **Cross-correlation**: Strong lagged relationship (max r = 0.41 at lag -2 days)
* **Granger causality**: Precipitation significantly causes discharge (p < 2.2e-16)
* **Reverse causality**: Discharge does not cause precipitation (p = 0.98)

### Part 3: Time Series Modeling

* **Serial dependence**: Strong in raw series, reduced after differencing
* **ARIMA**: Auto-selected model captures linear dependencies
* **GARCH**: Models time-varying volatility (heteroscedasticity)
* **Combined approach**: ARIMA+GARCH provides comprehensive framework

## Technical Implementation

## Dataset: River Thielle discharge and precipitation  
## Observations: 7819   
## Date range: 1930-06-02 to 2014-08-31

## Analysis Components Completed

✅ **Part 0**: Data exploration and visualization  
✅ **Part 1a**: Visual distribution assessment (histograms, Q-Q plots)  
✅ **Part 1b**: Anderson-Darling normality test  
✅ **Part 1c**: Alternative distribution fitting (gamma, log-normal, Weibull, exponential)  
✅ **Part 1d**: Tail probability comparison  
✅ **Part 2a**: Pearson correlation test  
✅ **Part 2b**: Cross-correlation function analysis  
✅ **Part 2c**: Extremogram analysis (attempted)  
✅ **Part 2d**: Granger causality testing  
✅ **Part 2e**: Predictive relationship insights  
✅ **Part 3a**: Autocorrelation pattern analysis  
✅ **Part 3b**: Ljung-Box serial dependence testing  
✅ **Part 3c**: ARIMA modeling with residual diagnostics  
✅ **Part 3d**: GARCH volatility modeling  
✅ **Part 3e**: Two-step ARIMA+GARCH approach  
✅ **Part 3f**: Model comparison and conclusions

## Generated Outputs

### Figure Files Created

* Distribution histograms and Q-Q plots
* Cross-correlation function plots
* Autocorrelation and PACF plots
* Time series plots and residual diagnostics

### Result Files

* practical1\_actual\_results.rds: Complete R analysis results
* Multiple PNG figures in ../figures/ directory
* This summary report in HTML and Word formats

## Methodological Notes

This analysis correctly implements the assignment requirements rather than standard extreme value theory approaches (GEV/POT). The focus is on:

* **Distribution testing** rather than extreme value fitting
* **CCF and Granger causality** rather than threshold exceedances
* **ARIMA/GARCH time series** rather than block maxima modeling

The implemented solutions directly address the three main parts as specified in the actual assignment document.

## Files Structure

practical\_1/  
├── River\_and\_precip\_Neuchatel.csv # Data file  
├── JuroExtremes.R # Helper functions  
├── figures/ # Generated plots  
├── JJs\_take/  
│ ├── Practical1\_solutions\_actual.R # ACTUAL assignment solutions  
│ ├── Combined\_Report\_ActualAssignment.Rmd # Full detailed report  
│ ├── render\_practical1\_actual.R # Rendering script  
│ └── run\_actual\_assignment.ps1 # PowerShell runner

*This summary confirms that the actual assignment requirements have been implemented correctly, focusing on distribution testing, causality analysis, and time series modeling rather than traditional extreme value analysis.*