FRM–SD Network Analysis for Cryptocurrencies

Project Overview

This project computes a Financial Risk Measure (FRM) for cryptocurrencies using quantile-lasso, builds monthly Stochastic Dominance (SD) Networks based on FRM signals, extracts network-centrality features, and constructs a network-risk factor. The final step evaluates this factor via Fama–French style regressions.

Objectives

- Compute monthly FRM index for top cryptocurrencies.
- Construct SD networks based on pairwise comparisons of FRM lambdas.
- Extract centralities: eigenvector, PageRank, in-degree, out-degree.
- Build a NetworkRisk factor (High minus Low portfolio).
- Evaluate NetworkRisk via regressions.

Methodology and Formulas

Monthly FRM (λ): For month t, the FRM for cryptocurrency i ($\lambda_{i,t}$) is defined as:

$$\lambda_{i,t} = \min\{\lambda \mid \beta_j(\lambda) = 0, \forall j \neq i\}$$

Scalar SD network: Directed edge from crypto i to crypto j if:

$$\lambda_{i,t} > \lambda_{j,t}$$

NetworkRisk Factor: Return difference between top-3 and bottom-3 cryptos ranked by eigenvector centrality:

$$\text{NetworkRisk}_t = \text{Return}_{\text{High},t} - \text{Return}_{\text{Low},t}$$

Fama–French Regression: Excess returns regression:

$$r_{i,t} - r_{f,t} = \alpha_i + \beta_i \text{NetworkRisk}_t + \varepsilon_{i,t}$$

Replication Steps

Step 1: Environment Setup

```
git clone https://github.com/ralupu/FRM_SD_GNN.git
cd FRM_SD_GNN
pip install -r requirements.txt
```

Step 2: Data Preparation

Place daily crypto price data in:

`data/crypto_prices.csv`

Step 3: Config Adjustments

Edit `config.yml`:

```
frequency: monthly
window: 12
step: 1
quantile: 0.05
bootstrap_draws: 0
```

Step 4: Run Pipeline

Execute the crypto pipeline:

```
python run_crypto.py --config config.yml
```

Outputs

Stored in `outputs/`, including:

- `NetworkRisk.csv`
- FRM lambdas and centralities
- Regression results

Further Notes

Modify parameters in `config.yml` for sensitivity analyses. Extend `analysis/features.py` for additional indicators or centralities.