PARSHWANATH CHARITABLE TRUST'S
A.P. SHAH INSTITUTE OF TECHNOLOGY
Department of Computer Science and Engineering
Data Science

Semester : VIII Subject : AIFB Academic Year: 2024-25

RUNNING THE GRAPHICAL LASSO (Glasso) Algorithm:

The following steps are followed to run glasso algorithm:

Step 1:- Compute the sample covariance matrix S from given data.

Step 2: Solve the Graphical Lasso ~~optimizati~~ optimization problem:

$$\boxed{\hat{\Theta} = \arg\min_{\Theta} \left(tr(S\Theta) - \log \det(\Theta) + \lambda \sum_{i \neq j} |\Theta_{ij}| \right)}$$

Step 3: Use L1 penalization to enforce sparsity, reducing overfitting.

Step 4: Tune regularization parameter λ to balance sparsity vs. accuracy.

Step 5: Interpret the sparse precision matrix to identify variable dependencies.

Example:

Using Glasso Algorithm extract 'estimated precision matrix for stock price data.

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt.
```

Semester: VIII   Subject: AIFB   Academic Year: 2024-25

```
from sklearn.covariance import GraphicalLasso
import yfinance as yf
# Step 1: Download stock price data for selected assets.
stocks = ['AAPL', 'MSFT', 'GOOGL', 'AMZN', 'TSLA'] # Example stocks
data = yf.download(stocks, start="2022-01-01", end="2024-01-01")['Adj Close']

# Step 2: Compute daily log returns
returns = np.log(data/data.shift(1)).dropna()

# Step 3: Apply Graphical Lasso to estimate a sparse precision matrix.
lambda_value = 0.05  # Regularization parameter (tune as needed)
glasso = GraphicalLasso(alpha = lambda_value)
glasso.fit(returns)

# Step 4: Extract estimated precision (inverse covariance) matrix
precision_matrix = ~~glasso.pre~~ glasso.precision_
print("Estimated Precision Matrix:\n", glasso.precision_)
```

Output:

Estimated Precision Matrix:

```
[[3e+03    -0        -0        -0        -0]
 [-0       1.4e+03   -0        -0        -0]
 [-0       -0        2.1e+03   -0        -0]
 [-0       -0        -0        2.7e+03   -0]
 [-0       -0        -0        -0        6.9e+02]]
```

Semester: VIII Subject: AIFB. Academic Year: ~~2024~~-25

Interpretation of results:

→ The Non-zero elements in the precision matrix Indicate direct dependencies between asset returns.

→ Zero elements suggest that two assets are conditionally independent, given all others.

→ Highly connected assets → Stocks with similar risk exposure (eg. same industry)

→ Sparsed dependencies – Diversified portfolio potential.

This is how we run Graphical Lasso Algorithm.