Optimal Portfolio
Using Linear Programming models

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Optimal Portfolio Using Linear Programming Models
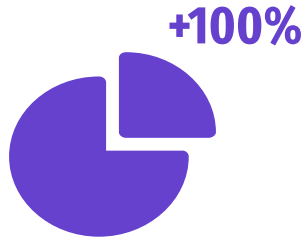
Problem Statement

+100%

Expected return and risk are the most important parameters with regard to **optimal portfolio**. It is possible to find other efficient portfolios that yields **higher expected return** for the same risk, or lower risk for the same expected return

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Method 01: Quadratic Programming

Quadratic programming(GP)

$$min \sum_{1=1}^{n} \sum_{i=1}^{n} \sigma_{ij} x_i x_j$$

$$s.t. \sum_{j=1}^{n} r_j x_j \geq \alpha B$$

$$\sum_{j=1}^{n} x_j = B$$

$$0 \leq x_j \leq u_j, j = 1, \ldots, n$$

where $\sigma_{ij} = (\frac{1}{T}) \sum_{t=1}^{T} (r_{it} - r_i)(r_{jt} - r_j)$

r_{jt} is the per krona return invested in security j over period t

r_j is the average return in security j over the entired period T

x_j is the portfolio allowcation of security j should nor exceed an upper bound u_j

α is the minimum (expected) return required by a particular investor

B is the total budget that is invested in portfolio

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Method 02: Maximin Formulation

Maximin formulation

(to maximize the minimum return)

$$\sum_{j=1}^{n} r_{jt} x_j \geq z$$

z is defined as the minimum return for every period

$$\max z$$

$$\text{s.t.} \sum_{j=1}^{n} r_j x_j \geq \alpha B$$

$$\sum_{j=1}^{n} x_j = B$$

$$\sum_{j=1}^{n} r_{jt} x_j \geq z$$

$$0 \leq x_j \leq u_j, j = 1, \ldots, n, z \geq 0$$

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Method 03: Mean Absolute Deviation Minimization

Mean absolute deviation minimization (MAD)

$$\min \frac{1}{T} \sum_{t=1}^{T} y_t$$

$$\text{s.t.} \quad y_t \geq - \sum_{j=1}^{n} (r_{jt} - r_j)$$

$$y_t \leq \sum_{j=1}^{n} (r_{jt} - r_j)$$

$$\sum_{j=1}^{n} r_j x_j \geq \alpha B$$

$$\sum_{j=1}^{n} x_j = B$$

$$0 \leq x_j \leq u_j, j = 1, \ldots, n$$

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DATASET

TATAMOTORS

automobile manufacturer includes a wide range of vehicles

Industry: Auto - Cars/UV/CV

DABUR

Products with hair care, oral care, health care, Skin care, home care and food & beverages.

Industry: Personal Care

ICICIBANK

Exclusive offers for privilege banking customer

Industry: Bank Private Sector

WIPRO

Offers end-to-end business solutions for digital transformation

Industry: IT Consulting & Software

BPCL

Oil & Gas company

Industry: Oil Refining & Marketing

IRCTC

Railway Catering and Tourism Corporation

Industry: Travel Agency, Tourism

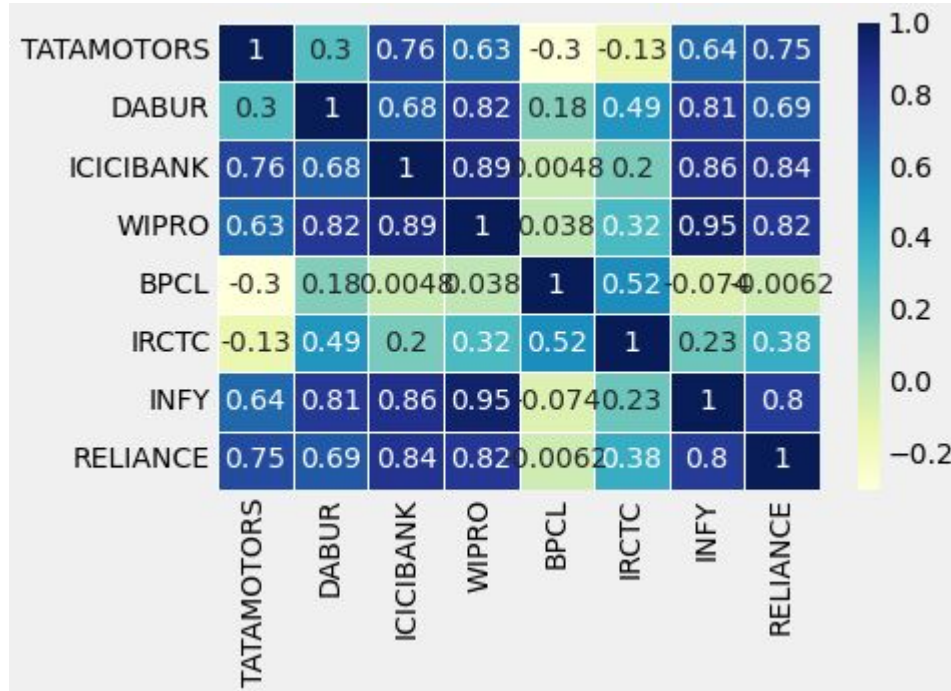### INFY

Digital services and consulting

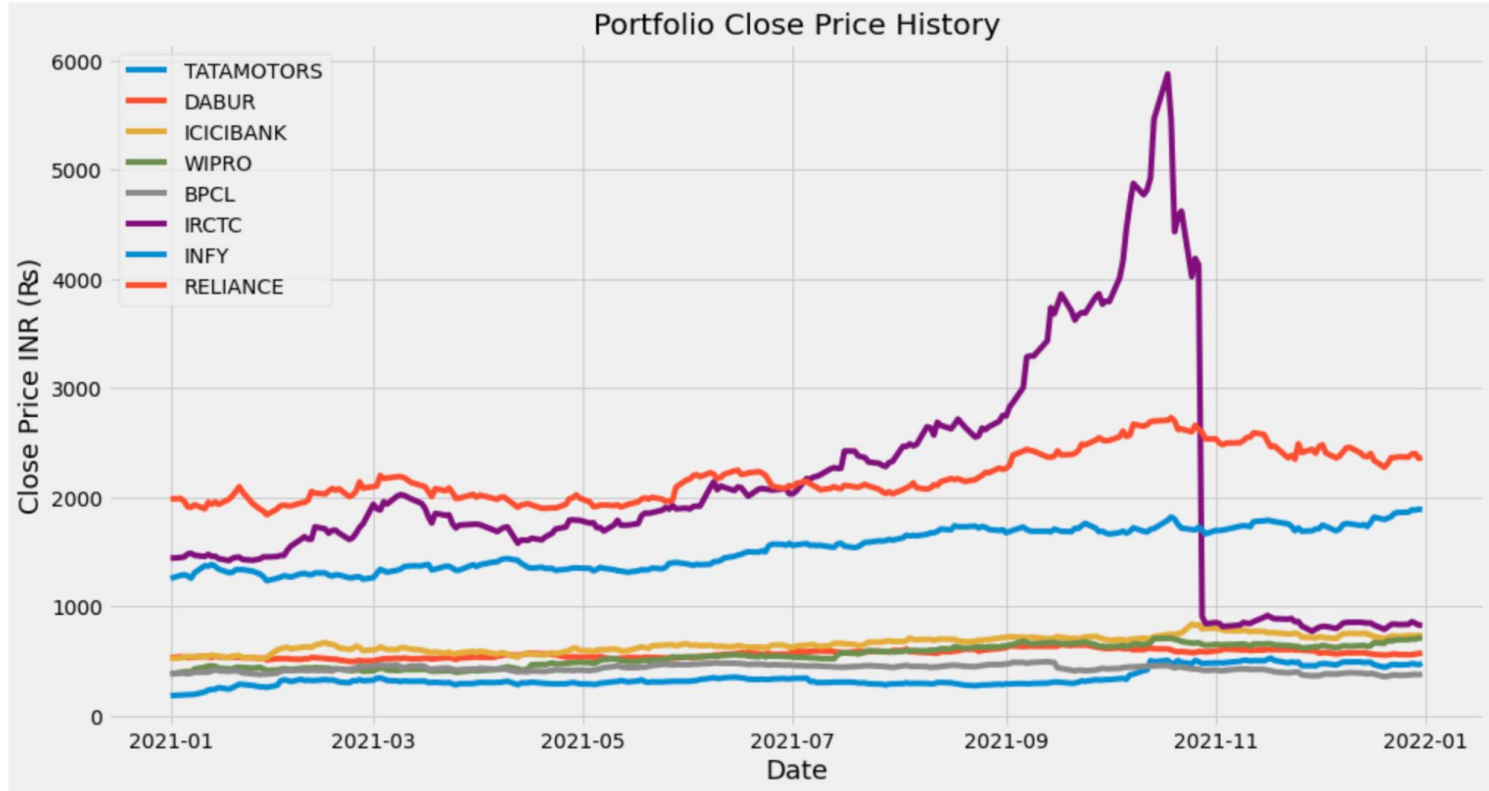**Industry: IT consulting and software**

RELIANCE

Energy, petrochemicals, natural gas, retail, telecommunications, mass media, and textiles

Industry: Diversify

Correlation between Stocks

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Portfolio Close Price History

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RESULTS

Comparison with 3 methods (%)							
TATAMOTORS	DABUR	ICICIBANK	WIPRO	BPCL	IRCTC	INFY	RELIANCE
Method 1	8.41	21.33	15.55	10.52	9.91	18.23	6.03	10.02
Method 2	100	0	0	0	0	0	0	0
Method 3	25.04	14.43	12.35	14.88	19.4	4.28	5.57	4.05

Thx!