Society of Actuaries in Ireland

Python-implemented Techniques for Reading the 'Tea Leaves' of Past Investment Performance & Risk Management of Funds

by
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Disclaimer

The views expressed in this presentation are those of the presenters and not necessarily of the Society of Actuaries in Ireland

Agenda

Why Python?
Funds
Return Statistics
Risk Statistics
Fees
Conclusion

Why Python?

- Closer to how you think
- Faster to build
- Less scope for error
- More flexible
- Wide range of libraries
- Shallow learning curve

Why Python?

```
import pandas as pd
import numpy as np
```

```
fund_a_prices = pd.read_excel('P:/Paper with John Caslin/Fund A.xlsx')
fund_b_prices = pd.read_excel('P:/Paper with John Caslin/Fund B.xlsx')
exchange_rates = pd.read_excel('P:/Paper with John Caslin/Exchange rates.xlsx')
```

```
all_prices = fund_b_prices.merge(exchange_rates, on = 'Date', how = 'inner')
all_prices['B price euro'] = all_prices['B price'] / all_prices['Exchange']
```

```
fund_a_prices['Date'] = pd.to_datetime(fund_a_prices['Date'], format = '%Y%m%d')
all_prices = all_prices.merge(fund_a_prices, on = 'Date', how = 'left')
all_prices.sort_values(by = 'Date', ascending = True, inplace = True)
all_prices['A price'].fillna(method = 'ffill', inplace = True)
```

Why Python?

```
all_prices['A return'] = np.log(all_prices['A price']) - np.log(all_prices['A price'].shift(1))
```

```
fund = 'A'
roll_days = 10
mean_column = fund + ' rolling ' + str(roll_days) + '-day mean'
std_column = fund + ' rolling ' + str(roll_days) + '-day standard deviation'
all_prices[mean_column] = all_prices[return_column].rolling(roll_days).mean()
all_prices[std_column] = all_prices[return_column].rolling(roll_days).std()
```

Why Python?

```
for fund in ['A', 'B']:
    return_column = fund + ' return'

    for roll_days in [5, 10, 20, 40]:
        mean_column = fund + ' rolling ' + str(roll_days) + '-day mean'
        std_column = fund + ' rolling ' + str(roll_days) + '-day standard deviation'
        all_prices[mean_column] = all_prices[return_column].rolling(roll_days).mean()
        all_prices[std_column] = all_prices[return_column].rolling(roll_days).std()
```

Three Funds

IGC Bond Fund

- Fixed income
- Investment grade
- Global universe
- Currency risk
- Derivatives for Efficient Portfolio Management

European Equity Fund

- Equities of companies domiciled in or with significant operations in Continental Europe
- Highly-concentrated portfolio
- Derivatives for Efficient Portfolio Management

Multi-Asset Fund

- At least 50% in investment-grade government & corporate bonds and high yield bonds
- At most 20% in equities
- Any balance in cash and money market instruments.
- Derivatives for leverage of up to 2x NAV

Three Funds

Investment Objective

- Do not target a specific return

Risk Objective

- Do not target a specific risk level

Track Record

Fund	Start Date of NAV Prices	End Date of NAV Prices	Length of Track Record (Number of Daily Returns)
IGC Bond	15/09/2003	12/03/2018	3,780
European Equity	01/06/2007	09/04/2018	2,743
Multi-Asset	20/04/2007	08/09/2018	2,751

Data

Data Set — Format

- Date
- Net Asset Value (“NAV”)

Daily Data — Tests

- Number of days between pricing dates
- Maximum, average, and standard deviation

Sample — Representative of time period

- Awareness of the time period of the sample
- Historic bull-runs or bear markets in the asset class

Range of Statistics Covered in the Presentation

v.

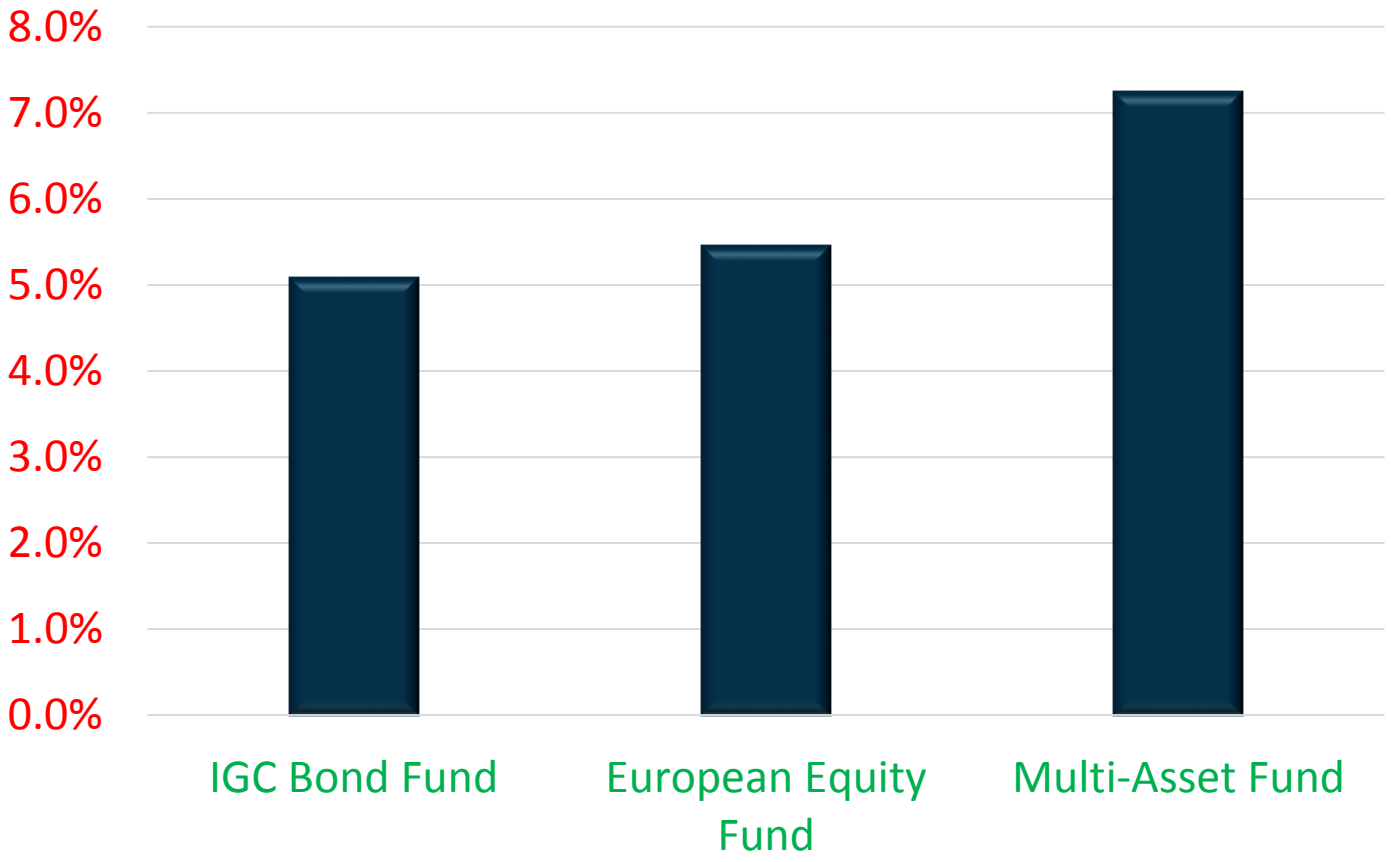
in the Paper and the Programs

Return Statistics

Return Statistics

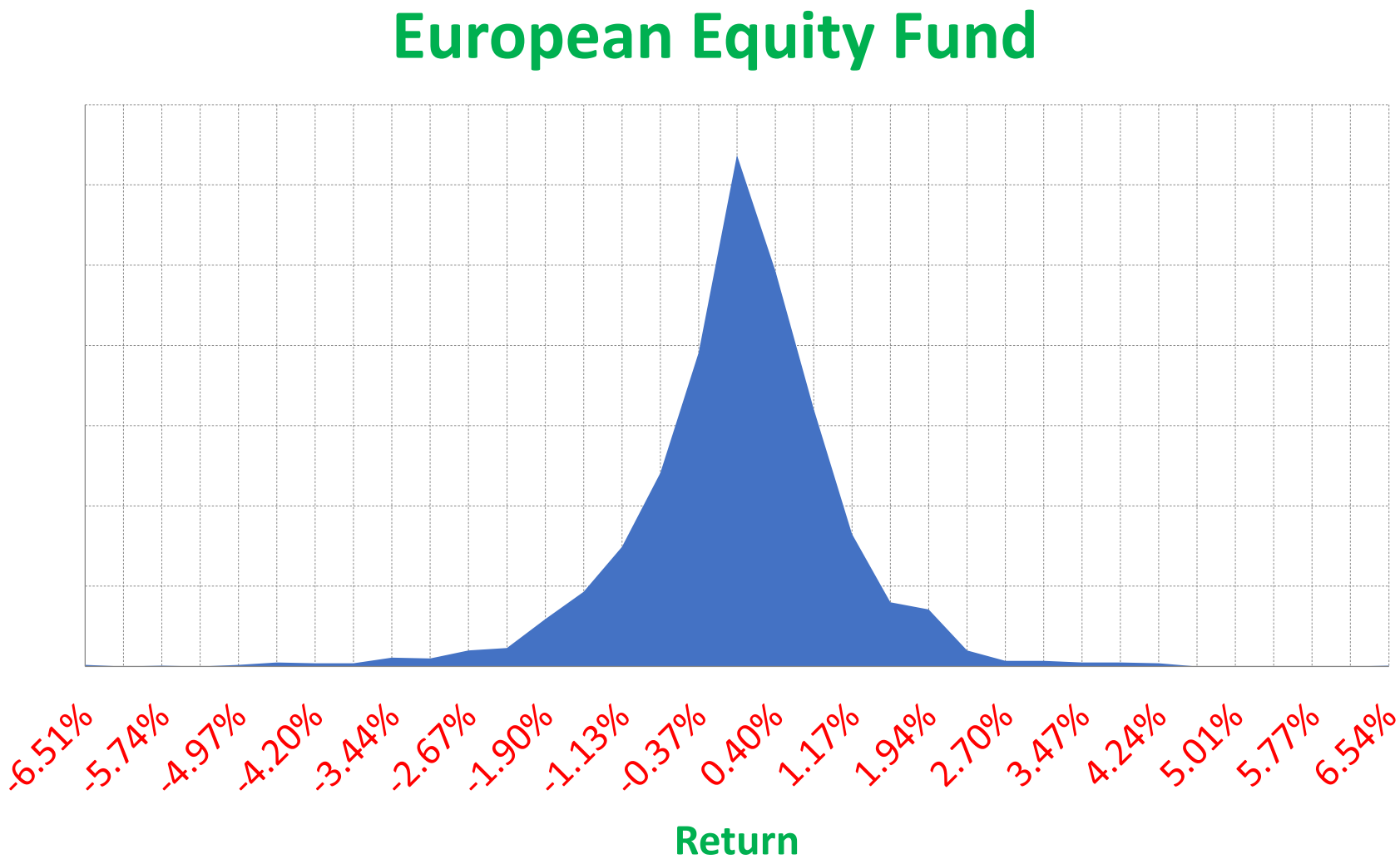
- Annualised returns
- Empirical PDF of daily returns
- Empirical plot of ordered pairs
- Number of days accounting for 90% of return
- Percentages of +ve and -ve returns
- Average +ve and -ve daily return
- Omega ratio
- Rolling rates of return

Annualised Rates of Return



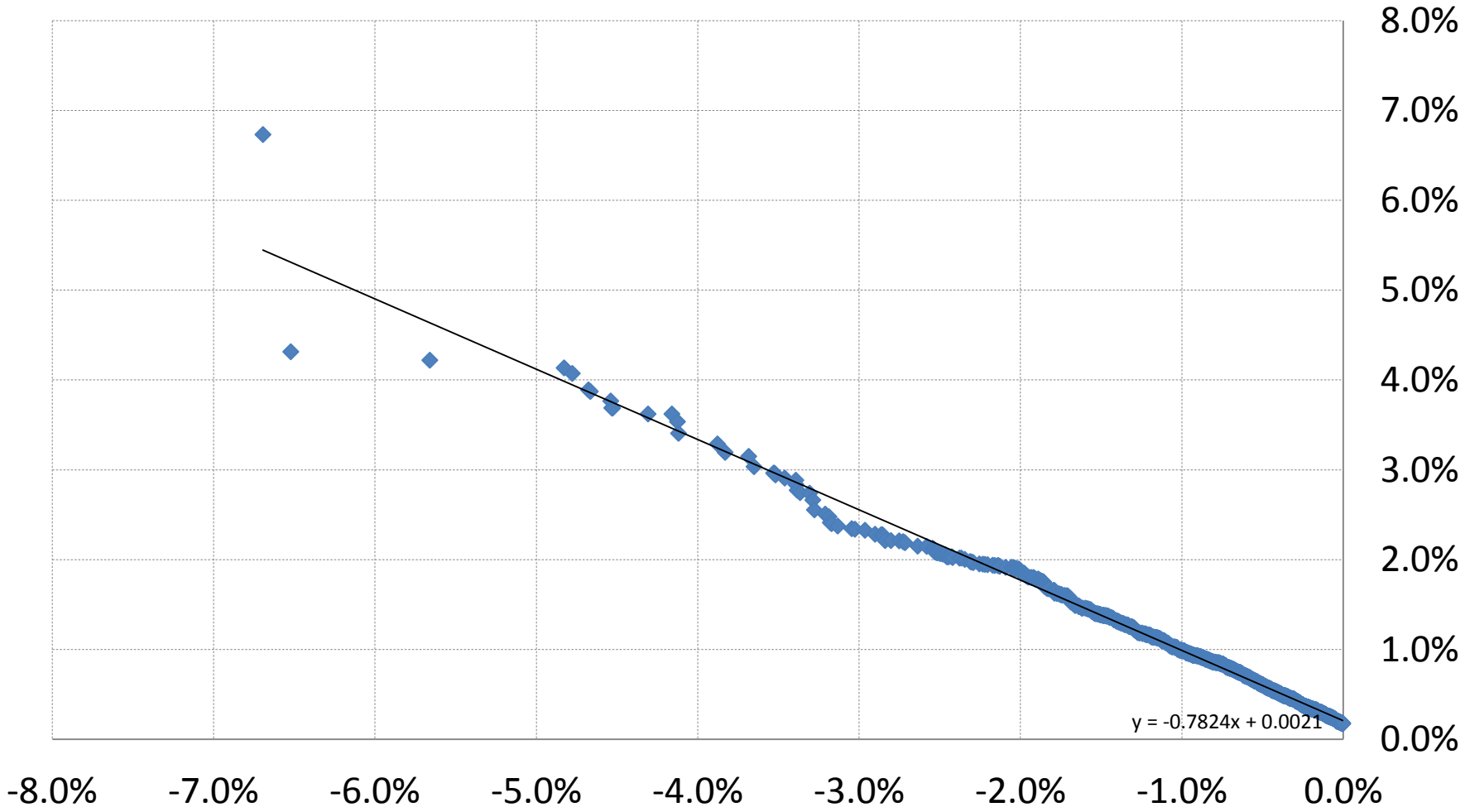
Only two data points used

Empirical PDF of Daily Returns



Empirical plot of ordered pairs

European Equity Fund



Return Statistics

Fund	Percentage of Positive Daily Returns	Average Positive Daily Return (bps)	Percentage of Negative Daily Returns	Average Negative Daily Return
IGC Bond	45.0%	19.07	33.5%	-19.74
European Equity	54.2%	71.73	45.2%	-81.41
Multi-Asset	50.0%	18.62	34.4%	-19.01

Return Statistics

Fund	Percentage of Days Accounting for 90% of Total Return
IGC Bond	3.3%
European Equity	0.5%
Multi-Asset	4.1%

Implications for market-timing strategies

Omega Ratio


IGC Bond Fund
Daily returns from lowest to highest
Return
0.02
0.015
0.01
0.005
0
-0.005
-0.01
-0.015
-0.02
-0.025

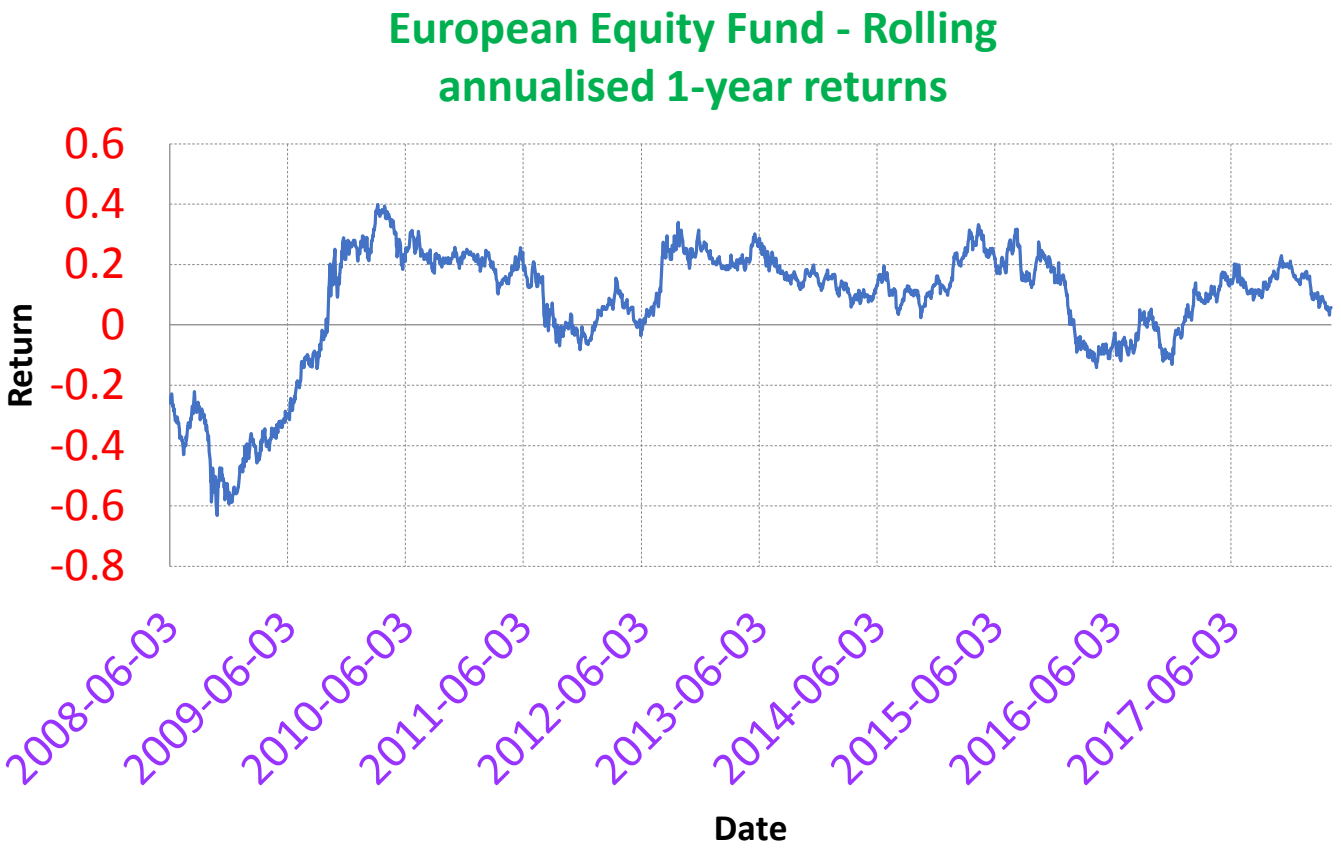
Omega Ratio


European Equity Fund
Daily returns from lowest to highest
Return
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08

Omega Ratio

Fund	Omega Ratio
IGC Bond	1.295
European Equity	1.057
Multi-Asset	1.423

Rolling Rates of Return



75% of rolling 1-year annualised returns are positive

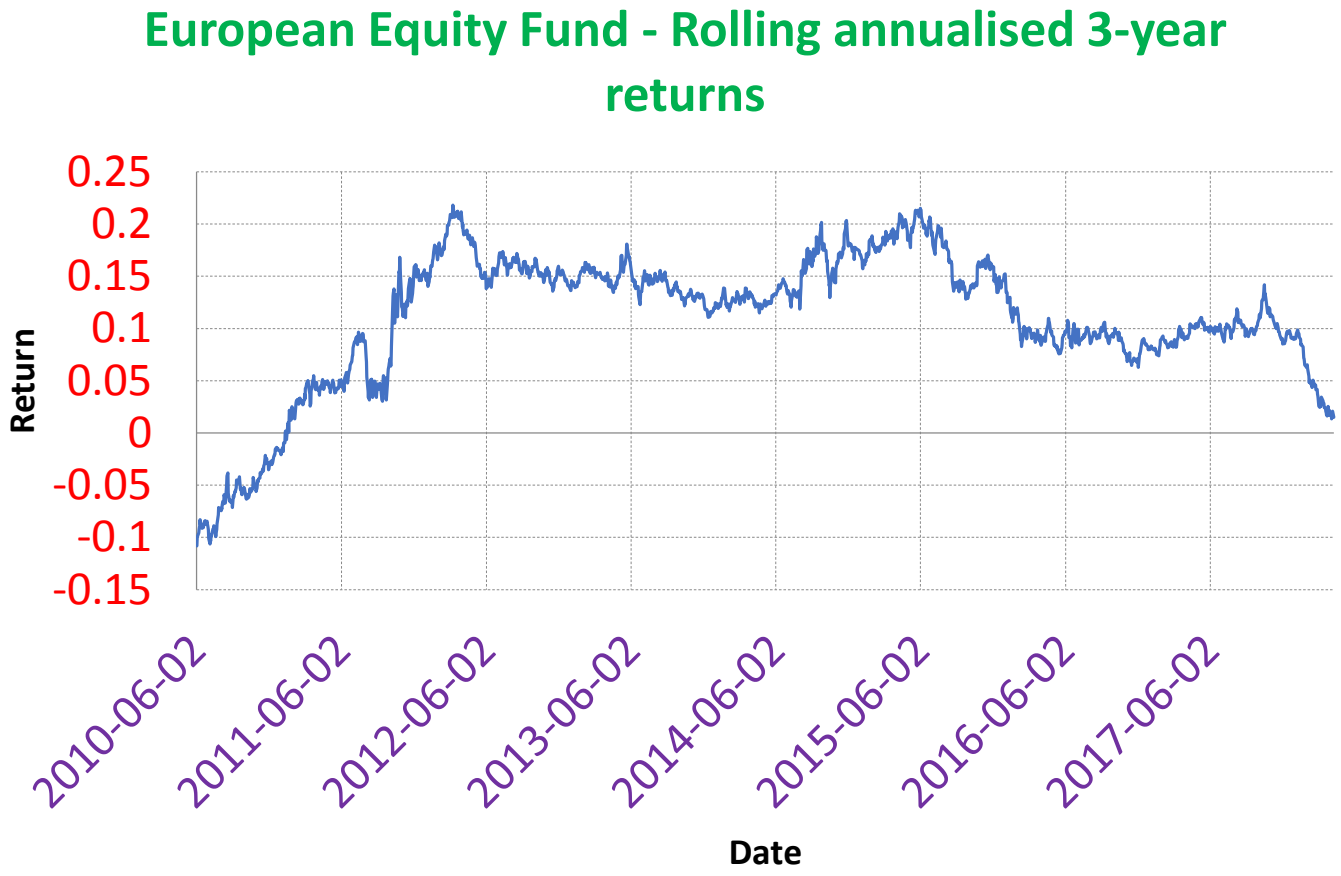
Rolling Rates of Return

Assess Performance v. Objective

Analysis of Different Time-cohorts

Not Independent

Rolling Rates of Return



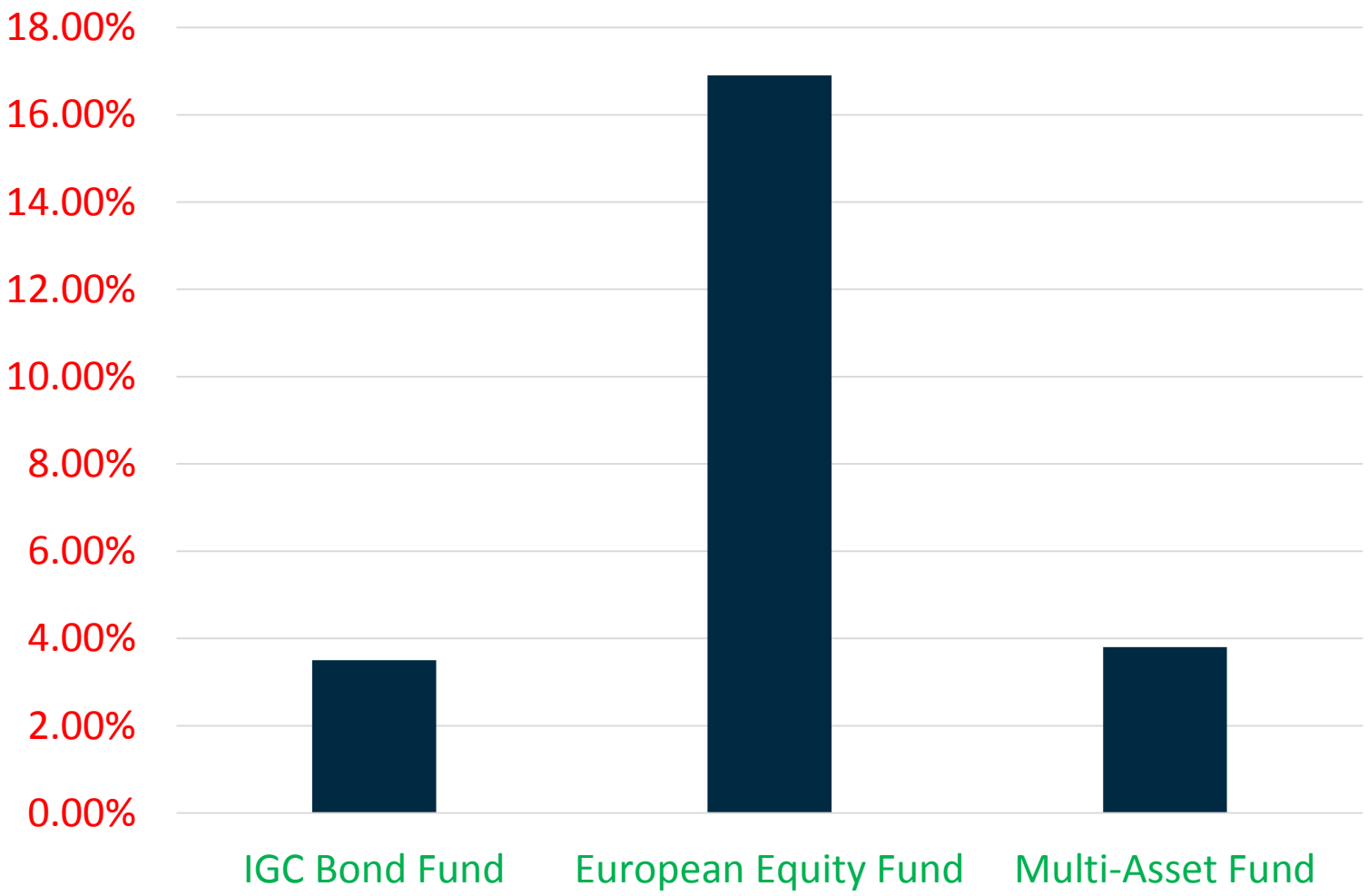
92% of rolling 3-year annualised returns are positive

Risk Statistics

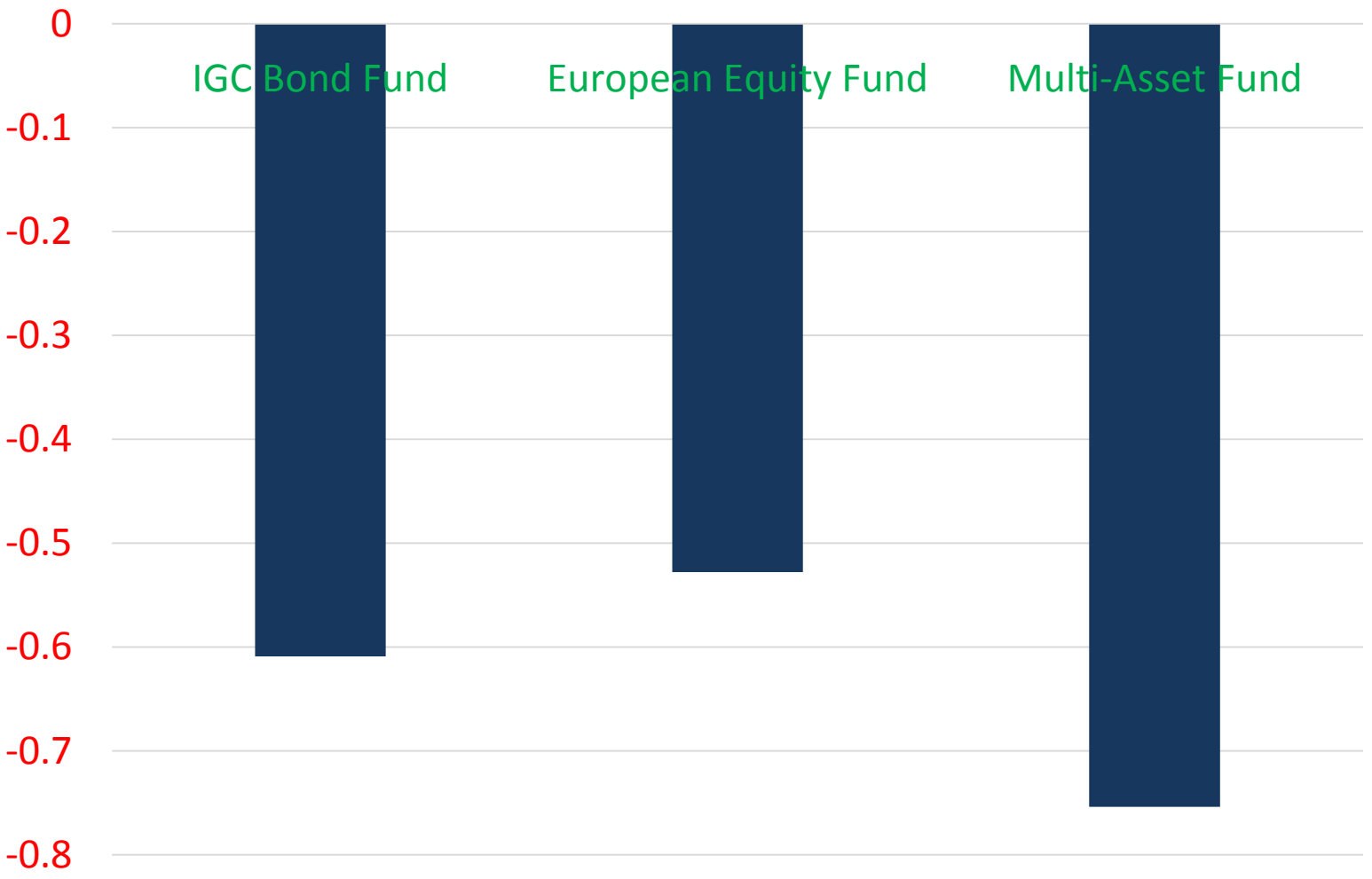
Risk Statistics

- Annualised standard deviation of returns
- Skewness of returns
- Kurtosis of returns
- Extreme standardised daily returns
- Maximum peak-to-trough fall in value
- Rolling 20-day volatility

Annualised Standard Deviation of Daily Returns

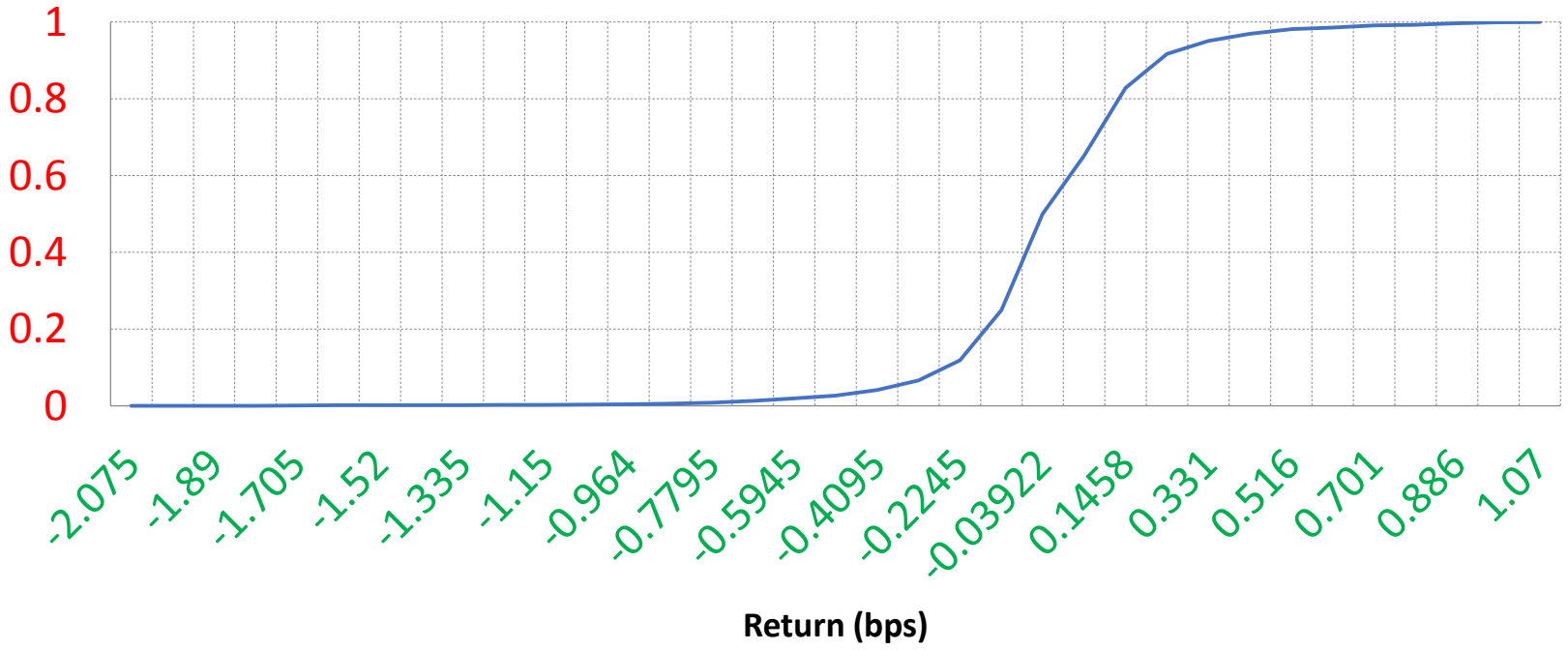


Skewness of Daily Returns



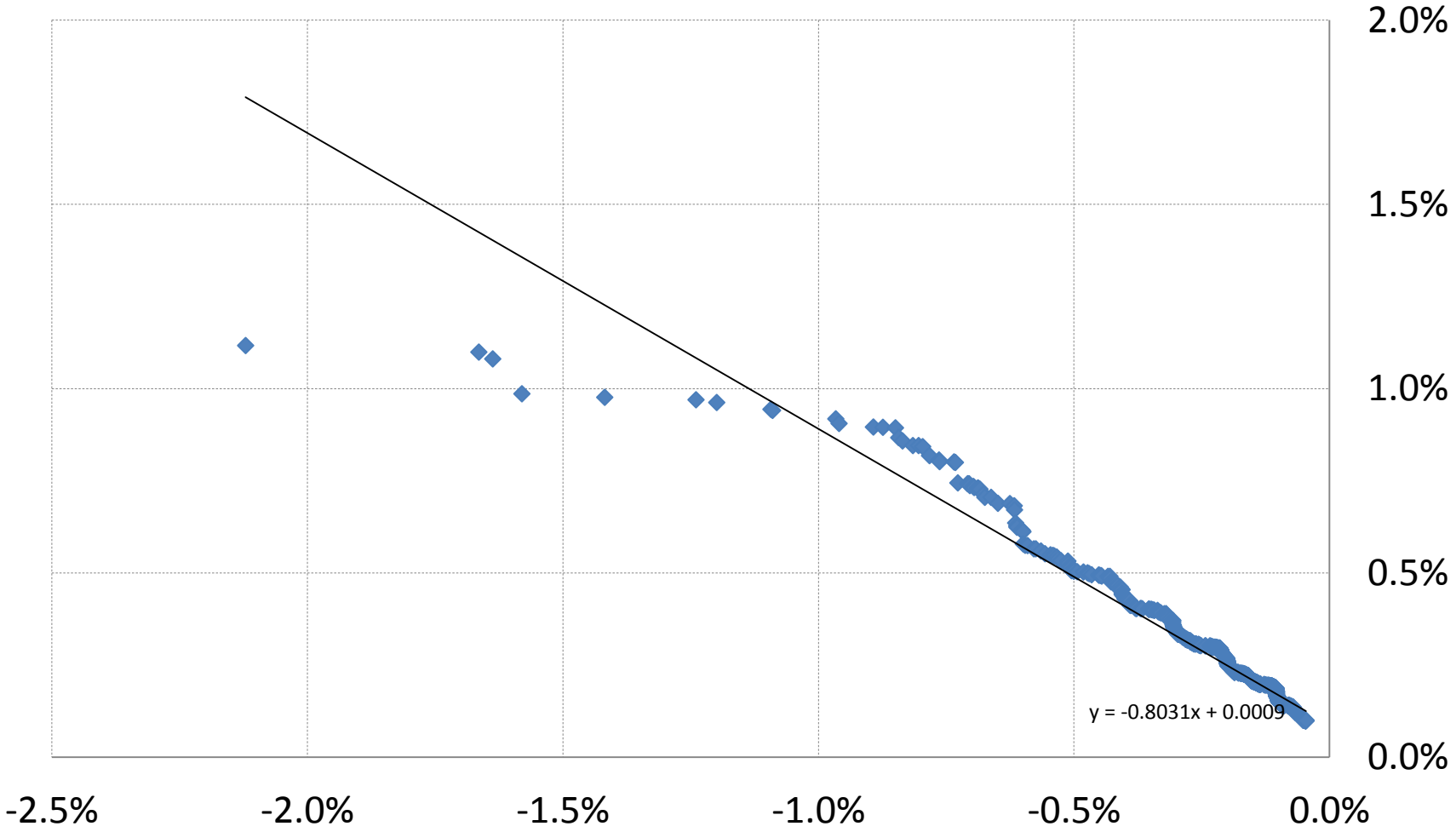
Empirical CDF of Daily Returns

Multi-Asset Fund



Empirical plot of ordered pairs

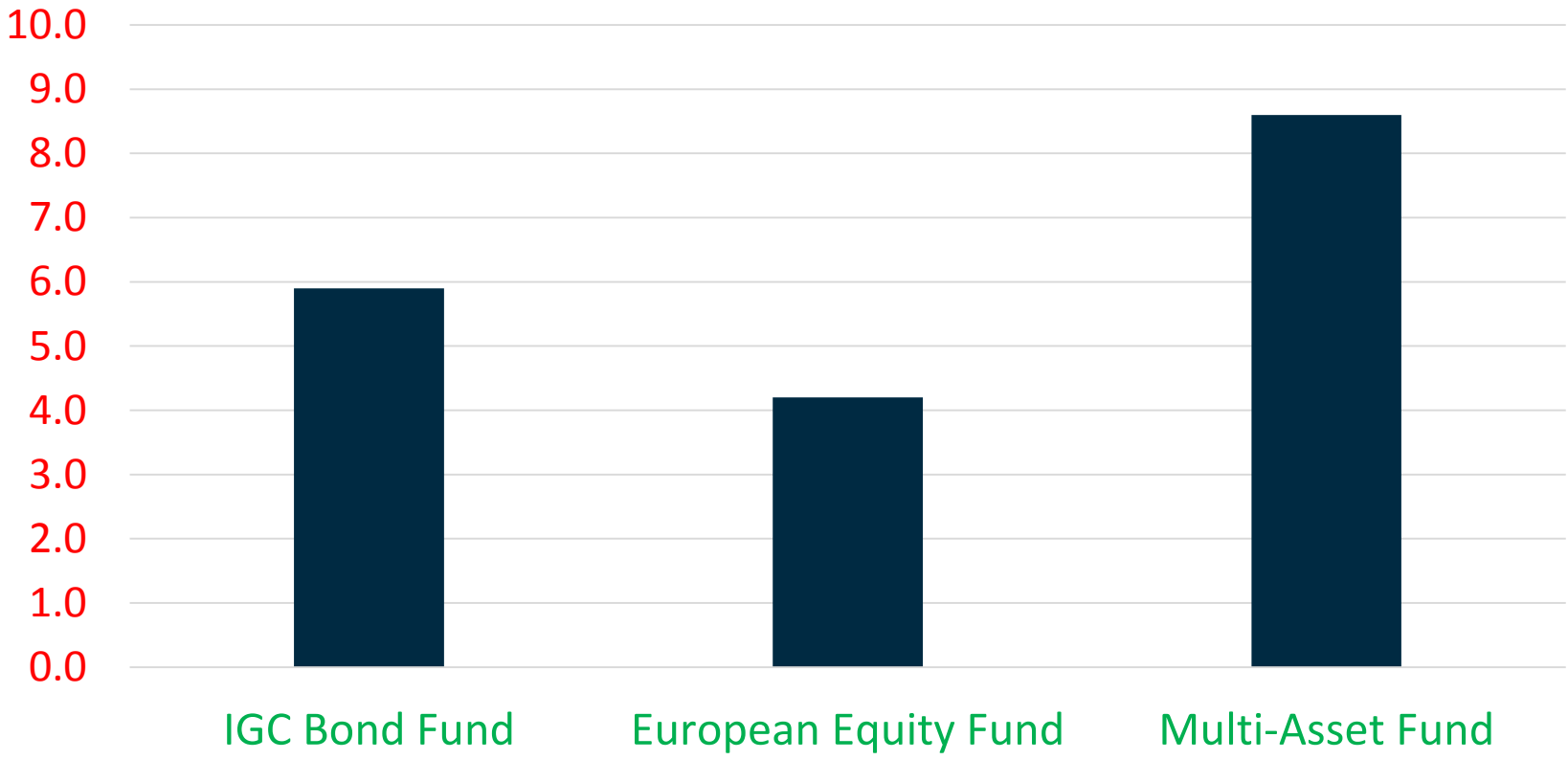
Multi-Asset Fund



Standardised Returns Below Mean

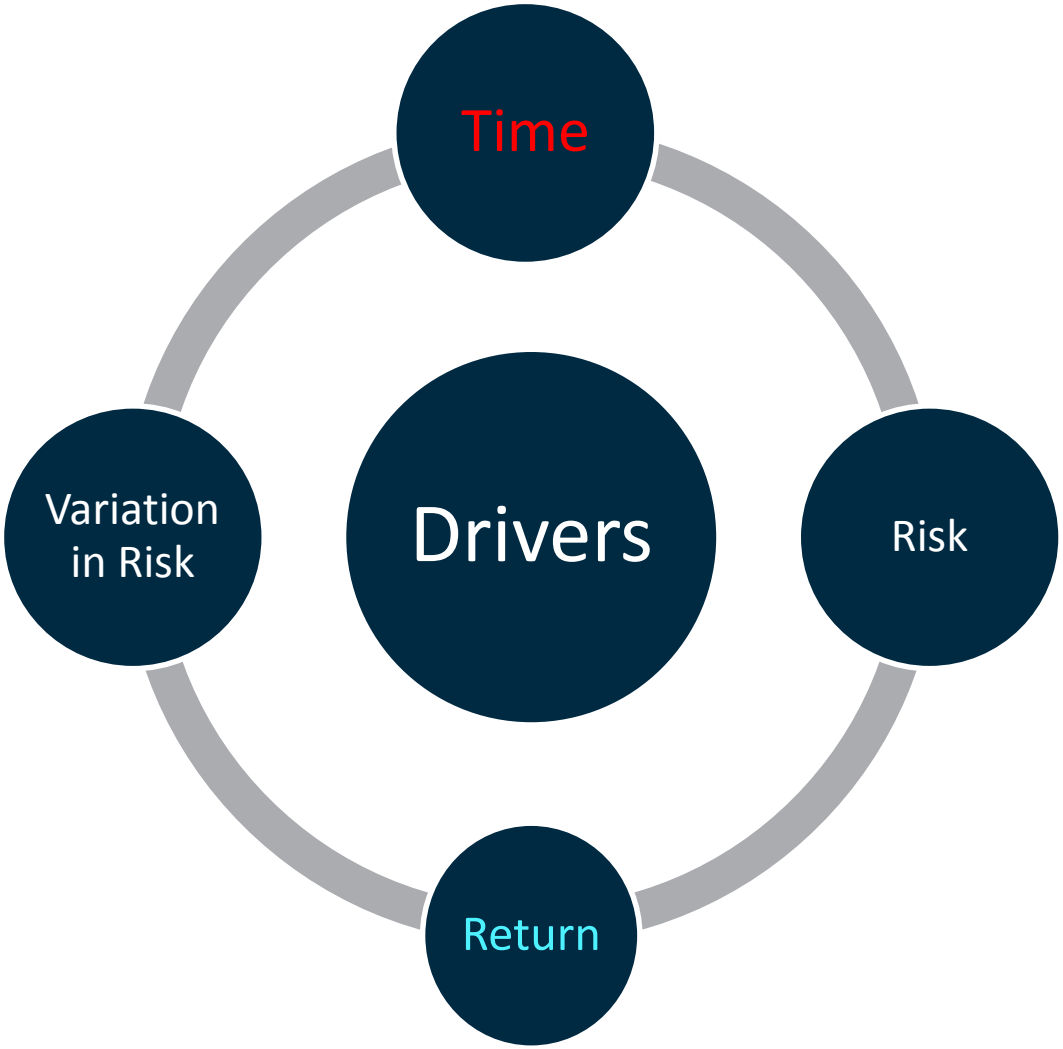
Excess Kurtosis of Daily Returns

$$Kurtosis\,(r_1,\ldots,r_n) = \frac{n(n+1)}{(n-1)(n-2)(n-3)}\sum_{i=1}^{n}\left(\frac{r_i-\bar{r}}{\sigma}\right)^4 - \frac{3(n-1)^2}{(n-1)(n-3)}$$

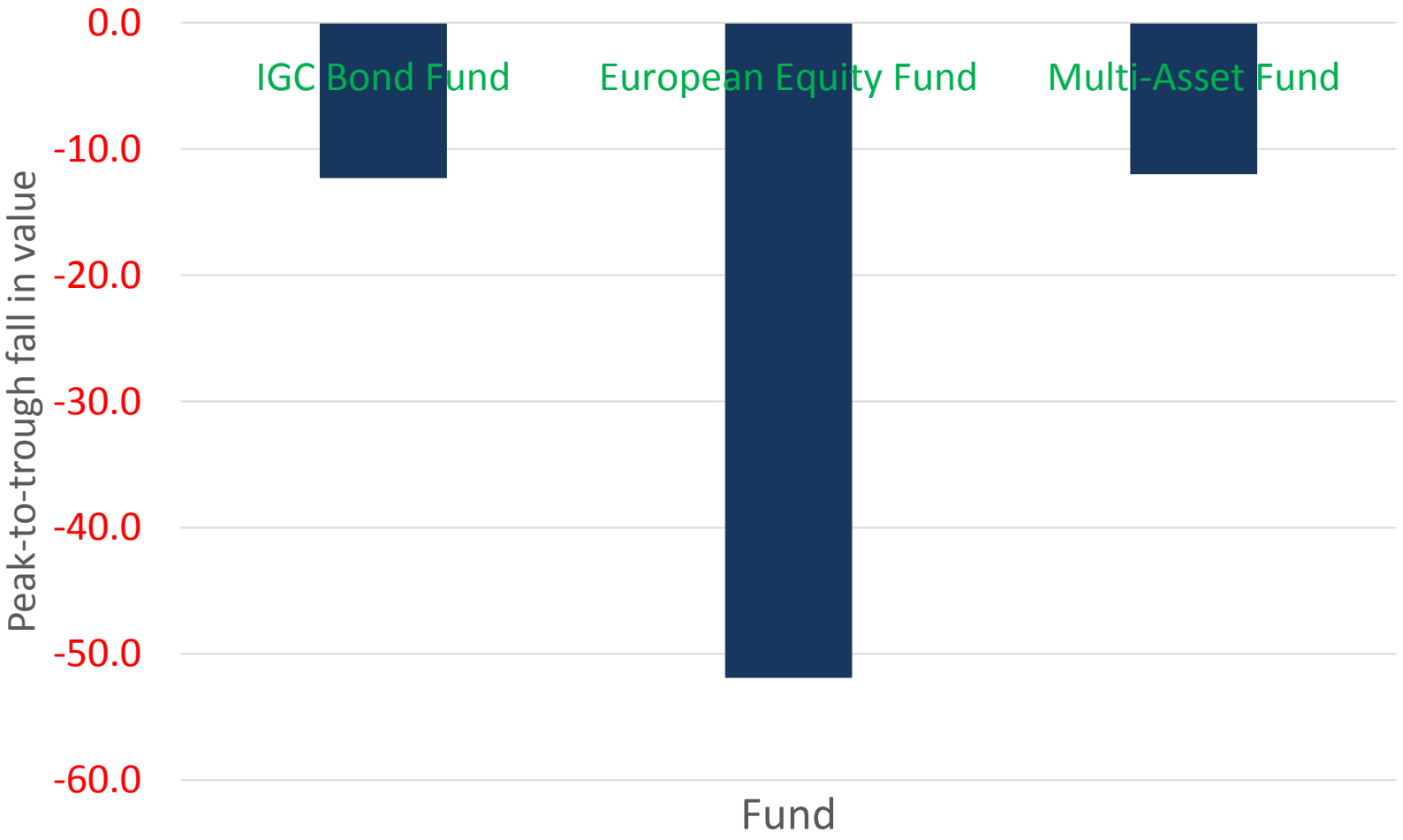


Source: http://www.styleadvisor.com/resources/statfacts/kurtosis.

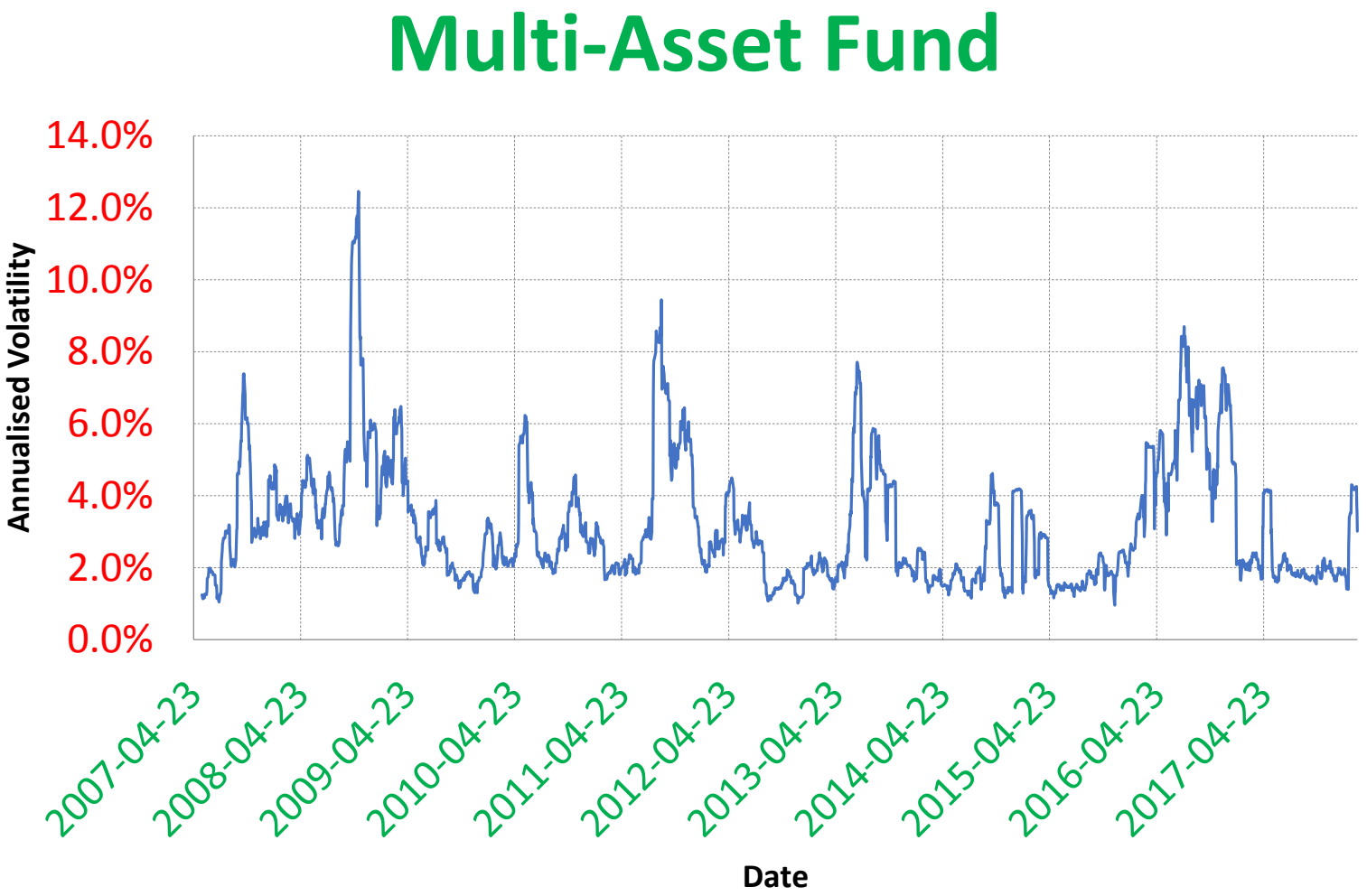
Maximum Peak-to-trough Fall in Value



Maximum Peak-to-trough Fall in Value



Rolling 20-day Volatility (annualised)



Rolling 20-day Volatility (annualised)

Has the Risk Objective been achieved?

Extent of Variation in Volatility

Assessment of Quality of Risk Management

Driver of Peak-to-trough Falls in Value

Fees

Fees

Fund (1)	Fees (2)	Realised Volatility (3)	Estimated Long-term Sharpe Ratio (4)	Expected Long-term Return (5)=(3)*(4)	Fees as a Percentage of Expected Return (6)
IGC Bond	0.49%	3.5%	0.4	1.4%	35%
European Equity	0.83%	16.9%	0.4	6.8%	12%
Multi-Asset	0.92%	3.8%	0.5	1.9%	48%

Conclusion

Why Python?

Only a sample of the statistics

Paper, programs, and data sets

DataCamp

EdX

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Thank you for your attention

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