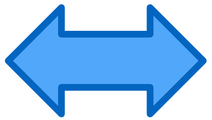
INTRODUCTION TO PORTFOLIO ANALYSIS

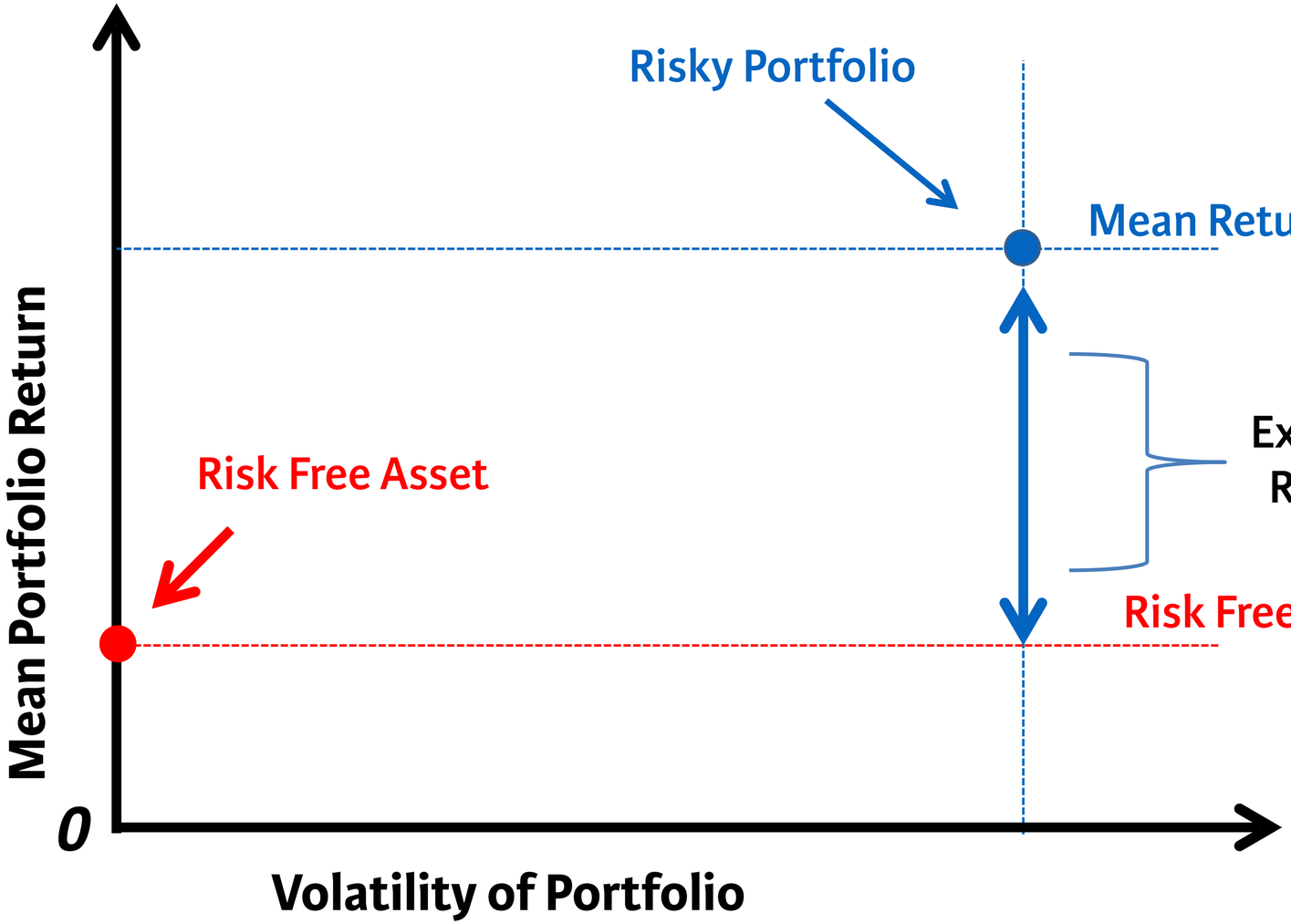
The (Annualized) Sharpe Ratio

Benchmarking Performance

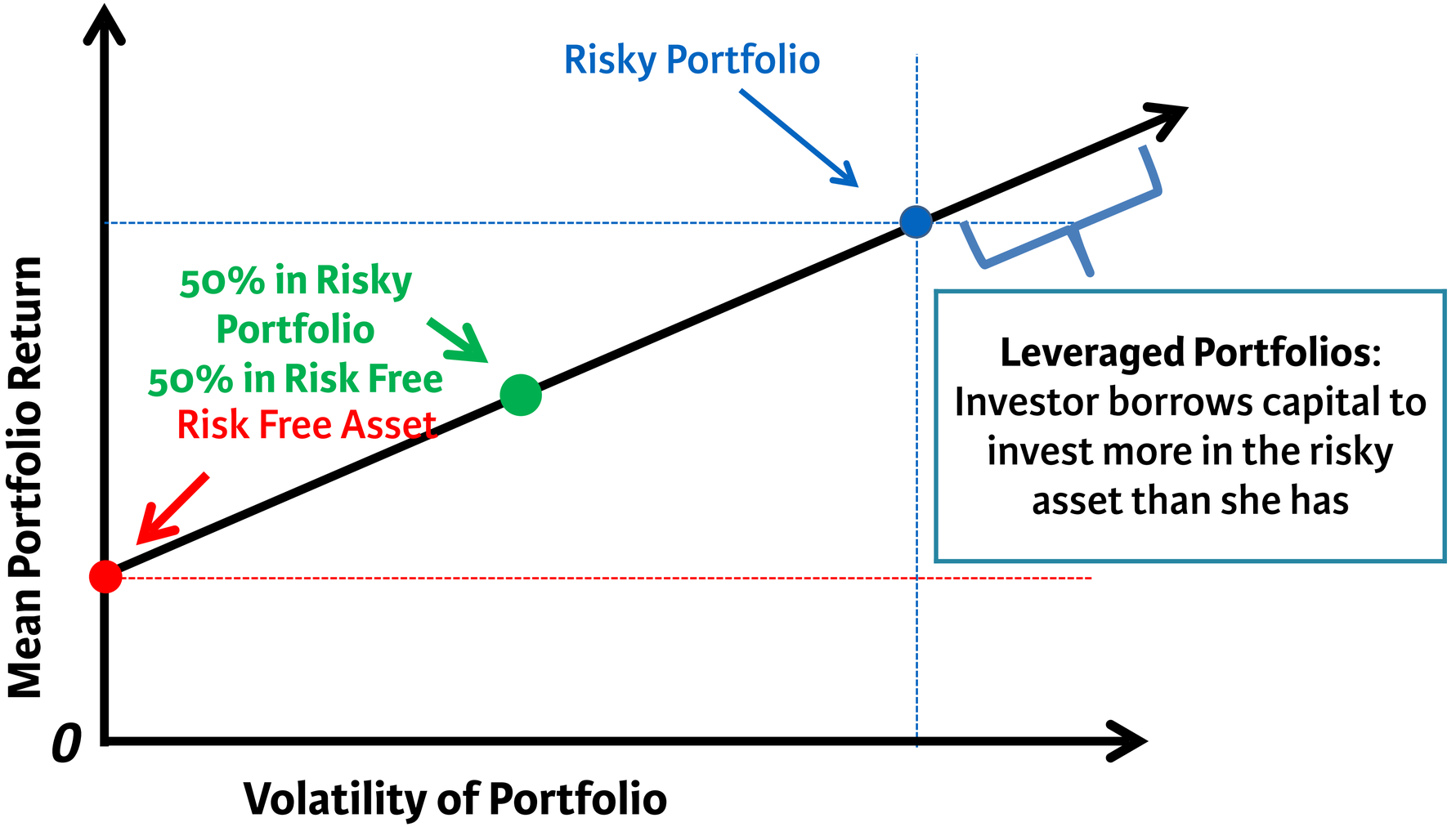
- Compare with investing in a risk free asset

Risky Portfolio **E.g:** portfolio invested in stocks, bonds, real estate, and commodities		**Risk Free Asset** **E.g:** US Treasury Bill
Reward: measured by mean portfolio return		**Reward**: measured by risk free rate
Risk: measured by volatility of the portfolio returns		**Risk**: No risk. The return is always equal to the risk free rate, thus volatility is 0

Risk-Return Trade-Off



Capital Allocation Line



Leveraged Portfolios:
Investor borrows capital to invest more in the risky asset than she has

The Sharpe Ratio

$$\text{Slope} = \frac{\text{Excess mean return}}{\text{Volatility of risky portfolio returns}}$$

Slope = ↕ / ↔

Risky Portfolio

Risk Free Asset

Mean Portfolio Return

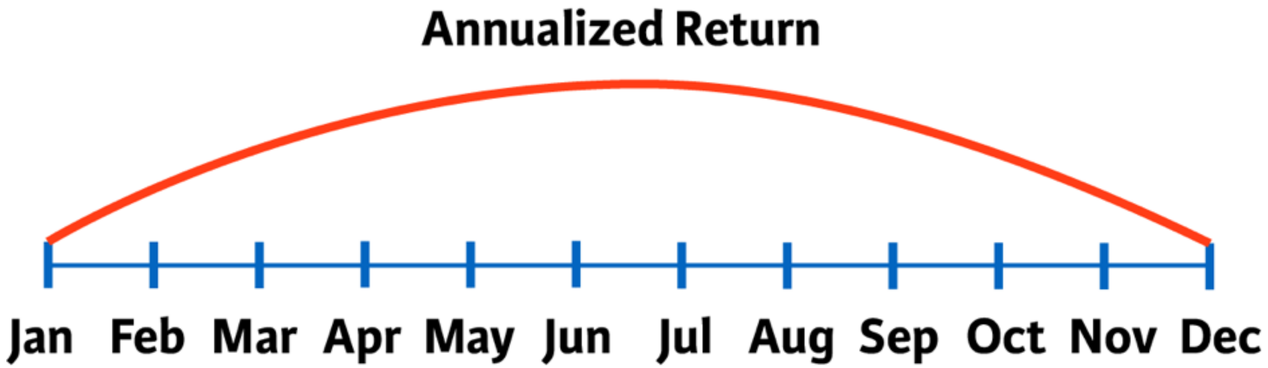
0

Volatility of Portfolio

Performance Statistics In Action

```
> library(PerformanceAnalytics)
> sample_returns <- c( -0.02, 0.00, 0.00, 0.06, 0.02, -0.01,
-0.01, 0.04)

> mean(sample_returns) # arithmetic mean
[1] 0.015

> mean.geometric(sample_returns) # geometric mean
[1] 0.01468148

> StdDev(sample_returns) # volatility
[1] 0.02725541

> Rf <- 0.004 # risk free

> # Sharpe Ratio with arithmetic mean
> (mean(sample_returns) - Rf)/StdDev(sample_returns)
[1] 0.4035897
```

Annualize Monthly Performance



- **Arithmetic mean**: monthly mean * 12
- **Geometric mean**, when R_i are monthly returns:

$$[(1 + R_1) * (1 + R_2) * \cdots (1+R_T)]^{\frac{12}{T}} - 1$$

- **Vol**: monthly vol * sqrt(12)

Performance Statistics In Action

```
> mean(sample_returns) # arithmetic mean
[1] 0.015

> mean.geometric(sample_returns) # geometric mean
[1] 0.01468148
```

* 12

```
> Return.annualized(sample_returns, scale = 12, geometric =
FALSE)
[1] 0.18

> Return.annualized(sample_returns, scale = 12, geometric =
TRUE)
[1] 0.1911235
```

Performance Statistics In Action

```
> # Volatility
> StdDev(sample_returns)
[1] 0.02725541
```

* sqrt(12)

```
> StdDev.annualized(sample_returns, scale = 12)
[1] 0.0944155
```

Performance Statistics In Action

```
> # Sharpe Ratio with arithmetic mean
> Rf <- 0.004 # risk free

> (mean(sample_returns) - RF) / StdDev(sample_returns)
[1] 0.4035897
```

*** sqrt(12)**

```
> Return.annualized(sample_returns, scale = 12) /
Std.Dev.annualized(sample_returns, scale = 12)
[1] 1.398076
```