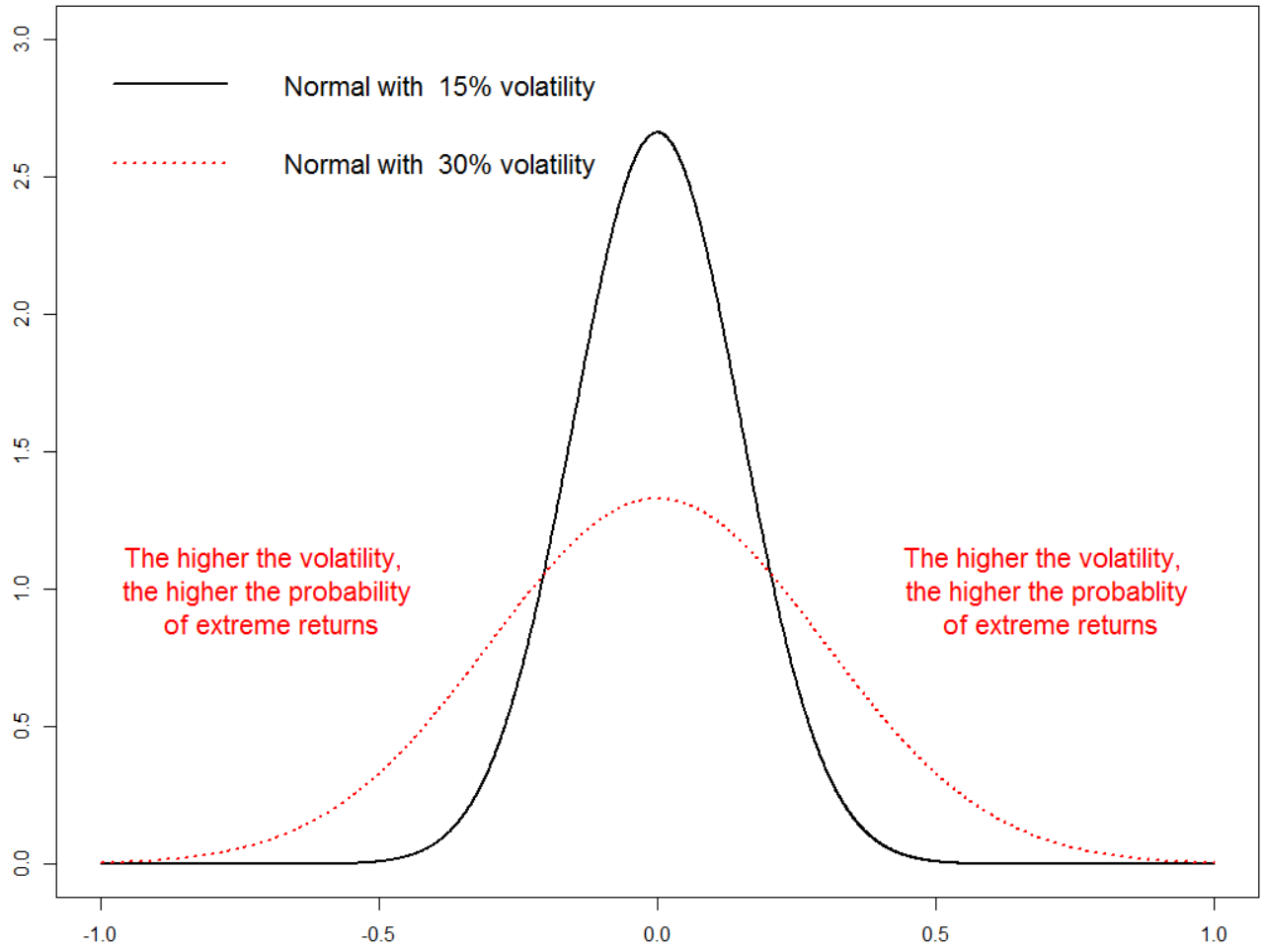
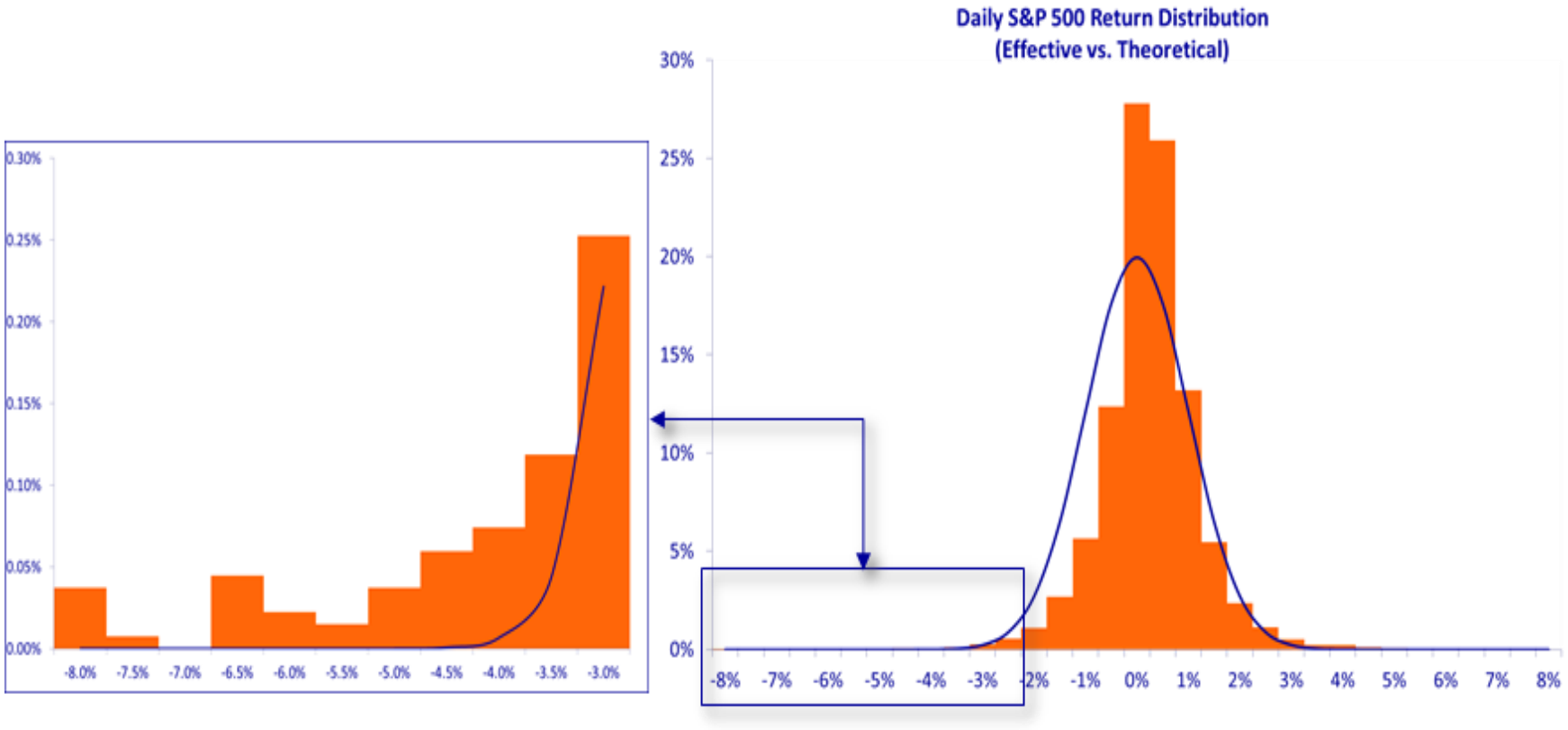
Video 4: The non-normality of the return distribution

Volatility describes “normal” risk



Non-normality of the return distribution



The portfolio return semideviation

Standard deviation of portfolio returns

*Take the **full sample** of returns* $R_1, R_2, \dots, R_T$

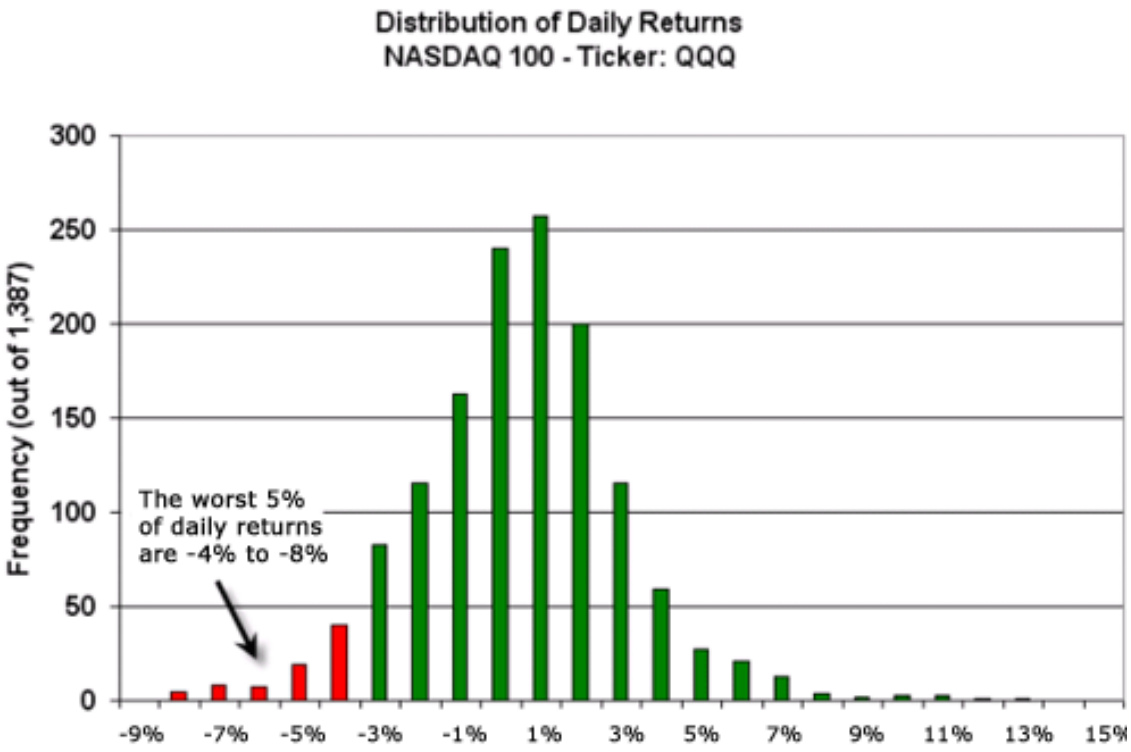
$$StdDev = \sqrt{\frac{(R_1 - \hat{\mu})^2 + (R_2 - \hat{\mu})^2 + \cdots + (R_T - \hat{\mu})^2}{T - 1}}$$

Semideviation of portfolio returns

*Take **the subset** of returns below the mean and denote them* $Z_1, Z_2, \dots, Z_n$

$$SemiDev = \sqrt{\frac{(Z_1 - \hat{\mu})^2 + (Z_2 - \hat{\mu})^2 + \cdots + (Z_n - \hat{\mu})^2}{n}}$$

The portfolio return Value-at-Risk and Expected Shortfall



The 5% most extreme negative returns are between -4% and – 8%:

- The 5% VaR is -4%: there is a 5% chance of an equally or more negative return
- The 5% ES is around -5%: it is the average of all the 5% most extreme negative returns

Source: http://www.investopedia.com/articles/04/092904.asp

Shape of the distribution

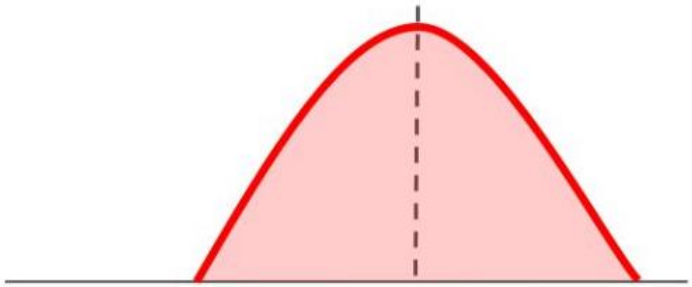
- Is it symmetric?

  ➔ Check the skewness

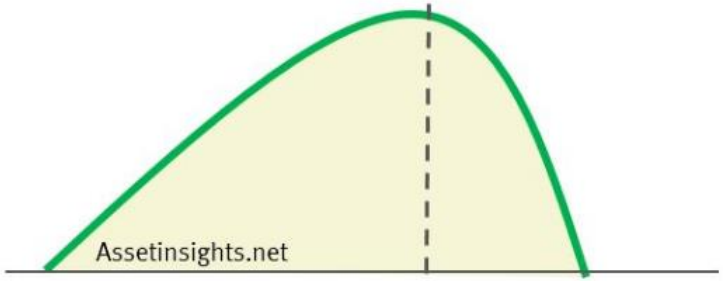
- Are the tails fatter than those of the normal

  ➔ Check the excess kurtosis

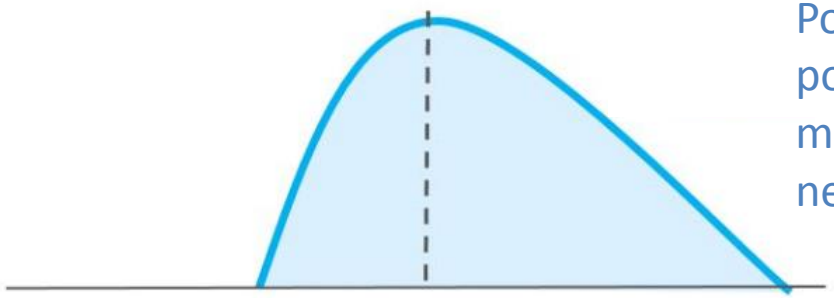
Skewness



Zero skewness: The return distribution is symmetric



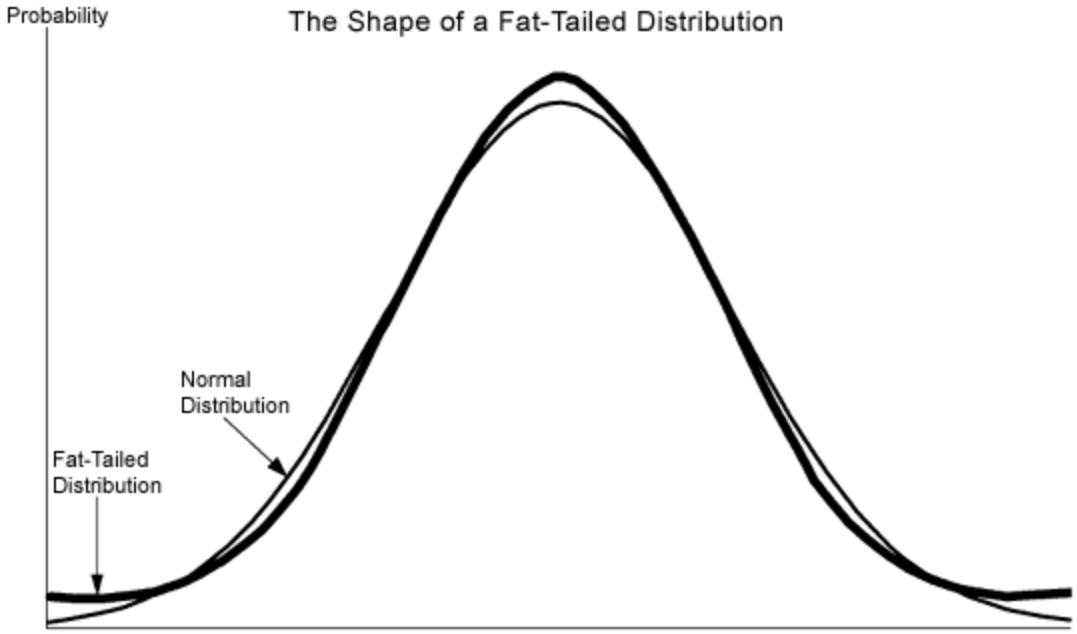
Negative skewness: Large negative returns occur more often than large negative returns



Positive skewness: Large positive returns occur more often than large negative returns

Excess kurtosis

- The distribution is fat-tailed when the excess kurtosis > 0



Source: http://www.fattails.ca/distribution.html