



# Risk & Return



# R E T U R N



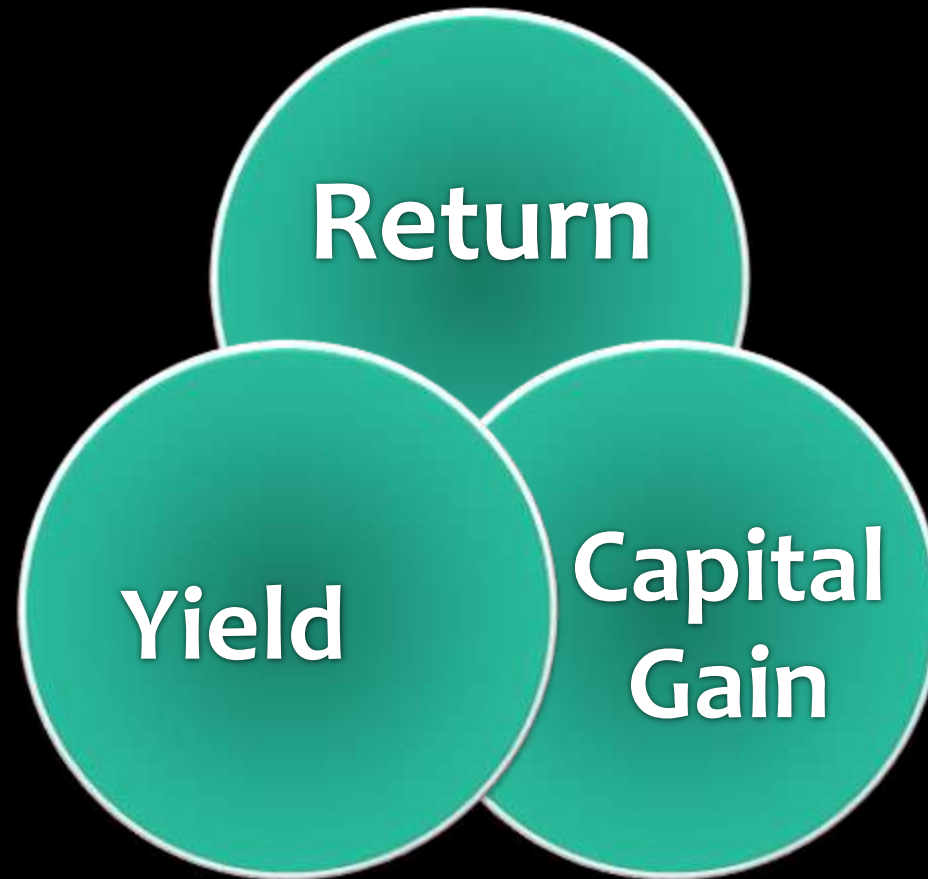
# What is Return?

**“Income received on an investment plus any change in market price, usually expressed as a percent of the beginning market price of the investment “**





# Components of Return



# Components of Return

- **Yield**

The most common form of return for investors is the periodic cash flows (income) on the investment, either interest from bonds or dividends from stocks.

- **Capital Gain**

The appreciation (or depreciation) in the price of the asset, commonly called the Capital Gain (Loss).



# Total Return

Total Return = Yield + Price Change

$$TR = [D_t + (P_t - P_{t-1})] / P_{t-1}$$

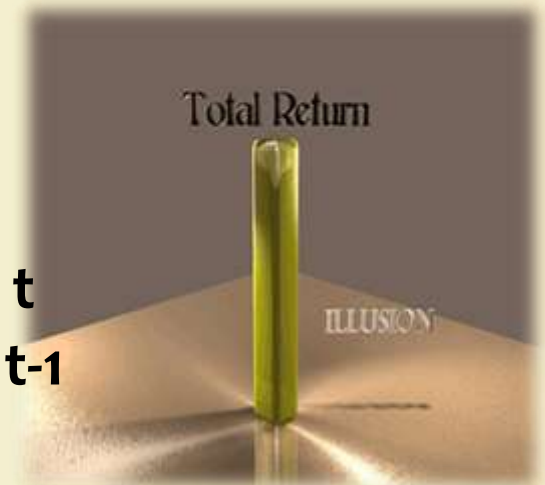
where,

TR = Total Return

$D_t$  = cash dividend at the end of the time period t

$P_t$  = price of stock at time period t

$P_{t-1}$  = price of stock at time period t-1



# Example

**Ali purchased a stock for Rs. 6,000. At the end of the year the stock is worth Rs. 7,500. Ali was paid dividends of Rs. 260. Calculate the total return received by Ali.**





# Solution



$$TR = [D_t + (P_t - P_{t-1})] / P_{t-1}$$

$$\begin{aligned} \text{Total Return} &= \frac{\text{Rs.}[260 + (7,500 - 6,000)]}{\text{Rs. } 6,000} \\ &= 0.293 \\ &= 29.3\% \end{aligned}$$

# Expected return



- The investor cannot be sure of the amount of return he/she is going to receive.
- There can be many possibilities.
- Expected return is the weighted average of possible returns, with the weights being the probabilities of occurrence

# Expected return

The background of the slide features a decorative graphic consisting of several thick, blue, 3D-style ribbons that are intertwined and looped. Scattered throughout this graphic are numerous gold-colored dollar signs (\$). The ribbons and dollar signs are rendered with soft shadows and highlights, giving them a three-dimensional appearance. The overall aesthetic is clean and professional, with a focus on financial themes.

Formula:

$$E(R) = \sum X * P(X)$$

where **X** will represent the various values of return, **P(X)** shows the probability of various return

# Example

Suppose, if you knew a given investment had a 50% chance of earning return of Rs.10, a 25% chance of earning a return of Rs. 20 and there is a 25% chance of bearing a loss of Rs.10.

What is your expected return?





# Solution

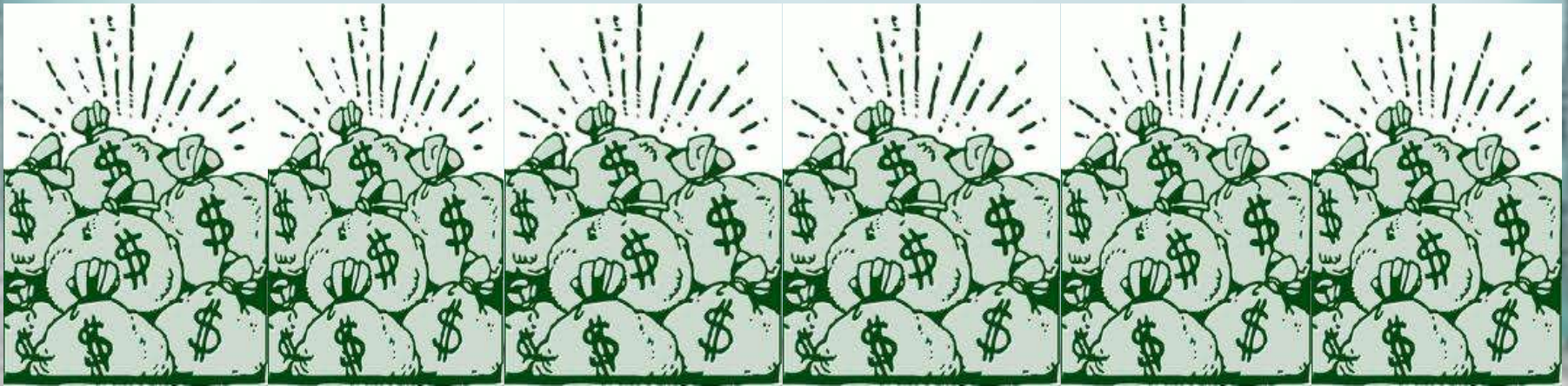


Return (X)	P(X)	$E(X) = X * P(X)$
10	0.50	5
20	0.25	5
-10	0.25	-2.5
TOTAL		<b>7.5</b>



# Relative Return

The relative return is the difference between absolute return achieved by the investment and the return achieved by the benchmark



# Example

For example, the return on a stock may be 8% over a given period of time. This may sound rather high,

**BUT,**

If the return on the designated benchmark is 20% over the same period of time, then the relative return on that stock is in fact -12%.

# Inflation adjusted return



- Also called real rate of return
- Inflation-adjusted return reveals the return on an investment after removing the effects of inflation.
- Formula

$$\text{Inflation - Adjusted Return} = \frac{(1 + \text{Return})}{(1 + \text{Inflation Rate})} - 1$$

# Example

- Return on Investment =  $R = 7\%$
- Inflation rate =  $IR = 3\%$
- Inflation Adjusted Return = ?



## Solution:

$$\begin{aligned}\text{Inflation Adjusted Return} &= [(1+ R)/(1+IR)] - 1 \\ &= [(1+0.07)/(1+0.03)] - 1 \\ &= 1.03883 - 1 \\ &= 0.0388 \\ &= \mathbf{4\% \text{ approximately}}\end{aligned}$$





# Alternate Solution

- A simple approximation for inflation-adjusted return is given by simply subtracting the inflation rate from the rate of return
- Inflation Adjusted Return =  $R - IR$   
= 7% - 3%  
= 4%





# So far we've discussed.....

- *Basic concept of return*
- *Components of Return*
- *Expected Return*
- *Relative Return*
- *Real Rate of Return*





## **What is Risk?**

**Risk is the variability between the expected and actual returns.**

A 3D rendered white figure stands on a light-colored floor, holding a large rectangular sign. The sign has a black background with the text 'TYPES OF RISK' written in bold, red, sans-serif capital letters with a yellow outline. The figure is positioned to the left of the sign, with its right arm resting on top of it. The background is a plain, light-colored wall. The entire scene is framed within a circular border with a yellow-to-red gradient.

**TYPES OF  
RISK**

# Interest Rate Risk

*It is the risk that an investment's value will change as a result of change in interest rates. This risk affects the value of bonds more directly than stocks.*





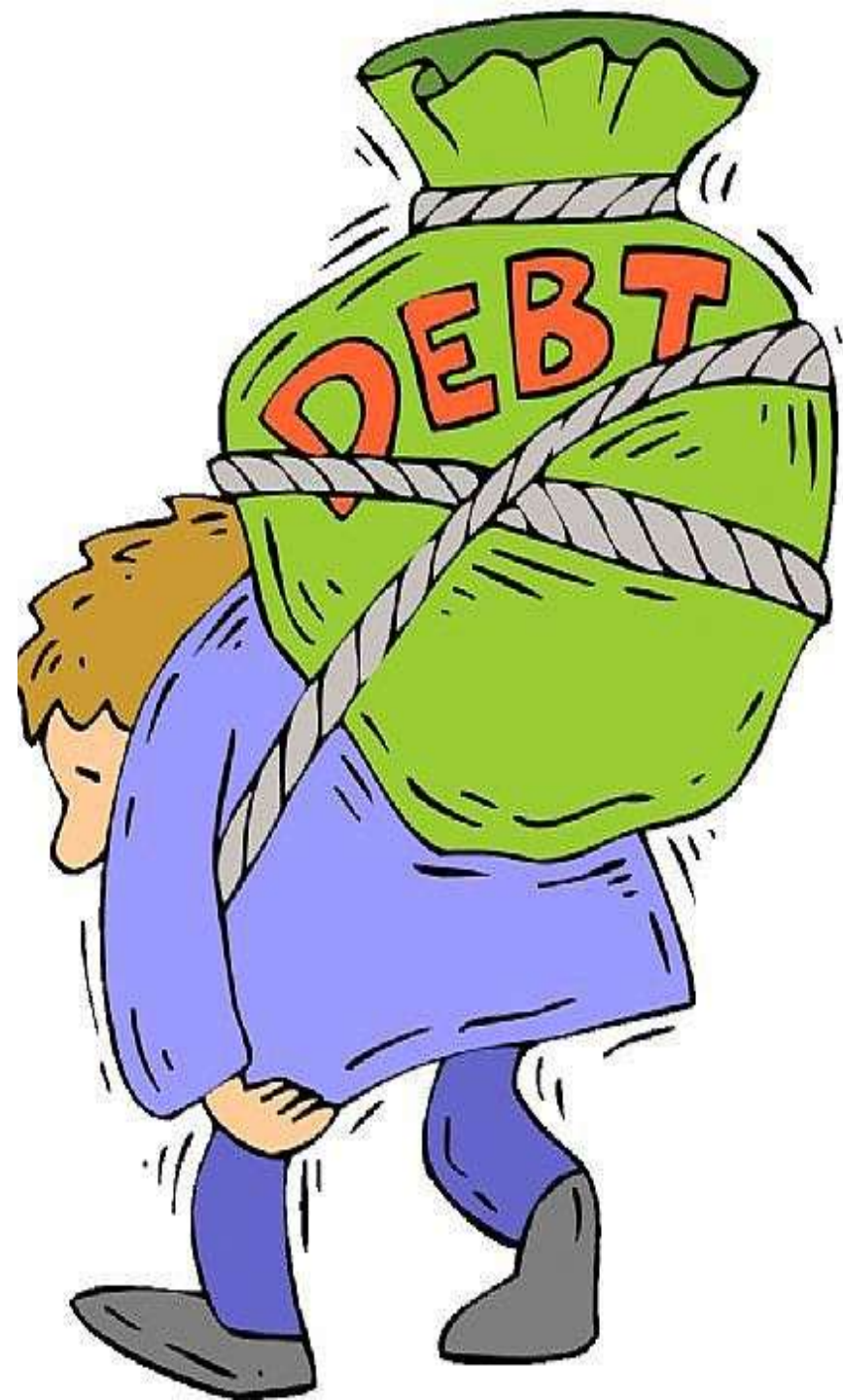
# Market Risk



*Market Risk refers to the variability in returns resulting from fluctuations in the overall market conditions*

# Financial Risk

*It is the risk associated with the use of debt financing. The larger proportion of assets financed by debt, the larger variability in returns, other things remaining equal.*



# Liquidity Risk

A close-up photograph of a hand in a white shirt cuff dropping several coins. The coins are in motion, creating a blurred trail as they fall. The background is a soft, out-of-focus light color.

*An investment that can be bought or sold quickly without significant price concession is considered liquid.*

*The more uncertainty about time element and the price concession, the greater the liquidity risk.*

# Foreign Exchange Risk

When investing in foreign countries one must consider the fact that currency exchange rates can change the price of the asset as well. This risk applies to all financial instruments that are in a currency other than your domestic currency.






# Country Risk

*This is also termed political risk, because it is the risk of investing funds in another country whereby a major change in the political or economic environment could occur. This could devalue your investment and reduce its overall return. This type of risk is usually restricted to emerging or developing countries that do not have stable economic or political arenas.*





A 3D rendered white character with a large head and small body is holding a large rectangular sign. The sign is white with a thin black border and contains the text 'SENSITIVITY ANALYSIS' in a bold, purple, sans-serif font. The character is standing on a light gray surface against a white background. The entire scene is framed within a circular purple border.

**SENSITIVITY  
ANALYSIS**

# SENSITIVITY ANALYSIS

- Sensitivity analysis is an approach for assessing risk that uses several possible return estimates to obtain a sense of variability among outcomes
- One of the tools used to perform this analysis is “RANGE”

# RANGE

Range is calculated by subtracting the pessimistic (worst) outcome from the optimistic (best) outcome.

***Formula:***

$$\text{RANGE} = \text{Maximum Value} - \text{Minimum Value}$$

# Example

Suppose that you expect to receive the following returns on a particular asset.

<b>Economic Situations</b>	<b>Expected Returns</b>
Deep recession	600
Mild recession	605
Normal	612
Minor Boom	626
Major Boom	635

**Min  
Return**

**Max  
Return**

# Solution



$$\begin{aligned}\text{Range} &= \text{Max Value} - \text{Min Value} \\ &= \text{Rs.635} - \text{Rs.600} \\ &= 35 \text{ rupees}\end{aligned}$$

*Higher the range,  
the more risky the asset is.*



# Standard Deviation

- \* Standard deviation is a tool for assessing risk associated with a particular investment.
- \* Standard deviation measures the dispersion or variability around a mean/expected value.

Formula:

$$\sigma = \sqrt{\sum X^2 * P(X) - [\sum X * P(X)]^2}$$



# Example



Outcomes	Return on Stock A (X)	Probability P(X)	Return on Stock B (Y)	Probability P(Y)
Outcome 1	13	0.25	7	0.25
Outcome 2	15	0.50	15	0.50
Outcome 3	17	0.25	23	0.25

# Solution - (S.D for Stock A)

X	P(X)	X * P(X)	X <sup>2</sup> * P (X)
13	0.25	3.25	42.25
15	0.50	7.50	112.50
17	0.25	4.25	72.25
Total	1.00	15.00	227

$$\text{S.D} = \sqrt{\sum X^2 * P(X) - [\sum X * P(X)]^2}$$

$$\text{S.D} = \sqrt{227 - (15)^2} = 1.41 \text{ rupees}$$



# Solution - (S.D for Stock B)

Y	P(Y)	Y* P(Y)	Y <sup>2</sup> * P (Y)
7	0.25	1.75	12.25
15	0.50	7.50	112.50
23	0.25	5.75	132.25
Total	1.00	15.00	257

$$\text{S.D} = \sqrt{\sum Y^2 * P(Y) - [\sum Y * P(Y)]^2}$$

$$\text{S.D} = \sqrt{257 - (15)^2} = 5.66 \text{ rupees}$$





# Solution

	STOCK A	STOCK B
Expected Return	15 rupees	15 rupees
Standard Deviation	1.41 rupees	5.66 rupees

comparing the two stocks, we see that both stocks have the same expected returns. But the SD or risk is different.

The S.D of stock B > S.D of stock A

We can say that the return of stock B is prone to higher fluctuation as compared to stock A



# Coefficient of Variation

- CV is a measure of relative risk.
- It tells us the risk associated with each unit of money invested.
- Formula:

$$CV = \sigma_{(X)} / E(X)$$

# Example

- Stock A has an expected return of Rs. 15 and an expected variation (S.D) of Rs. 4
- Stock B has an expected return of Rs. 20 and an expected variation (S.D) of Rs. 5.
- **Which stock is riskier?**



# Solution

	STOCK A	STOCK B
Expected Value (Mean)	15	20
Standard Deviation	4	5
Formula	$\sigma / E(A)$	$\sigma / E(B)$
• <b>Calculation</b>	Stock A is $0.27 = 4/15$ which means that against every rupee invested, there is a risk of 0.27 paisas.	Stock B is $0.25 = 5/20$ which means that against every rupee invested, there is a risk of 0.25 paisas.

- The CV of Stock B is 0.25 which means that against every rupee invested, there is a risk of 25 paisas.
- Since  $CV(A) > CV(B)$ , so Stock A has more risk.





# Risk and Return of Portfolio

# PORTFOLIO

- **Portfolio:** A grouping of financial assets such as stocks, bonds, etc
- A good portfolio consists of financial assets that are not strongly positively correlated



# Portfolio Return

STOCK	RETURN ( R )	S. D ( s )	Weightage of Investment (W)
A	16%	15%	0.50
B	14%	12%	0.50

*Assume that the correlation coefficient between A and B is 0.4*

What is the expected return of the portfolio comprising of stock A and B?

The formula for expected return of a portfolio is:

$$E (R_p) = \sum W_i * R_i$$

Hence, in the expected return of the portfolio in this case is:

$$= (0.5)(0.16) + (0.5)(0.14) = 0.08 + 0.07 = 0.15 = 15\%$$

# Portfolio Risk

$$\sigma_P = \sqrt{\sum_{A=1}^n \sum_{B=1}^n W_A W_B \sigma_{AB}}$$

Where,

$\sigma_P$  = Risk of a portfolio

$W_A$  is the weight (investment proportion) for the Stock A in the portfolio,

$W_B$  is the weight (investment proportion) for the Stock B in the portfolio,

$\sigma_{AB}$  is the covariance between returns of Stock A and Stock B

**STOCK – A**  
(col 1)

**STOCK – B**  
(col 2)

$$\begin{array}{l} \text{STOCK A (row1)} \\ \text{STOCK B (row2)} \end{array} \left[ \begin{array}{cc} W_A W_A \sigma_{A.A} & W_A W_B \sigma_{A.B} \\ W_B W_A \sigma_{B.A} & W_B W_B \sigma_{B.B} \end{array} \right]^{1/2}$$



# How to calculate covariance...?

**Formula:**

$$\mathbf{COV}_{AB} = r_{A.B} * \sigma_A * \sigma_B$$

**Where,**

$r_{A.B}$  = correlation between A and B

$\sigma_A$  = standard deviation of Stock A

$\sigma_B$  = standard deviation of Stock B



# Calculating Co-variances...

$$\begin{aligned} \text{COV}_{A.A} &= \sigma_{AA} = r_{A.A} * \sigma_A * \sigma_A \\ &= (1.00)(0.15)(0.15) = \mathbf{0.0225} \end{aligned}$$

$$\begin{aligned} \text{COV}_{A.B} &= \sigma_{AB} = r_{A.B} * \sigma_A * \sigma_B \\ &= (0.4)(0.15)(0.12) = \mathbf{0.0072} \end{aligned}$$



$$\begin{aligned} \text{COV}_{B.A} &= \sigma_{BA} = r_{B.A} * \sigma_B * \sigma_A \\ &= (0.4)(0.12)(0.15) = \mathbf{0.0072} \end{aligned}$$

$$\begin{aligned} \text{COV}_{B.B} &= \sigma_{B.B} = r_{B.B} * \sigma_B * \sigma_B \\ &= (1.00)(0.12)(0.12) = \mathbf{0.0144} \end{aligned}$$

$$\sigma_P = \left[ \begin{array}{cc} W_A W_A \sigma_{A.A} & W_A W_B \sigma_{A.B} \\ W_B W_A \sigma_{B.A} & W_B W_B \sigma_{B.B} \end{array} \right]^{1/2}$$

$$\sigma_P = \left[ \begin{array}{cc} (0.5)(0.5)(0.0025) & (0.5)(0.5)(0.0072) \\ (0.5)(0.5)(0.0072) & (0.5)(0.5)(0.0144) \end{array} \right]^{1/2}$$





$$\sigma_P = \left[ \begin{array}{cc} 0.000625 & 0.001800 \\ 0.00180 & 0.003600 \end{array} \right]^{1/2}$$

Adding the rows and columns, we get 0.01345. Hence, the risk of the portfolio is:

$$\sigma = (0.01345)^{1/2}$$

$$\sigma = 11.597\% = 11.6\% \text{ approx.}$$

This value of S.D (11.6) is a measure of the risk associated with the portfolio consisting of Stock A and Stock B.

*Note that the amount of portfolio risk is lesser than the individual risk of stock A and B.*

# CV – A better representation of risk

STOCK	EXPECTED RETURN ( R )	STANDARD DEVIATION ( $\sigma$ )	Coefficient of Variation = $\sigma / E(R)$
A	16%	15%	= 15/16 = 0.93
B	14%	12%	= 12/14 = 0.85
Portfolio of A & B	15%	11.6%	= 11.6/15 = 0.77

Hence if the investor make an investment only in Stock A, the risk against each rupee invested would be 93 paisas. For stock B alone, it would be almost 85 paisas but if half of the money is invested in stock A and half of it is invested in stock B then for each rupee the investor shall have to bear a risk of only 77 paisas. Hence one can reduce the risk by means of a portfolio.

# DIVERSIFICATION

***Diversification is basically used as a tool to spread the risk across the number of assets or investments.***

*The traditional theory on diversification: "Don't put your eggs in one basket"*

*(Photo courtesy of [www.merriam-webster.com](http://www.merriam-webster.com))*

***A diversified portfolio should consist of securities that are not perfectly positively correlated.***

***A portfolio should contain some high-risk and some low-risk securities***





*How much risk reduction is possible?*

*How many different securities are required in order to minimize the risk factor?*





**For a company, a portfolio containing 20-25 securities is suitable.**

**For an individual, a portfolio of almost 7 different securities is considered good.**

# ***KINDS OF***



**Systematic  
Risk**

**&**

**Unsystematic  
Risk**

# Systematic Risk

Systematic risk is the one that affects the overall market such as change in the country's economic position, tax reforms or a change in the world energy situation.



# Unsystematic Risk



*The risk which is independent of economic, political and all other such factors. It is associated with a particular company or industry.*

- The investor can only reduce the “unsystematic risk” by means of a diversified portfolio.
- The “systematic risk” cannot be avoided.



- Since the investor takes systematic risk, therefore he should be compensated for it.
- Return/Compensation depends on level of risk To measure the risk, we use the Capital Asset Pricing Model.










# **CAPITAL ASSET PRICING MODEL**



# CAPM

CAPM was developed in 1960s by William Sharpe's.

This model states the relationship between expected return, the systematic return and the valuation of securities.



# CAPM

Sharpe found that the return on an individual stock or a portfolio of stocks should equal its cost of capital.

$$R = R_f + (R_m - R_f)\beta$$

Where,

$R$  = required rate of return of security

$R_f$  = risk free rate

$R_m$  = expected market return

$B$  = beta of the security

$R_m - R_f$  = equity market premium

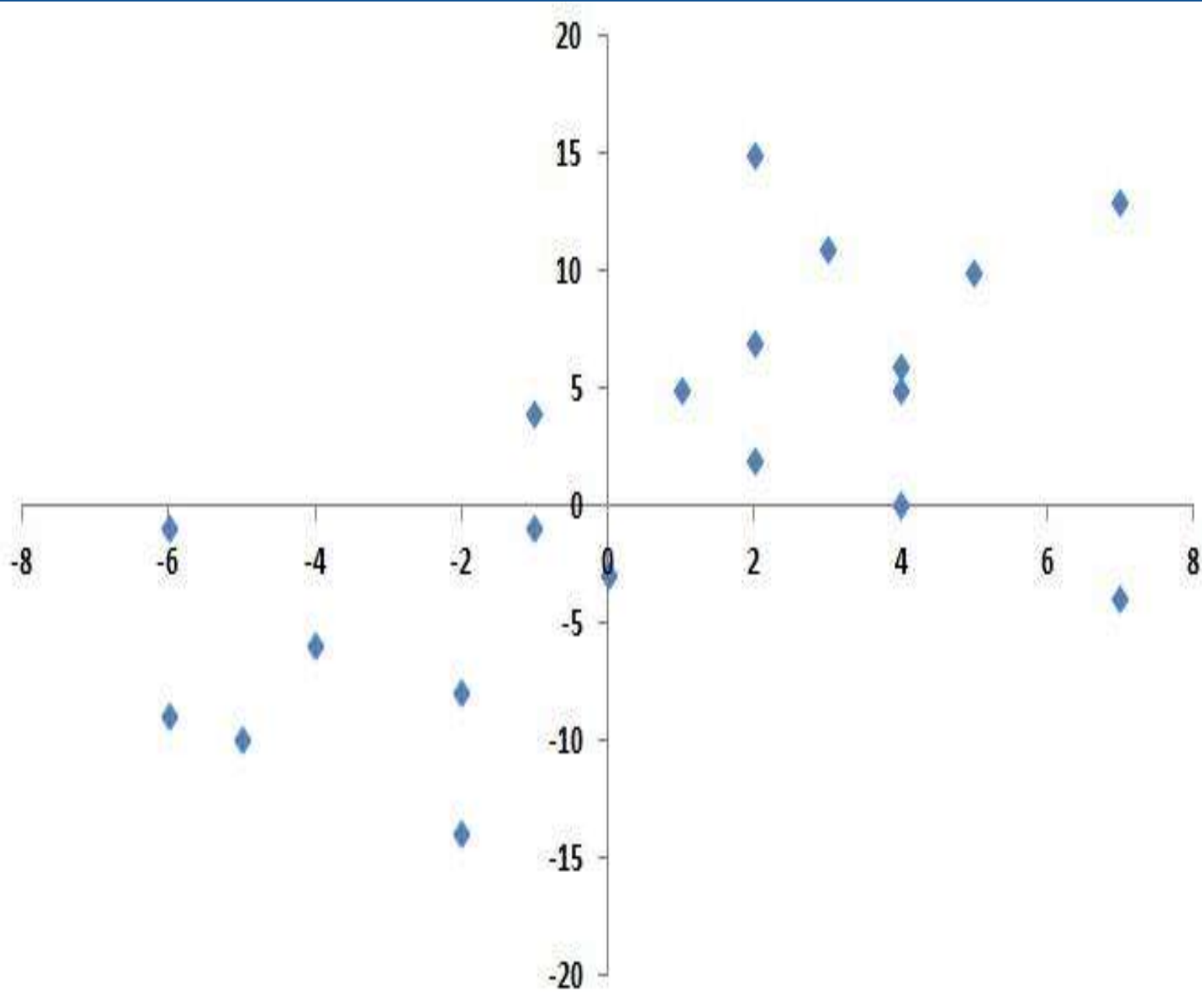
# Characteristic Line

A characteristic line is a regression line that shows the relationship between an individual's security returns and returns on market portfolio. In order to draw this line we will have to find the returns that an investor is getting in excess of the risk free rate.

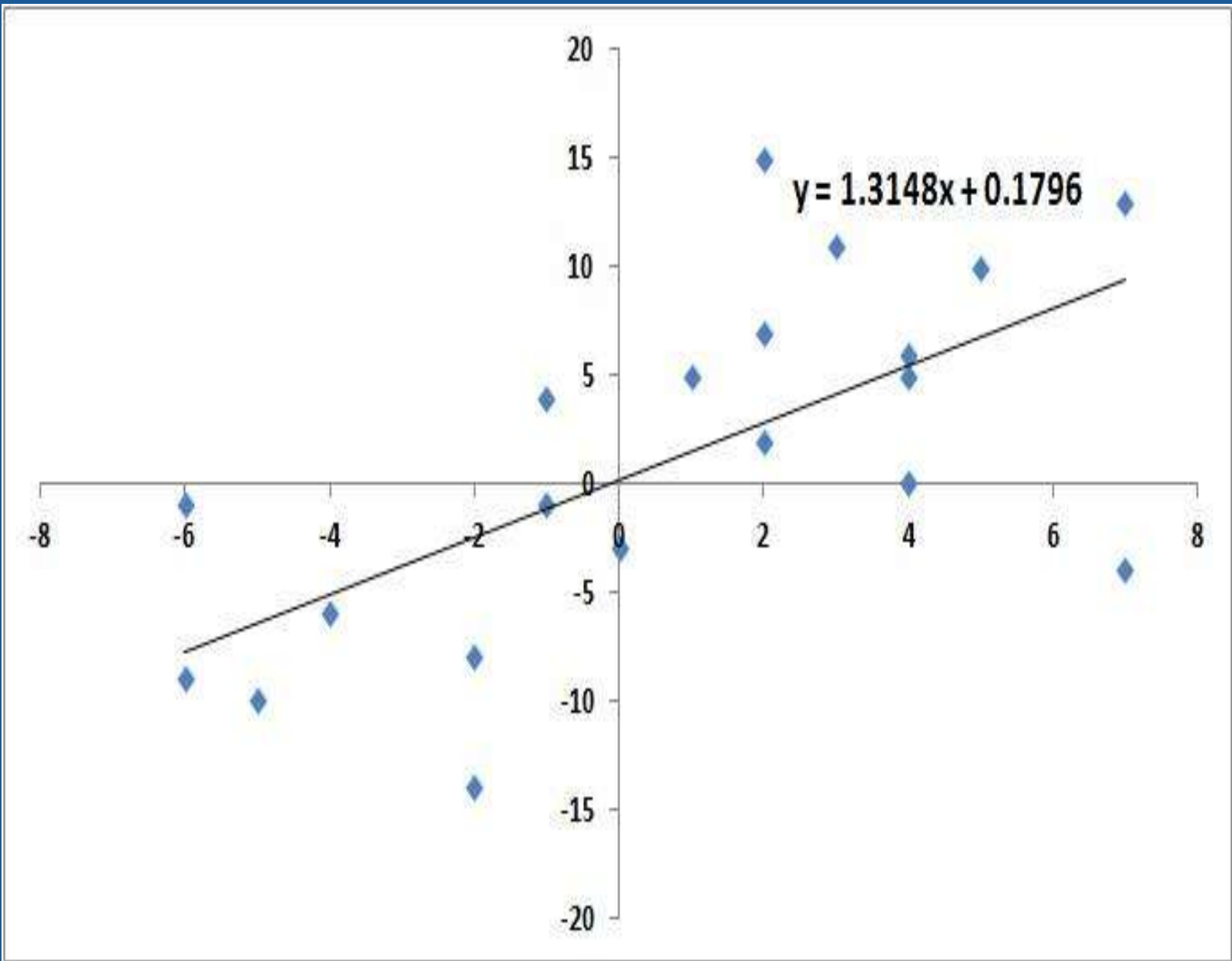
<b>Y e a r</b>	<b>Excess Return on Stock ABC</b>	<b>Excess Return on Market Portfolio</b>	<b>Y e a r</b>	<b>Excess Return on Stock ABC</b>	<b>Excess Return on Market Portfolio</b>
1	4	5	11	7	13
2	5	10	12	-1	4
3	-4	-6	13	-6	-1
4	-5	-10	14	-6	9
5	2	2	15	-2	-14
6	0	-3	16	7	-4
7	2	7	17	2	15
8	-1	-1	18	4	6
9	-2	-8	19	3	11
10	4	0	20	1	5



# Scatter Diagram



# Characteristic Line





- β The **slope of characteristic line** is called **beta**.
- β Beta represents the systematic risk.
- β Beta measures the change in excess return on the stock over the change in the excess return on the market portfolio.

- For  $\beta = 1$ : The risk associated with the individual stock is the same as the risk associated with the market portfolio.



- For  $\beta > 1$ : It shows that the stock has more unavoidable risk as compared to the market as a whole. This kind of stock is known as aggressive investment.



- For  $\beta < 1$ : The stock is less risky as compared to the stocks in the market portfolio. This kind of stock is known as defensive investment.



BETA

BETA

As mentioned earlier, according to CAPM, return is calculated by:

$$R = R_f + (R_m - R_f) * \beta$$





BETA

BETA

Suppose the risk free rate of the security is 6%.

The market rate is 12% and the beta is 1.25,

Then the required rate of return for the security would be

$$R = 6 + (12 - 6) * 1.25$$

$$R = 6 + 7.5$$

$$R = 13.5\%$$

Reconsider the above example but suppose that the value of  $B = 1.60$ .  
Then the return would be:

$$R = 6 + (12 - 6) * 1.60$$

$$R = 6 + 9.6$$

$$R = 15.6\%$$



***So, we see that greater the value of beta, the greater the systematic risk and in turn the greater the required rate of return.***

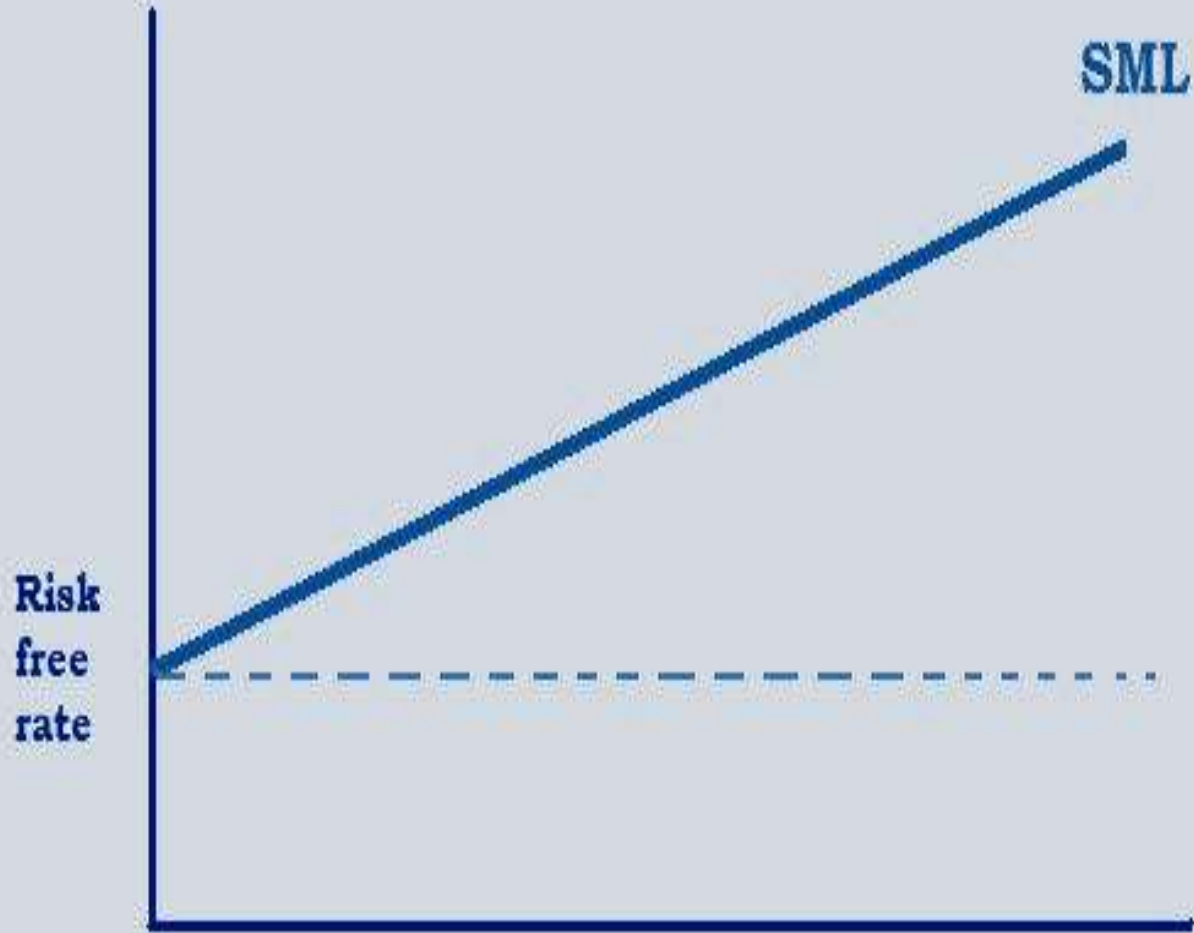
# SECURITY MARKET LINE



*A security market line describes the linear relationship between the expected return and the systematic risk as measured by beta.*

# Security Market Line

Required Return



SML

Risk  
free  
rate

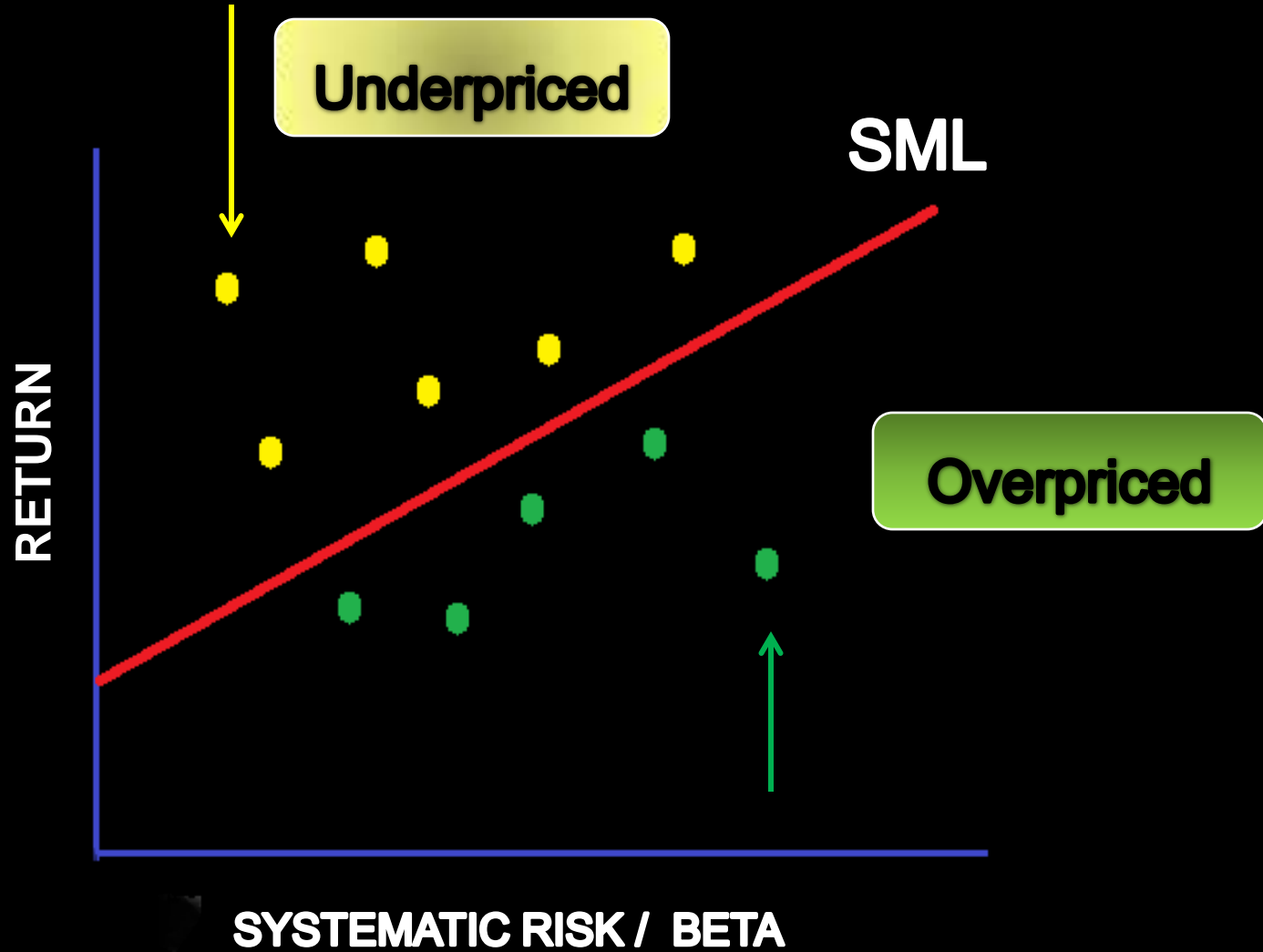
Beta = Systematic Risk

**What if the expected and  
required rate of return are not  
the same??**

**Then there is disequilibrium.**



# UNDERPRICED & OVERPRICED STOCKS





Conclusion

Thank you ...



# Bibliography

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