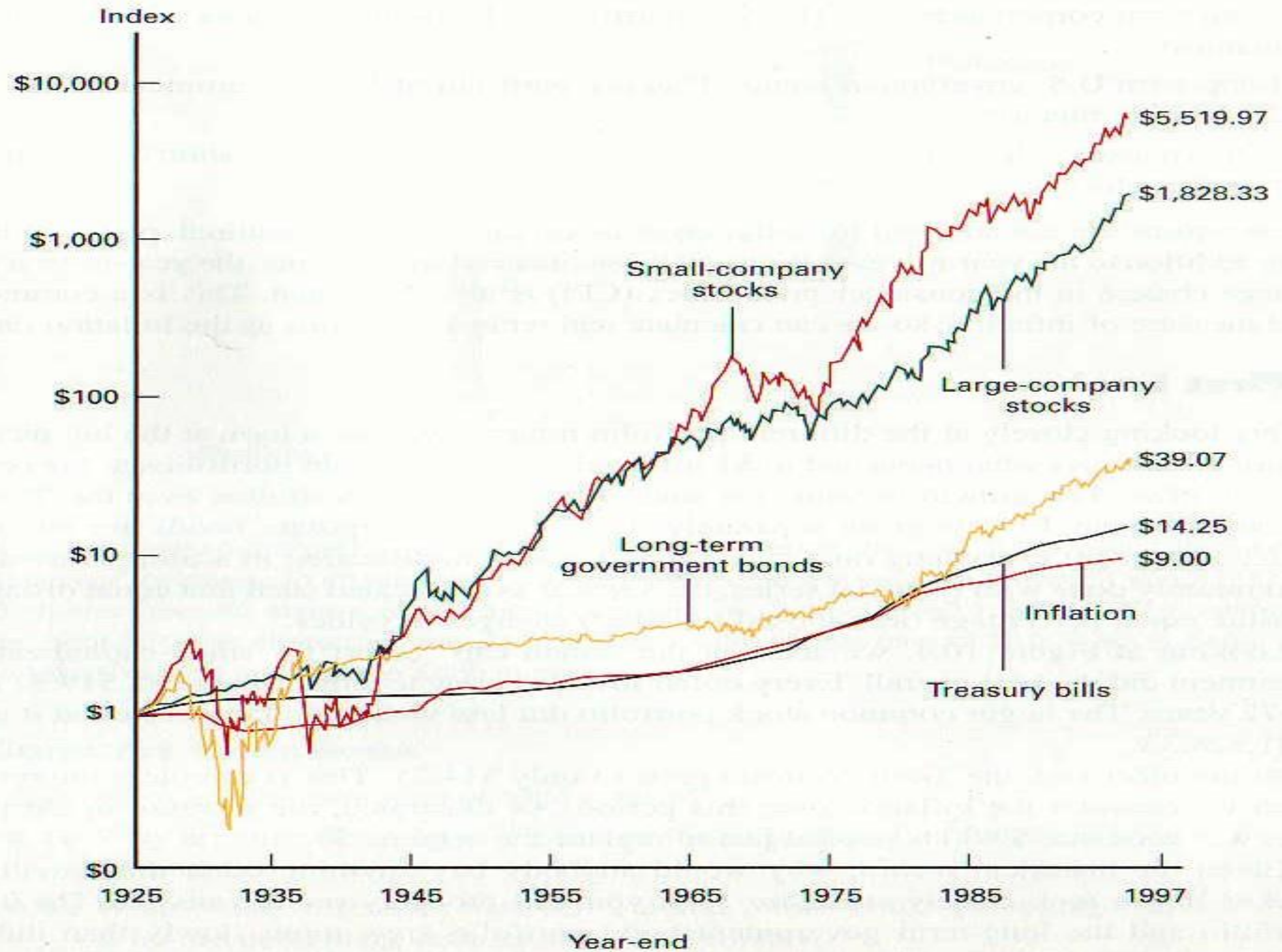
Risk and Return

1. **What rate of return do you expect on your investment (savings) this year?**
2. **What rate will you actually earn?**
3. **Does it matter if it is a bank FD or a share of stock?**

A $1 Investment in different types of portfolios: 1926-1997 (Year end 1925 = $1)



SOURCE: *Stocks, Bonds, Bills, and Inflation 1997 Yearbook*™, Ibbotson Associates, Inc., Chicago (annually updates work by Roger G. Ibbotson and Rex A. Sinquefield).

Annual Average Returns 1926-1997

Investment	Average Return
Common stocks	13.0%
Small stocks	17.7
Long-term corporate bonds	6.1
Long-term government bonds	5.6
U.S. Treasury bills	3.8
Inflation	3.2

SOURCE: *Stocks, Bonds, Bills, and Inflation 1997 Yearbook*™, Ibbotson Associates, Inc., Chicago (annually updates work by Roger G. Ibbotson and Rex A. Sinquefield). All rights reserved.

Annual Average Returns in India

- Equity Shares 16-20%
- Bonds/Deposits 11-15%
- Government Bonds 8-9%
- But, try looking at the yearly rates of return in either of the cases
- The most fluctuating will be stocks i.e., stock returns vary widely over time.

Introduction

- **Unfortunately, if we try for future, the graph is expected risk and return (a.k.a. security market line)**
- **Investors demand for more from a riskier project**
- **Unfortunately, it is (really) difficult -- if not impossible -- to make such predictions with any degree of certainty.**
- **As a result, investors often use history as a basis for predicting the future.**
- **We will begin by evaluating the risk and return characteristics of individual assets, and end by looking at portfolios of assets.**
- **How do we find the risk of an individual asset (say, a equity share)**

Risk and Return Defined

- In the context of business and finance, risk is defined as the chance of suffering a financial loss.
- Assets (real or financial) which have a greater chance of loss are considered more risky than those with a lower chance of loss.
- Risk may be used interchangeably with the term uncertainty to refer to the variability of returns associated with a given asset.
- Return represents the total gain or loss on an investment

Example

Risk and Return		
	Return	
year	**Stock A**	**Stock B**
1	6%	20%
2	12%	30%
3	8%	10%
4	-2%	-10%
5	18%	50%
6	6%	20%

Single Financial Assets

Historical Risk

Standard Deviation

What you type

	Observed Return for	**Observed Return for**
year	**Stock A**	**Stock B**
1	0.06	0.2
2	0.12	0.3
3	0.08	0.1
4	[illegible]	[illegible]
5	[illegible]	[illegible]
6	0.06	0.2
Average	**=AVERAGE(B4:B9)**	**=AVERAGE(C4:C9)**
Standard Deviation	**=STDEV(B4:B9)**	**=STDEV(C4:C9)**

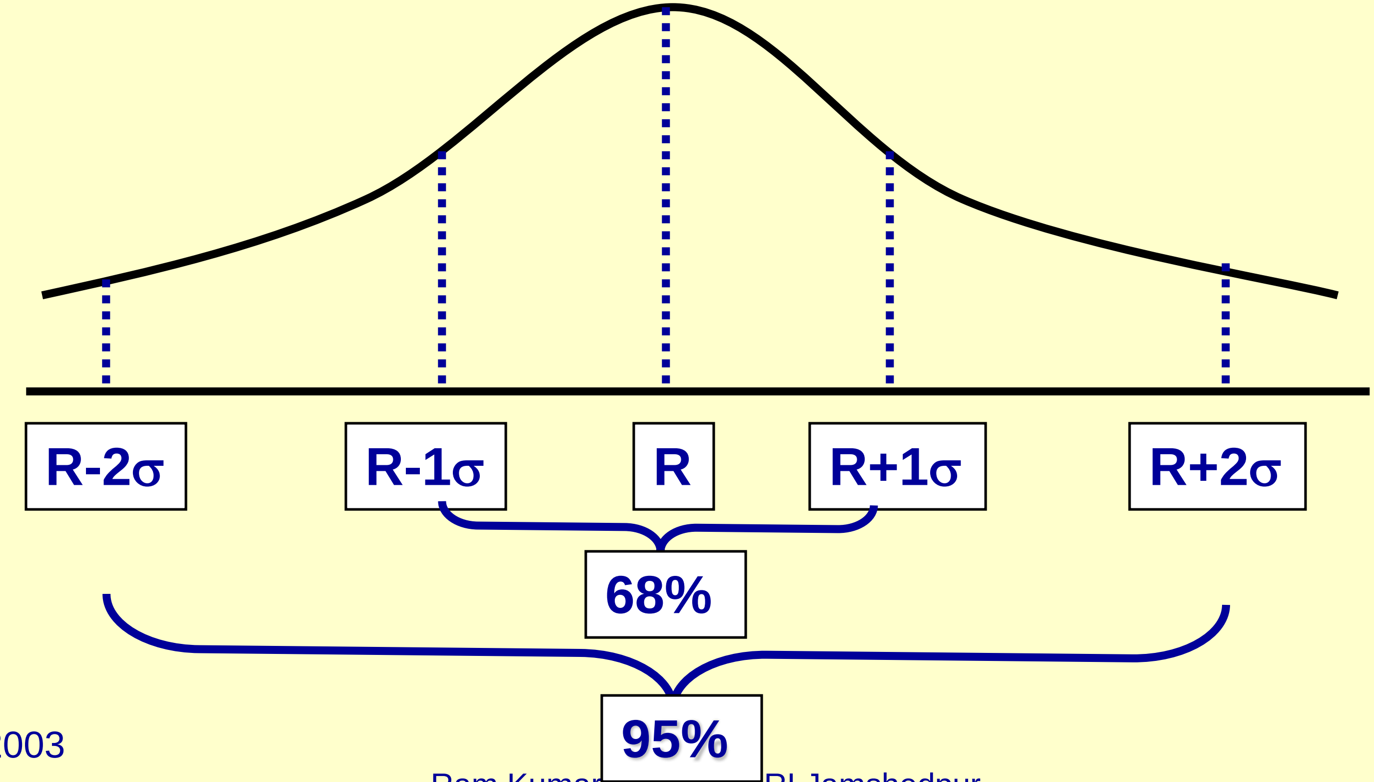
What you see

	Observed Return for	**Observed Return for**
year	**Stock A**	**Stock B**
1	6%	20%
2	12%	30%
3	8%	10%
4	[illegible]	[illegible]0%
5	[illegible]	[illegible]%
6	[illegible]	20%
Average	**8.00%**	**20.00%**
Standard Deviation	**6.69%**	**20.00%**

Single Financial Assets

Historical Risk

Normal Distribution



Single Financial Assets

Expected Return & Risk

- Investors and analysts often look at historical returns as a starting point for predicting the future.
- However, they are much more interested in what the returns on their investments will be in the future.
- For this reason, we need a method for estimating future or “ex-ante” returns.
- One way of doing this is to assign probabilities for future states of nature and the returns that would be realized if a particular state of nature would occur.

Single Financial Assets

Expected Return & Risk

Expected Return E(R) = $\Sigma\, p_i R_i$,

where p_i = probability of the *i*th scenario, and

R_i = the forecasted return in the *i*th scenario.

Also, the variance of E(R) may be computed as:

$$\sigma^2 = \Sigma pi[Ri - E(R)]^2$$

and hence the standard deviation as:

$$\sqrt{\sigma^2} = \sqrt{\Sigma pi[Ri - E9R)]^2}$$

Single Financial Assets

Expected Return & Risk

Expected Return			
State	Probability	Stock A	Stock B
Boom	30%	17%	29%
Normal	50%	12%	15%
Bust	20%	5%	-2%
Expected Return		12.1%	15.8%

Single Financial Assets

Expected Return & Risk

Risk, Variance, & Standard Deviation			
State	Pi	Stock A	pi[Ai - E(R)]^2
Boom	0.30	17	7.203
Normal	0.50	12	0.005
Bust	0.20	5	10.082
Expected Return		12	
Variance = Sum of pi[Ai - E(R)]^2			17.290
Standard Deviation = (Var)$^{1/2}$			4.158

Single Financial Assets

Coefficient of Variation

- One problem with using standard deviation as a measure of risk is that we cannot easily make risk comparisons between two assets.
- The coefficient of variation overcomes this problem by measuring the amount of risk per unit of return.
- The higher the coefficient of variation then more is the risk per return.
- So, an investor would prefer selecting the asset with the lower coefficient of variation.

Single Financial Assets

Coefficient of Variation

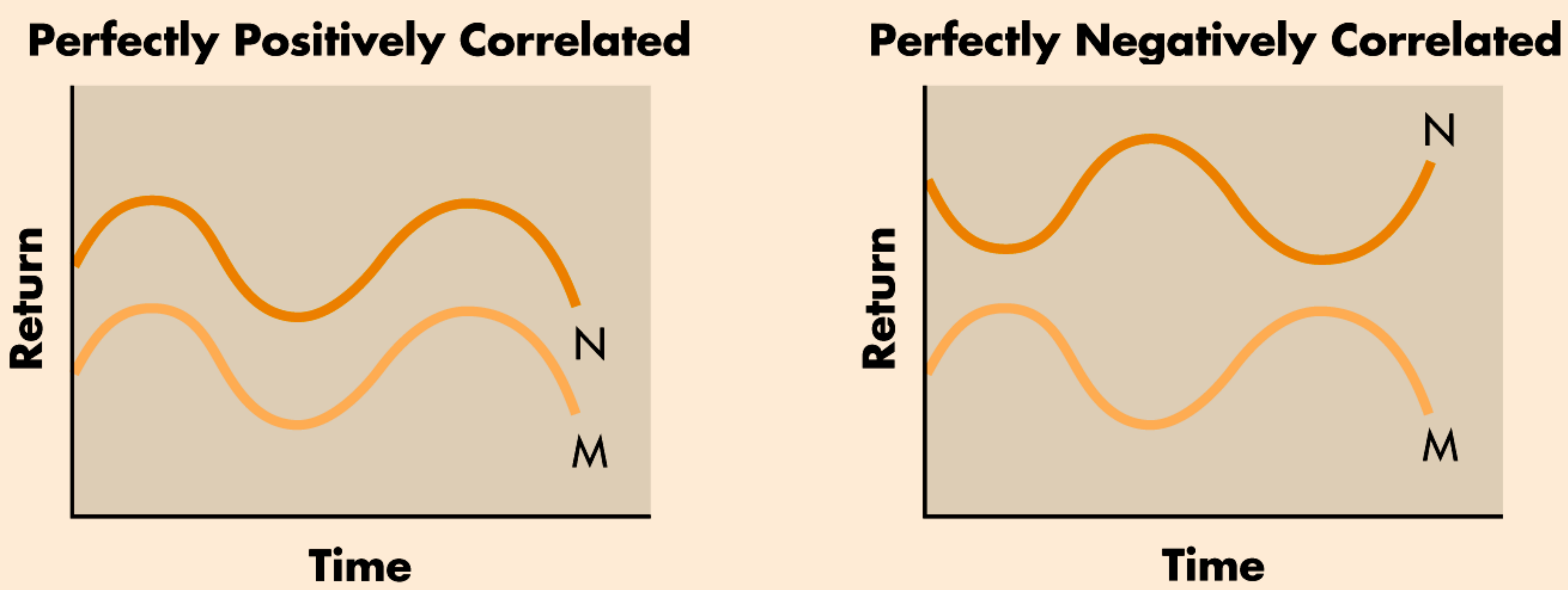
Coefficient of Variation			
State	**Pi**	**Stock A**	**Stock B**
Boom	0.3	17	30
Normal	0.5	12	15
Bust	0.2	5	-5
Expected Return		12.1	15.5
Standard Deviation		4.16	10.517
Coefficient of Variation		0.344	0.679

Portfolios of Assets

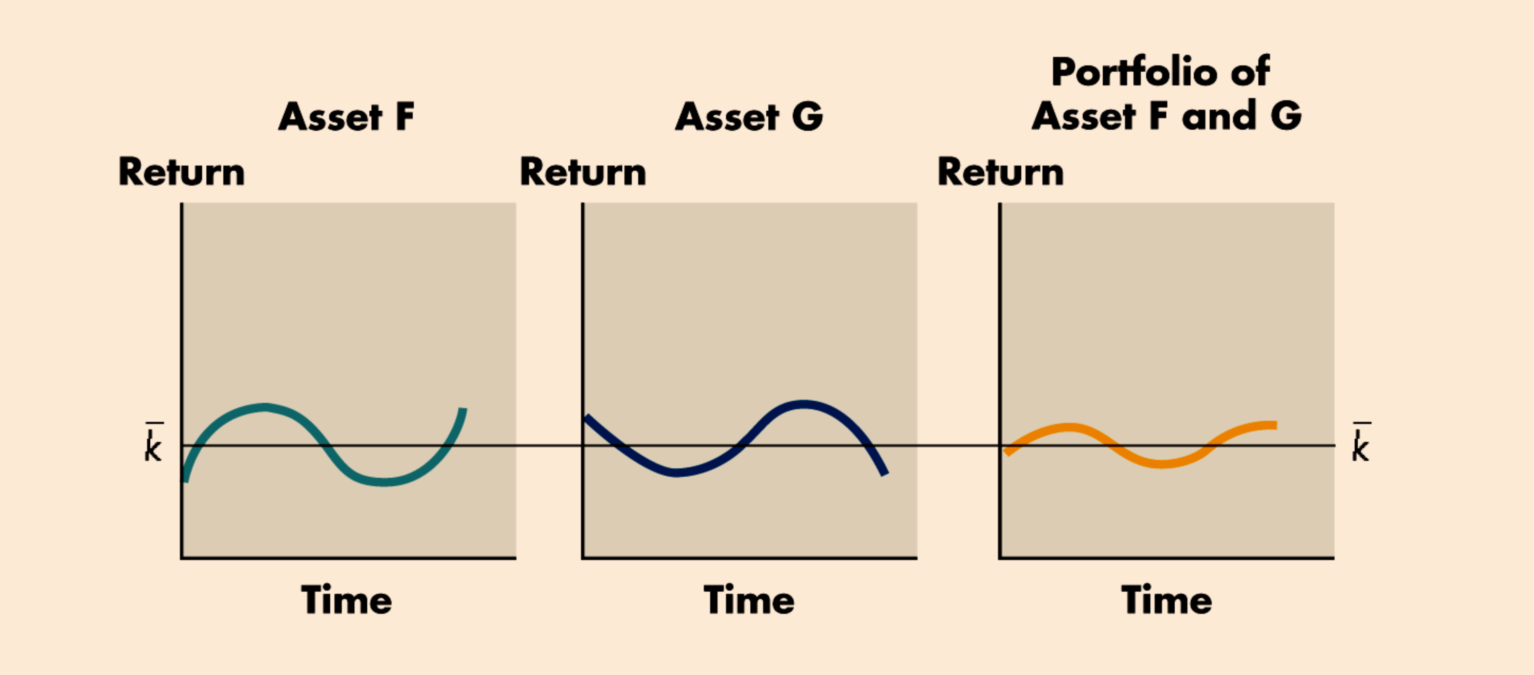
- An investment portfolio is any collection or combination of financial assets.
- If we assume all investors are rational and therefore risk averse, that investor will ALWAYS choose to invest in portfolios rather than in single assets.
- Investors will hold portfolios because he or she will *diversify* away a portion of the risk
- If an investor holds a single asset, he or she will fully suffer the consequences of poor performance.

Portfolios of Assets

- Diversification is enhanced depending upon the extent to which the returns on assets "move" together.
- This movement is typically measured by a statistic known as "correlation" as shown in Figures below



Portfolios of Assets



Portfolios of Assets

Portfolio AB

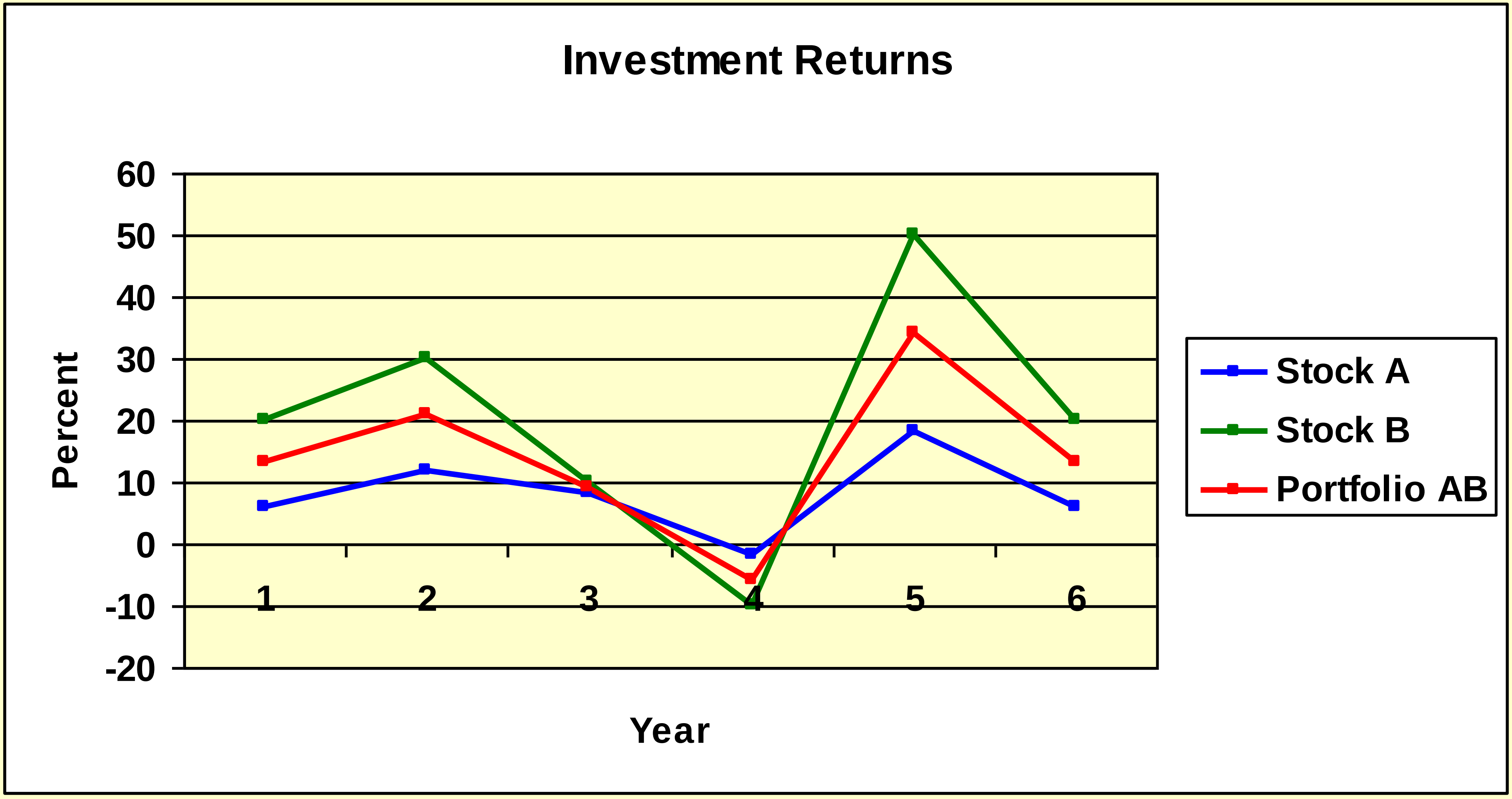
(50% in A, 50% in B)

	Stock A		Stock B		Portfolio AB
	Percent	Percent	Percent	Percent	Weighted
Year	Weight	Return	Weight	Return	Return
1	50%	6	50%	20	13
2	50%	12	50%	30	21
3	50%	8	50%	10	9
4	50%	-2	50%	-10	-6
5	50%	18	50%	50	34
6	50%	6	50%	20	13
Weight A	**50%**		**Sum of Weighted Returns**		**84**
Weight B	**50%**		**Portfolio Average Return**		**14**

Portfolios of Assets

Portfolio AB

(50% in A, 50% in B)



Portfolios of Assets

Portfolio AB

(40% in A, 60% in B)

	Stock A		Stock B		Portfolio AB
	Percent	Percent	Percent	Percent	Weighted
Year	Weight	Return	Weight	Return	Return
1	40%	6	60%	20	14.4
2	40%	12	60%	30	22.8
3	40%	8	60%	10	9.2
		-2	60%	-10	-6.8
		18	60%	50	37.2
6	40%	6	60%	20	14.4
Weight A	**40%**		**Sum of Weighted Returns**		**91.2**
Weight B	**60%**		**Portfolio Average Return**		**15.2**

Changing the weights

Portfolios of Assets

Portfolio AB

(20% in A, 80% in B)

	Stock A		Stock B		Portfolio AB
	Percent	Percent	Percent	Percent	Weighted
Year	Weight	Return	Weight	Return	Return
1	20%	6	80%	20	17.2
2	20%	12	80%	30	26.4
3	20%	8	80%	10	9.6
[illegible]	[illegible]	-2	80%	-10	-8.4
[illegible]	[illegible]	18	80%	50	43.6
6	20%	6	80%	20	17.2
Weight A	**20%**		**Sum of Weighted Returns**		**105.6**
Weight B	**80%**		**Portfolio Average Return**		**17.6**

And Again

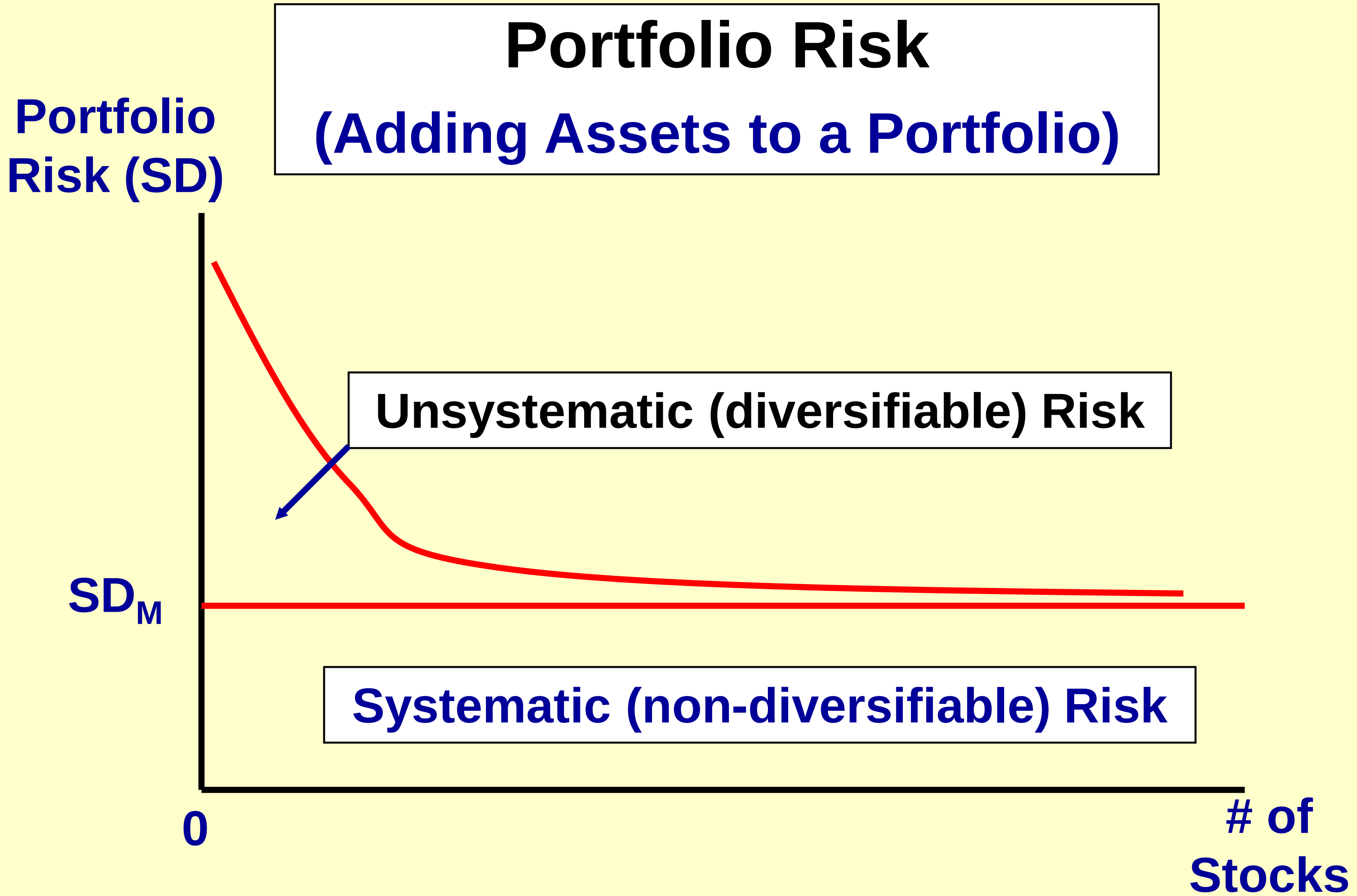
Portfolios of Assets

Portfolio Risk & Return

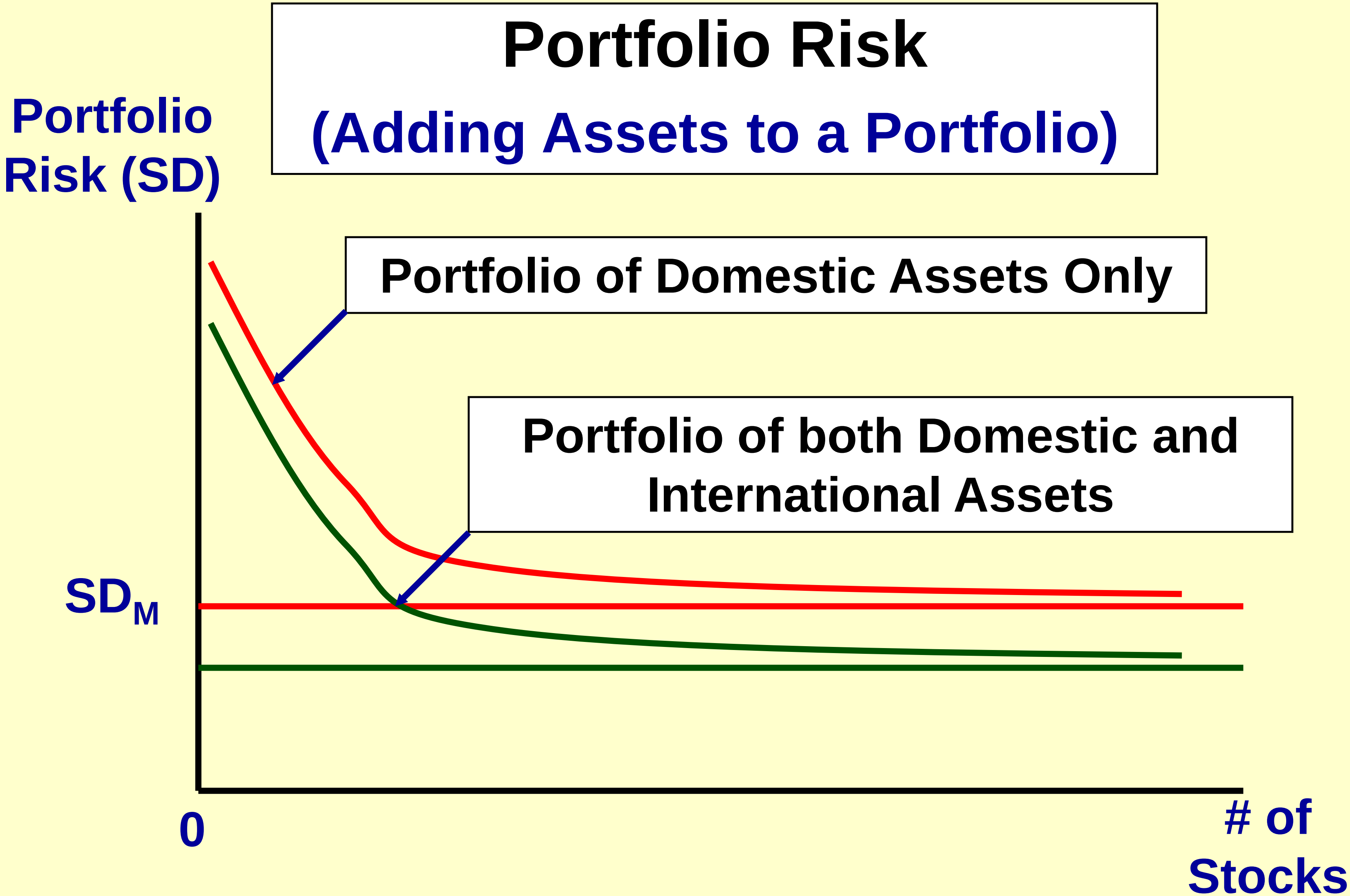
Summarizing changes in risk and return as the composition of the portfolio changes.

Weight A	Return A (%)	Return B (%)	Return AB (%)	SD-A (%)	SD-B (%)	SD-AB (%)
100%	8.0	20.0	8.0	6.7	20.0	6.7
80%	8.0	20.0	10.4	6.7	20.0	9.3
60%	8.0	20.0	12.8	6.7	20.0	11.9
40%	8.0	20.0	15.2	6.7	20.0	14.6
20%	8.0	20.0	17.6	6.7	20.0	17.3
0%	8.0	20.0	20	6.7	20.0	20.0

Portfolios of Assets



Portfolios of Assets



Portfolios of Assets

Capital Asset Pricing Model (CAPM)

- If you notice, a good part of a portfolio's risk (the standard deviation of returns) can be eliminated simply by holding a lot of stocks.
- The risk you can't get rid of by adding stocks (systematic) cannot be eliminated through diversification because that variability is caused by events that affect most stocks similarly.
- Examples would include changes in macroeconomic factors such interest rates, inflation, and the business cycle.

Portfolios of Assets

Capital Asset Pricing Model (CAPM)

- In the early 1960s, Sharpe & co developed an asset pricing model that measures only the amount of systematic risk a particular asset has.
- In other words, they noticed that most stocks go down when interest rates go up, but some go down a whole lot more.
- They reasoned that if they could measure this variability -- the systematic risk -- then they could develop a model to price assets using only this risk.
- The unsystematic (company-related) risk is irrelevant because it could easily be eliminated simply by diversifying.

Portfolios of Assets

Capital Asset Pricing Model (CAPM)

- To measure the amount of systematic risk an asset has, they simply regressed the returns for the "market portfolio" -- the portfolio of ALL assets -- against the returns for an individual asset.
- The slope of the regression line -- beta -- measures an assets systematic (non-diversifiable) risk.
- In general, cyclical companies like auto companies have high betas while relatively stable companies, like public utilities,have low betas.
- Let's look at an example to see how this works.

Portfolios of Assets

Capital Asset Pricing Model (CAPM)

This slide is the result of a regression using the Excel. The slope of the regression (beta) in this case is 1.92. Apparently, this stock has a considerable amount of systematic risk.

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.993698							
				F	*ignificance F*			
				235.7556	0.0006			
Total		2000						
	Coeffic	*ard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*Ipper 95.0%*
Intercept	-3.7751	2.018166	-1.87057	0.158163	-10.1978	2.64758	-10.1978	2.64758
10	1.917349	0.124873	15.35433	0.0006	1.519946	2.314753	1.519946	2.314753

What is Beta?

An index of **systematic risk**.

It measures the sensitivity of a stock’s returns to changes in returns on the market portfolio.

The **beta** for a portfolio is simply a weighted average of the individual stock betas in the portfolio.

Portfolios of Assets

Capital Asset Pricing Model (CAPM)

- The **required return** for *all* assets is composed of two parts: the risk-free rate and a risk premium.

The risk premium is a function of both market conditions and the asset itself.

The risk-free rate (r_f) is usually estimated from the return on Govt. Treasury bills

Portfolios of Assets

Capital Asset Pricing Model (CAPM)

- The **risk premium** for a stock is composed of two parts:
  - The **Market Risk Premium** which is the return required for investing in any risky asset rather than the risk-free rate
  - **Beta**, a risk coefficient which measures the sensitivity of the particular stock's return to changes in market conditions.

Portfolios of Assets

Capital Asset Pricing Model (CAPM)

- After estimating beta, which measures a specific asset's systematic risk, it is relatively easy to estimate other variables (may be obtained to calculate an asset's required return) …

$$K_e = R_f + ß\,[R_m - R_f], \text{ where}$$

K_e = an asset's expected or required return,

R_f = the risk free rate of return,

$ß$ = an asset or portfolio's beta

R_m = the expected return on the market portfolio.

Portfolios of Assets

Capital Asset Pricing Model (CAPM)

Example

Calculate the required return for RIL shares assuming it has a beta of 1.25, the rate on T-bills is 7.5%, and the expected return for the BSE Sensex is 16%.

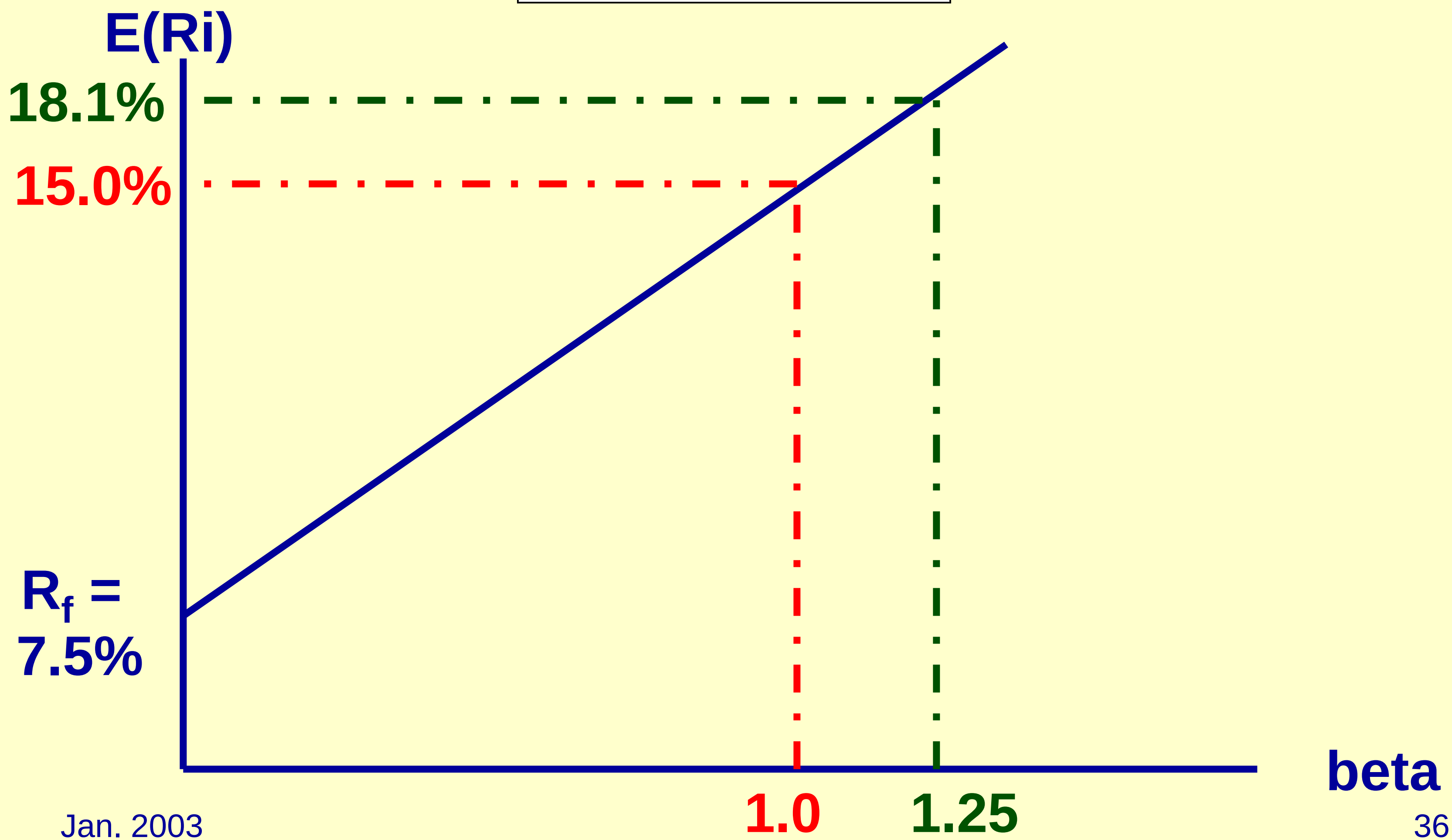
$$K_e = 7.5 + 1.25\ [16\% - 7.5\%]$$

$$K_e = 18.125\%$$

Portfolios of Assets

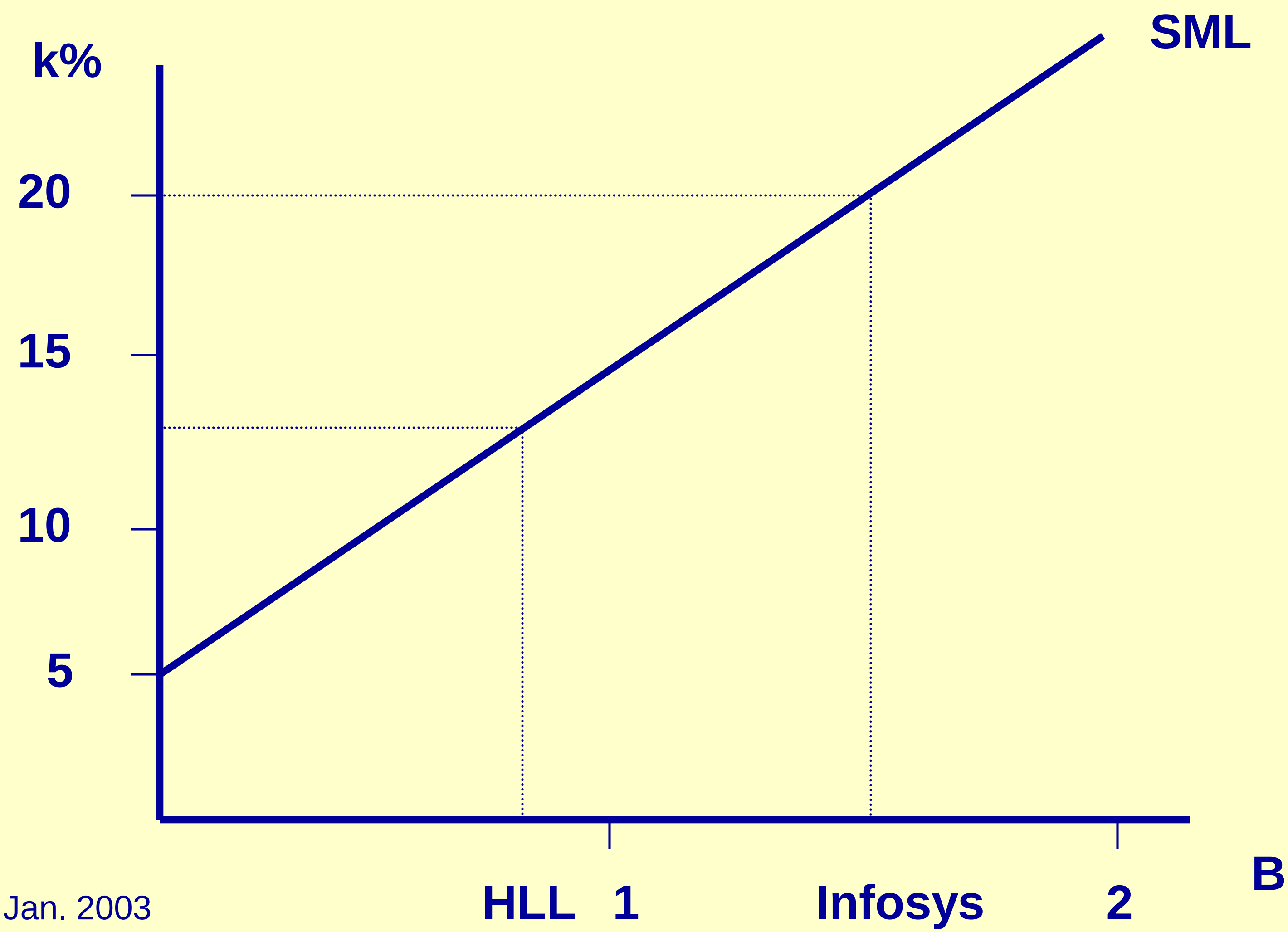
Capital Asset Pricing Model (CAPM)

Graphically



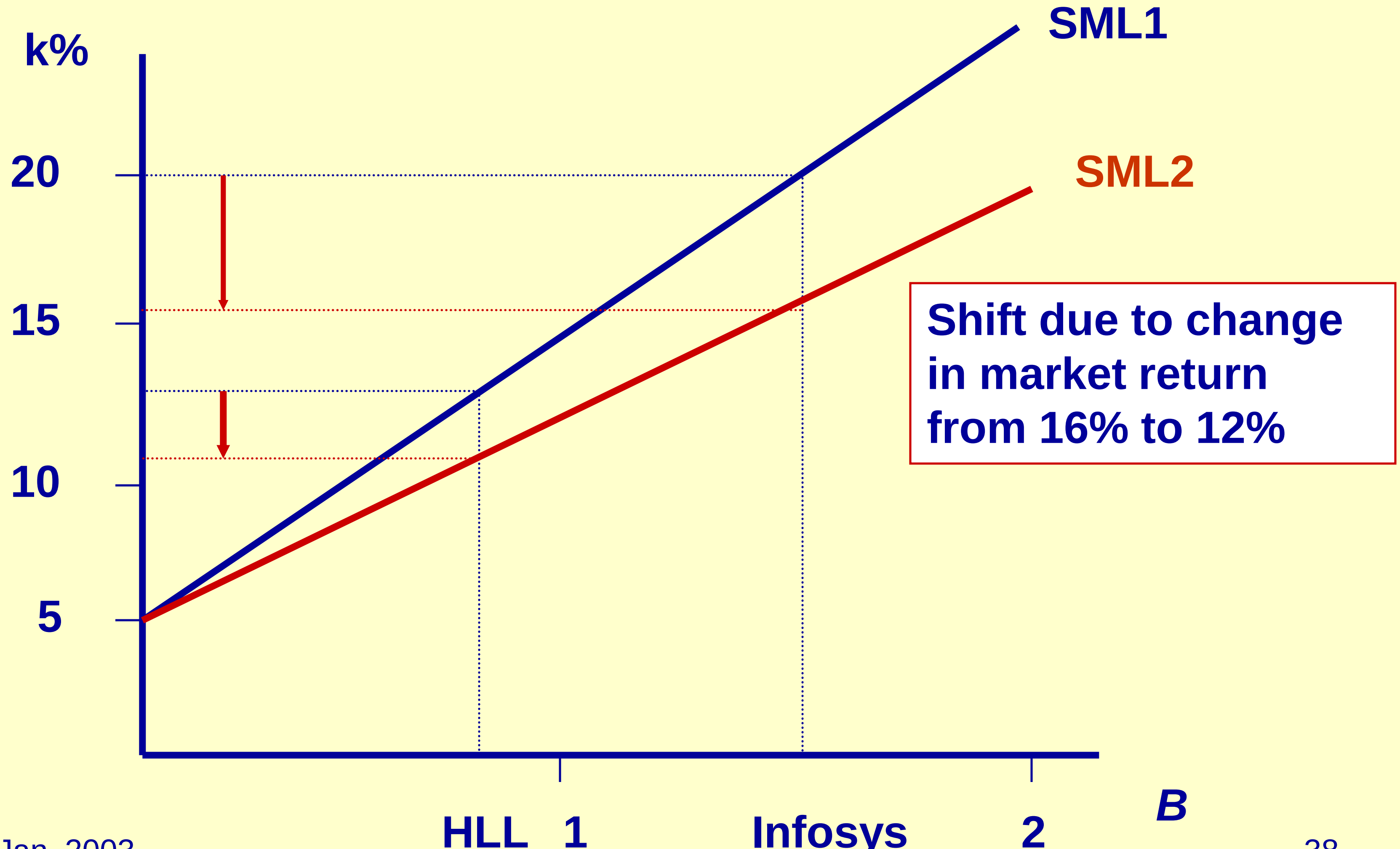
Portfolios of Assets

Capital Asset Pricing Model (CAPM)



Portfolios of Assets

Capital Asset Pricing Model (CAPM)



Company Name	Beta
Britannia Industries Ltd.	0.19
Wockhardt Ltd.	0.34
HDFC	0.43
Aventis Pharma Ltd.	0.44
Siemens Ltd.	0.45
HDFC Bank Ltd.	0.47
E. Merck (India) Ltd.	0.51
Ranbaxy Laboratories Ltd.	0.52
Sun Pharma	0.58
ICICI Bank	0.75
LIC Housing Finance Ltd.	0.80
State Bank of India	0.91
Kotak Mahindra Bank Ltd.	1.06
IDBI	1.24
Oriental Bank of Commerce	1.26
Union Bank of India Ltd.	1.41
Bank of Rajasthan	1.55
IFCI	1.72
Global Trust Bank	1.93
Satyam Computers	1.93

Levered Beta

- All the beta calculations written till now were unlevered betas i.e., they did not take into account the leverage of the companies.
- Levered Beta =

Unlevered Beta [1+(1-tax rate)(D/E)]

Where,

D/E is the debt-to-equity ratio of the company.

Tax rate is the corporate tax rate.