

# Financial Instruments

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## Financial Instrument

- Contract
- Two parties



- Looking for a set of payments and returns
- Short vs Long
- Time Horizon

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## Returns

The returns will depend on one or more variables:

- Stock prices
- Indexes
- Interest Rates
- Exchange Rates
- Commodity prices
- Specific Events: Earthquakes, Life-expectancy
- Bitcoin

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## Commodities



Energia



Metais



Comida



Animais



Grão

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## Derivatives

Future and Forwards  
Swaps  
Calls  
Puts

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## Other Derivatives

Corporate Bonds  
Sovereign Bonds  
Mortgages  
Insurances  
Exotic Options  
Credit Default Swaps

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## Classification Matrix

	<b>Present</b>	<b>Future</b>
<b>Present</b>	Cash 	Borrowing
<b>Future</b>	Lending	Derivative

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## Derivatives: Why do we need them?

To construct a hedging strategy:

- Protection against an increase or decrease of prices
- Protection against an increase or decrease of interest rate

What about speculation and arbitrage ?

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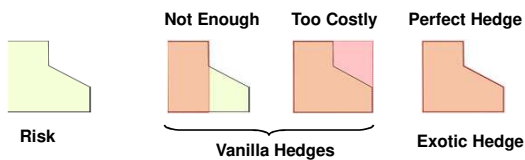
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## Risk Management

Client has risk exposure

Buys a product from a bank to limit its risk



Client transfers risk to the bank which has the technology to handle it  
Product fits the risk

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## Derivative Markets

- Japan, 17th century, *Rice Future Market*
- Chicago Board of Trade-CBOT (1848), *Future Markets*
- Chicago Mercantile Exchange-CME (1898),
- New York Futures Exchange (1979),
- Bolsa de Mercadorias & Futuros-BM&F (1985), 31/1/1986 –Gold Future Contracts, next month Ibovespa Future Contracts

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## Brazilian Markets

- BM&F : Future Market  
(Bolsa de Mercadorias e Futuros - [www.bmf.com.br](http://www.bmf.com.br))  
Open 1985-Ticker BMEF3 (11/29/2007)
  - Bovespa : Spot Market  
(Bolsa de Valores de São Paulo- [www.bovespa.com.br](http://www.bovespa.com.br))  
Created in 1967, but began 1895-Ticker BOVH3 (10/25/2007)
  - BVRJ : Carbon Market  
(Bolsa de Valores de Rio de Janeiro-[www.bvrj.com.br](http://www.bvrj.com.br))  
Open in 1845 and Brokedown 1986
- Regulated by
- CVM : like Security Exchange Comision (SEC)  
(Comissão de Valores Mobiliários- [www.cvm.gov.br/](http://www.cvm.gov.br/))

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## BMFBOVESPA

- 03/25/2008 Boards agree to merge BM&F and Bovespa.
- As a result a new market called BM&FBovespa become the third in the world.



- <http://www.bmfbovespa.com.br/>
- Ticker: BVMF3 (08/20/2008)

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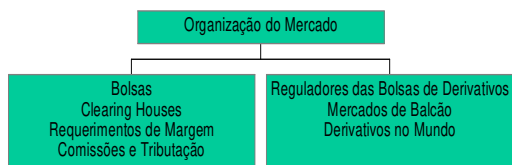
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## Market Organization



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## Margin Requirements

Example:

- Initial margin= 50%
- Margin call= 25%

Buy 1 share of asset in future market for R\$100:

Margin=50/100=50%

If share price increase to 125, margin=75/125=60%

You can use R\$12.50 , which results in a 50% margin

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## Margin Requirements

If asset price *decrease to 75*, margin results in to  $25/75=33.3\%$

The margin account now is restricted,

If asset price *decrease to 60*, margin would be  $10/60=16.7\%$

**(Liquidation or additional deposit of R\$20, margin  $30/60=50\%$ )**

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## Another Example: CALLS.

January	July
<p>I would like to buy your house in July for \$350,000.(option)</p> <p>if you pay me now \$50,000 extra it's a deal</p> <div style="display: flex; justify-content: space-around;"> </div>	<p style="color: #0000FF; font-weight: bold;">House prices go up</p> <p>Thanks for the house</p> <p>Thanks for \$350,000.</p> <div style="text-align: center;">  ↔  </div>
<div style="text-align: center;"> </div>	<p style="color: #0000FF; font-weight: bold;">↓ House prices go down</p> <p>I've decided Not to buy.</p> <p>OK. But I will stay with the \$50,000.</p>

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## Liquid results: "Zero Sum Game"

House prices go up to \$410,000		↓ House prices											
<p>I did well I bought a \$410,000 house for \$350,000.</p> <div style="text-align: center;"> </div>	<p>I did bad: I have sold my house undepiced</p> <div style="text-align: center;"> </div>	<p>Buying a call was a bad business</p> <div style="text-align: center;"> </div>	<p>I am happy with the call ;</p> <div style="text-align: center;"> </div>										
<table style="width: 100%; border-collapse: collapse;"> <tr><td style="text-align: right;">\$410,000</td></tr> <tr><td style="text-align: right;">- 350,000</td></tr> <tr><td style="text-align: right;">- 50,000</td></tr> <tr><td style="text-align: right; border-top: 1px solid black;">\$ 10,000</td></tr> </table>	\$410,000	- 350,000	- 50,000	\$ 10,000	<table style="width: 100%; border-collapse: collapse;"> <tr><td style="text-align: right;">\$- 410,000</td></tr> <tr><td style="text-align: right;">350,000</td></tr> <tr><td style="text-align: right;">50,000</td></tr> <tr><td style="text-align: right; border-top: 1px solid black;">\$ - 10,000</td></tr> </table>	\$- 410,000	350,000	50,000	\$ - 10,000	<table style="width: 100%; border-collapse: collapse;"> <tr><td style="text-align: center;">\$ - 50,000</td></tr> </table>	\$ - 50,000	<table style="width: 100%; border-collapse: collapse;"> <tr><td style="text-align: center;">\$ 50,000</td></tr> </table>	\$ 50,000
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## Derivative Pricing

- Example: Earthquake Insurance

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## Payoff Table

**Earthquake Insurance**

Richter	damage	Return
0 - 4.9	nothing	\$ 0
5.0 - 5.4	soft	750
5.5 - 5.9	small	10,000
6.0 - 6.9	medium	25,000
7.0 - 8.9	Large	50,000

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## Expected Return

- Insurance Return:  $(X_1, X_2, \dots, X_j, \dots, X_n)$
- Historical Probabilities:  $(Q_1, Q_2, \dots, Q_j, \dots, Q_n)$

$$0 \leq Q_j \leq 1 \text{ for all } j$$

and

$$Q_1 + Q_2 + \dots + Q_1 + \dots + Q_n = 1$$

$$\text{Expected Return} = Q_1X_1 + Q_2X_2 + \dots + Q_jX_j + \dots + Q_nX_n$$

$$\text{Alternatively: } E(X) \equiv \sum_j Q_j X_j$$

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## Present Value: $r=5\%$

Historical Probability  $\times$  Risk Aversion Adjustment = Risk Neutral Probability

Richter Escalade	damage	Return	Probability Historical	Adjust Risk Neutral	Probability Risk Neutral	Expect Return Risk Neutral
0 - 4.9	nothg	\$ 0	.850	$\times$ .9939	= .845	0
5.0 - 5.4	soft	750	.100	$\times$ .9976	= .100	75
5.5 - 5.9	small	10,000	.030	$\times$ 1.0472	= .031	310
6.0 - 6.9	medium	25,000	.015	$\times$ 1.1430	= .017	425
7.0 - 8.9	large	50,000	.005	$\times$ 1.3787	= .007	350
<b>Expected Future Value:</b>						<b>\$1,160</b>

$$\sum p_i X_i = .845(0) + .100(750) + .031(10,000) + .017(25,000) + .007(50,000) = 1,160$$

$$\text{Present Value: } \$1,160/1.05 = \$1,104.76$$

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## Arbitrage Opportunities

A Arbitrage Opportunity exists if and only if:

- Two portfolios can be constructed with identical returns, but with different costs.
- Two portfolios can be constructed with equal costs but with different returns.

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## Fundamental Theorem of Asset Pricing

*“Risk Neutral Probabilities exist if and only if there is no arbitrage opportunities”*

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## Final Thought

After 2008 financial crisis:

“Derivatives are financial weapons of mass destruction...” Warren Buffet

- Do we need derivatives?
- Do we need more regulation?

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## But..

Satoshi Nakamoto (2008).

- Do we need Centralization?
- Bitcoin

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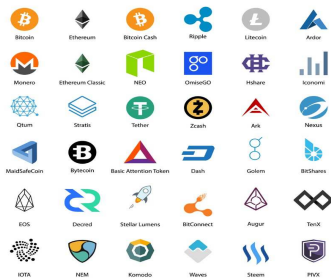
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## Where we are now...



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## The response...

“They will have to be held accountable so that they can be fully trusted,”

“Technology companies entering the banking space forcefully must be subject to regulation”

“We don’t want innovation that would shake the system so much that we would lose the stability that is needed,”

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“First they ignore you then they laugh at you then they fight you then you win” ...

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