TORINO, 29-11-2012

RISK CONTROL WITH R:
ENTERPRISE APPLICATION AND MODELING FOR A RETAIL ENERGY PLAYER

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COMPANY OVERVIEW

VISION

IN A WORLD OF NUMBERS, WE PROVIDE YOU THE ONES UPON WHICH YOU CAN BASE YOUR DECISIONS.

WE BELIEVE COMPANIES CAN ACHIEVE EXCELLENCE ONLY IF THEY USE AS MUCH DATA AS POSSIBLE TO DRIVE ACTIONS,

ADVANCED ANALYTICS TO FORESEE FUTURE EVENTS AND

APPLICATIONS TO SUPPORT DECISIONS AT ANY LEVEL.

COMPANY OVERVIEW

ADVANCED ANALYTIC APPLICATIONS

We create AAA based on Advanced Analytics, the most advanced predictive methodologies. Our AAA foresee and predict accurately

1

INDUSTRY SPECIFIC ANALYTICS

Our Advanced Analytics are the result of a deep vertical expertise. The validity of the outcomes is also guaranteed by the deep knowledge of the sector.

2

EMBEDDED IN PROCESSES

We provide AAAs strongly focused on business processes, the only way to let them express their full potential.

3

BUSINESS FOCUS

We generate AAAs specifically for Business User. Accurate outcomes don't imply Statistical/Mathematical or IT knowledge, but only business knowledge.

4

ACTIONABLE RESULTS

We trasform information into business actions, our AAAs are able to industrialize and automate decision making process.

5

VERTICAL KNOWLEDGE

FINANCE	TELCO	ENERGY	RETAIL	MANUFACTURING
				
1	2	3	4	5

AGENDA

- RISK CONTROL IN ENERGY MARKETS
- TECHNOLOGICAL AND METHODOLOGICAL APPROACH
- HOW WE MADE IT
- HAVE A LOOK

AGENDA

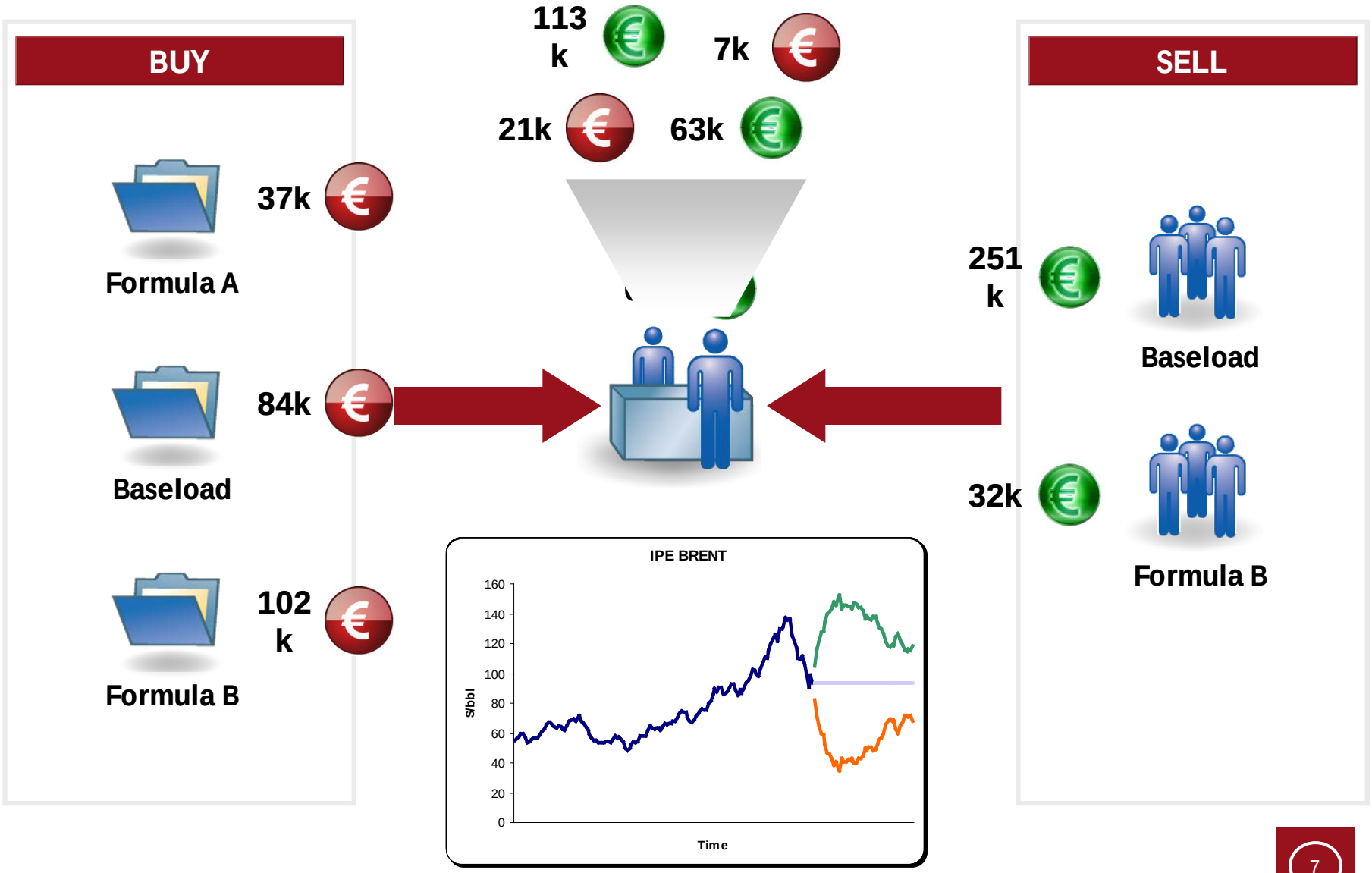
RISK CONTROL IN ENERGY MARKETS

TECHNOLOGICAL AND METHODOLOGICAL APPROACH

HOW WE MADE IT

HAVE A LOOK

RISK CONTROL IN ENERGY MANAGEMENT



E4C PRICE RISK POWER

Business Pain	Key Features
▪ Net Exposure	▪ Net Exposure Report: Volumes for sell and buy offers Break in commodities ▪ Commodities management ▪ Price Index Definition
▪ Portfolio open position	▪ Hedging contracts: Contracts on energy and commodities ▪ Report Financial Open Position: Final portfolio position
▪ Risk measure ▪ Best hedging strategy	▪ Monte Carlo Simulation: Commodities PUN ▪ Hedging What If:

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AGENDA

RISK CONTROL IN ENERGY MARKETS

TECHNOLOGICAL AND METHODOLOGICAL APPROACH

HOW WE MADE IT

HAVE A LOOK

TECNOLOGICAL APPROACH

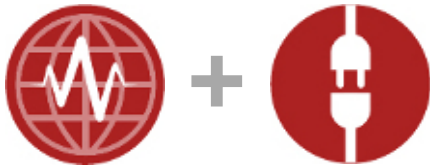
STARTING POINT

i4C solution for Energy Trade and Risk Management vertically integrated with user's business process

R integration used mainly for forecasting purposes

BUSINESS NEED

Risk Control with Monte Carlo simulation vertically integrated with user's business process and R engine



TECNOLOGICAL APPROACH

SOLUTION

R Engine embedded in ETRM Application:

- Interface to upload R scripts
- R engine invoked in Monte Carlo simulation
- Input and output standard encoding

METODOLOGICAL APPROACH

STARTING POINT

Monte Carlo procedure in java script

BUSINESS NEED

- Multiple models availability
- Fast and user-friendly re-writing of the procedures in order to respect business needs
- Implementation in R of a new model based on the customer's updated Commodity Risk measurement methods (*E. Schwartz and J. Smith, Short-Term Variations and Long-term Dynamics in commodity Prices, Management Science, Vol. 46, No. 7, July 2000 pp 893-911*)

METODOLOGICAL APPROACH

SOLUTION

- Possibility of writing multiple R scripts
- Delivery of a R script which follows the requirements of the customer's updated Commodity Risk measurement methods, which consist in the calculation of profit scenarios through an overall simultaneous run of:
  - commodity forward price simulation (Schwarz and Smiths paper)
  - exchange rate simulation (geometric Brownian motion with zero drift term)
  - CO2 contract price simulation (ad-hoc price model based on the hypothesis that prices of CO2 contracts fluctuate around an yearly equilibrium level)

AGENDA

RISK CONTROL IN ENERGY MARKETS

TECHNOLOGICAL AND METHODOLOGICAL APPROACH

HOW WE MADE IT

HAVE A LOOK

HOW WE MADE IT: INPUT AND OUTPUT MANAGEMENT

STANDARD ENCODING FOR INPUT MANAGEMENT

ETRM APPLICATION DB

+

Commodity 1	*Commodity 2*	*Tipo di Parametro*	*Descrizione Parametro*	*Valore Parametro*
API 2	IPE BRENT L1 TONS	Coefficiente per coppia di commodities	hedge_ratio	0,6
IPE BRENT L1 TONS	IPE BRENT L1 TONS	Coefficiente per coppia di commodities	Corr_STLT	0,15
IPE BRENT L1 TONS		Coefficiente per commodity	K	6,92
IPE BRENT L1 TONS		Coefficiente per commodity	LambdaChi	0,13
IPE BRENT L1 TONS		Coefficiente per commodity	MuPsi	0,000183
IPE BRENT L1 TONS		Coefficiente per commodity	MuStarPsi	0,01
IPE BRENT L1 TONS		Coefficiente per commodity	Rho	0,9999

Single vectors uploaded as a data frame

Object specific and encoded format

Time series in a data frame object, vectors

	COMMODITY	TYPE	VALUE
1	Ipe.Brent.L1.tons	K	6.920000
2	Ipe.Brent.L1.Cambiato	K	1.300000
3	Ipe.Brent.L1.tons	LambdaChi	0.130000
4	Ipe.Brent.L1.Cambiato	LambdaChi	0.130000
5	Ipe.Brent.L1.tons	MuPsi	0.000183
6	Ipe.Brent.L1.tons	MuStarPsi	0.010000
7	Ipe.Brent.L1.Cambiato	MuStarPsi	0.010000
8	Ipe.Brent.L1.tons	Rho	0.999900

	Comm1	Comm2	Type	Value
1	Ipe.Brent.L1.tons	Ipe.Brent.L1.Cambiato	Corr_LTLT	0.43
2	Ipe.Brent.L1.tons	Ipe.Brent.L1.tons	Corr_STLT	0.15
3	Ipe.Brent.L1.Cambiato	Ipe.Brent.L1.Cambiato	Corr_STLT	0.15
4	Ipe.Brent.L1.tons	Ipe.Brent.L1.Cambiato	Corr_STLT	0.41
5	Ipe.Brent.L1.tons	Ipe.Brent.L1.Cambiato	Corr_STST	0.17

HOW WE MADE IT: INPUT AND OUTPUT MANAGEMENT

STANDARD ENCODING FOR OUTPUT MANAGEMENT

Numerical and character vectors

```
> head(Par_Perc)
1% 2% 3% 4% 5% 6%
18.57721 19.02299 19.35827 19.55320 19.71150 19.83884

OUT_testo <- c("Simulation ended with success",Esp_netta[,1])
```

Files & Workspace

Embedded function

```
VAR output = "
        save(list = ls(all=TRUE), file=\"#{stateFile.fileName}\")
        write.table(OUT_ESP_NETTA, file=\"#{exportFile.fileName}\",
        sep=\";\", row.names=FALSE, dec = \",\")";
RETURN output;
```

Work in progress: Data frame

HOW WE MADE IT: MULTIVARIATE NORMAL DISTRIBUTION

Specific requirement

'All random variables have to be simulated simultaneously according to a multivariate normal distribution with

mean = 0

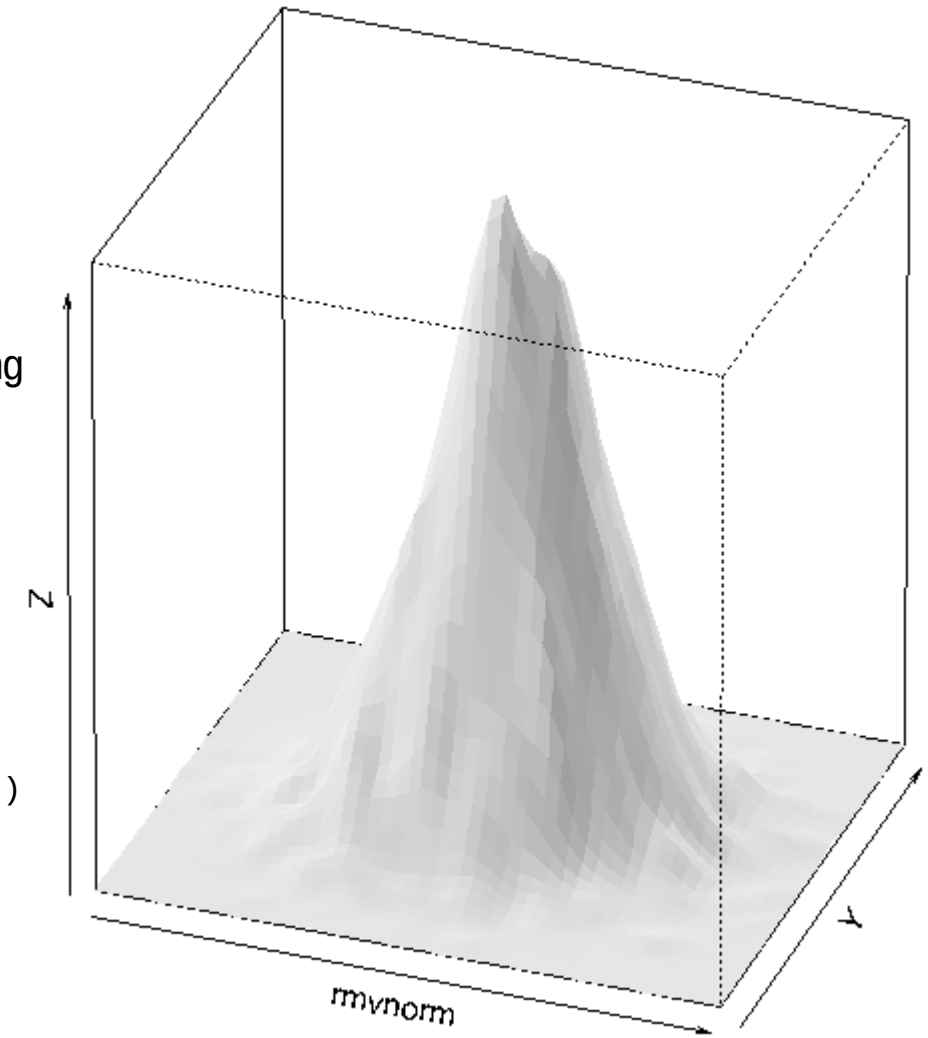
covariance matrix = coefficient for both long and short term of each major commodity , *exchange rate and CO2 '*

Implementation

```
library(mvtnorm)

CovMat <- CorMat*outer(SigmaTot,SigmaTot,"*")

rmvnorm(n=iteration_number, mean=rep(0,
ncol(CovMat)), sigma=CovMat)
```

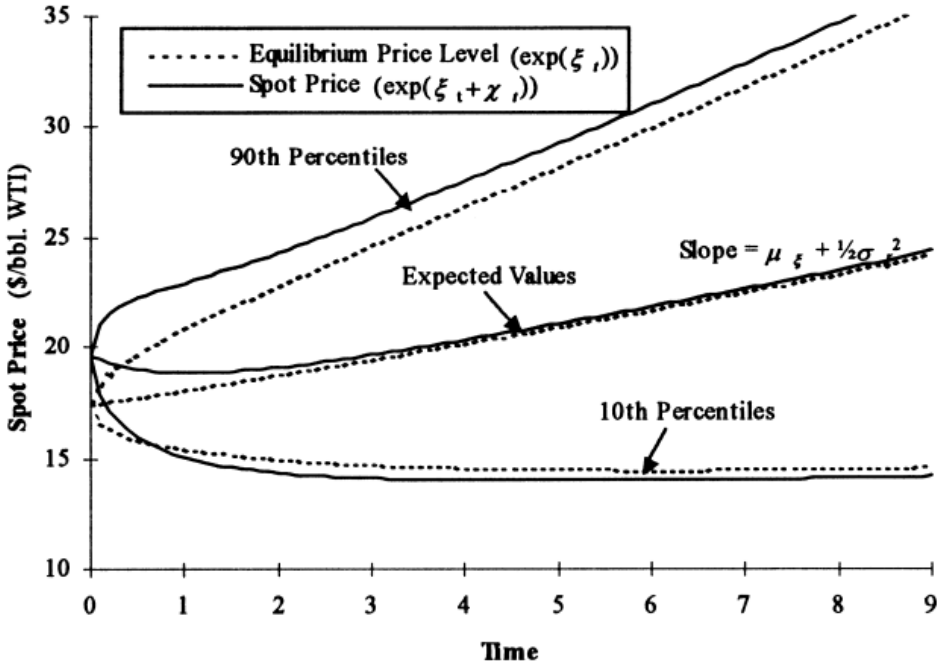


HOW WE MADE IT: MEAN REVERTING PROCESS

Specific requirement

The model has to be composed of two complementary terms:

- long-term equilibrium price level
- short-term which describe how prices deviate from equilibrium, which is expected to revert toward zero following a mean reverting process



Implementation

Deviation in spot prices are calculated according to a mean reverting process

$$d\chi_t = -\kappa\chi_t dt + \sigma_\chi dW_\chi$$

where K is the mean reversion coefficient which measures the strength that pull prices back to the equilibrium level

AGENDA

RISK CONTROL IN ENERGY MARKETS

TECHNOLOGICAL AND METHODOLOGICAL APPROACH

HOW WE MADE IT

HAVE A LOOK

HAVE A LOOK: PROCESS

Input upload → **Model definition (upload R script)** → **Exposure selection** → **Monte Carlo Simulation**

HAVE A LOOK: MODEL SET UP

Modello Risk

ID: Par_Model *

Nome: Par_Model *

Descrizione:

Logica di calcolo:

Stato di validità: Valido

Sintassi di conversione commodity Base-Liquida
Selezionata: LiquidExposure_RSyntax.R
Clear
Seleziona un file .r di Sintassi R:

Sintassi di analisi del rischio
Selezionata: Par_Model_FinalRSyntax.R
Clear
Seleziona un file .r di Sintassi R:

R script uploaded from file

Parametri:

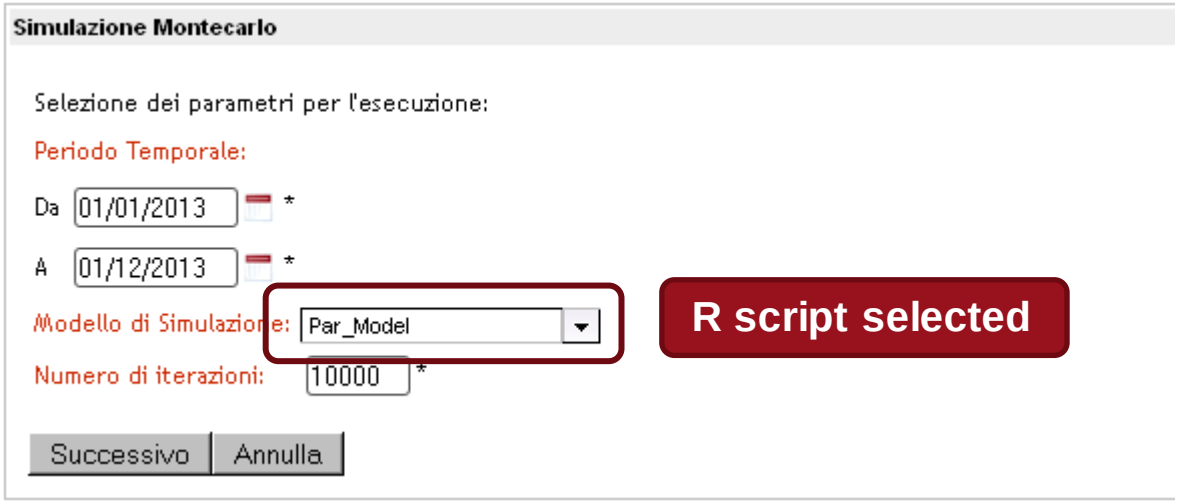
Nome	Tipo	Descrizione	Valore	Commodity 1	Commodity 2
Api 2Ipe Brent L1 tons	Coefficiente per coppia di commodities	hedge_ratio	0.60	Api 2	Ipe Brent L1 tons
Api 4Ipe Brent L1 tons	Coefficiente per coppia di commodities	hedge_ratio	0.52	Api 4	Ipe Brent L1 tons
Gamma_Co2	Coefficiente per commodity	Gamma_CO2	1.00	Ipe Brent L1 tons	-
Ipe Brent L1 bblIpe Brent L1 tons	Coefficiente per coppia di commodities	hedge_ratio	0.13	Ipe Brent L1 bbl	Ipe Brent L1 tons
K_Co2	Coefficiente per commodity	K_CO2	0.40	Ipe Brent L1 tons	-
K_ipe	Coefficiente per commodity	K	6.92	Ipe Brent L1 tons	-
Lambda_ipe	Coefficiente per commodity	LambdaChi	0.13	Ipe Brent L1 tons	-
MuPsi	Coefficiente per commodity	MuPsi	0.00	Ipe Brent L1 tons	-
MuStarPsi_Ipe	Coefficiente per commodity	MuStarPsi	0.01	Ipe Brent L1 tons	-
Rho_Ipe	Coefficiente per commodity	Rho	1.00	Ipe Brent L1 tons	-

« « 1 » »

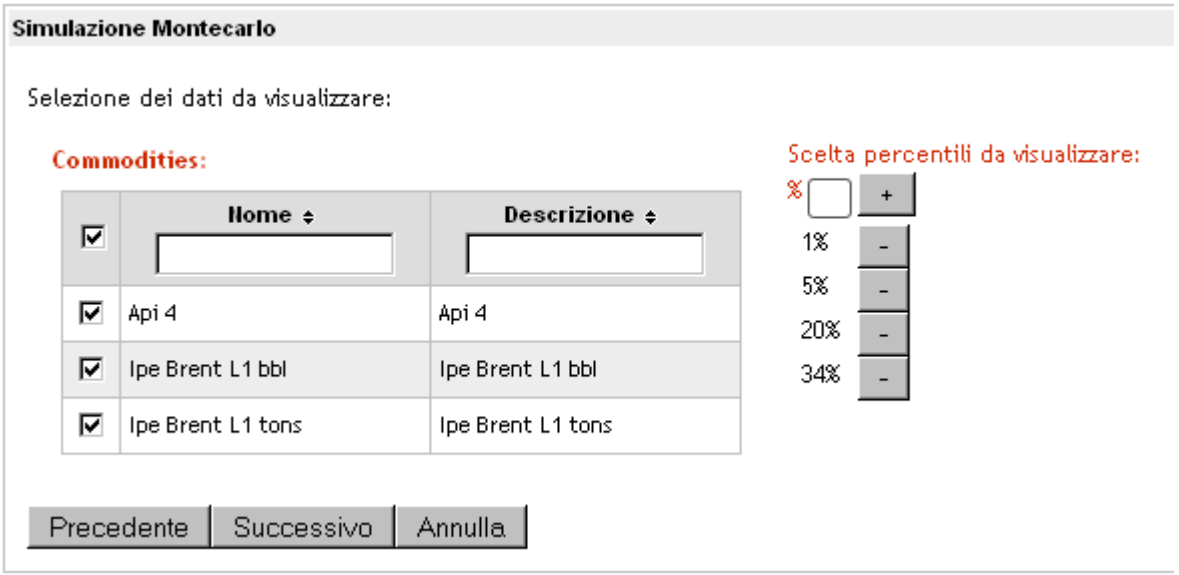
Successivo Annulla

HAVE A LOOK: MONTE CARLO SIMULATION DETAILS

STEP 1

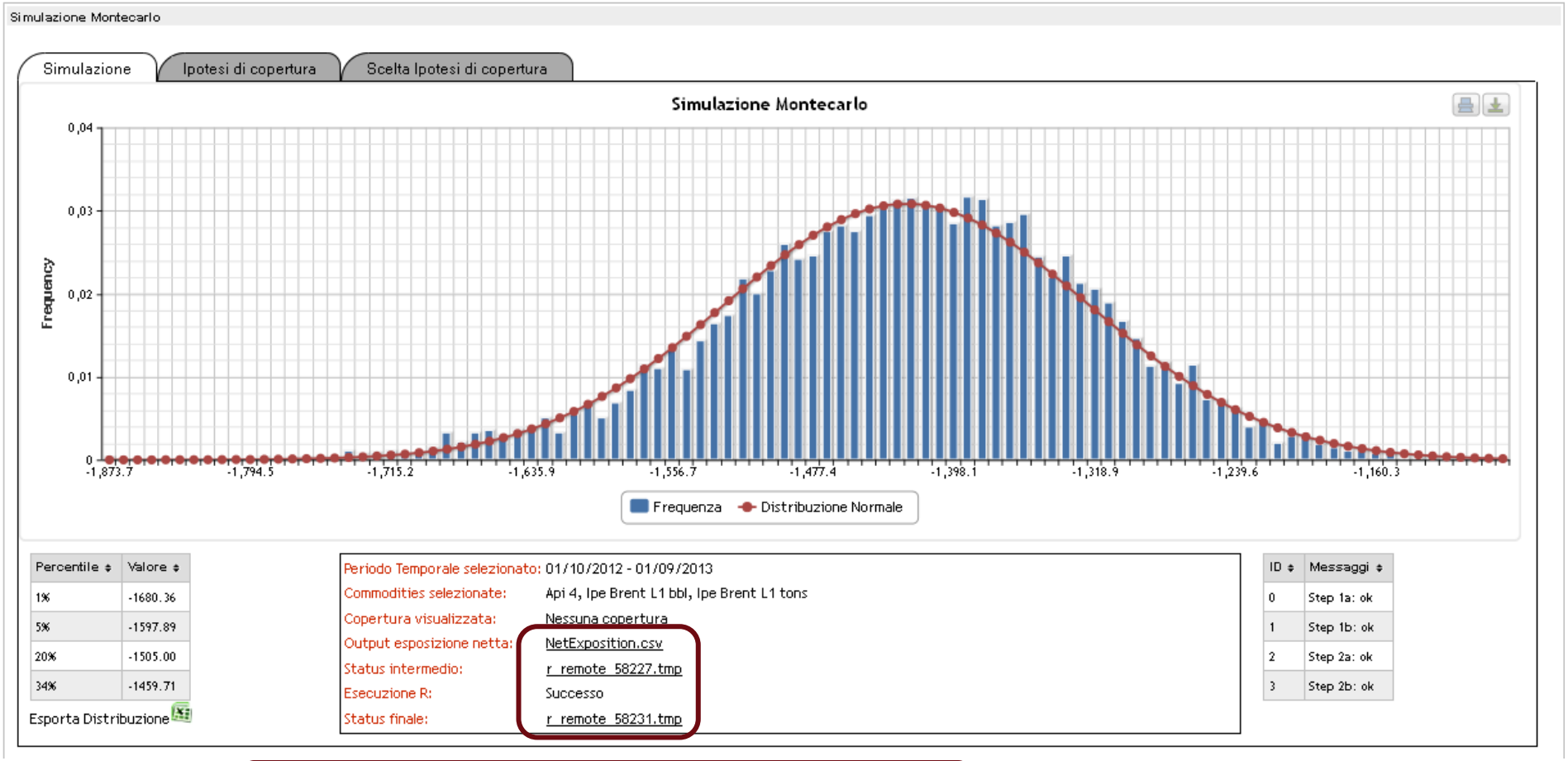


STEP 2



HAVE A LOOK: MONTE CARLO SIMULATION RESULTS

STEP 3



File .csv , intermidiate and final workspace

Q&A

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