CME SPAN®

Standard Portfolio Analysis of Risk®

CME SPAN® - Standard Portfolio Analysis of Risk

- Developed in 1988 by Chicago Mercantile Exchange Inc. to effectively assess risk on an overall portfolio basis.

- SPAN is a market simulation based Value At Risk system which has been reviewed and approved by market regulators and participants world wide.

- SPAN is the official Performance Bond mechanism of 54 exchanges and clearing organizations world-wide, making it the global standard for portfolio margining.

- SPAN's risk based margin requirements allows for effective margin coverage while preserving efficient use of capital.

- SPAN assesses risk for a wide variety of financial instruments including: futures, options, physicals, equities, or any combination.

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CME SPAN® - Objectives

- SPAN assesses the risk of a portfolio, by calculating the maximum likely loss that could be suffered by the portfolio based on parameters set by the margin-setting authority, usually an exchange or clearing organization.

- The core of SPAN risk analysis is to simulate potential market moves and calculate the profit or loss on individual contracts given the market moves.

- Exchanges may determine any number of market scenarios to be included in the SPAN analysis.

- Most SPAN exchanges and clearing organizations use 16 scenarios.

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CME SPAN® - Methodology

- SPAN groups together financial instruments with the same underlying for analysis.

- For example, Futures on an Equity Index and Options on the Equity Index would be grouped together for analysis.

- Each product is referred to as a Combined Commodity.

- SPAN uses parameters set by the exchange or clearing organization to evaluate a portfolio with the following two step analysis:

  ➢ Step 1: SPAN first analyzes the risk of each Combined Commodity in isolation from other Combined Commodities.

  ➢ Step 2: SPAN then seeks risk reducing offsets between Combined Commodities.

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Scan Risk Arrays

CME SPAN® - Scan Risk

- The core of SPAN risk analysis to simulate potential market moves and calculate the profit or loss on individual contracts.

- Exchanges or clearing organizations may determine any number of market scenarios to be included in SPAN analysis.

- Most SPAN exchanges or clearing organizations use 16 scenarios.

- The 16 scenarios are referred to as SPAN Risk Arrays.

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CME SPAN® - Scan Risk Arrays

- SPAN Risk Arrays represent a contract's hypothetical gain/loss under a specific set of market conditions from a set point in time to a specific point in time in the future.

- Risk Arrays typically consist of 16 profit/loss scenarios for each contract.

- Each Risk Array scenario is comprised of a different market simulation, moving the underlying price up or down and/or moving volatility up or down.

- The risk array representing the maximum likely loss becomes the Scan Risk for the portfolio.

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CME SPAN® - Scan Risk Example

- The next slide demonstrates the Scanning Risk calculation for an S&P500 portfolio:
  - ➤ Long 1 Sep 2010 SP Futures (price is 1100)
  - ➤ Short 1 Sep 2010 SP 1000 Call Option (implied volatility is 28%)
- The Price Scan Range is $22,500 or 90 points (CVF for SP500 is $250, $22,500/$250 = 90points)
- The Volatility Scan Range for SP500 is 7%

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CME SPAN® - Scan Risk Example

Scenario	SP Underlying Price Move	Volatility Move	SP Future Gain/Loss	SP Option Gain/Loss	Portfolio Gain/Loss
1	UNCHANGED	UP	0	1,807	1807
2	UNCHANGED	DOWN	0	-1,838	-1,838
3	UP 33%	UP	-7,499	7,899	400
4	UP 33%	DOWN	-7,499	5,061	-2,438
5	DOWN 33%	UP	7,499	-3,836	3,663
6	DOWN 33%	DOWN	7,499	-8,260	-761
7	UP 67%	UP	-15,001	14,360	-641
8	UP 67%	DOWN	-15,001	12,253	-2,748
9	DOWN 67%	UP	15,001	-8,949	6,052
10	DOWN 67%	DOWN	15,001	-13,980	1,021
11	UP 100%	UP	-22,500	21,107	-1,393
12	UP 100%	DOWN	-22,500	19,604	-2,896
13	DOWN 100%	UP	22,500	-13,455	9,045
14	DOWN 100%	DOWN	22,500	-18,768	3,732
15	UP 300%	UNCHANGED	-22,275	21,288	-987
16	DOWN 300%	UNCHANGED	22,275	-9,160	13,115
			Largest Potential Loss = SPAN Risk		**13,115**

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CME SPAN® - Scan Risk Extreme Scenarios

- Deep out-of-the-money short options may pose significant risk, as unusually large price changes may result in unexpectedly large losses, particularly as expiration nears.

- SPAN accounts for this risk by including Extreme Scenarios in the Risk Arrays.

- Extreme Scenarios may be used to simulate a significant market move designed to shock deep out-of-the-money options.

- Extreme Scenarios are determined by the Exchange or Clearing Organization.

- CME uses a market move equal to 3 times the Price Scan Range for a given product. The resulting gain or loss is then multiplied by a percentage of 33% to determine the potential exposure.

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CME SPAN® - Composite Delta Scenarios

- Composite Delta is derived as the weighted average of the deltas, where the weights are associated with each underlying price scan point.

- Below is an example of the 7 Delta Points used by CME:

Scenario	Underlying Price Change as % of Price Scan Range	Probability Weight
1	UNCHANGED	0.27
3	UP 33%	0.217
5	DOWN 33%	0.217
7	UP 67%	0.11
9	DOWN 67%	0.11
11	UP 100%	0.037
13	DOWN 100%	0.037

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SPAN® Analysis

Spread Types & Formations

Short Option Minimum & Delivery Add-On Charge

Net Option Value

CME SPAN® - Spread Types & Formation

- **Intra-Commodity Spread** : Evaluate the basis risk between contract periods with different expirations within the same product. Spreads are prioritized by lowest charge.

- **Inter-Commodity Spread** : Evaluate credit available for offsetting positions in related instruments. Spreads are prioritized by greatest total savings.

- SPAN forms Intra-Commodity Spreads before Inter-Commodity Spreads.

- **Super Inter-Commodity Spread** : Allows Inter-Commodity Spreads to be evaluated before Intra-Commodity Spreads.

- **Inter-Exchange Spread Credit**: Allows spreads to be formed for portfolios containing products listed on multiple Exchanges, as defined by the Exchange.
  - ➢ The formation of Inter-Exchange Spreads is similar to process of forming Inter-Commodity Spreads, however each Exchange can only provide a credit for its own products.

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CME SPAN® - Intra-Commodity Spread Risk

- Since futures prices do not correlate exactly across contract months, a gain in one month may not exactly offset losses in another month.

- An Intra-Commodity Spread Charge can be set in SPAN to cover the risk of calendar spread positions.

- The Intra-Commodity Spread Charge can be tailored for contract pairs or specified groups of contracts.

- There is no limit to the number of contract legs that can be specified in an Intra-Commodity Spread, also known as tiered intra-commodity spreading.

- The Intra-Commodity Spread Charge can also be tailored to specific calendar months.

- For example, a March versus September calendar spread can have a different charge rate than a March versus December calendar spread. This is also known as series specific intra-commodity spreading.

- The next slide shows an example of an Intra-commodity Spread for a portfolio with 1 long September 2010 and 1 short September 2010 Eurodollar.

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CME SPAN® - Intra-Commodity Spread Example

- The Intra-Commodity Spread Charge for Nov 2010 vs. Dec 2010 is $200.
- Since the gains on Nov ED exactly offset the losses on Dec ED, the Scan Risk is $0.
- Therefore, the Intra-Commodity Spread Charge of $200 becomes SPAN Risk.

Scenario	SP Underlying Price Move	Volatility Move	Nov ED Gain/Loss	Dec ED Gain/Loss	Portfolio Gain/Loss
1	UNCHANGED	UP	0	0	0
2	UNCHANGED	DOWN	0	0	0
3	UP 33%	UP	-250	250	0
4	UP 33%	DOWN	-250	250	0
5	DOWN 33%	UP	250	-250	0
6	DOWN 33%	DOWN	250	-250	0
7	UP 67%	UP	-500	500	0
8	UP 67%	DOWN	-500	500	0
9	DOWN 67%	UP	500	-500	0
10	DOWN 67%	DOWN	500	-500	0
11	UP 100%	UP	-750	750	0
12	UP 100%	DOWN	-750	750	0
13	DOWN 100%	UP	750	-750	0
14	DOWN 100%	DOWN	750	-750	0
15	UP 300%	UNCHANGED	-743	743	0
16	DOWN 300%	UNCHANGED	743	-743	0

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CME SPAN® - Inter-Commodity Spread Risk

- To recognize the risk reducing aspects of portfolios containing off-setting positions in highly correlated instruments, SPAN forms Inter-Commodity Spreads.

- Inter-Commodity Spreads produce credits which reduce the overall performance bond or margin requirement.

- The universe of recognized spreads, rates, and priority are determined by the Exchange.

- Below is an example of 1 Long SP future and 2 Short Nasdaq futures. The recognized spread ratio is 1 SP vs. 2 ND and the spread credit is 85%.

Combined Commodity	Position	Outright PB Requirement	Recognize Spread Credit	SPAN Requirement
SP	Long 1	$22,500		
NP	Short 2	$14,000 x 2 = $28,000		
Total		$50,500	X 85% = $42,925	$7,575

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CME SPAN® - Inter-Commodity Delta Based Spreading

• Delta Based Spreading is performed after the Scan Risk or Scanning process.

• One result of the Scanning process for each Combined Commodity is a Net Delta position, which is an estimate of market exposure that has not been offset within the Combined Commodity which is available to be offset between Combined Commodities.

• Each exchange defines a table of recognized Inter-Commodity Spread formations and the margin credit to apply for such formations.

• SPAN takes the Inter-commodity spread table and seeks out the defined spread formations, giving margin credit for each spread formed.

• A Delta based spread may contain any number of spread legs.

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CME SPAN® - Inter-Commodity Scanning Based Spreading

- Another method of recognizing offsetting positions between Combined Commodities is Scanning Based Spreading.

- Scanning Based Spreading recognizes risk offsets among Combined Commodities by scanning them together.

- Scanning Based Spreading allows for the recognition of risk reduction due to correlated underlying price moves and also the risk reduction due to offsetting option positions.

- In recognizing that the correlations between Combined Commodities may not be perfect, the gains in the Scanning process may be limited by a gain allowance factor set by the exchange.

- The next two slides show an example of the potential benefits achieved through Scanning Based Spreading as opposed to Delta Based Spreading. Both slides use the same position of:
  - ➢ Long 90 Bond futures
  - ➢ Short 90 10yr futures

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CME SPAN® - Delta Based Spread Example

- Long 90 Bond futures & Short 90 10yr futures

Spread Positions	Product	Position	Outright PB Requirement	Spread Ratio	Spread Credit
	Bond	90	$2,500	2	70%
	10 yr	-90	$1,400	3	

Spread Credit	Product	Position	Outright PB Requirement	Position x Outright PB	Spread Credit
	Bond	60	$2,500	$150,000	$276,000 x .7 =$193,200
	10 yr	90	$1,400	$126,000	

Remaining Delta	Product	Position	Outright PB Requirement	Position x Outright PB
	Bond	30	$2,500	$75,000
	10 yr	0	$0	$0

Delta-Based Total Requirement	Remaining Delta PB Requirement	Spread Req. (30%)	Total PB Requirement
	$75,000	$82,800	**$157,800**

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CME SPAN® - Scanning Based Spread Example

- Long 90 Bond futures & Short 90 10yr futures

Scenario	Underlying Price Move	Volatility Change	Gain/Loss
1	UNCHANGED	UP	$0
2	UNCHANGED	DOWN	$0
3	UP 33%	UP	-$10,449
4	UP 33%	DOWN	-$10,449
5	DOWN 33%	UP	$45,549
6	DOWN 33%	DOWN	$45,549
7	UP 67%	UP	-$21,051
8	UP 67%	DOWN	-$21,051
9	DOWN 67%	UP	$91,251
10	DOWN 67%	DOWN	$91,251
11	UP 100%	UP	-$31,500
12	UP 100%	DOWN	-$31,500
13	DOWN 100%	UP	$136,800
14	DOWN 100%	DOWN	$136,800
15	UP 300%	UNCHANGED	-$31,185
16	DOWN 300%	UNCHANGED	$135,432
	Scanning Based PB Requirement		$136,800

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CME SPAN® - Short Option Minimum

- Deep out-of-the-money short options may show zero or minimal Scan Risk given the price & volatility moves in the 16 market scenarios.

- However, in extreme events these options may move closer to-the-money or in-the-money, thereby generating potentially large losses.

- To account for this potential exposure, a Short Option Minimum can be set for each product.

- If the Scan Risk is lower than the Short Option Minimum, then the Short Option Minimum is charged.

- The next slide shows an example of the Short Option Minimum using a deep out-of-the-money short put.
  - ➢Short 1 SP500 Sep 2010 Put @500 (underlying price is 1100)
  - ➢Short Option Minimum on 1 SP500 is $225

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CME SPAN® - Short Option Minimum Example

- Scan Risk is $88, however SOM is $225, so the requirement is $225.

Scenario	Underlying Price Move	Volatility Change	Gain/Loss
1	UNCHANGED	UP	$16
2	UNCHANGED	DOWN	-$10
3	UP 33%	UP	$8
4	UP 33%	DOWN	-$10
5	DOWN 33%	UP	$27
6	DOWN 33%	DOWN	-$9
7	UP 67%	UP	$3
8	UP 67%	DOWN	-$11
9	DOWN 67%	UP	$41
10	DOWN 67%	DOWN	-$7
11	UP 100%	UP	-$1
12	UP 100%	DOWN	-$11
13	DOWN 100%	UP	$62
14	DOWN 100%	DOWN	-$4
15	UP 300%	UNCHANGED	-$4
16	**DOWN 300%**	**UNCHANGED**	**$88**
		Scan Risk	$88

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CME SPAN® - Summary of SPAN Analysis

- **Scan Risk**: Evaluate the directional market risk.

- **Intra-Commodity Spread Charge**: Evaluate the basis risk between contract periods with different expirations within the same product.

- **Inter-Commodity Spread Credit**: Evaluate credit available for offsetting positions in related instruments.

- **Delivery Add-On Charge**: Evaluate contract periods for increasing volatility during delivery.

- **Short Option Minimum**: Evaluate short option positions for potential increased risk, using the greater of the Scan Risk or Short Option Minimum.

- SPAN Requirement for a Combined Commodity is the greater of:
  - (Scan Risk + Intra Commodity Spread Charge + Delivery Charge – Inter Commodity Spread Credit)
  - Short Option Minimum

- The Total SPAN Requirement for a portfolio is the sum of the SPAN Requirement for all Combined Commodities.
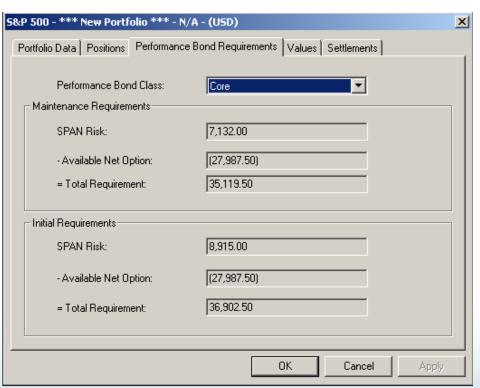
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CME SPAN® - Net Option Value

- Mark-to-market of options is reflected in the Net Option Value component of SPAN.

- The Total Performance Bond Requirement for a portfolio reflects the Total SPAN Requirement and the Net Option Value of the portfolio.

- **The Net Option Value (NOV)** of a portfolio is equal to the Long Option Value minus the Short Option Value.

- **Long Option Value (LOV)**: The total value of all the long options in the portfolio.

- **Short Option Value (SOV)**: The total value of all the short options in the portfolio.

- LOV reduces the overall Total Performance Bond Requirement.

- SOV increases the overall Total Performance Bond Requirement.

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CME SPAN® - Net Short Option Value

- The portfolio below includes:
  - ➢ Long 1 Sep 2010 SP Futures (price is 1100)
  - ➢ Short 1 Sep 2010 SP 1000 Call Option (price is $119.10, value is $28,150)
  - ➢ Long 1 Sep 2010 SP 900 Put Option (price is $3.20, option value is $162.50)

S&P 500 - *** New Portfolio *** - N/A - (USD)

Portfolio Data | Positions | Performance Bond Requirements | Values | Settlements

Performance Bond Class: `Core`

Maintenance Requirements

SPAN Risk:	7,132.00
- Available Net Option:	(27,987.50)
= Total Requirement:	35,119.50

Initial Requirements

SPAN Risk:	8,915.00
- Available Net Option:	(27,987.50)
= Total Requirement:	36,902.50

OK | Cancel | Apply

SPAN Risk = $7,132

LOV = $162.50

SOV = $28,150

NOV = ($27,987.50)

Total Requirement =

SPAN Risk + NOV

$7,132 - ($27,987.50) = **$35,119.50**

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CME SPAN® - Net Long Option Value

- The portfolio below includes:
  - ➤ Short 1 Sep 2010 SP Futures (price is 1100)
  - ➤ Long 1 Sep 2010 SP 1000 Call Option (price is $119.50, value is $28,150)
  - ➤ Short 1 Sep 2010 SP 900 Put Option (price is $3.20, option value is $162.50)

SPAN Risk = $585

LOV = $28,150
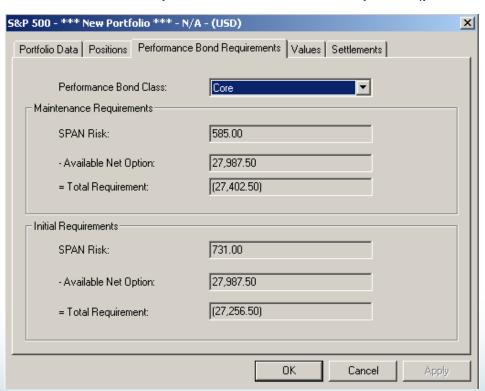
SOV = $162.50

NOV = $27,987.50

Total Requirement =

SPAN Risk + NOV

$585 - $27,987.50 = **($27,402.50)**