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.

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.

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.

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.

CME SPAN® - Scan Risk Arrays

- Below is an example of the 16 Scan Risk Arrays used by CME

Scenario	Underlying Price Change as % of Price Scan Range	Volatility Move
1	UNCHANGED	UP
2	UNCHANGED	DOWN
3	UP 33%	UP
4	UP 33%	DOWN
5	DOWN 33%	UP
6	DOWN 33%	DOWN
7	UP 67%	UP
8	UP 67%	DOWN
9	DOWN 67%	UP
10	DOWN 67%	DOWN
11	UP 100%	UP
12	UP 100%	DOWN
13	DOWN 100%	UP
14	DOWN 100%	DOWN
15	UP 300%	UP
16	Down 300%	UP

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CME SPAN® - Scan Risk Example

• The next slide demonstrates the Scanning Risk calculation for an S&P 500 portfolio:

  ➢Long 1 MAR 2019 SP Future (price is 2,790)

  ➢Short 1 MAR 2019 SP 2825 Call Option (implied volatility is 16%)

• The Price Scan Range is $30,000 or 120 points (CVF for SP 500 is $250, $30,000/$250 = 120 points)

• The Volatility Scan Range for SP 500 is 35%

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	$1,994	$1,994
2	UNCHANGED	DOWN	$0	-$1,517	-$1,517
3	UP 33%	UP	-$9,999	$6,291	-$3,708
4	UP 33%	DOWN	-$9,999	$2,178	-$7,821
5	DOWN 33%	UP	$9,999	-$714	$9,285
6	DOWN 33%	DOWN	$9,999	-$2,876	$7,123
7	UP 67%	UP	-$20,001	$12,281	-$7,720
8	UP 67%	DOWN	-$20,001	$8,818	-$11,183
9	DOWN 67%	UP	$20,001	-$2,183	$17,818
10	DOWN 67%	DOWN	$20,001	-$3,179	$16,822
11	UP 100%	UP	-$30,000	$19,772	-$10,228
12	UP 100%	DOWN	-$30,000	$17,607	-$12,393
13	DOWN 100%	UP	$30,000	-$2,857	$27,143
14	DOWN 100%	DOWN	$30,000	-$3,218	$26,782
15	UP 300%	UP	-$29,700	$25,503	-$4,197
16	Down 300%	UP	$29,700	-$1,063	$28,637
			Largest Potential Loss = SPAN Risk		**$28,637**

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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 3x Price Scan Range and 1x Vol Scan for a given product. The resulting gain or loss is then multiplied by 33% to determine the potential exposure.

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 April calendar spread can have a different charge rate than a March versus September 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 Mar 2019 Eurodollar and 1 short April 2019 Eurodollar.

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CME SPAN® - Intra-Commodity Spread Example

- The Intra-Commodity Spread Charge for Mar 2019 vs. Apr 2019 is $70.

- Since the gains on Mar ED exactly offset the losses on Apr ED, the Scan Risk is $0.

- Therefore, the Intra-Commodity Spread charge of $70 becomes SPAN Risk.

Scenario	ED Underlying Price Move	Volatility Move	Mar ED Gain/Loss	Apr ED Gain/Loss	Portfolio Gain/Loss
1	UNCHANGED	UP	$0	$0	$0
2	UNCHANGED	DOWN	$0	$0	$0
3	UP 33%	UP	-$60	$60	$0
4	UP 33%	DOWN	-$60	$60	$0
5	DOWN 33%	UP	$60	-$60	$0
6	DOWN 33%	DOWN	$60	-$60	$0
7	UP 67%	UP	-$120	$120	$0
8	UP 67%	DOWN	-$120	$120	$0
9	DOWN 67%	UP	$120	-$120	$0
10	DOWN 67%	DOWN	$120	-$120	$0
11	UP 100%	UP	-$180	$180	$0
12	UP 100%	DOWN	-$180	$180	$0
13	DOWN 100%	UP	$180	-$180	$0
14	DOWN 100%	DOWN	$180	-$180	$0
15	UP 300%	UP	-$178	$178	$0
16	Down 300%	UP	$178	-$178	$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 5 Short Nasdaq futures. The recognized spread ratio is 1 SP vs. 5 NQ and the spread credit is 75%

Combined Commodity	Position	Outright PB Requirement	Recognized Spread Credit	SPAN Requirement
SP	Long 1	$30,000		
NQ	Short 5	$7,600 x 5 = $38,000		
Total		$68,000	X 75% = $51,000	$17,000

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. Any remaining deltas are margined at the outright rate.

CME SPAN® - Delta Based Spread Example

- Long 50 Soybean (S) futures & Short 50 Corn (C) futures

Spread Position	Product	Position	Outright PB Requirement	Spread Ratio	Spread Credit
	S	50	$1,750	1	60%
	C	-50	$700	2	

Spread Credit	Product	Position	Outright PB Requirement	Position x Outright PB	Spread Credit
	S	25	$1,750	$43,750	$78,750 x .60 = $47,250
	C	50	$700	$35,000	

Remaining Delta	Product	Position	Outright PB Requirement	Position x Outright PB	
	S	25	$1,750	$43,750	
	C	0	$700	$0	

Delta-Based Total Requirement	Remaining Delta PB Requirement	Spread Req (40%)	Total PB Requirement
	$43,750	$31,500	$75,250

CME SPAN® - Inter-Commodity Scanning Based Spreading

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

- Scanning Based Spreading allows Combined Commodities which are part of the spread to go through SPAN's 16 scenarios simultaneously, ensuring they are subject to the same worst case loss scenario and that offsetting futures and options delta positions between them automatically offset.

- 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.

CME SPAN® - Scanning Based Spread Example

- Long 90 Bond futures & Short 90 10yr futures

Scenario	Underlying Price Move	Volatility Move	Portfolio Gain/Loss
1	UNCHANGED	UP	$0
2	UNCHANGED	DOWN	$0
3	UP 33%	UP	-$15,255
4	UP 33%	DOWN	-$15,255
5	DOWN 33%	UP	$54,095
6	DOWN 33%	DOWN	$54,095
7	UP 67%	UP	-$30,420
8	UP 67%	DOWN	-$30,420
9	DOWN 67%	UP	$108,131
10	DOWN 67%	DOWN	$108,131
11	UP 100%	UP	-$45,675
12	UP 100%	DOWN	-$45,675
13	DOWN 100%	UP	$162,225
14	DOWN 100%	DOWN	$162,225
15	UP 300%	UP	-$45,202
16	Down 300%	UP	$160,619
Scanning Based PB Requirement			**$162,225**

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 SP 500 Mar 2019 1750 Put (underlying price is 2790)
  - ➢ Short Option Minimum on 1 SP 500 is $240

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CME SPAN® - Short Option Minimum Example

- Scan Risk is $228, however SOM is $240, so the requirement is $240.

Scenario	Underlying Price Move	Volatility Move	Portfolio Gain/Loss
1	UNCHANGED	UP	$52
2	UNCHANGED	DOWN	-$1
3	UP 33%	UP	$38
4	UP 33%	DOWN	-$1
5	DOWN 33%	UP	$70
6	DOWN 33%	DOWN	-$1
7	UP 67%	UP	$28
8	UP 67%	DOWN	-$1
9	DOWN 67%	UP	$95
10	DOWN 67%	DOWN	-$1
11	UP 100%	UP	$20
12	UP 100%	DOWN	-$1
13	DOWN 100%	UP	$127
14	DOWN 100%	DOWN	-$1
15	UP 300%	UP	$1
16	Down 300%	UP	$228
Scanning Based PB Requirement			$228

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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.

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.

CME SPAN® - Net Short Option Value

- The portfolio below includes:
  - ➤ Long 1 Mar 2019 SP Futures (price is 2,790)
  - ➤ Short 1 Mar 2019 SP 2750 Call Option (price is $51.36, option value is $11,975)
  - ➤ Long 1 Mar 2019 SP 2650 Put Option (price is $5.94, option value is $1,825)

SPAN Risk = $13,037
LOV = $1,825
SOV = $11,975
ANOV = ($10,150)
SPAN Risk - ANOV = Total Requirement
$13,037 - ($10,150) = $23,187

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CME SPAN® - Net Long Option Value

- The portfolio below includes:
  - Short 1 Mar 2019 SP Futures (price is 2790)
  - Long 1 Mar 2019 SP 2750 Call Option (price is $51.36, option value is $11,975)
  - Short 1 Mar 2019 SP 2650 Put Option (price is $5.94, option value is $1,825)

SPAN Risk = $3,992
LOV = $11,975
SOV = $1,825
ANOV = $10,150
SPAN Risk - ANOV = Total Requirement
$3,992 - $10,150 = ($6,158)

Disclaimer