A. Spreads vs Days to Expiry (DTE)

1. CM - FUT1 Spread (%) - Spot Future Parity

2. FUT1 - FUT2 Spread (%) - Calendar Spread


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OBSERVATIONS (Problem 1.A):
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1. CONVERGENCE (The Cone Shape): The CM-FUT1 spread (Plot 1) exhibits clear
   convergence. At 30+ DTE, spreads fluctuate between -2% and +1%. As DTE
   approaches 0, the spread narrows significantly, forcing Spot-Future parity.

2. CONTANGO VS BACKWARDATION: The cluster of points is predominantly positive
   (Contango), but significant negative outliers (Backwardation) appear,
   likely driven by corporate actions (dividends) or short-term volatility.

3. CALENDAR STABILITY: The FUT1-FUT2 spread (Plot 2) remains relatively stable
   across the expiry cycle compared to the Spot spread, representing the
   'Cost of Carry' between two future months.
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B. Volume Ratios vs Days to Expiry

Volume Ratio: FUT1 / FUT2 (Liquidity Migration)
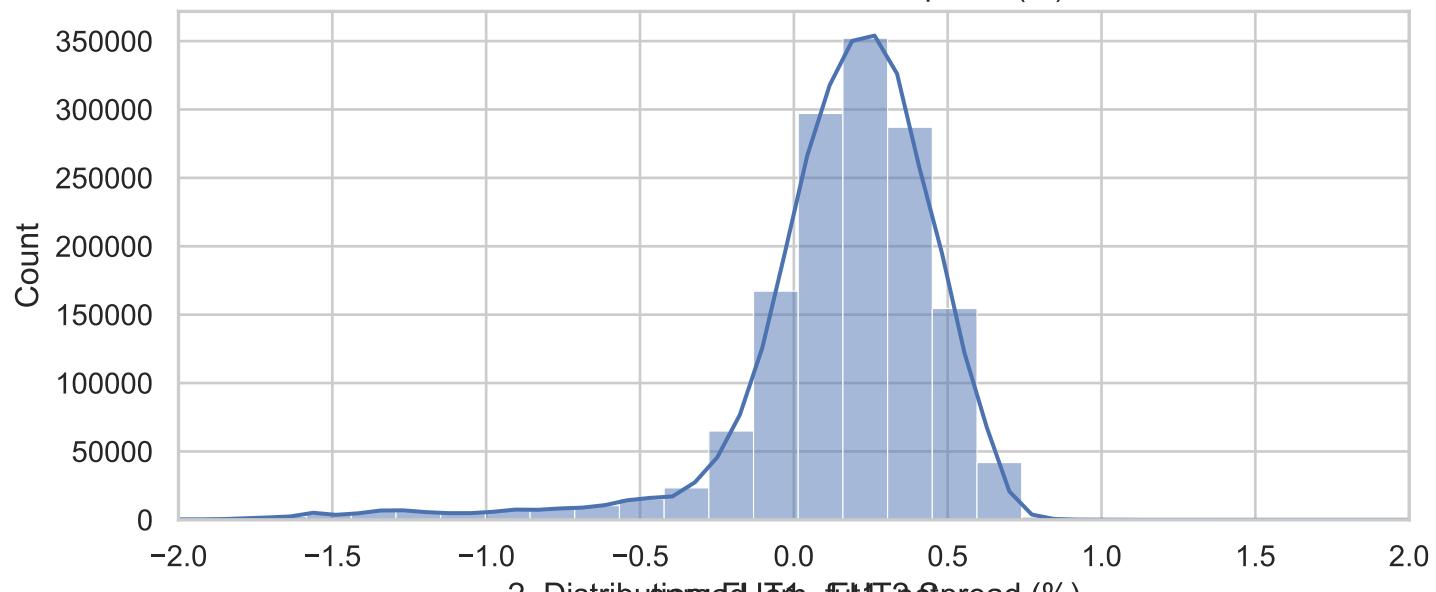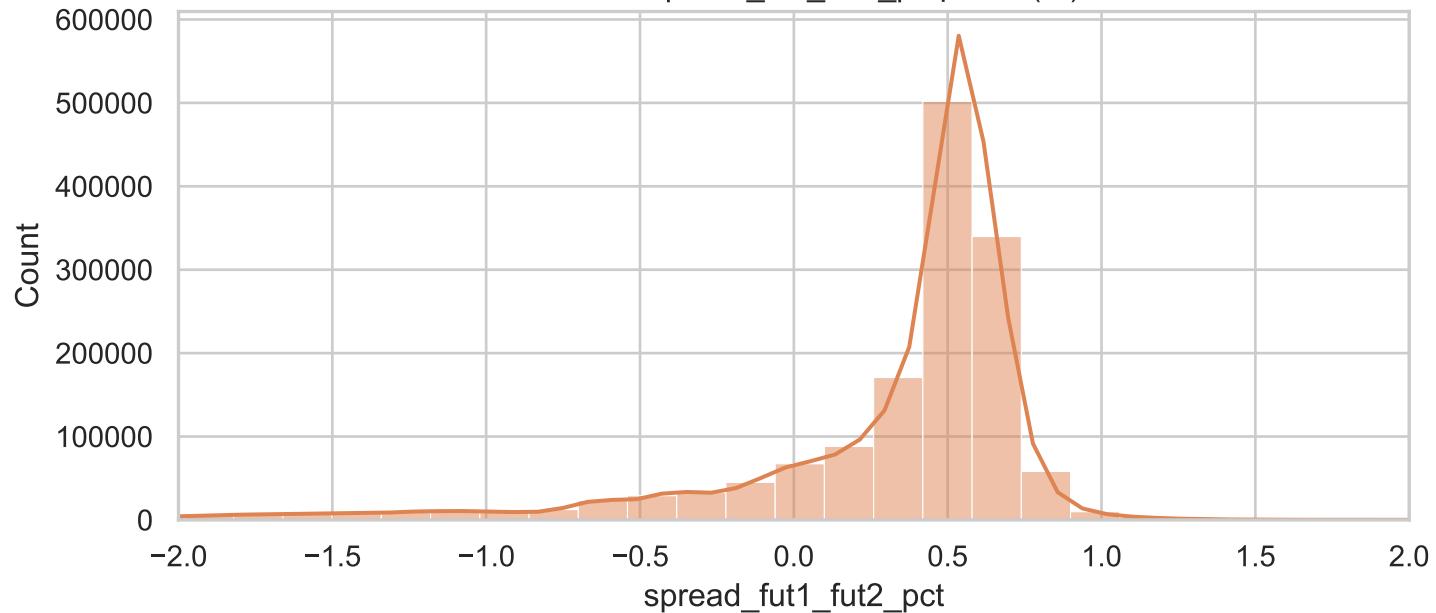

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OBSERVATIONS (Problem 1.B):
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1. LIQUIDITY ROLLOVER: The FUT1/FUT2 volume ratio demonstrates a textbook
   rollover pattern. At the start of the cycle (35 DTE), the Near Month
   (FUT1) volume is ~25x higher than the Far Month (FUT2).

2. THE CROSSOVER: As expiry approaches, traders close FUT1 positions and
   open FUT2 positions. The ratio decays linearly, dropping below 1.0
   in the final days, indicating that liquidity has successfully
   migrated to the next month's contract.

3. STRATEGIC IMPLICATION: Execution algorithms must account for this
   liquidity shift. Trading spreads involving FUT2 is costly at 30 DTE
   due to thin liquidity (high impact cost), but becomes optimal near expiry.
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C. Distribution of Spreads

1. Distribution: CM - FUT1 Spread (%)

2. Distribution: FUT1 - FUT2 Spread (%)


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OBSERVATIONS (Problem 1.C):
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1. LEPTOKURTIC (FAT TAILS): Both distributions are highly Leptokurtic,
   characterized by a high central peak and fat tails. This confirms that
   while spreads usually stay near a 'fair value', extreme deviations
   occur more frequently than a Normal Gaussian distribution predicts.

2. SKEWNESS: The CM-FUT1 distribution (Plot 1) is slightly positively
   skewed, reflecting the structural Cost of Carry (Interest Rates).

3. STRATEGY VALIDATION: The distinct mean-reverting bell curve supports
   the use of Z-Score based statistical arbitrage strategies. However,
   the presence of fat tails necessitates robust risk management (Stop
   Losses) to survive 'Black Swan' spread widening events.
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