

# Project Report

**Week 1(12/5/23 - 19/5/23):** Learned the basics of Commodity derivatives and risk management from the NPTEL course.

Topics covered from lectures 1-15.

1. Introduction
2. Futures Contracts Specifications
3. Mark - to - Market Margin
4. Commodity Options and Commodity Spreads
5. Pricing and Valuation of Futures Contract
6. Convenience Field, Contango and Backwardation
7. Commodity Basic Risk
8. Minimum Variance Hedge Ratio
9. Commodity Indexes

**Week 2 (20/5/23 - 26/5/23):** Revised the week 1 concept and read research papers.

S. No	Research Paper	What it talks about	Modelling Used	Links
1	Fundamentals of Futures and Options	<ol style="list-style-type: none"><li>1. Futures Contracts</li><li>2. Option Contracts</li><li>3. Put-Call Parity</li><li>4. Option Pricing</li><li>5.</li></ol>		<a href="#">Link</a>
2	CME Group Volatility Index (CVOLtm) Benchmark Methodology	<ol style="list-style-type: none"><li>1. CME Group Volatility Index (CVOL) Methodology for Single Product,</li></ol>		<a href="#">Link</a>

		<p>Single Expiration</p> <p>2. Broad-Based Index Construction (Vega)</p> <p>3. Derivative Indicators</p> <p>4. Short-Term Interest Rate (STIR) Methodology</p> <p>5. Yield-Volatility Methodology</p>		
3	GARCH101	<p>1. ARCH/GARCH Models</p> <p>2. A Value at Risk</p> <p>3. Extensions and Modifications of GARCH</p>		<a href="#">Link</a>
4	Volatility Models	<ul style="list-style-type: none"> <li>• Characteristics of volatility</li> <li>• Structure of a model</li> <li>• ARCH Model</li> <li>• GARCH Model</li> <li>• Extensions to the GARCH framework</li> <li>• The stochastic volatility model</li> <li>• Multivariate GARCH models</li> </ul>		<a href="#">Link</a>
5	Conditional price volatility,	1. Granger casualty test	1. GARCH condition	<a href="#">Link</a>

	speculation, and excessive speculation in commodity markets: sheep or shepherd behaviour?	<ol style="list-style-type: none"> <li>2. Nonlinear Granger causality: Diks and Panchenko test</li> <li>3. Volatility measures</li> <li>4. Speculative measures</li> <li>5. Non-speculative measures</li> </ol>	<ol style="list-style-type: none"> <li>al volatility</li> <li>2. Granger analysis</li> </ol>	
6	Relation between Open Interest and Volatility in Commodity Markets	<p>A two-stage the authors employed the following methodology:</p> <ol style="list-style-type: none"> <li>1. The authors investigate the relationship between open interest and volatility.</li> <li>2. The authors employ the E-GARCH model and consider the asymmetric response of volatility to shocks of different signs.</li> </ol> <p>Finally, the authors believe in a regression framework to scrutinise the contemporary</p>	<ol style="list-style-type: none"> <li>1. EGARCH Model</li> </ol>	<a href="#">Link</a>

		relationships between open interest and futures prices (volatility).		
7	Volatility and Commodity Price Dynamics	<ol style="list-style-type: none"> <li>1. Model of Price, Inventory and Volatility</li> <li>2. Euler equation</li> <li>3. Empirical Specification</li> <li>4. Data and estimation</li> <li>5. GMM (Generalized method of moments) estimation</li> </ol>		<a href="#">Link</a>

**Week 3 (27/5/23 - 2/6/23):** Focused on three topics:

**Read Research papers on the relationship between volume, open interest and volatility.**

S.No	Research Paper	What it talks about	Modelling Used	Link
1	<b>Relation between Open Interest and Volatility in</b>	<p>A two-stage the authors employed the following methodology:</p> <ol style="list-style-type: none"> <li>3. the authors</li> </ol>	2. EGARCH Model	<a href="#">Link</a>

	<b>Commodity Markets</b>	<p>investigate the relationship between open interest and volatility.</p> <p>4. the authors employ the E-GARCH model and consider the asymmetric response of volatility to shocks of different signs.</p> <p>Finally, the authors consider a regression framework to scrutinise the contemporaneous relationships between open interest and futures prices (volatility).</p>		
2	<b>Analysis of Volatility Volume and Open Interest for the Nifty Index Futures Using GARCH Analysis and VAR Model</b>	<p>GARCH is used to estimate volatility for Nifty Index futures on day trades. To determine if a <b>contemporaneous or causal relation</b> exists between volatility volume and open interest for Nifty Index futures traded on the NSE.</p>	<ul style="list-style-type: none"> <li>• GARCH (1,1) Model</li> <li>• VAR Model</li> </ul>	<a href="#">Link</a>

		<p>according to this study, empirical analysis establishes that volume has a stronger impact on volatility than open interest. The impulse originating from the volatility of volume and open interest is low.</p> <p>Sections:</p> <ul style="list-style-type: none"> <li>• Literature review</li> <li>• Data description</li> <li>• GARCH (1,1) Model</li> <li>• VAR Model</li> <li>• Variance Decomposition</li> <li>• Impulse Response</li> <li>• Empirical Findings</li> </ul>		
3	<p><b>Volatility, open interest, volume, and arbitrage: evidence from the S&amp;P 500 futures market</b></p>	<p>The VAR model is used to study the dynamic interactions and causal relationships among volatility, open interest, trading volume and arbitrage opportunities. As market volatility increases, investors sell their equity and futures positions with relatively larger price</p>	<ul style="list-style-type: none"> <li>• VAR Model</li> </ul>	<a href="#">Link</a>

		<p>drops. Pricing error is critical in linking implied volatility and the level of open Interest.</p> <p>Section:</p> <ul style="list-style-type: none"> <li>• VAR Model</li> <li>• Data and variable measurement</li> <li>• Empirical results</li> </ul>		
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**Some of the research papers which is to study:**

- ❖ **Dynamics between trading volume, volatility and open interest in agricultural futures markets: A Bayesian time-varying coefficient approach [\(Link\)](#)**
- ❖ **An empirical examination of the relationship between future spreads, volatility, volume, and open interest [\(Link\)](#)**
- ❖ **Options and earnings announcements: an empirical study of volatility, trading volume, open interest and liquidity [\(Link\)](#)**
- ❖ **Rational Theory of Warrant Pricing [\(Link\)](#)**
- ❖ **Stock Volatility and the Levels of the Basis and Open Interest in Futures Contracts [\(Link\)](#)**

## **Studied the topics of Time Series [\(Notes\)](#)**

- Autocorrelation and Partial correlation
- Stationarity
- Unit roots
- Augmented Dickey-Fuller Test
- White Noise
- Lag Operator
- Autoregressive model
- Moving Average Model
- Moving Average and ACF
- Invertibility of time series
- ARMA Model
- ARIMA Model
- Seasonality
- Seasonal ARIMA Model (SARIMA Model)
- ARCH Model
- GARCH Model
- VAR Model
- Granger Causality

**Studied various volatility models:** A research paper compiling the modelling of various types of volatility models (univariate and stochastic models) [\(Link\)](#)

- Characteristics of volatility
- Structure of a model
- ARCH Model
- GARCH Model
- Extensions to the GARCH framework
- The stochastic volatility model
- Multivariate GARCH models



