UBC FRE 360 New Course Proposal
Analysis of Commodity Prices
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Course Overview

In this course students will examine renewable commodity prices over from both an economics and financial investment perspective. The economics perspective will emphasize the economic fundamentals of supply and the demand, whereas the financial investment perspective will emphasize speculation, forecasting and hedging. The course is designed for third year students who have MATH 104, ECON 101 and an introductory course in statistics (e.g., STAT 251, COMM 291, ECON 325). The empirical applications in the course have both an Excel version and a Python version. Students with little programming experience will typically work with the Excel version of the applications, whereas students with moderate or strong programming experience (e.g., UBC CPSC 103) will typically work with the Python version of the applications. Group work for homework questions will allow the two streams of students to learn from each other. Questions on the midterm and final exams will not be specific to Excel or Python, and will therefore be the same for both streams of students. Financial concepts such as the time value of money and the theory of forward curves will be taught at the beginning of the course. The empirical analysis of commodity spot and futures prices consists of non-econometric methods such as visualization, moving average price forecasting and calculated value at risk (VAR). The commodities included in the empirical analysis are the renewables, which include agricultural commodities, forestry, ethanol and the Nasdaq Salmon Index.

Learning Outcomes

Upon completing this course, students should be able to:

- Retrieve historic daily commodity futures data (e.g., Quandl) using Excel data import methods or Python API and related tools.
- Describe how the supply and demand information in the USDA WASDE reports can be used to analyze past, current and projected commodity prices.
- Explain the underlying economics of commodity futures prices such as carrying costs and convenience yield.
- Use Excel's Solver tool or use Python's (Numpy) polyfit() function to fit a polynomial to spreads in commodity futures prices for the purpose of identifying seasonality.
- Program Excel or Python to calculate Bollinger Bands for commodity futures prices, and then back test this technical trading strategy.
- Implement exponential smoothing procedures in Excel or Python for commodity price forecasting.
- Describe the process of hedging price risk with commodity futures.
- Use Excel or Python to estimate how hedging reduces value at risk, and how currency swaps can be used to reduce foreign exchange risk.

Assessment

Four problem sets, completed with either Excel or Python	20%
Data analysis project (completed in small teams)	20%
Midterm exam	25%
Final exam	35%

Textbooks

- Melicher, Ronald W *Introduction to finance: markets, investments, and financial management* Riley (2011). Available on-line from UBC Library.
- Bodie, Zvi, Alex Kane and Alan Marcus *Investments* 10th Edition McGraw Hill (2014). Select chapters will be made available.
- Carter, Colin *Futures and Options Markets: An Introduction* Rebel Text (2012)
- Mallory, Mindy Price Analysis: *A Fundamental Approach to the Study of Commodity Prices* (2018): http://mindymallory.com/PriceAnalysis/

Topics

1. Background
    a. Overview of the term structure of interest rates, the time value of money and futures – spot parity theorem: Chs. 8 and 9 from Melicher (2011), Ch. 22 from Bodie (2014)
    b. Rules and procedures for trading commodity futures (e.g., margin account, open interest): Ch. 2 from Carter and Ch. 22 from Bodie (2014)
    c. Methods for retrieving and graphing economic data such as the U.S. GDP and S&P 500 index, freely available from Quandl: https://www.quandl.com/data/FRED/GDP-Gross-Domestic-Product
        i. Excel application: working with Quandl XLS and XML data, and using the free Quandl Excel add-in: https://www.quandl.com/tools/excel
        ii. Python application: Using the Quandl Python API to retrieve and graph data http://www.smileofthales.com/computation/quandl-python/

2. Pricing Fundamentals for Agricultural Commodities
    a. Global Supply and Demand
        i. USDA World Agricultural Supply and Demand Estimates (WASDE), stocks-to-use ratios and commodity prices
        Farm Credit Corporation (FCC)
        - https://www.fcc-fac.ca/en/knowledge/ag-economics/the-one-statistic-you-need-to-know-this-crop-year.html
        - https://www.fcc-fac.ca/en/knowledge/ag-economics/supply-and-demand.html
        - https://www.fcc-fac.ca/en/knowledge/ag-economics/how-to-recognize-volatility-in-a-market.html

        Mallory (2018): Chs 6, 11.
        ii. Archived WASDE reports and data on commodity price volatility
        - https://usda.library.cornell.edu/concern/publications/3t945q76s?locale=en

- https://www.ivolatility.com/options.j?ticker=CORN:NYSEArca&R=1&period=6&chart=02&vct=4

iii. Excel application: Using Microsoft's Power Query Editor to read in multiple WADSE reports and analyze aggregate data
iv. Python application: Read in multiple WADSE reports and analyze aggregate data

b. Determinants of basis and spreads in futures prices: Chapter 3 from Carter (2012)
   i. Carrying costs, convenience yield, spot-futures convergence, transportation
   ii. Contango and backwardated markets
   iii. Seasonality due to annual harvest and stock outs

c. Fitting a polynomial to corn futures price spreads (data supplied)
   i. Excel application: Pivot tables for creating a price spread time series and Solver for fitting a polynomial
   ii. Python application: Using the Numpy polyfit() function to fit the polynomial: See https://machinelearningmastery.com/time-series-seasonality-with-python/ (Section = Seasonal Adjustment with Modeling)

3. Speculation and Forecasting
   a. Technical analysis for trading commodity futures: Chapter 12 of Bodie et al. "Behavioral Finance and Technical Analysis"
   b. Bollinger bands for trading lumber futures prices:
      https://www.bollingerbands.com/bollinger-bands
      https://www.barchart.com/futures/quotes/LS*0/price-history/historical
      i. Excel: Many Youtube and other resources on-line
      ii. Python: https://towardsdatascience.com/trading-technical-analysis-with-pandas-43e737a17861
   c. Back testing a trading strategy for an agricultural ETF (Ch 3. Bodie et al.)
      Data: Invesco DB Agriculture Fund (DBA)
      https://finance.yahoo.com/quote/DBA/history?p=DBA
      i. Excel application: Many Youtube and other resources on-line for back testing a trading strategy with Excel
      ii. Python application:
         - Overview of back testing: https://corporatefinanceinstitute.com/resources/knowledge/trading-investing/backtesting/
         - Code: https://www.oreilly.com/content/algorithmic-trading-in-less-than-100-lines-of-python-code/

   d. Forecasting weekly salmon prices using exponential smoothing with seasonality (Holt-Winters method):
      - Guttormsen, Atle "Forecasting weekly salmon prices: Risk management in fish", Aquaculture Economics and Management (1999) https://www.tandfonline.com/doi/abs/10.1080/13657309909380242
      - Canela M.Á., Alegre I., Ibarra A. (2019) Holt-Winters Forecasting. In: Quantitative Methods for Management. Springer, Cham. (available online from UBC Library)

i. Excel Application: Carlberg, *Conrad Predictive Analytics: Microsoft® Excel 2016* (Chs 4, 5)
ii. Python application:
- Python method: https://medium.com/datadriveninvestor/how-to-build-exponential-smoothing-models-using-python-simple-exponential-smoothing-holt-and-da371189e1a1
- Data: https://salmonprice.nasdaqomxtrader.com/public/report;jsessionid=1ED5970E0D8F308F7330B7D3171AAF6D?0

4. Risk Management
   a. Theory of hedging with commodity futures: Carter (2012) Ch 7
   b. Value at Risk (VAR) calculations for foreign exchange risk
      i. Excel application: VAR via Monte Carlo simulation and the *Model Risk* add-in https://www.vosesoftware.com/products/modelrisk/
      ii. Python application: Impact of hedging on value at risk (VaR) for a foreign exchange portfolio https://developers.refinitiv.com/article/measuring-impact-hedging-var-fx-portfolio-python-eikon-data-api
   c. Using foreign exchange swaps to reduce export price risk in global lumber markets
      i. Excel application: Risk analysis of a swap transaction via Monte Carlo Simulation
      ii. Python application: https://www.bankofcanada.ca/wp-content/uploads/2014/11/boc-review-autumn14-paligorova.pdf; http://gouthamanbalaraman.com/blog/interest-rate-swap-quantlib-python.html
   d. Managing risk and return from the soybean crush spread
      i. Excel application: Mallory (Ch 13)
      ii. Python application: https://github.com/epogrebnyak/soybean-crush-spread