Renewable Energy Commodity Trading Educational Program
Report 1: Detailed Work Plan Initial *detailed work plan outlining key performance benchmarks and timeline*
1.15.14

Timeline

1.	Initial detailed work plan outlining key performance benchmarks and timeline	September 1, 2013
2.	Final Report for State of Practice Activity	September 1, 2013
3.	Interim Reports for Dataset Development and Curriculum Alternatives Activities	September 1, 2013
4.	Interim Reports for Teaching models & Simulation Modeling & Infrastructure/Technology Installation Activities	November 1, 2013
5.	Final Reports for Dataset Development, Curriculum Alternatives, Teaching Models, Simulation Modeling & Infrastructure/Technology Installation Activities	January 1, 2014
6.	Interim Report on Program Delivery Activity	April 1, 2014
7.	Final Report on all Exhibit A Activities	July 1, 2014
8.	Contracting Interface Activity	July 1, 2015
9.	Development of Models Activity	December 31, 2015
10.	Interim Report on Delivery of Educational Program Activity	April 1, 2016
11.	Delivery of Educational Programs Activity	June 30, 2017

2. ***State of Practice:*** A study of current practices will be conducted to understand risk management, and trading and logistics strategies, and existing training sources in the renewable energy space. This information will be used to identify learning objectives, design and develop educational materials, select best modes of delivery, and develop examples best suited the biofuels sector.

3. ***Develop Relevant Data Sets and Curriculum.*** Relevant primary data will be assembled. Datasets include costs and prices related to inputs, outputs, storage and transportation, Renewable Identification Numbers (RINs), futures, options and other derivatives.

   A draft curriculum will be developed and reviewed by educational professionals and industry peers to ascertain relevance and accomplishment of learning objectives. Training programs will be publicized at key industry forums and conferences (Growth Energy, Renewable Fuels Association, and BBI International).

4. ***A. Develop models to measure risk and analyze risk management strategies:*** Existing risk measurement techniques will be reviewed and revised if necessary. New risk measures will be developed and integrated into the curriculum.

   B. Develop logistics models of the renewable energy sector: Logistics models will be reviewed and those most viable will be integrated into the teaching program.

   C. Create simulation models and programs for teaching risk, strategy, and logistics management: Simulation modules will be developed and incorporated into the curriculum.

5. ***Integrate the data, models and simulations into the Commodity Trading Room***: Hardware, software and data will be installed in trading room. The data, models and simulation modules will be integrated into the Commodity Trading Room for teaching purposes.

6. ***/11. Deliver educational programs***: The educational program will be delivered to on-campus NDSU students and industry workshops. Curriculum for the renewable energy program will be developed in modules to permit greatest flexibility in delivery and tailoring to specific niche audiences.

8. ***A. Contracting Practice in feedstock (corn)-biofuels interface:*** A two-step process will be conducted for this purpose. One is to review other industries and studies to identify the common features and strategies used in contracting for grains and product sales. Based on this, a set of interviews of the bio-fuels sector will be conducted to identify common practices, problems and challenges related to contracting.

   B. Develop analytical models that can be used to analyze contracting strategies: Data sets and analytical models that can be used to analyze contracting strategies. In concept, these are based on the Principal-Agent (PA) problem in economics where the principal (buyer) designs

contracts and terms to provide incentives for acceptance (incentive compatibility) and performance. These will be extended to include risk which is critical in these industries.

Key Performance Benchmarks

Develop pilot course according to finalized curriculum	June 30, 2014
Test and refine course for initial delivery	September 31, 2014

Timeline:

Final Reports for Dataset Development, Curriculum Alternatives, Teaching Models, Simulation Modeling & Infrastructure/Technology Installation Activities *(to be revised, if necessary, and submitted after Q1 deliverables are accepted)*	Winter 2014
Interim Report on Program Delivery Activity	April 1, 2014
Final Report on all Exhibit A Activities	July 1, 2014
Initial course delivery (date will determined based on industry input/availability)	Fall/Winter 2014/2015

Reports2

Report 2: *Renewable Energy Commodity Trading Educational Program*

State of Practice
Ethanol Trading and Risk Management

Final Report

David Ripplinger
January 2014

Through the first 8 months of 2013, the domestic corn ethanol industry produced 8.6 billion gallons of ethanol and 22 million metric tons of dried distillers grains using 3 billion bushels of corn.

The industry, which consists of 207 refineries, is subject to significant levels of price volatility for both inputs and outputs. However, price risk is just one of many challenges that must be managed to ensure the long-term viability of corn-ethanol refineries. Risk management in context of corn-ethanol refining requires a well-educated, professional workforce, especially in today's environment.

This report summarizes the current state of practice in commodity trading and risk management as it pertains to US corn-ethanol refineries. The intent is to inform the design and development of bioenergy courses by the Department of Agribusiness and Applied Economics at North Dakota State University.

The report describes the primary sources of learning and information for today's corn-ethanol commodity traders and risk managers as well as core competencies of new merchants and risk managers.

Higher Education

Graduates of agricultural economics programs at land grant universities have traditionally been among the largest single sources of new agricultural commodity merchants and agricultural processing risk managers. The Department of Agribusiness and Applied Economics at North Dakota State University has a strong reputation in industry for preparing students for careers in these areas.

The Energy Institute at Tulane University has developed a niche the educator of choice in the area of energy finance, risk management, and training. In addition to a face-to-face master's of management in energy program, The Energy Institute also provides undergraduate and graduate courses in energy and executive education opportunities both on and off-campus.

Workforce Training

Many of the trading and risk management employees hired during the rapid growth of the industry came from grain merchandising. For many corn-ethanol refiners, the marketing of ethanol was originally and continues to be handled by third parties.

On-the-job training is common practice for many corn-ethanol refiners. This training can take a number of forms including sink-or-swim, mentorship and shadowing, or more formal training programs.

Energy Management Institute

The Energy Management Institute (EMI) provides education and trading, market data and news, and advisory services to the energy industry. EMI's education and training group has developed dozens of face-to-face and distance-based courses.

EMI currently has two bioenergy courses listed: *Biofuel Fundamentals*, which focuses on the ethanol industry, and *Biodiesel Fundamentals*. These provide an overview of the industries including production and operations, feedstocks, and fuel specifications. EMI does not provide courses in commodity merchandising or risk management as specific to biofuels. A course *Ethanol Fundamentals and Risk*

Management was offered at one time, but is no longer listed. EMI has not regularly offered either *Biofuel Fundamentals* or *Biodiesel Fundamentals* in recent years.

Seminars and Conferences

Ethanol industry specific CTRM training is regularly provided at select national and international conferences. The Fuel Ethanol Workshop (FEW) typically has a few sessions on the topics of risk management, commodity marketing, and related issues during its annual conference. These sessions are presentation driven and provide brief, but valuable coverage of timely issues. Given the organization of the Workshop, fundamentals and complex concept and tools are typically not presented or fully explored.

A number of short training opportunities on select biofuel industry issues are provided by market information and advisory firms. For example in the past year, a number of one or two-day workshops on the topic of RINS have been held including by OPIS.

Certification

A national certificate for biofuels trading and risk management does not currently exist.

The National Futures Association (NFA) requires that individuals who sell commodities and futures license pass an exam to receive a Series 3 license. While the job functions of a merchant and broker vary, the content of the Series 3 exam is pertinent to merchants and risk managers.

A Bloomberg Certificate is a valued designation in finance. However, the use of Bloomberg Terminals in agriculture is uncommon.

Tools

Some ethanol refiners and third party firms have developed customized tools help manage commodity trading and risk. Among the most common are crush margin worksheets, and position reports. These may be integrated with data providers to allow for real-time updating of positions.

DTN has developed workbooks for ethanol and biodiesel producers to manage risk. These workbooks are available as add-ons to its ProphetX system as part of its *Ethanol Edition.* The workbook includes predefined pages for futures contracts, corn spot prices, DTN FastRacks, and DTN ethanol news among others. The Ethanol Workbook includes a number of risk management tools including a corn crush worksheet, ethanol margin worksheet, position report, and sensitivity calculator

Commodity Trading and Risk Management Solutions

Commodity Trading and Risk Management (CTRM) software applications provide comprehensive solutions for companies involved in commodities. While system functionality varies, they typically allow for management of physical and financial instrument trading, risk management, position management, profit and loss, and logistics. CTRM is typically integrated with a company's accounting and ERP software and allows for seamless execution of trades.

Among the largest CTRM vendors are EKA and Triple Point Technology (TPT) in addition to e-markets.

Market Data Solutions/Trading Platforms

Access to market prices and news is critical to making timely trading and risk management decisions. Market data solutions are information technology systems that provide access to real-time market prices and news as well as data analysis capabilities. Three different solutions have a significant market share in this space: DTN ProphetX, Bloomberg, and Reuters Eikon. DTN ProphetX is the leading trading platform in the United States. Bloomberg and Reuters Eikon are more costly. Bloomberg dominates in the field of finance.

Core Competencies

The following core competencies were identified based on input from commodity trading and risk management education professionals and validated by a merchandiser working in ethanol refining. These competencies and associated learning objectives will be validated by others working in the sector in the fourth quarter of 2013.

1. An understanding of risk management in the context of biofuel producers
2. An understanding of basis and spreading as it relates to feedstock merchandising (to the level covered in The Art of Grain Merchandising (Lorton and White 2010))
3. An understanding of the theory, mechanics, and use of basis, futures, options for hedging biorefinery inputs and products (equivalent to that required to pass related parts of the Series 3 Exam)
4. Understanding and use of corn crush and position reports
5. Ability to access market data and news, and build interactive models using trading platforms (DTN Prophet X) and Microsoft Excel
6. The ability to manage feedstock and biofuel logistics
7. Knowledge of risk measures, their calculation and use in risk management
8. The use of OTC derivatives and contracts to manage risk

References

Biodiesel Fundamentals. Energy Management Institute. http://www.energyinstitution.org/education/course-detail.php?filterby=I&filterval=31&returnto=offerings&id=50

Biofuel Fundamentals. Energy Management Institute. http://www.energyinstitution.org/education/course-detail.php?filterby=I&filterval=31&returnto=offerings&id=33

Bittman, J.B. 2008. Trading & Hedging with Agricultural Futures and Options. Marketplace Books.

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One View Eka.Agriculture. EKA. http://www.ekaplus.com/images_website/ags_diagram_large.jpg

Ethanol Fundamentals and Risk Management. 2008. Energy Management Institute.

DTN Ethanol Edition Users Guide. 2007. DTN.

Biofuels/Ethanol Courses. The Oxford Princeton Programme. http://www.oxfordprinceton.com/biofuelsethanol.html

Lorton, S. and D. White. 2010. The Art of Grain Merchandising. Stipes Publishing. Champaign, IL.

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Renewable Energy Commodity Trading Educational Program
Report 3-2: Curriculum Alternatives Activities

Ethanol Merchandising and Risk Management
January 2014

Program Description: The course will provide an overview of the ethanol industry as well as tools and strategies to manage bio-refiner's risk. Basis and futures; hedging theory, mechanics, and applications; contracts; position reports; and logistics will be covered. Participants will apply their learning by completing a series of exercises that make use of the NDSU Commodity Trading Lab's unique data and software capabilities.

Program Objectives:

1. Provide an understanding of the ethanol industry and bio-refiner's role in the supply chain
2. Develop an understanding of trading theory and mechanics, such as basis, futures, swaps, contracts, and margins as used in the ethanol industry
3. Understand and use risk measurement techniques and strategies

A working knowledge of grain merchandising, trading, and the ethanol industry is helpful, but not required. Fundamentals will be discussed during each stage of the course, which provide a refresher and clarification of basic concepts for experienced participants. Advanced hedging and risk management will then build on the fundamentals earlier discussed in training.

Prerequisites: Having at least a basic knowledge of the use of XLS is important. Participants will apply their learning through a series of technology-based exercises that make use of a range of basic and advance concepts, tools, and methods.

Target Audience: Merchants and risk management professionals employed by ethanol refiners. Third party commodity brokers, ethanol and petroleum marketers, ethanol plant managers.

Duration: The program will be designed as either 3 full days, or 3 ½ days.

Module 1a: Introduction[1][2]

- **a. Administrative Details**
  - **i. Course Structure**
  - **ii. Expectations**
- **b. CTR Technologies**

Module 1b: Ethanol Trading and Risk

- c. VeraSun Energy Case Study
- d. Introduction to Merchandising

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[1] Once the program is organized, we will seek collaboration/presentations from the following:

- CME on futures and ethanol
- Zaner hedging—specialist in ethanol hedging
- DTN and Bloomberg: To illustrate features of their tools for ethanol mfg information and risk mgmt..

[2] Case studies have been prepared and are currently being experimented with in AE444 and AE711 at NDSU. These will be revised based on student input.

e. Risk Management in the Context of Ethanol Refining
    i. Vocabulary of Risk Management (futures and platts, forward, options, swaps)

Module 2: The US Ethanol Industry

a. US corn-ethanol supply chain
b. Role of corn-ethanol refiners and their relationship with input and product markets
c. Crush Margin (an introduction to the relationship between physical and contractual positions and profits)
d. Exercise –
    a. basic crush margin worksheet
    b. setting up dynamic links with DTN
e. Sources of Risk in Ethanol Refining (motivated from an understanding of refinery operations, inputs, and products; and the crush margin worksheet)
f. Hedging (an introduction to the concept, types and effectiveness of various hedges)
g. Exercise: Variability of the Margin

Module 3: Taxonomy of Markets (Using Wilson's Existing Materials)

a. Futures
b. Basis

Break 15 Min

Module 4: Futures

a. Futures Theory
    a. Development
    b. Comparison to others instruments/physicals
b. Futures Contracts
    a. Futures and forward contracts compared
    b. Details on futures
        i. Corn
        ii. Ethanol (CME and Platt's)
        iii. DDGs
        iv. NG
        v. others
c. Structure
    a. Delivery mechanisms/process
    b. Temporal characterization of markets
        i. Normal markets
        ii. Inverted Markets
d. Compare Standardized and Non Standardized Contracts
e. Rules and Regulations
    a. Price limits
    b. Clearinghouse
    c.
f. Margin Requirements
g. Exercise:
    a. Extract Corn Futures Price Data from DTN. Determine the appropriate margin calls
    b. Simulating margin requirements in practice

Lunch

Exercise: Trading Technologies

i. Technical Price Analysis: For use in Trading Technologies
ii. Use Trading Technologies to demonstrates Bio-fuel processer short corn
Have them buy futures contracts for various contract months to hedge short position

Module 5: Basis

a. Derivations
b. Factors influencing the Basis
    i. Time (Storage)
    ii. Quality (Premiums Discounts)
    iii. Location (Transportation costs)
    iv. Local Supply/Demand
    v. Arbitrage or Intermarket Competition
    vi. DTN Heat Maps about the Basis or Bloomberg(No generic logins for everyone)
c. Exercise:
    a. Grain Hedge or geograin.com
    b. Extracting basis data
    c. Seasonality in basis data
    d. Using MACD and other technical tools for projections

Break

Module 6: Hedging With Futures

a. Hedging Theory
    a. Risk reduction
    b. Short hedging
    c. Long hedging
b. Short Hedging and Long Hedging
c. Basis
    a. Effect of change on long/short hedger
    b. Effect on price of delivered commodity
d. Hedging Calculations
e. Example: Hedging Ethanol (Long)
f. Example: Hedging Corn (Short)
g. Position Reports for ethanol mfgs
    a. Corn, ethanol and ddg positions
    b. Derivation of net position
h. Spreading
    a. Execution
    b. Expectations
        i. Basis
        ii. Normal or inverted market
    c. Types
i. RINS: Impact on margins, hedging, etc.

Recap of above materials

Module 7: Options

a. Terminology and Theory
b. Option Hedging Strategies and Calculations (compared to futures hedge)
c. Exercise:
    a. Options and Net Payoffs Using Excel
d. Option Pricing
    a. Volatility
    b. Interest
    c. Time
    d. Market Value to Strike Price
    e. Intrinsic Value
    f. Extrinsic Value
e. Exercise, Assignment, Settlement
f. Black Pricing Model
    a. Greeks
g. Exercise:
    a. Option price calculation using Black Sholes; xls on basic payoffs.
    b. Contracting with options (Min, max, and min/max contracts)

Module 7: Hedging with Options

a. Option Theory
    a. Risk, leverage, premium for long and short
b. Option Hedging Strategies and Calculations (compared to futures hedge)
    a. Long put/short hedge
    b. Long call/long hedge
c. Exercise: Options and Net Payoffs Using Excel
d. Exercise: Hedging with Options and Futures Compared

Guest Speaker/Tour/Lunch

Module 8: Hedging Strategies I

a. Arbitrage in futures and options markets
b. Ethanol hedging: Which market to hedge
c. Other:
    a. OTC Defined
    b. Credit Risk
    c. CME Clear Port
    d. Types of Swaps
        i. Basic Commodity
        ii. DTN Basis
        iii. Calendar Swaps
d. Exercise: Swaps (between biorefinery and blender)

Break

Module 9: Hedging Strategies II

a. Cash Contracts
    i. Forward Contracts
    ii. Basis Contracts

iii. HTA Contracts
iv. NPE Contracts

b. Futures Contracts
   i. Market Liquidity
   ii. Denatured Ethanol Futures
   iii. Platts Ethanol Futures
   iv. Platts Ethanol Swaps

c. Exercise:
   a. Mechanics of Using Cash Contracts
   b. Mechanics of Using Futures Contracts
   c. Arbitrage between CME futures and Platts'

Break

Exercise: Position Reports

a. Fill out position report and determine the variability of the crush margin for alternative hedging strategies

Recap of above materials

Module 11: Logistics I

a. Supply Chain

Break

Module 12: Logistics II

b. Inventory
c. Transportation
d. Exercise:
   I. xls on managing inventory and transportation

Lunch

Module 13: Contracting

c. Purchasing Feedstocks
d. Processing
e. Logistics
f. Streamline Supply Chain can equate to Supply Chain Savings

Module 14: Measuring and Monitoring Risk

a. Position reports: corn, ethanol, DDGs and hedge ratios
b. Measuring Risk using VAR
c. Exercise
   a. Net positions in position reports
   b. VAR interpretation(s)

Break

Module 15: Advanced Risk Management

i. Cross-Hedging

ii. MV Portfolio
    1. Efficiency Frontier and Hedge Ratio
iii. VaR and hedging strategies
    2. Position Report and VaR

Module 16: Wrap-up

a. Summary of Modules
b. DTN Ethanol Workbook
c. Setting up a Hedging Strategy

Data sets available for curriculum

Bloomberg

Instrument	Source	Comment
Corn futures	CBOT	This is sourced from various sites
Corn cash	CGB	Available at various locations
Ethanol futures	CBOT	Available
Ethanol spot	USDA	Limited Availability
DDGS	USDA	Limited Availability
RINS	Progressive Fuels LTD	Limited Availability
Platts	CME	Limited Availability
Corn oil	OPIS/USDA	Limited Availability
NG Futures	NYM	Available
NG Spot	ICE	Available

DTN

Instrument	Source	Comment
Corn futures	CBOT	This is sourced from various sites
Corn cash	CGB	Available at various locations
Ethanol futures	CBOT	Available
Ethanol spot	Opis	Limited Availability, Not W/Subscription
DDGS	CME	Limited availability
RINS	NYM	Limited availability
Platts	CME	Availability, Not with Subscription
Corn oil	OPIS/Platts	Available
NG Futures	NYM	Available
NG Spot	NYM	Available Basis values

Program summary: At the end of the training session, the following objectives should be met:

1- Participants should be able to understand and provide an overview of the entire ethanol industry description, supply chain description and players within the supply chain and how to make informed decisions
2- Participants should be able to understand and interpret the types of contracts to deal in in, how to calculate the net hedge positions of their inputs and output products, and how uncertainties from product price and demand, logistics and transportation can impact their profit margin and business operation
3- Participants should be able to understand, and interpret basic risk management strategies and tools, while dealing with what are basis, futures, hedging mechanics, contracts, position reports, and some advance risk management strategies and tools.

References

Series 3 Guide.
DTN Ethanol Workbook.
The Art of Grain Merchandising
Trading and Hedging with Agricultural Futures and Options
EMI. Biofuels Fundamental
EMI. Ethanol Markets and Risk Management

Renewable Energy Commodity Trading Educational Program

Report 4: *Interim reports for teaching models and simulation modeling and infrastructure/technology installation activities*

January 2014

This report provides a summary of work to date on teaching models, simulation studies and installation.

Teaching Models: A set of ethanol hedging case studies were developed. These include the problem setting, decisions to be made and relevant data.

1. Experiment during Fall 2014. These case studies were developed and used during teaching in NDSU courses during Fall 2013. There were two case studies.

2. Revised case studies: Based on the experience from these case studies, we revised them for future use. These are attached and it is planned these would comprise the basis of future case studies, and for the course curriculum.

Simulation Modeling: We are currently very far into development of several simulation models that would be used in the teaching program. These include:

1. Hedging I: This is a model to analyze alternative hedging strategies for ethanol. Comparisons are made amongst:

    - Hedging anticipated forward sales in alternative futures contracts for ethanol;

    - Hedging net corn positions in corn, as a hedge against forward ethanol sales

2. Arbitrage I: There are alternative futures contracts for ethanol. These have important different features which impact the choice for hedgers. They also have embedded options (Asian options) which facilitate 30 day swap strategies.

    The model analyzes the efficiency of these market alternatives and seeks to identify arbitrage opportunities for hedgers.

3. Logistics models. Our interviews with market participants indicated that strategies regarding logistics are extremely important in this industry and have major impacts on risk and returns for market participants. Indeed the critical variables include: storage space for corn, DDG's and ethanol; contracting for forward purchases of corn, and sales of products; rail car leasing strategies (all ethanol companies have a large number of rail cars leased and this is a strategic

variable); amongst others. Those variables that cause the greatest exposure to risk include prices (or basis) for each of the commodities (corn, ethanol and DDGs), rail performance, amongst others.

We have interviewed 3 ethanol manufactures on their approach and challenges in managing logistics. From this, we have discerned the critical variables for managing risks. We are in the process of creating a simulation model using risk optimizer to quantify risks, and effects of risk mitigation strategies.

This should be completed in the coming months, the results of which will be used to develop case studies for the latter modules in the course curriculum.

Trading game We are planning to develop an ethanol trading game to be used for teaching. This is planned for summer 2014.

- This will be developed with the NDSU computer science department which has a group that develops computer simulation games for teaching purposes.[1] This will be called the ethanol simulation game.

- Features of the game (at this point) will included:

    - Corn buying; and selling of DDGs and ethanol; and for each will include forward and nearby sales
    - Hedging of each of these commodities, including several alternatives for each
    - Storage of corn and products
    - Shipping and logistics including: storage, rail car leasing,
    - Risks: Commodity prices risk and logistics risk (car performance, etc.)

Installation: Development of the Commodity Trading Room (CTR) and installation of software and information technologies has been complete. Thus, the CTR is now fully operating.

Technology Details[2] The technology and software included in the CTR includes:

[1] There are a series of computer simulation games being developed for use in the CTR. Currently, a farm management game is being developed and expected to be done in March 2014 (this is a different project). Based on this experience, we will specify features of an ethanol game and this is planned to be developed during summer 2014.

- 32 live work stations
- 1 podium with 2 live work stations
- HD Monitors for presentations
- Information technology: 20 DTN and 12 Bloomberg work stations
- Risk software: Pallisade @risk

Planned Future Additions: We are evaluating the cost and alternatives for adding an interactive video feature to the room. It would exploit the HD monitors and other features of the room. Its purpose would be to bring in speakers from industry and outside to supplement course materials.

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[2] The CTR now has a u-tube video that describes its features and use in teaching. See

SEE IT FOR YOURSELF!
The Commodity Trading Room is a high-technology room with live information feeds for financial information including equities and credit, plus commodity market information such as agriculture, energy and biofuels See it on YouTube: http://www.youtube.com/watch?v=9ErABR4COLI

Appendix 1: *Ethanol Risk Management Case Studies*

Below is the text of 2 case studies on ethanol risk management. These were developed for and used initially in AE711 and AE 444 during Fall 2013. They were then revised based on the experiences of those exercises.

In addition to these texts, the case studies are accompanied by: 1) a detailed ppt for instruction; and 2) multiple xls containing data and transformations.

AgEcon 711: CTR10

Assignment: Hedging for an Ethanol Plant

Due: Nov 5 2013

Problem: Ethanol is an industry with substantial price risk. This problem seeks to illustrate the impacts of risk and hedging on the variability of margins in the industry.

Data: See attached xls. This data contains Spot/Cash price and Futures Price data was collected or available in BB/DTN. Daily data was collected, but other data frequencies are available

- Corn Futures
- Corn Spot
- Ethanol Platts

- Ethanol Spot
- Corn Oil Spot
- DDG

Conversion rates: Below are relevant conversion rates:

- 1 bushel of corn=2.8 gallons of ethanol
- 1 bushel of corn=17.25 pounds of DDGS
- 1 bushel of corn=1.5 pounds of corn oil
- 1 bushel of corn= 2.8 unit of RINS
- 34 cubic feet = 1 gallon Ethanol
- 1000 cubic feet = 1 MMBtu

1. Derive the ethanol crushing margin using the data attached and conversion rates.

    - Parameter Variables
        - AE=Extraction ethanol
        - ADDGS=Extraction of DDGS
        - ACO=Extraction of corn oil
        - AMC=Extraction of corn
        - CF= CF natural gas to Produce 1 Gallon Ethanol
        - MMBtu = Conversion to CF

    - Crush Margin (NB: This is after all necessary conversion) = ($/gal of ethanol*AE)+($/ton DDGS*ADDGS) + ($/ton Corn oil*ACO) -($/bush Corn*AMC)

2. Determine the best fit distributions for each of the price variables[3].
    - Insert the best fit distributions formula into Random Price Data Box in Sheet CornEthanolPos2(Make sure to Include function RiskCorrmat(TableArray,Position)

3. Derive the correlation matrix among these variables

4. **Trading positions/risk management strategies:** Fill out a position report with the following information:
    1. Daily capacity of an ethanol plant is 0.334 million gallons of ethanol. i.e. 10millions gallons monthly and 120MGY (million gallons per year ethanol capacity), and assume you operate 30d/month:

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[3] **Hint, You can do a "batch fit" in @Risk that will choose the best fit distribution based off the fitting criteria (AIC, BIC, etc.) and then output a correlation matrix as well.**

2. Derive the relevant quantities of corn/ethanol quantity required, and corn oil and DDGS meal that would be produced. (**HINT: Extraction rates**)
3. Create a position report with the following positions.
    1. The Ethanol Plant is Long Ethanol in Oct. 11,500,000 gal.
    2. Sold 60 days of ethanol in April, but are short equivalent in flat price corn;
    3. Bought Flat Price Corn enough for 60 days of ethanol production in November; but, have not sold ethanol;
    4. Sold 30 days ethanol in November and own 100,000 bu of corn in Oct., Buys 100,000 bu of Corn Spot Price, Buys 100,000 bu HTA Contract, 40,000 bu Basis Contract, and 24,285 bu NPE Contract
    5. For DDGS the ethanol Plant has sold DDGS on a forward contract for 1000 lbs in Aug, 200lbs in Nov, 300lbs in Dec, 500lbs in Jan, 600lbs in Feb to Dairy Farms and Feedlots.
    6. For Corn Oil the Ethanol Plant has sold on a forward contract 200lbs in Nov

4. Determine the optimal number of Corn and Ethanol Platts Swap contracts to hedge the cash positions **close** to a hedge ratio of 1.00.

5. Create two more position in the position report and analyze a hedging strategy for the acquisition of corn, assuming:
    1. Hedge corn to offset the sale of ethanol for 6 months forward in July. Thus, the ethanol sale requires short positions 60 mill gal, meaning you are short corn equivalent to ethanol (**Hint Extraction rates),** there is now 21,428,571 Bushels of Corn July Inventory.
    2. Hedge corn and ethanol futures to offset the sale of ethanol for 6 months forward in August. Thus, the ethanol sale requires short positions 60 mill gal, meaning you are short corn equivalent to ethanol (**Hint Extraction rates),** there is now 21,428,571 Bushels of Corn August Inventory.

6. Determine the impacts of hedging on margin, the variability of the margin and the probability that the margin would be negative for questions 5.1 and 5.2.

AgEcon 444: Assignment 11

Topic: Ethanol risk management and crush margin

Due: Nov. 19

Email and/or turn in to: blackboard

Purpose: To illustrate mechanics of evaluating risk management in an ethanol processing plant. This is similar to the one conducted on and can be applied in other areas.

1. **Derive Ethanol Crush Margin: Develop/Use the data set provided to derive crush margins over time for an ethanol producing plant.**
   - Spot/Cash price data is provided or available in BB/DTN
   - Futures prices are also can be extracted from BB/DTN
   - Use daily, weekly, or monthly data
   - Extraction rates:
     - 1 bushel of corn=2.8 gallons of ethanol
     - 1 bushel of corn=17.25 pounds of DDGS
     - 1 bushel of corn=1.5 pounds of corn oil
     - 1 bushel of corn= 2.8 unit of RINS

   Example: Corn $/gal=$\frac{\$6.00}{\cancel{1\,bu}} * \frac{\cancel{1\,bu}}{2.8\,gal} =$ $2.14/gal

   1. Use the above information and data provided in xls. to calculate the ethanol crush margin in $/gal or $/bushel.
   2. Plot the crushing margin over time and interpret its behavior.

2. **Dynamic links:** Based on the ethanol crush margin calculated in (1), open a quote sheet in DTN and dynamically link the margin. You can also do this in Bloomberg or Excel.

3. **Sensitivities:** In 1 above, conduct sensitivity analyses with respect to the questions below, and show how margins are impacted. This can be done just for a recent period (day or week) instead of the entire time series. Also conclude which parameter sensitivities has/have the most impact on margins.

   1) Extraction rates for corn oil change by 2%
   2) Ethanol spot/cash price change +5%,+10%,+15%, and -5%,-10%,-15%
   3) Corn Spot/Cash price change from +5%,+10%,+15%, and -5%,-10%,-15%

4. **Position Reports Strategy:** Create a hedging strategy for the following:

7. Daily capacity of an ethanol plant is 0.334 million gallons of ethanol. i.e. 10millions gallons monthly and 120MGY (million gallons per year ethanol capacity), and assume you operate 30d/month:
8. Derive the relevant quantities of corn/ethanol quantity required, and corn oil and DDGS meal that would be produced. (**HINT: Extraction rates**)
9. Create a position report with the following positions.
10. Determine the optimal number of Corn and Ethanol Platts Swap contracts to hedge the net cash positions in the corn daily position report and ethanol position report **close** to a hedge ratio of 1.00.

    1. The Ethanol Plant is Long Ethanol in Oct. 11,500,000 gal.
    2. Sold 60 days of ethanol in April, but are short equivalent in flat price corn;
    3. Bought Flat Price Corn enough for 60 days of ethanol production in November; but, have not sold ethanol;
    4. Sold 30 days ethanol in November and own 100,000 bu of corn in Oct., Buys 100,000 bu of Corn Spot Price, Buys 100,000 bu HTA Contract, 40,000 bu Basis Contract, and 24,285 bu NPE Contract
    5. For DDGS the ethanol Plant has sold DDGS on a forward contract for 1000 lbs in Aug, 200lbs in Nov, 300lbs in Dec, 500lbs in Jan, 600lbs in Feb to Dairy Farms and Feedlots.
    6. For Corn Oil the Ethanol Plant has sold on a forward contract 200lbs in Nov

5. **Hedging with alternative strategies within the Position Report**
    1. Sell Ethanol 600,000 gal of ethanol August, purchase enough flat price corn in august to produce the ethanol need for august contract. What is the net position? How much more DDGS need to be sold to offset your realized DDGS Position?

    2. Long Flat Price 200,000 bu Corn in July and Sell 250,000 gal of ethanol in July. Hedge remainder net position in corn and ethanol futures

6. **EXTRA CREDIT:** Extract your own data on Bloomberg and DTN for any realistic period (different from the ones provided). Create/graph the corn/ethanol crush margin over time, as well as the elements (futures for each of corn, ethanol, corn oil, and DDGS).
    - Interpret these values

Report 5

Renewable Energy Commodity Trading Educational Program

Report 5: *Final Repots for Dataset Development, Curriculum Alternatives, Teaching Models, Simulations Modeling and Infrastructure/Technology Installation Activities*

January (submitted March) 2014

This report provides a final report on data set development, curriculum alternatives, teaching models, simulation modeling and instruction technology installation activities.[1]

Teaching Models: A set of ethanol hedging case studies were developed. These include the problem setting, decisions to be made and relevant data.

1. Experiment during Fall 2013 and Spring 2014. These case studies were developed and used during teaching in NDSU courses during fall 2013. There were two case studies.

2. Revised case studies: Based on the experience from these case studies, we revised them for future use. These are attached and it is planned these would comprise the basis of future case studies, and for the course curriculum.

Simulation Modeling: We are currently very far into development of several simulation models that would be used in the teaching program. These include:[2]

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[1] This report was prepared without comments from review of our previously submitted Report 4. These were submitted along with the others on Jan 31, 2014.

We were anticipating to hold off on submitting this report till comments were received. Nevertheless, to move forward, we prepared this report.

[2] Specifically, the way we are organizing is to develop several research reports, which will include data etc. about the core problems confronting the industry. These will provide materials for the industry short courses.

We met with 3 large regional ethanol manufactures to get input and insight into their managerial problems related to risk and logistic. Information from these meetings are being used to guide our research and report development.

To date, we are in the process of preparing the following research reports (drafts are available for review):

1) Logistics and risk: A model of supply-chain that can be used to evaluate risk and strategy for ethanol manufacturers;

2) Hedging I: An analysis as to which is the best futures market for hedging ethanol;

3) Hedging II: A model to capture a hedging portfolio that captures advanced distributions among market values;

4) Arbitrage among futures: This is a detailed model to analyze arbitrage opportunities in trading among the 2 futures in ethanol, corn, and the underlying option values.

1. Hedging I: This is a model to analyze alternative hedging strategies for ethanol. Comparisons are made amongst:

    - Hedging anticipated forward sales in alternative futures contracts for ethanol;

    - Hedging net corn positions in corn, as a hedge against forward ethanol sales

2. Arbitrage I: There are alternative futures contracts for ethanol. These have important different features which impact the choice for hedgers. They also have embedded options (Asian options) which facilitate 30 day swap strategies.

    The model analyzes the efficiency of these market alternatives and seeks to identify arbitrage opportunities for hedgers.

3. Logistics models. Our interviews with market participants indicated that strategies regarding logistics are extremely important in this industry and have major impacts on risk and returns for market participants. Indeed the critical variables include: storage space for corn, DDG's and ethanol; contracting for forward purchases of corn, and sales of products; rail car leasing strategies (all ethanol companies have a large number of rail cars leased and this is a strategic variable); amongst others. Those variables that cause the greatest exposure to risk include prices (or basis) for each of the commodities (corn, ethanol and DDGs), rail performance, amongst others.

    We interviewed 3 ethanol manufactures on their approach and challenges in managing logistics. From this, we have discerned the critical variables for managing risks. We are in the process of creating a simulation model using risk optimizer to quantify risks, and effects of risk mitigation strategies.

    This should be completed in the coming months, the results of which will be used to develop case studies for the latter modules in the course curriculum.

Plans for the Industry Short Course: A detailed proposed course has been outlined in Report 3-2.[3] This is the anticipated program to be developed for the industry short course.

Dr. Ripplinger is dialoguing with industry to find the best time for the short-course. At this point, it will either be during November 2014 or Spring term 2015. This will be resolved in the coming weeks.

[3] This was previously submitted for review. A copy is attached at the end of this report for reference.

Trading game we are planning to develop an ethanol trading game to be used for teaching. This is planned for summer 2014.

- This will be developed with the NDSU computer science department which has a group that develops computer simulation games for teaching purposes.[4] This will be called the ethanol simulation game.

- Features of the game (at this point) will included:

    - Corn buying; and selling of DDGs and ethanol; and for each will include forward and nearby sales
    - Hedging of each of these commodities, including several alternatives for each
    - Storage of corn and products
    - Shipping and logistics including: storage, rail car leasing,
    - Risks: Commodity prices risk and logistics risk (car performance, etc.)

Installation: Development of the Commodity Trading Room (CTR) and installation of software and information technologies has been complete. Thus, the CTR is now fully operating.

Technology Details[5] The technology and software included in the CTR includes:

- 32 live work stations
- 1 podium with 2 live work stations
- HD Monitors for presentations
- Information technology: 20 DTN and 12 Bloomberg work stations
- Risk software: Pallisade @risk

Planned Future Additions: We are evaluating the cost and alternatives for adding an interactive video feature to the room. It would exploit the HD monitors and other

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[4] There are a series of computer simulation games being developed for use in the CTR.

Currently, a farm management game is being developed and expected to be done in March 2014 (this is a different project). Based on this experience, we will specify features of an ethanol game and this is planned to be developed during summer 2014.

[5] The CTR now has a u-tube video that describes its features and use in teaching. See

SEE IT FOR YOURSELF!
The Commodity Trading Room is a high-technology room with live information feeds for financial information including equities and credit, plus commodity market information such as agriculture, energy and biofuels See it on YouTube: http://www.youtube.com/watch?v=9ErABR40OLI

features of the room. Its purpose would be to bring in speakers from industry and outside to supplement course materials.

Appendix 1: *Ethanol Risk Management Case Studies*

Below is the text of 2 case studies on ethanol risk management. These were developed for and used initially in AE711 and AE 44 during Fall 2013. They were then revised based on the experiences of those exercises.

In addition to these texts, the case studies are accompanied by: 1) a detailed ppt for instruction; and 2) multiple xls containing data and transformations.

AgEcon 711: CTR10

Assignment: Hedging for an Ethanol Plant

Due: Nov 5 2013

Problem: Ethanol is an industry with substantial price risk. This problem seeks to illustrate the impacts of risk and hedging on the variability of margins in the industry.

Data: See attached xls. This data contains Spot/Cash price and Futures Price data was collected or available in BB/DTN. Daily data was collected, but other data frequencies are available

- Corn Futures
- Corn Spot
- Ethanol Platts

- Ethanol Spot
- Corn Oil Spot
- DDG

Conversion rates: Below are relevant conversion rates:

- 1 bushel of corn=2.8 gallons of ethanol
- 1 bushel of corn=17.25 pounds of DDGS
- 1 bushel of corn=1.5 pounds of corn oil
- 1 bushel of corn= 2.8 unit of RINS
- 34 cubic feet = 1 gallon Ethanol
- 1000 cubic feet = 1 MMBtu

1. Derive the ethanol crushing margin using the data attached and conversion rates.

    - Parameter Variables
        - AE=Extraction ethanol
        - ADDGS=Extraction of DDGS
        - ACO=Extraction of corn oil
        - AMC=Extraction of corn
        - CF= CF natural gas to Produce 1 Gallon Ethanol
        - MMBtu = Conversion to CF

    - Crush Margin (NB: This is after all necessary conversion) = ($/gal of ethanol*AE)+($/ton DDGS*ADDGS) + ($/ton Corn oil*ACO) -($/bush Corn*AMC)

2. Determine the best fit distributions for each of the price variables[6].
    - Insert the best fit distributions formula into Random Price Data Box in Sheet CornEthanolPos2(Make sure to Include function RiskCorrmat(TableArray,Position)

3. Derive the correlation matrix among these variables

4. **Trading positions/risk management strategies:** Fill out a position report with the following information:
    1. Daily capacity of an ethanol plant is 0.334 million gallons of ethanol. i.e. 10millions gallons monthly and 120MGY (million gallons per year ethanol capacity), and assume you operate 30d/month:

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[6] **Hint, You can do a "batch fit" in @Risk that will choose the best fit distribution based off the fitting criteria (AIC, BIC, etc.) and then output a correlation matrix as well.**

2. Derive the relevant quantities of corn/ethanol quantity required, and corn oil and DDGS meal that would be produced. (**HINT: Extraction rates**)
3. Create a position report with the following positions.
    1. The Ethanol Plant is Long Ethanol in Oct. 11,500,000 gal.
    2. Sold 60 days of ethanol in April, but are short equivalent in flat price corn;
    3. Bought Flat Price Corn enough for 60 days of ethanol production in November; but, have not sold ethanol;
    4. Sold 30 days ethanol in November and own 100,000 bu of corn in Oct., Buys 100,000 bu of Corn Spot Price, Buys 100,000 bu HTA Contract, 40,000 bu Basis Contract, and 24,285 bu NPE Contract
    5. For DDGS the ethanol Plant has sold DDGS on a forward contract for 1000 lbs in Aug, 200lbs in Nov, 300lbs in Dec, 500lbs in Jan, 600lbs in Feb to Dairy Farms and Feedlots.
    6. For Corn Oil the Ethanol Plant has sold on a forward contract 200lbs in Nov

4. Determine the optimal number of Corn and Ethanol Platts Swap contracts to hedge the cash positions **close** to a hedge ratio of 1.00.

5. Create two more position in the position report and analyze a hedging strategy for the acquisition of corn, assuming:
    1. Hedge corn to offset the sale of ethanol for 6 months forward in July. Thus, the ethanol sale requires short positions 60 mill gal, meaning you are short corn equivalent to ethanol (**Hint Extraction rates),** there is now 21,428,571 Bushels of Corn July Inventory.
    2. Hedge corn and ethanol futures to offset the sale of ethanol for 6 months forward in August. Thus, the ethanol sale requires short positions 60 mill gal, meaning you are short corn equivalent to ethanol (**Hint Extraction rates),** there is now 21,428,571 Bushels of Corn August Inventory.

6. Determine the impacts of hedging on margin, the variability of the margin and the probability that the margin would be negative for questions 5.1 and 5.2.

AgEcon 444: Assignment 11

Topic: Ethanol risk management and crush margin

Due: Nov. 19

Email and/or turn in to: blackboard

Purpose: To illustrate mechanics of evaluating risk management in an ethanol processing plant. This is similar to the one conducted on and can be applied in other areas.

1. **Derive Ethanol Crush Margin: Develop/Use the data set provided to derive crush margins over time for an ethanol producing plant.**
   - Spot/Cash price data is provided or available in BB/DTN
   - Futures prices are also can be extracted from BB/DTN
   - Use daily, weekly, or monthly data
   - Extraction rates:
     - 1 bushel of corn=2.8 gallons of ethanol
     - 1 bushel of corn=17.25 pounds of DDGS
     - 1 bushel of corn=1.5 pounds of corn oil
     - 1 bushel of corn= 2.8 unit of RINS

   Example: Corn $/gal=$\frac{\$6.00}{\cancel{1\,bu}} * \frac{\cancel{1\,bu}}{2.8\,gal} =$ $2.14/gal

   1. Use the above information and data provided in xls. to calculate the ethanol crush margin in $/gal or $/bushel.
   2. Plot the crushing margin over time and interpret its behavior.

2. **Dynamic links:** Based on the ethanol crush margin calculated in (1), open a quote sheet in DTN and dynamically link the margin. You can also do this in Bloomberg or Excel.

3. **Sensitivities:** In 1 above, conduct sensitivity analyses with respect to the questions below, and show how margins are impacted. This can be done just for a recent period (day or week) instead of the entire time series. Also conclude which parameter sensitivities has/have the most impact on margins.

   1) Extraction rates for corn oil change by 2%
   2) Ethanol spot/cash price change +5%,+10%,+15%, and -5%,-10%,-15%
   3) Corn Spot/Cash price change from +5%,+10%,+15%, and -5%,-10%,-15%

4. **Position Reports Strategy:** Create a hedging strategy for the following:

7. Daily capacity of an ethanol plant is 0.334 million gallons of ethanol. i.e. 10millions gallons monthly and 120MGY (million gallons per year ethanol capacity), and assume you operate 30d/month:
8. Derive the relevant quantities of corn/ethanol quantity required, and corn oil and DDGS meal that would be produced. (**HINT: Extraction rates**)
9. Create a position report with the following positions.
10. Determine the optimal number of Corn and Ethanol Platts Swap contracts to hedge the net cash positions in the corn daily position report and ethanol position report **close** to a hedge ratio of 1.00.

    1. The Ethanol Plant is Long Ethanol in Oct. 11,500,000 gal.
    2. Sold 60 days of ethanol in April, but are short equivalent in flat price corn;
    3. Bought Flat Price Corn enough for 60 days of ethanol production in November; but, have not sold ethanol;
    4. Sold 30 days ethanol in November and own 100,000 bu of corn in Oct., Buys 100,000 bu of Corn Spot Price, Buys 100,000 bu HTA Contract, 40,000 bu Basis Contract, and 24,285 bu NPE Contract
    5. For DDGS the ethanol Plant has sold DDGS on a forward contract for 1000 lbs in Aug, 200lbs in Nov, 300lbs in Dec, 500lbs in Jan, 600lbs in Feb to Dairy Farms and Feedlots.
    6. For Corn Oil the Ethanol Plant has sold on a forward contract 200lbs in Nov

5. **Hedging with alternative strategies within the Position Report**
    1. Sell Ethanol 600,000 gal of ethanol August, purchase enough flat price corn in august to produce the ethanol need for august contract. What is the net position? How much more DDGS need to be sold to offset your realized DDGS Position?

    2. Long Flat Price 200,000 bu Corn in July and Sell 250,000 gal of ethanol in July. Hedge remainder net position in corn and ethanol futures

6. **EXTRA CREDIT:** Extract your own data on Bloomberg and DTN for any realistic period (different from the ones provided). Create/graph the corn/ethanol crush margin over time, as well as the elements (futures for each of corn, ethanol, corn oil, and DDGS).
    - Interpret these values

Renewable Energy Commodity Trading Educational Program
Report 3-2: Curriculum Alternatives Activities

Ethanol Merchandising and Risk Management
January 2014

Program Description: The course will provide an overview of the ethanol industry as well as tools and strategies to manage bio-refiner's risk. Basis and futures; hedging theory, mechanics, and applications; contracts; position reports; and logistics will be covered. Participants will apply their learning by completing a series of exercises that make use of the NDSU Commodity Trading Lab's unique data and software capabilities.

Program Objectives:

1. Provide an understanding of the ethanol industry and bio-refiner's role in the supply chain
2. Develop an understanding of trading theory and mechanics, such as basis, futures, swaps, contracts, and margins as used in the ethanol industry
3. Understand and use risk measurement techniques and strategies

A working knowledge of grain merchandising, trading, and the ethanol industry is helpful, but not required. Fundamentals will be discussed during each stage of the course, which provide a refresher and clarification of basic concepts for experienced participants. Advanced hedging and risk management will then build on the fundamentals earlier discussed in training.

Prerequisites: Having at least a basic knowledge of the use of XLS is important. Participants will apply their learning through a series of technology-based exercises that make use of a range of basic and advance concepts, tools, and methods.

Target Audience: Merchants and risk management professionals employed by ethanol refiners. Third party commodity brokers, ethanol and petroleum marketers, ethanol plant managers.

Duration: The program will be designed as either 3 full days, or 3 ½ days.

Module 1a: Introduction[78]

- **a. Administrative Details**
  - **i. Course Structure**
  - **ii. Expectations**
- **b. CTR Technologies**

Module 1b: Ethanol Trading and Risk

- c. VeraSun Energy Case Study
- d. Introduction to Merchandising
- e. Risk Management in the Context of Ethanol Refining

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[7] Once the program is organized, we will seek collaboration/presentations from the following:

- CME on futures and ethanol
- Zaner hedging—specialist in ethanol hedging
- DTN and Bloomberg: To illustrate features of their tools for ethanol mfg information and risk mgmt..

[8] Case studies have been prepared and are currently being experimented with in AE444 and AE711 at NDSU. These will be revised based on student input.

i. Vocabulary of Risk Management (futures and platts, forward, options, swaps)

Module 2: The US Ethanol Industry

a. US corn-ethanol supply chain
b. Role of corn-ethanol refiners and their relationship with input and product markets
c. Crush Margin (an introduction to the relationship between physical and contractual positions and profits)
d. Exercise –
    a. basic crush margin worksheet
    b. setting up dynamic links with DTN
e. Sources of Risk in Ethanol Refining (motivated from an understanding of refinery operations, inputs, and products; and the crush margin worksheet)
f. Hedging (an introduction to the concept, types and effectiveness of various hedges)
g. Exercise: Variability of the Margin

Module 3: Taxonomy of Markets (Using Wilson's Existing Materials)

a. Futures
b. Basis

Break 15 Min

Module 4: Futures

a. Futures Theory
    a. Development
    b. Comparison to others instruments/physicals
b. Futures Contracts
    a. Futures and forward contracts compared
    b. Details on futures
        i. Corn
        ii. Ethanol (CME and Platt's)
        iii. DDGs
        iv. NG
        v. others
c. Structure
    a. Delivery mechanisms/process
    b. Temporal characterization of markets
        i. Normal markets
        ii. Inverted Markets
d. Compare Standardized and Non Standardized Contracts
e. Rules and Regulations
    a. Price limits
    b. Clearinghouse
    c.
f. Margin Requirements
g. Exercise:
    a. Extract Corn Futures Price Data from DTN. Determine the appropriate margin calls
    b. Simulating margin requirements in practice

Lunch

Exercise: Trading Technologies

i. Technical Price Analysis: For use in Trading Technologies
ii. Use Trading Technologies to demonstrates Bio-fuel processer short corn
Have them buy futures contracts for various contract months to hedge short position

Module 5: Basis

a. Derivations
b. Factors influencing the Basis
    i. Time (Storage)
    ii. Quality (Premiums Discounts)
    iii. Location (Transportation costs)
    iv. Local Supply/Demand
    v. Arbitrage or Intermarket Competition
    vi. DTN Heat Maps about the Basis or Bloomberg(No generic logins for everyone)
c. Exercise:
    a. Grain Hedge or geograin.com
    b. Extracting basis data
    c. Seasonality in basis data
    d. Using MACD and other technical tools for projections

Break

Module 6: Hedging With Futures

a. Hedging Theory
    a. Risk reduction
    b. Short hedging
    c. Long hedging
b. Short Hedging and Long Hedging
c. Basis
    a. Effect of change on long/short hedger
    b. Effect on price of delivered commodity
d. Hedging Calculations
e. Example: Hedging Ethanol (Long)
f. Example: Hedging Corn (Short)
g. Position Reports for ethanol mfgs
    a. Corn, ethanol and ddg positions
    b. Derivation of net position
h. Spreading
    a. Execution
    b. Expectations
        i. Basis
        ii. Normal or inverted market
    c. Types
i. RINS: Impact on margins, hedging, etc.

Recap of above materials

Module 7: Options

a. Terminology and Theory
b. Option Hedging Strategies and Calculations (compared to futures hedge)

c. Exercise:
    a. Options and Net Payoffs Using Excel
d. Option Pricing
    a. Volatility
    b. Interest
    c. Time
    d. Market Value to Strike Price
    e. Intrinsic Value
    f. Extrinsic Value
e. Exercise, Assignment, Settlement
f. Black Pricing Model
    a. Greeks
g. Exercise:
    a. Option price calculation using Black Sholes; xls on basic payoffs.
    b. Contracting with options (Min, max, and min/max contracts)

Module 7: Hedging with Options

a. Option Theory
    a. Risk, leverage, premium for long and short
b. Option Hedging Strategies and Calculations (compared to futures hedge)
    a. Long put/short hedge
    b. Long call/long hedge
c. Exercise: Options and Net Payoffs Using Excel
d. Exercise: Hedging with Options and Futures Compared

Guest Speaker/Tour/Lunch

Module 8: Hedging Strategies I

a. Arbitrage in futures and options markets
b. Ethanol hedging: Which market to hedge
c. Other:
    a. OTC Defined
    b. Credit Risk
    c. CME Clear Port
    d. Types of Swaps
        i. Basic Commodity
        ii. DTN Basis
        iii. Calendar Swaps
d. Exercise: Swaps (between biorefinery and blender)

Break

Module 9: Hedging Strategies II

a. Cash Contracts
    i. Forward Contracts
    ii. Basis Contracts
    iii. HTA Contracts
    iv. NPE Contracts
b. Futures Contracts
    i. Market Liquidity

ii. Denatured Ethanol Futures
iii. Platts Ethanol Futures
iv. Platts Ethanol Swaps

c. Exercise:
    a. Mechanics of Using Cash Contracts
    b. Mechanics of Using Futures Contracts
    c. Arbitrage between CME futures and Platts'

Break

Exercise: Position Reports

a. Fill out position report and determine the variability of the crush margin for alternative hedging strategies

Recap of above materials

Module 11: Logistics I

a. Supply Chain

Break

Module 12: Logistics II

b. Inventory
c. Transportation
d. Exercise:
    I. xls on managing inventory and transportation

Lunch

Module 13: Contracting

c. Purchasing Feedstocks
d. Processing
e. Logistics
f. Streamline Supply Chain can equate to Supply Chain Savings

Module 14: Measuring and Monitoring Risk

a. Position reports: corn, ethanol, DDGs and hedge ratios
b. Measuring Risk using VAR
c. Exercise
    a. Net positions in position reports
    b. VAR interpretation(s)

Break

Module 15: Advanced Risk Management

i. Cross-Hedging
ii. MV Portfolio
    1. Efficiency Frontier and Hedge Ratio
iii. VaR and hedging strategies
    2. Position Report and VaR

Module 16: Wrap-up

a. Summary of Modules
b. DTN Ethanol Workbook
c. Setting up a Hedging Strategy

Data sets available for curriculum

Bloomberg

Instrument	Source	Comment
Corn futures	CBOT	This is sourced from various sites
Corn cash	CGB	Available at various locations
Ethanol futures	CBOT	Available
Ethanol spot	USDA	Limited Availability
DDGS	USDA	Limited Availability
RINS	Progressive Fuels LTD	Limited Availability
Platts	CME	Limited Availability
Corn oil	OPIS/USDA	Limited Availability
NG Futures	NYM	Available
NG Spot	ICE	Available

DTN

Instrument	Source	Comment
Corn futures	CBOT	This is sourced from various sites
Corn cash	CGB	Available at various locations
Ethanol futures	CBOT	Available
Ethanol spot	Opis	Limited Availability, Not W/Subscription
DDGS	CME	Limited availability
RINS	NYM	Limited availability
Platts	CME	Availability, Not with Subscription
Corn oil	OPIS/Platts	Available
NG Futures	NYM	Available
NG Spot	NYM	Available Basis values

Program summary: At the end of the training session, the following objectives should be met:

1- Participants should be able to understand and provide an overview of the entire ethanol industry description, supply chain description and players within the supply chain and how to make informed decisions
2- Participants should be able to understand and interpret the types of contracts to deal in in, how to calculate the net hedge positions of their inputs and output products, and how uncertainties from product price and demand, logistics and transportation can impact their profit margin and business operation
3- Participants should be able to understand, and interpret basic risk management strategies and tools, while dealing with what are basis, futures, hedging mechanics, contracts, position reports, and some advance risk management strategies and tools.

References

Series 3 Guide.
DTN Ethanol Workbook.
The Art of Grain Merchandising
Trading and Hedging with Agricultural Futures and Options
EMI. Biofuels Fundamental
EMI. Ethanol Markets and Risk Management

Report 6

Renewable Energy Commodity Trading Educational Program

Report 6: Interim Report on Program Delivery Activity

October 2015

This report provides an interim report on program delivery. Previous reports were submitted summarizing the project activities.[1] Of particular reference, Report 5 provides extensive detail on the teaching program, specifically, our incorporation of risk management modules and exercises in our NDSU course on commodity trading and risk management (i.e., AE 491, AE 444 and AE711).

This report summaries our extension/outreach program which was a component of this project.

Industry Seminar 2015:

1) Overview.

A three-day course on corn-ethanol marketing, risk, and logistics was delivered June 16-18, 2015, in the commodity trading room at North Dakota State University. The program was marketed by email, phone, and promotion at the Fuel Ethanol Workshop to regional corn ethanol refineries, lenders, and analysts.

2) ***Agenda of topics***:

The course included coverage an overview of the ethanol industry, ethanol trading and risk, trading simulations, basis, hedging with futures and options, contracting, distillers grains marketing, ethanol transportation and storage.

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[1] These include:

1. Initial detailed work plan outlining key performance benchmarks and timeline
2. Final Report for State of Practice Activity
3. Interim Reports for Dataset Development and Curriculum Alternatives Activities
4. Interim Reports for Teaching models & Simulation Modeling & Infrastructure/Technology Installation Activities
5. Final Reports for Dataset Development, Curriculum Alternatives, Teaching Models, Simulation Modeling & Infrastructure/Technology Installation Activities

2015 Ethanol Risk Training Final Agenda

Day 1	June 16, 2015	
8 am	Registration	
8.15 am	Welcome and introductions	
8.30 am	The US Ethanol Industry	Ripplinger
9 am	Ethanol Trading and Risk	Ripplinger
9.30 am	Taxonomy of Markets	Wilson
10.30 am	Commodity Lab Overview	Wilson
11 am	Ethanol Racks (Using DTN & Excel)	Ripplinger
Noon	LUNCH	
1 pm	Trading Simulation	Wilson
1.30 pm	Basis	Wilson
3 pm	Geograin	Wilson
4 pm	Industry Speaker	
Day 2	June 17, 2015	
8.30 am	Futures	Ripplinger
9.30 am	Hedging with Futures	Wilson
10.15 am	Ethanol Crush	Ripplinger
11 am	Options	WIlson
Noon	LUNCH	
1 pm	Trading Simulation	Wilson
1.30 pm	Contracting	Wilson
2.15 pm	Position Reports	Wilson
3 pm	Hedging with Options	Ripplinger
4 pm	Industry Speaker	
Day 3	June 18, 2015	
8.30 am	DDG Marketing	Ripplinger
9.15 am	Ethanol Transportation	Ripplinger
10.15 am	Case study (transit time)	Ripplinger
10.45 am	Case study (buy or lease)	Ripplinger
11.15	Risk Policy	Wilson
Noon	LUNCH	
1 pm	Trading Simulation	Wilson
1.30 pm	Case Study (delivered or FOB)	Ripplinger
2 pm	Case study (car placement)	Ripplinger
2.30 pm	Storage	Ripplinger
3 pm	Case study (expansion)	Ripplinger
3.30 pm	Industry Speaker	
4.30 pm	Evaluation	

3) **Course review (synopsis from respondents survey)**

Initial, informal reactions to the training from ethanol operators, lenders, and analysts were all very positive.[2] Course participants were asked to evaluate the training using an electronic survey. Respondents strongly agreed that the training was well-organized, the content was relevant, the information was new, and that topics received adequate coverage. They strongly agreed that the venue was convenient and adequately laid out. The only negative noted was program length. Respondents felt that three days was too long.

Plans for the Future:

A second course will be offered in late spring/summer 2016. This course will likely be shortened from the three days offered in 2015. North Dakota and other regional ethanol refiners, lenders, and analysts will be surveyed in Fall 2015 to identify the best time for the 2016 delivery.

Other:

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[2] **From:** Schwartz, Nicole
Sent: Friday, June 19, 2015 9:53 AM
To: 'David Ripplinger'; 'william.willson@ndsu.edu'
Subject: RE: Ethanol Risk Management Training Logistics

Good Morning,
I just wanted to say thanks to both of you for the training you put on. I'm sorry I had to leave so abruptly. I ended up with 6 stitches! I would highly recommend this training to anyone if you do choose to put it on again. And I will make sure our management here at AgCountry is aware also. Have a great weekend!

Nicole Schwartz

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Report 7

Renewable Energy Commodity Trading Educational Program

Report 7: Final Report on all Exhibit A Activities

Date: March 2016 (original due date July 1 2014)

This report provides a summary of the Final Report. Previous reports were submitted summarizing the project activities.

Extension: We had requested an extension for this project on Oct 9 2015. This was requested as a 1 year extension at no cost; and, we are operating as if it has been approved.

We presume that was concurred and hence report accordingly. At that time, we had submitted Items 1-6 (i.e. Reports 1-6).

Report of Activities: The primary activities were reported in the previous Reports 1-6.[1] Notable among these include briefly the below primary activities:

1) ***Educational seminars***: We hosted our first educational seminar at NDSU in June 2015. In addition, we developed several case studies and these have been included in Dr. Wilsons' courses in commodity trading (AE 444 and AE 711).

   These were reported on in detail in Report 6.

   We are now in the process of preparing for our June 2016 seminar. It is building on the June 2015 seminar with revisions, and is planned for June 14-15, 2016 in the NDSU Commodity Trading Room.

2) ***Ethanol Management/Trading Game*** As part of this program we are developing an Ethanol Management/Trading Game. This is now under development and is planned to be completed in fall 2016.

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[1] These include:

1. Report 1: Initial detailed work plan outlining key performance benchmarks and timeline
2. Report 2: Final Report for State of Practice Activity
3. Report 3: Interim Reports for Dataset Development and Curriculum Alternatives Activities
4. Report 4: Interim Reports for Teaching models & Simulation Modeling & Infrastructure/Technology Installation Activities
5. Report 5: Final Reports for Dataset Development, Curriculum Alternatives, Teaching Models, Simulation Modeling & Infrastructure/Technology Installation Activities

6.Report 6: : Interim Report on Program Delivery Activity Oct 2015

The game is being developed jointly with Dr. Brian Slator and his colleagues at the NDSU Computer System Institute. Dr. Slator is engaged in research dealing with learning in role-based simulations.[2]

Key features of the game include:

a. Structure of the game. This is designed with the following structure
    i. Multiple users, representing competing plants
    ii. Managers buy corn, trade futures/options, produce ethanol, sell ethanol and ddg for differing periods forward, and, in the process of this arrange shipping and manage customers (growers, suppliers and end-use customers buying ethanol)
    iii. The instructor can
        1. Set the initiation parameters for the game
        2. Introduce exogenous events into the game
        3. Evaluate performance of the players.

b. Other features of the game are identified below
c. Plants: 1, or up to N to allow for multiplane firms
    i. Processing costs: FC and VC
    ii. Extraction rates
d. Markets: Corn and DDGs
    i. Local basis market for each period forward
e. Markets: Ethanol
    i. Cash values for 1, or M ethanol destinations: chgo, pnw, etc)
f. Shipping
    i. Shipping costs for ethanol from N to M
    ii. Advanced
        1. Uncertain shipping times
        2. Car leasing
g. Trading
    i. Goal: lock in margin for each month
        1. Values to measure
            a. Margin and profit
            b. Risk
        2.
    ii. Months forward: allow trading from 1 to 12 or 18 months forward
    iii. Spot cash and forward cash markets
    iv. Hedging in either CME or plants for 1 to 12 or 18 months forward
h. Exogenous events to develop
    i. Separately, we would identify exogenous changes to introduce, and to evaluate how students should respond
    ii. These can be identified in time, and prior to starting, we could create a complete list
    iii. Responses, as a beginning would include below
        1. Supply interruptions

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[2] He is affiliated with the World Wide Web Instructional Committee which is an ad hoc group of NDSU faculty dedicated to developing internet-based educational software. Their current projects include computer science, biology, geology, and anthropology.

a. Need to expand market area for procurement
b. Supply disruptions
c. Unexpected change in extraction rates
d. Farmer defaulting on delivery
e. Growers having greater supply the previously expected

2. Changes in demand

3. Change in outbound shipping
   a. Change in rates
   b. Rail car shortage

3) Research Papers Completed: Several research papers have been prepared, and/or are in the process of being prepared. These were summarized in previous report. Notably, these include papers on:

Hedging and risk management in ethanol

Logistics strategy, and risks in ethanol firm management

Plans for the Future: Our focus in the coming months include

1) Ethanol Management/Trading Game. Working toward development of this game
2) Other research initiatives: including
   a. Contracting with end-users
   b. Contracting with growers
3) Educational Seminars: Further execution and development in 2016, 2017 and possibly beyond.

References:

1) Iddrisu, Awudu, and W. Wilson "Hedging Strategy for Ethanol Processing with Copula Distributions" *Energy Economics*, November 2014. Ms. Ref. No.: ENEECO-D-14-00939. Resubmitted, May 8 2015; Resubmitted July 27 2015

Papers below are at varying stages of completion, though, in all cases, the analytical work has been completed, Each will be published as an AgEcon research report, and also submitted to an academic journal:

2) Kristopher Skadberg, William Wilson, Iddrisu Awudu, and Bruce Dahl, "Optimal hedging in commodities for an agribusiness processing plant"

3) Wilson, W. and A. Iddrisu, "Logistics, risks and ethanol firm strategies."