THE POWER OF KNOWLEDGE: REDUCING INFORMATIONAL BARRIERS AND IDENTIFYING VALUE-ADDED MARKETING OPPORTUNITIES FOR MONTANA, IDAHO AND WASHINGTON WHEAT PRODUCERS FY 2010

Informational barriers are often a significant source of market inefficiency and can prevent agricultural producers from maximizing profits. For wheat producers in the Montana-Idaho-Washington (MT-ID-WA) region, such barriers exist because of inaccessible (or excessively costly) price and basis (price difference between terminal and local markets) information. This project gathers a unique data set of daily cash prices—gathered from the extensive USDA-AMS archive and supplemented by a private collection—to model the specific structure of wheat basis in the MT-ID-WA region. The empirical research results are used to create and maintain a free website that provides wheat producers with real-time price information and wheat basis and price forecasts for over 70 MT-ID-WA markets. The work has the potential of contributing numerous long-term benefits including reductions in price spreads between producers and consumers, significant increases in producer and consumer well-being, improvements in identity preserved wheat marketing, and increased wealth generation in farming communities. Educational outreach and website demonstrations were provided to wheat producers at numerous regional venues. Furthermore, collaboration with Fort Peck Community College (which provides education to wheat producers on the Fort Peck Indian Reservation) helped increase the project's impact on the well-being of socially-disadvantaged American Indian wheat producers.

FINAL REPORT

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The Power of Knowledge: Reducing Informational Barriers and Identifying Value-Added Marketing Opportunities for Montana, Idaho, and Washington Wheat Producers

Federal State Marketing Improvement Program 10.156

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Project Highlights

- The research focuses on improving information flows of agricultural market data to increase economic well-being of producers and consumers.
- Wheat producers in the Montana, Idaho, and Washington region face unique marketing challenges, but lack tools to successfully overcome them.
- The project developed a web-based wheat price prediction tool that helps improve optimal marketing decisions while reducing information search and acquisition costs.
- The web-based tool was founded in data-driven economic models of historical basis information for over 70 grain delivery locations in the region.
- WheatBasis.montana.edu has an intuitive design and helpful descriptions that provide value even to users who are unfamiliar with interpreting basis and price forecasts.
- Outreach activities helped encourage the tool's adoption and gather useful feedback.
- A portion of outreach activities focused on educating young and underprivileged producers and American Indian farmers.

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Abstract

Informational barriers are often a significant source of market inefficiency and can prevent agricultural producers from maximizing profits. For wheat producers in the Montana-Idaho-Washington (MT-ID-WA) region, such barriers exist because of inaccessible (or excessively costly) price and basis (price difference between terminal and local markets) information. This project gathers a unique data set of daily cash prices—gathered from the extensive USDA-AMS archive and supplemented by a private collection—to model the specific structure of wheat basis in the MT-ID-WA region. The empirical research results are used to create and maintain a free website that provides wheat producers with real-time price information and wheat basis and price forecasts for over 70 MT-ID-WA markets. The work has the potential of contributing numerous long-term benefits including reductions in price spreads between producers and consumers, significant increases in producer and consumer well-being, improvements in identity preserved wheat marketing, and increased wealth generation in farming communities. Educational outreach and website demonstrations were provided to wheat producers at numerous regional venues. Furthermore, collaboration with Fort Peck Community College (which provides education to wheat producers on the Fort Peck Indian Reservation) helped increase the project's impact on the well-being of socially-disadvantaged American Indian wheat producers.

Issue Overview

National and global economic conditions cause significant changes in wheat prices and basis volatility. Large volatility can weaken the basis (i.e., increase the price spread between a terminal market and a local market) and reduce the ability of wheat producers to maximize profits (U.S. Commodity Futures Trading Commission). In the MT-ID-WA region, informational barriers and transportation limitations significantly distort price linkages between producers and consumers, and contribute to weak and volatile basis. A reduction in basis volatility, stronger basis levels, and improved informational flows are crucial for increasing marketing opportunities, optimizing product distribution, and promoting growth in producer, consumer, and social well-being. For example, in 2008 the MT-ID-WA region produced almost one-fifth of the total U.S. wheat supply, but its total realized value—$2.49 billion or 5.5% of regional GDP—may not have been maximized due to informational barriers between producers and consumers and the resulting increased uncertainty in wheat markets.

In Montana, for example, annualized basis volatility ranged between 1.16% for ordinary hard red winter wheat (HRW) to 24.80% for 13 percent protein HRW. For hard red spring wheat (HRS), volatility ranged between 12.04% for 13 percent protein and 35.08% for 14 percent protein. The wheat basis volatility in this region generally exceeds the 8.35%–18.34% volatility range that exists across other regional markets in the United States (USDA Agricultural Marketing Service). In such volatile markets, decisions about where and when to market agricultural commodities are critical to improving economic outcomes and farm sustainability. This is especially the case

for farms that may lack storage, transportation, and market information assets.

The MT-ID-WA wheat farmers also face unique marketing challenges due to grain buyers' large emphasis on quality differentiation and the region's consumers being largely international agribusinesses. Unlike in the Midwestern and southern wheat production regions, where all wheat is typically treated as a single commodity, prices of MT-ID-WA grain are dependent on protein levels. In Montana, for example, 15% protein wheat receives typical premiums ranging from $0.15 to $0.50 per bushel over 14% protein wheat (USDA Agricultural Marketing Service). Weather conditions can cause volatile changes in protein premiums, affecting MT-ID-WA wheat producers' profits. Furthermore, emerging global markets and changing agricultural industry conditions, rising price risk, climate change, and world population growth are creating additional challenges and opportunities for MT-ID-WA grain producers.

Improving farmers' marketing effectiveness depends largely on an unobstructed flow of information.

While farmers with larger operations, such as those in the Midwest, are more likely to bear the costs associated with such market uncertainties and have more available resources to overcome them, producers in the MT-ID-WA region may be less able to do so. For example, 76% of producers in the MT-ID-WA region received less than $50,000 in farm sales (2007 Agricultural Census). Moreover, only few marketing tools are available to these farmers, and those that do exist are associated with relatively high acquisition costs. Producers are still largely required to incur high time costs (e.g., personally gathering market information from multiple sources) and/or significant monetary expenses (e.g., subscription or service fees for privately collected market information). Such barriers to information that can help lower marketing and price uncertainty can perpetuate low profitability for MT-ID-WA farms.

Improving MT-ID-WA farmers' marketing effectiveness depends largely on an unobstructed flow of information between consumers and producers. When this flow is inhibited or information is costly, however, significant losses of value occur. This is the case for wheat producers in the Montana, Idaho, and Washington region and, because of location and cultural barriers, American Indian wheat producers in Montana. One approach to aid farmers in this region is by providing them with up-to-date market information tools that are founded in extensive economic data. Enabling producers to effectively acquire market information can enhance their ability to develop profit-maximizing marketing strategies.

The purpose of this project was to reduce informational barriers in local MT-ID-WA wheat markets. The primary method of producer-consumer communication is price, and we, therefore, develop a mechanism that effectively relays current and future price information to producers, helping remove obstacles that impede optimal marketing, transportation, and distribution of agricultural commodities. This mechanism is provided to MT-ID-WA in the form of a web-based tool, which leverages farmers' rapidly

increasing access to information technology to expand their ability for gathering market information quickly and at substantially lower costs.

Recent surveys indicate that rural households overwhelmingly have Internet access. For example, a study by the USDA Economics Research Service indicates that 68.6% of rural households in the western United States use Internet (Stenberg and Low, 2009). Furthermore, responses from a January 2010 survey of eastern Washington wheat producers by local input dealers and agricultural lenders indicates widespread Internet access and interest in web-based educational programs. Of the 151 farms surveyed, 92% reported having Internet access in their homes or offices. When asked about their interest in participating in web-based educational programs, over 50% reported interest in participating. The majority of producers (72%) reported that time limitations were the primary reason for not attending workshops or participating in educational programs. This suggests that web-based information may increase the reach and effectiveness of grain marketing educational programs. The widespread access of MT-ID-WA farmers to the Internet indicates that a web-based price information tool is likely to be widely used and provide important market knowledge that can improve producers' competitiveness and long-term economic sustainability.

Plan and Approach

The primary goal of this project was to use a multi-state, multi-institution, multi-disciplinary collaborative effort to develop effective data-driven econometric methods that increase forecasting accuracy of future wheat prices, and enabling MT-ID-WA producers to easily access this information at a relatively low cost. The delivery of the information is in the form of a free, largely self-sustainable website that provides real-time, instantaneous access to local and regional wheat price information. Outreach events complemented the research and web-based price tool to provide educational training about underlying topics in understanding and hedging price risk and effective adoption and use of the new technology.

Basis Basics

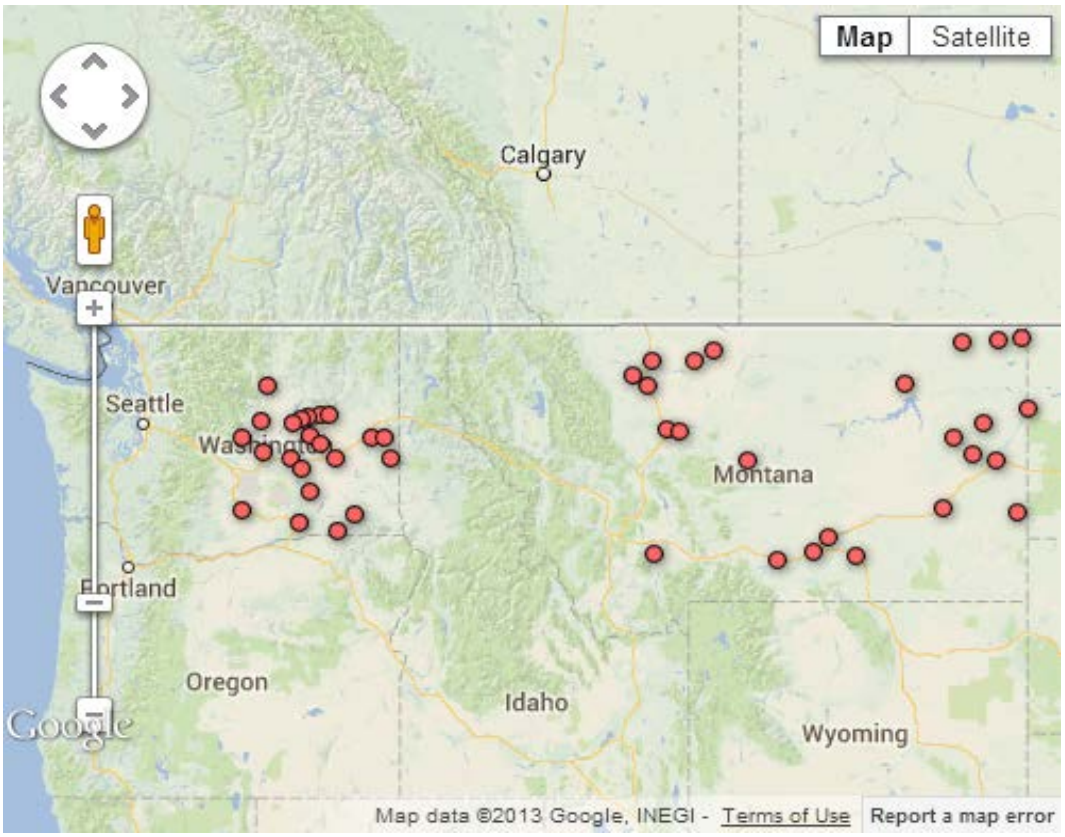
Using a multi-regional, multi-disciplinary approach, we formulated an economic model of wheat basis. Basis is defined as the difference between a cash price offered for a commodity at a specific location and a futures contract price for that commodity:

$$\text{Basis} = (\text{Local Price} - \text{Futures Price})$$

This difference occurs because futures markets, which capture global conditions and expectations, do not fully reflect the conditions in any particular local market. For example, discrepancies may be due to local variability in a commodity's quality levels, local demand and supply, and differences in transportation modes and costs. If none of these factors affected prices in a local market, then the basis would be zero, because the local price would be identical to the futures price.

Basis, rather than local cash prices or futures prices alone, have consistently been found to be preferable in predicting local agricultural prices. Consider, for example, the following scenario: Suppose that you were asked to predict the price of wheat in your local market three months from today. One reasonable strategy may

Figure 1: Locations of hard red winter and hard red spring wheat delivery locations in the MT-ID-WA region



Note: Locations shown are approximate and represent the centroid of the ZIP code where a delivery facility is located. Source: WheatBasis.montana.edu

be to determine the local price last year or take an average of several previous years. However, you would be using only information about what had already occurred, without incorporating expectations of what will occur in the future. A second approach could be to look only at the price of a futures contract expiring three months from today and assume that price to be most likely in a local market. This approach is also likely to lead to inaccurate predictions, because although the futures price accounts for national and international expectations about future wheat prices, it does not accurately characterize local market conditions and prices.

Using the combination of historical local information and market expectations about the future has been found to be a reasonable resolution. Historically, basis is much less variable than either local or futures market prices alone. This is because the volatility in prices caused by market fundamentals tends to affect both local and futures prices in the same direction. That is, when futures prices rise, local prices generally also increase. Similarly, decreases in local prices are associated with lower futures prices. Therefore, the difference between the local and futures prices, basis, is not likely to change by the same magnitude as prices themselves.

This stability of basis over time and across locations makes it effective in predicting factors impacting basis levels. Our modeling approach seeks to identify these factors.

Economic Wheat Basis Model

The primary aim of the modeling approach is twofold: (1) develop an econometric specification that produces basis (and price) forecasts with maximum precision; and (2) use that model to provide wheat producers with real-time access to wheat price bids based on wheat types, protein levels, and delivery locations.

The foundation of the economic model was based on extant literature regarding agricultural commodity basis forecasting (Taylor, Dhuyvetter, and Kastens, 2006; Tonsor, Dhuyvetter, and Mintert, 2004) and wheat marketing (Taylor, Brester, and Boland, 2005; Brester, 1999; Moutou, Brester, and Fox, 1998). A unique feature of this research, however, is its focus on modeling basis as a function of specific wheat attributes in the MT-ID-WA region including differing wheat types, protein levels, and geographical linkages among markets. Moreover, we incorporated information that accounted for basis differences between different spatially separated wheat delivery locations and across numerous wheat characteristics—critical components to grain marketing in the MT-ID-WA region (Goodwin and Smith, 2009; Bekkerman, 2010).

To empirically evaluate the economic models, we gathered market-level data for over 70 grain elevators or processing facilities in the MT-ID-WA region (shown in Figure 1) from both public and privately

Modeling Wheat Basis in the Montana, Idaho, and Washington Region

Behavior of wheat basis in the MT-ID-WA region is unique. For example, much of the commodity is shipped to ports in the Pacific Northwest for export, protein content considerations are critical, and harvests occur several weeks after wheat is harvested in the U.S. Midwest. These and other factors play important roles in affecting local basis.

In modeling basis in the MT-ID-WA markets, the following factors were considered:

- Wheat class (hard red spring and hard red winter)
- Wheat quality (protein content)
- Differences in markets' geographic locations
- Futures prices from the Kansas City Board of Trade (hard red winter wheat) and the Minneapolis Grain Exchange (hard red spring wheat)
- Futures price volatility
- Spread between HRS and HRW wheat futures prices
- Basis in previous periods
- Seasonal fluctuations

maintained sources. Public sources include the USDA Agricultural Marketing Service and private databases of cash price information and futures price data include *Cash Grain Bids, Inc.* and the *Commodity Research Bureau*, respectively. The weekly basis data ranged from January 2005 to February 2011, providing a sufficient number of observations to accurately estimate the relationships between basis and other observed variables.

These data were used to estimate numerous harvest-time econometric models of wheat basis (see the focus box "Modeling Wheat Basis in the Montana, Idaho, and Washington Region" for details about factors considered in the specifications). That is, because most producers market their grain immediately after its harvest and prices are most uncertain during those periods, the models estimate harvest-time basis only. We then used several statistical criteria to evaluate the ability of a particular statistical model to predict basis.

First, each model was assessed based on its capacity to predict basis values that already occurred (in-sample predictions). These assessment measures included comparisons of the coefficients of determination and the Akaike's and Bayesian information criteria across models. Second, models were graded on their accuracy of forecasting future harvest time basis (out-of-sample predictions).

More recent basis data best characterized the increased price and basis volatility observed since 2008.

The statistical models that minimized the prediction errors (measured using forecast root mean squared error, mean absolute error, and mean absolute percent error) were then chosen. Greater emphasis was placed on selecting models that made the fewest errors in forecasting future basis values.

Special considerations were given to the increased price and basis volatility observed after 2008. We tested the in-sample and out-of-sample model performances using the entire available data set and using only more recent subsamples. The empirical results indicate that most accurate predictions of current wheat markets was associated with models that used the more recent information, which better characterized the increased price and basis volatilities. Additionally, we eliminated locations that did not have a sufficient number of price data to accurately estimate basis for those markets.

In total, 52 different specifications were estimated and tested. Table 1 presents a summary of the specifications selected from the 52 candidates for the two classes of wheat. Lagrange multiplier and Wald tests were used to determine that the models should be estimated separately for each wheat class (hard red winter and hard red spring) but using categorical variables for specifying different protein content levels.

The table indicates that basis for both wheat classes are explained by similar characteristics, including protein levels, markets' expectations of future prices, the uncertainty in those expectations, the interactions between winter and spring wheat markets, seasonal effects on basis, and differences in cash market locations.

For hard red winter wheat, information about the preceding week's basis is also important, although (somewhat surprisingly) not for hard red spring wheat. These estimated models were then used as the foundation for developing a web tool that offers basis forecasts for wheat markets in the MT-ID-WA region.

Table 1: Specifications of the Harvest Time Wheat Basis Models by Class

Wheat Class	*Model Variables*
Hard Red Winter	Basis in preceding week Protein level Futures price Futures price volatility HRW/HRS price spread Weekly indicator Location indicator
Hard Red Spring	Protein level Futures price Futures price volatility HRW/HRS price spread Weekly indicator Location indicator

Wheat Basis Website

While the economic and econometric analyses offer important insights about the forces underlying the MT-ID-WA grain markets, these alone are only a means, rather than an end, in the goal to reduce informational barriers faced by the region's producers. A key objective of this project, then, was to develop a free, easily accessible tool that can use the lessons learned from the economic modeling to increase producers' knowledge about wheat pricing. Our approach to meeting this objective was by developing an interactive, self-sustainable basis and cash price prediction website.

The website is based on the framework in which selected econometric models developed are combined with real-time wheat futures contract prices to provide up-to-date wheat price forecasts. Website users are able to specify numerous criteria. These criteria are then used to generate

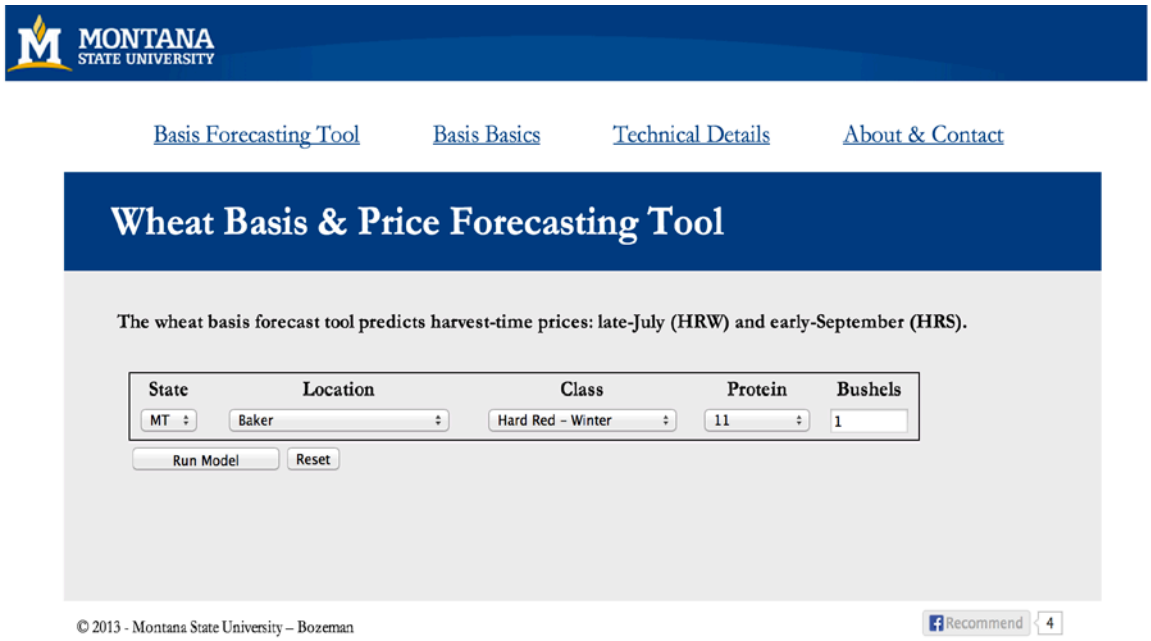
WheatBasis.montana.edu

basis price forecasts using appropriate nearby futures contract prices. In addition, wheat producers are instantly able to compare current cash price offerings from numerous relevant locations, improving their selling decisions while minimizing information search costs.

After a significant amount of testing by the project's team, WheatBasis.montana.edu became fully available to the public on February 1, 2013. It is hosted on a server provided by the Montana State University's College of Agriculture, enabling the website to sustain a large number of visitors, retrieve and display relevant information quickly, and minimize the likelihood of outages.

The web tool was designed with two main priorities: ease of use and sustainability, both of which are expected to ensure that the tool is a long-term asset to MT-ID-WA wheat producers. Feedback obtained from previous outreach activities suggested that the ease of website navigability is a major factor in determining whether agricultural producers adopt web-based tools. Many existing tools overwhelm users by presenting too many input fields and options. Therefore, developing a website that was both informative and had a high

Figure 2: Screenshot of the WheatBasis.montana.edu Homepage. Users Can Select Numerous Market Parameters for Generating Basis and Cash Price Predictions.



likelihood of adoption was a critical objective.

When users log onto the website's homepage, they are presented with a straightforward, intuitive interface, shown in Figure 1. The user can make four selections: the state of the delivery location, the city of the location, wheat class, and the protein level. Each selection is conditional on the previous choice, minimizing the amount of initial information that users must have. For example, if a location only accepts hard red winter wheat, users will be unable to select hard red spring wheat or the higher protein levels associated with HRS. Lastly, users may enter an amount of grain (in bushels) that they wish to deliver to a location.

Initiation of the tool prompts a user's selections to launch the prediction model, which is calibrated by the econometric estimation results. Figure 3 shows the prediction results presented to the user, which is divided into three sections: basis and price predictions, scenario analyses, and location map.

The basis and price predictions section presents seven results. First, the futures price for the particular class of wheat is shown. This is the closing futures price from the previous day and is associated with the Kansas City Board of Trade if the user selects hard red winter wheat and with the Minneapolis Grain Exchange if hard red spring wheat was selected. Next, the table presents the predicted basis and a 95% confidence interval around this prediction. The confidence interval provides inferences about the range of most likely basis outcomes, with the majority of outcomes predicted to be within the provided interval. It is important to consider both the single estimate and the confidence interval when interpreting the statistical model forecasts.

Figure 3: Screenshot of the WheatBasis.montana.edu Prediction Results—Basis and Price Predictions, Scenario Analysis Matrix, and Selected Location Map

Wheat Basis & Price Forecasting Tool

The wheat basis forecast tool predicts harvest-time prices: late-July (HRW) and early-September (HRS).

State	Location	Class	Protein	Bushels
MT	Fairview	Hard Red – Spring	13	100

Run Model Reset

Futures Price (Dollars per Bushel)	$7.84
Basis (Cents per Bushel)	-72
Basis 95% Confidence Interval	(-126 , -19)
Expected Cash Price (Dollars per Bushel)	$7.12
Price 95% Confidence Interval	($6.58 , $7.65)
Expected Revenue (Price × Bushels)	$711.55
Expected Revenue 95% Confidence Interval	($658.05 , $765.04)

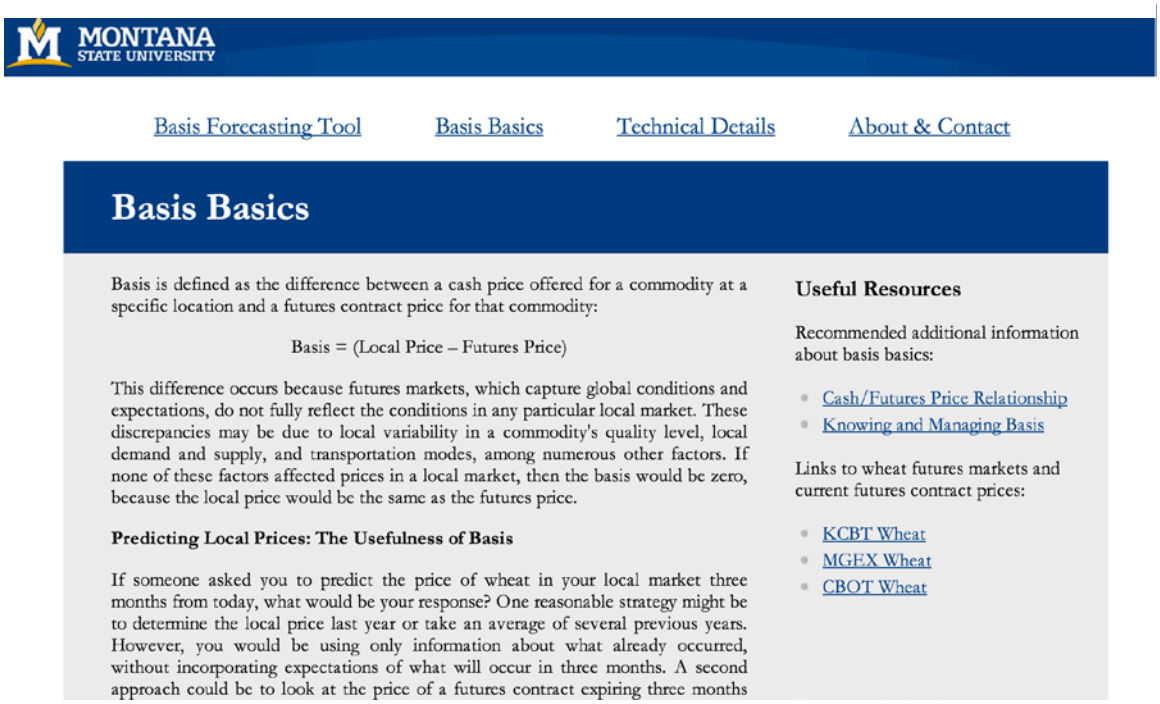
Note: Futures price is the settlement price on the previous business day. How to Interpret

	-$0.92	-$0.82	-$0.72	-$0.62	-$0.52
$6.84	$5.92	$6.02	$6.12	$6.22	$6.32
$7.04	$6.12	$6.22	$6.32	$6.42	$6.52
$7.24	$6.32	$6.42	$6.52	$6.62	$6.72
$7.44	$6.52	$6.62	$6.72	$6.82	$6.92
$7.64	$6.72	$6.82	$6.92	$7.02	$7.12
$7.84	$6.92	$7.02	$7.12	$7.22	$7.32
$8.04	$7.12	$7.22	$7.32	$7.42	$7.52
$8.24	$7.32	$7.42	$7.52	$7.62	$7.72
$8.44	$7.52	$7.62	$7.72	$7.82	$7.92
$8.64	$7.72	$7.82	$7.92	$8.02	$8.12
$8.84	$7.92	$8.02	$8.12	$8.22	$8.32

$ 0.20 Futures Increment $ 0.10 Basis Increment
(Change an increment and press Enter)

Note: Locations shown are approximate and represent the centroid of the ZIP code where a facility is located.
Use for reference purposes only.

Figure 4: Screenshot (partial) of the WheatBasis.montana.edu Description of Basis Page



MONTANA STATE UNIVERSITY

Basis Forecasting Tool | Basis Basics | Technical Details | About & Contact

Basis Basics

Basis is defined as the difference between a cash price offered for a commodity at a specific location and a futures contract price for that commodity:

Basis = (Local Price – Futures Price)

This difference occurs because futures markets, which capture global conditions and expectations, do not fully reflect the conditions in any particular local market. These discrepancies may be due to local variability in a commodity's quality level, local demand and supply, and transportation modes, among numerous other factors. If none of these factors affected prices in a local market, then the basis would be zero, because the local price would be the same as the futures price.

Predicting Local Prices: The Usefulness of Basis

If someone asked you to predict the price of wheat in your local market three months from today, what would be your response? One reasonable strategy might be to determine the local price last year or take an average of several previous years. However, you would be using only information about what already occurred, without incorporating expectations of what will occur in three months. A second approach could be to look at the price of a futures contract expiring three months

Useful Resources

Recommended additional information about basis basics:

- Cash/Futures Price Relationship
- Knowing and Managing Basis

Links to wheat futures markets and current futures contract prices:

- KCBT Wheat
- MGEX Wheat
- CBOT Wheat

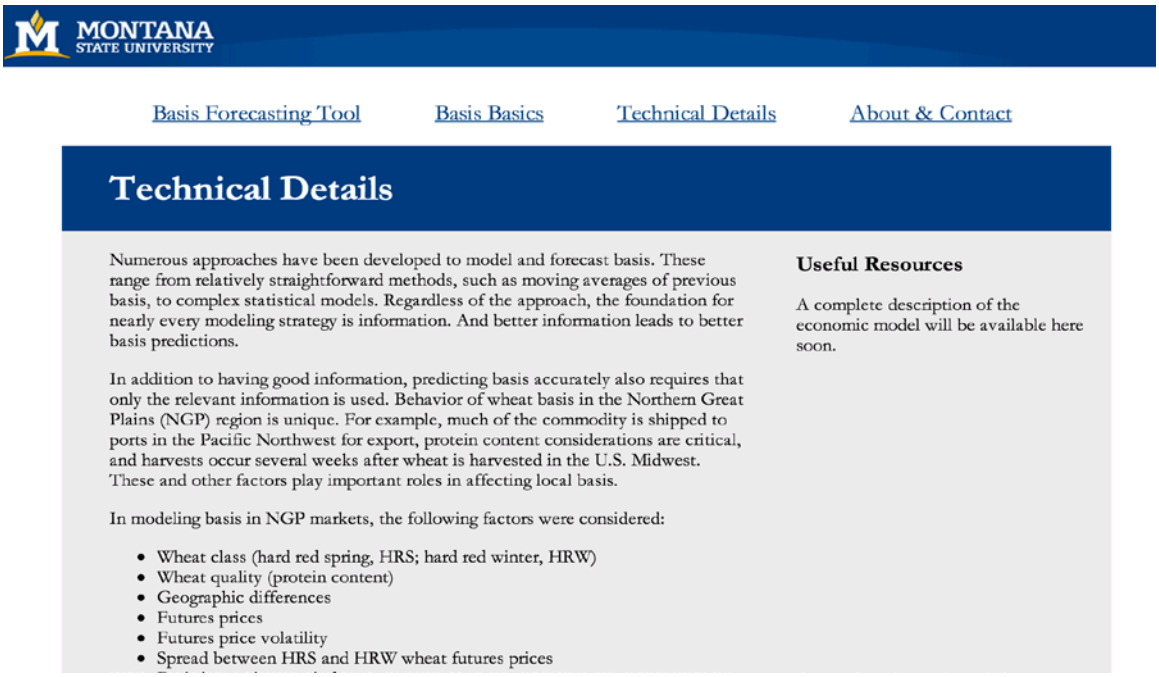
The basis prediction and futures price are then used to calculate the expected cash price and associated confidence interval at the selected location and for the selected wheat class and protein level. Lastly, users are presented with the expected revenue for the number of bushels they entered in the initial tool setup. At the bottom of the basis and predictions table, users can click on a link that creates a pop-up window in which these results are explained. Therefore, even users who may be unfamiliar with a particular term or may not be certain about how to interpret a specific result are offered a description.

The second, scenario analysis section in Figure 3 offers users an opportunity to make minor manual adjustments to the futures price value and local basis prediction. For example, users may wish to examine how cash price predictions could change if there is movement in futures prices or if local market conditions are particularly anomalous. Therefore, even though the web tool offers a relatively structured, straightforward framework for users to obtain local market information, it also provides an opportunity for producers to exercise some judgment (which the econometric model may not be capturing) and allow for the tool to be relatively flexible.

Lastly, the results page provides a map of the selection location for users to evaluate the potential transportation costs they may incur to deliver the grain to the elevator. Because these maps are generated using the Google Maps API, users have the same dynamic capabilities as with any other

The intuitive website design and helpful descriptions provide value even to users unfamiliar with interpreting basis forecasts.

Figure 5: Screenshot (partial) of the WheatBasis.montana.edu Technical Modeling Details Page



Google map, including zooming, panning, and requesting directions.

In addition to being an interactive basis and price prediction tool, the website offers important information about grain marketing and the technical details of the underlying model. Figure 4 shows a screenshot of the website's page that describes basics of understanding basis. The screenshot of the page outlining the technical details and a map of all locations used in the study is shown in Figure 5. Lastly, we provide information about individuals who contributed to the website, including the role of the FSMIP, and several ways that individuals are able contact us.

The interactive and intuitive website design allows users to easily obtain up-to-date, relevant local market information. In addition to this ease-of-use criterion, our second objective was to ensure that the tool is a long-term asset to MT-ID-WA producers. That is, because markets conditions are fluid and can change dramatically within a short period of time, it is important to effectively capture these changes in a timely manner and provide the updated information to producers. However, manually monitoring for market changes is extremely costly and may result in an eventual demise of the tool.

To overcome this challenge, the website's database is automatically updated each day using data-collection scripts. The scripts are designed to gather and store relevant price data from numerous sources at the end of each business day, and then organize and update the database used by the website to generate basis and price predictions. This process is performed without any additional actions from website administrators. Error checking mechanisms are included in the scripts so that any data collection or processing errors are recorded to a log and immediately reported to an administrator

via email. Only in the event of such a report does the administrator need to determine the source and apply a solution. Therefore, this automated data collection, updating, and error checking structure substantially reduces website maintenance costs and allows the tool to maintain a largely self-sustainable structure.

Measuring the Impacts: Website Use and Outreach Activities

This project was evaluated using two approaches. First, it was important to gauge website visitation and use, including number of unique visitors, frequency of repeat visits, and approximate geographic location of visitors. Second, outreach programs were organized to introduce and educate producers on the uses and benefits of this website. Outreach efforts focused on education about the short- and long-term benefits of understanding basis, discovering and forecasting prices for specific wheat types, using the website to discover marketing opportunities, and increasing wealth through the implementation of optimal marketing strategies. Both project evaluation strategies are important to understanding the adoption levels, value added to website users, interest in further development of this or similar tools, and reaching out to the broader agricultural community in the MT-ID-WA region.

Tracking of the web-based tool's adoption and use was done with a website visitor tracking mechanism provided by *www.statcounter.com*. The mechanism anonymously collects information about the number of unique visitors to the

Summary of WheatBasis.montana.edu Visits (February 10, 2013–June 18, 2013)

Page Loads	*Unique Visits*	*First Time Visits*	*Returning Visits*
862	288	258	30

Visitor Location	*Percent of Total Visits from Location*
MT-ID-WA Region	76.00%
Western U.S. Region	10.80%
Midwest Region	8.60%
Eastern U.S. Region	2.40%
Australia	0.60%
Switzerland	0.60%
Bahrain	0.20%
Canada	0.20%
Egypt	0.20%
India	0.20%
United Kingdom	0.20%

website, the approximate location of visitors, and if users have made repeat visits. The focus box "Summary of WheatBasis.montana.edu Visits" provides a descriptive summary of users accessing the web-based tool. As expected, most visitors are from the MT-ID-WA region.

The outreach component of this project was crucial for encouraging initial adoption and increasing the website's use. Specifically, producers' ability to navigate the website, implement its features, and understand displayed results and analyses will determine the long-term success of the project.

An important component of the outreach efforts was the collaboration with Fort Peck Community College, a 1994 Land Grant Institution, which helped improve the economic opportunities for American Indian wheat producers on the Fort Peck Indian Reservation. Over 10% of Montana's American Indian population reside in Roosevelt County (the Fort Peck Indian Reservation comprises most of the county). The median household income on the Reservation is about $22,000 which is $10,000 less than that of Montana's general population ($33,024). More than 30% of Reservation families live below the poverty level compared to 10.5% for the entire State. Roosevelt County ranks ninth in total wheat production in Montana. The county has 833 agricultural operations and more than 100 American Indian producers. However, the geographical location of Roosevelt County contributes to one of the weakest wheat basis regions in Montana, which creates significant competitive disadvantages for American Indian wheat producers. Our research and educational outreach efforts can reduce informational barriers and improve the profitability of American Indian wheat producers on the Fort Peck Indian Reservation.

Outreach was crucial for encouraging initial adoption and increasing use of the website.

The outreach activities were performed in numerous ways throughout the MT-ID-WA region. Outreach programs generally included brief overviews of the underlying issues, tutorials on the importance of removing informational barriers in agricultural marketing, demonstrations of website features, and examples of how to use and understand the analyses. Presentations were made at annual meetings of several professional groups in Montana, including the Montana Grain Growers Association, the Montana Agribusiness Association, and the Montana Bankers Association. The website tool was also presented to the Montana Agricultural Statistical Service's survey and census collection team. Individuals at these presentations are either directly involved in producing and marketing grain or are in frequent contact with farmers and can communicate the information to those individuals.

Additionally, presentations of this project were made during outreach programs targeting young and underprivileged farmers—a group that included a significant number of American Indian producers. These farmers are least able to bear the costs of informational barriers, and would obtain the greatest benefits from improving their marketing strategies. The web-based tool was also discussed on Montana Ag Live, a weekly television program aired by the regional Public

Broadcasting System (PBS) affiliate. The program is watched by many producers in the MT-ID-WA region and the tool's discussion helped increase its exposure to a broad audience.

The project's collaborator at Fort Peck Community College will hold educational and training sessions for American Indian wheat growers on the Fort Peck Indian Reservation. These efforts are critical to encouraging improved marketing approaches by producers who face additional challenges due to their geographic location. The targeted presentation approaches ensure greater effectiveness in successfully communicating important information about wheat marketing and techniques to reduce informational barriers.

In addition to direct communication efforts, the launch and purpose of the website was disseminated in printed media. These included the Montana Grain Growers Associations monthly newsletter (Montana Grain News), Montana State University's College of Agriculture quarterly newsletter (distributed to all alumni and affiliates of the College of Agriculture), and the Department of Agricultural Economics and Economics biannual newsletter (distributed to all department alumni and affiliates). Furthermore, the project's information was requested to be distributed by the Washington State University extension program.

Conclusions, Lessons Learned, and Future Work Recommendations

This project intended to meet three important goals: (1) generate knowledge that will increase the value of agricultural products sold per farm; (2) enhance the sustainability and profitability MT-ID-WA farmers and their rural communities; and (3) enhance the efficiency and equity of information use by those in the agriculture sector. To this end, the data-driven development of a wealth-enhancing marketing tool and dissemination of information about this tool through educational efforts will have both direct and indirect positive economic impacts on MT-ID-WA farmers and rural communities. Specifically, the viability and sustainability of MT-ID-WA farmers will help maintain economic and population growth in rural areas and contribute to the growth of local businesses and public services, perpetuating the economic health of rural communities in the MT-ID-WA region.

Although the outcomes of this project largely meet these objectives, there were several important lessons learned throughout the project that offer insights for future work. The first, and rather encouraging lesson, was the enthusiasm with which producers and other members of the agricultural industry received the idea and implementation of the web-based basis and price discovery tool. An important implication is that the industry is rapidly moving to using web-based information tools and future work for introducing new tools could be critical to improving the well-being of agricultural markets. It was also evident that developing web-based tools alone is insufficient. Rather, the ease of use and navigability is just as important (if not more so) for effectively communicating information and encouraging adoption and widespread use. While there are undoubtedly a wide variety of available tools from the USDA, state experiment stations, and other public and private organizations, reconsidering the design of

those tools can have significant impacts on increasing their use and effectiveness.

A challenge that provided another insight was the lack of sufficient data for markets in the MT-ID-WA and the broader Northern Great Plains (NGP) regions. For example, while there are numerous public USDA sources that offer detailed price information on a multitude of markets in the Midwest, this is much less the case for markets in the NGP. As broad market conditions continue to change and evolve (e.g., the deregulation of the Canadian Wheat Board and increased global demand for wheat grown in the NGP), the importance of this agricultural region will continue to grow. However, this growth is also likely to be associated with an increased demand for information by both producers and consumers. Continued efforts by public agencies to gather market information and by researchers to develop methods to improve the usefulness of these data can be beneficial to the long-term well-being of the agricultural industry in the NGP.

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Predicting Local Wheat Basis: Introducing WheatBasis.Montana.edu

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MSU Department of Agricultural Economics and Economics

2012 MGGA Annual Convention

Great Falls, MT

December 5, 2012

OUTLINE

1. Price Forecasting

2. Expected Basis

3. Forecasting Basis

4. WheatBasis.Montana.edu

The Most Often Asked Question?

1. **What is the price of wheat going to be next ……?**
2. **If someone really knew the answer**
   a. **What would be their incentive to tell you?**
3. **But, the question is certainly important**
   a. **For planning**
   b. **For marketing**
   c. **For financial decision-making**

Price Forecasting Methods

1. **Listen to experts and pundits**
   a. **What would be their incentive to tell you?**

Bing

Price Forecasting Methods

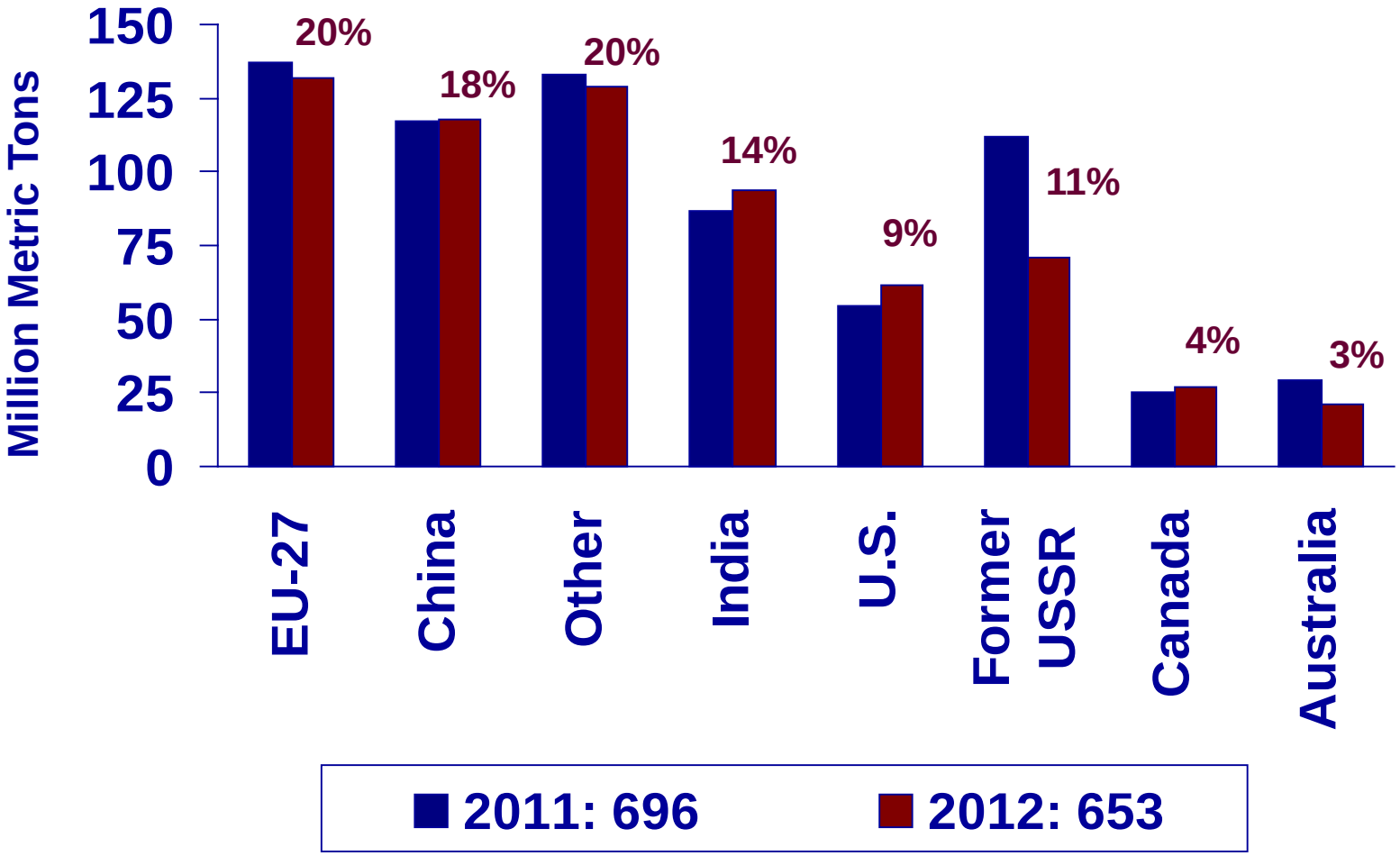
1. **Listen to experts and pundits**
   a. **What would be their incentive to tell you?**
2. **You can enlist divine intervention**

Price Forecasting Model

Price Forecasting Methods

1. Listen to experts and pundits
   a. What would be their incentive to tell you?
2. You can enlist divine intervention
3. You can evaluate domestic and world demand and supply fundamentals
   a. This activity is important in general for numerous reasons

Global Wheat Production



Source: U.S. Foreign Agricultural Service

Price Forecasting Methods

1. **Listen to experts and pundits**
   a. **What would be their incentive to tell you?**
2. **You can enlist divine intervention**
3. **You can evaluate domestic and world demand and supply fundamentals**
   a. **This activity is important in general for numerous reasons**
4. **Develop statistical models**

Statistical Models

(15) $$c|\boldsymbol{F} \sim N(\mu_c^{post}, \Omega_c^{post}),$$

where $\mu_c^{post} = Dd$, $\Omega_c^{post} = \sigma_u^2(|\Delta\boldsymbol{q}|'''\Delta\boldsymbol{q}|)^{-1}$, $D^{-1} = |\Delta\boldsymbol{q}|'(\sigma_u^2)^{-1}|\Delta\boldsymbol{q}| + (\Omega_c^{prior})^{-1}$, and $d = |\Delta\boldsymbol{q}|'(\sigma_u^2)^{-1}|\Delta\boldsymbol{F}| + (\Omega_c^{prior})^{-1} + \mu_c^{prior}$. The conditional distributions of σ_u^2 and $\boldsymbol{q}$ for both HAS and FGM measures are:

(16) $$\sigma_u^2|\boldsymbol{F} \sim IG(\alpha^{post}, \beta^{post}),$$

where $\alpha^{post} = \alpha^{prior} + t/2$, $\beta^{post} = \beta^{prior} + \Sigma u_t^2/2$, with $\alpha^{prior} = \beta^{prior} = 10^{-12}$ and:

(17) $$q_t^{post}|\boldsymbol{F} \sim Bernoulli(p_{buy}),$$

where $p_{buy} = e^{(4cp_t)/(\sigma_u^2)}(e^{2c(m_{t-1}+m_{t+1})/(\sigma_u^2)} + e^{(4cF_t)/(\sigma_u^2)})$ is the probability that $q_t = +1$. The prior parameters for c are $\mu_c^{prior} = 0$ and $\Omega_c^{prior} = 10^6$, while the prior for q_t is $q_t^{prior} \sim Bernoulli(1/2)$. We run 2,000 sweeps with the Gibbs sampler to estimate the full posterior $F(c, \sigma_u^2, \boldsymbol{q}|\boldsymbol{F})$. To reduce dependency on the initial values, the first 400 (20%) are considered burn in and are discarded. The posterior mean of c is obtained as the mean of the remaining 1,600 simulated values of c. The posterior mean is multiplied by two to get the estimate of the bid-ask spread.

To test hypotheses about factors influencing option liquidity costs, we estimate the following regression equation:

(18) $$y_{kt} = \beta_0 + \beta_1 M_{kt} + \beta_2 T_{kt} + \beta_3 D_{kt} + \beta_4 Z_{kt} + \beta_5 N_{kt} + \vartheta_k + \varepsilon_{kt},$$

Source: JARE, Brorsen, 2012

Price Forecasting Methods

1. Listen to experts and pundits
   a. What would be their incentive to tell you?
2. You can enlist divine intervention
3. You can evaluate domestic and world demand and supply fundamentals
   a. This activity is important in general for numerous reasons
4. Develop statistical models
5. Futures markets
   a. Adjusted for expected basis

Why Futures Markets?

1. **Compilation of 1,000s of people**
   a. **All of whom are using real money**
2. **Because they constantly evaluate new information**
   a. **This means that forecasts of future prices change continually**

OUTLINE

1. Price Forecasting
2. **Expected Basis**
3. Forecasting Basis
4. WheatBasis.Montana.edu

Why Adjust for Basis?

1. **Basis is the difference between your local selling price and the futures markets**

2. **"Expected" basis is the real issue because the actual basis varies over time because of changes in**

   a. **Transportation costs**

   b. **Local supply/demand conditions**

   c. **Logistical concerns**

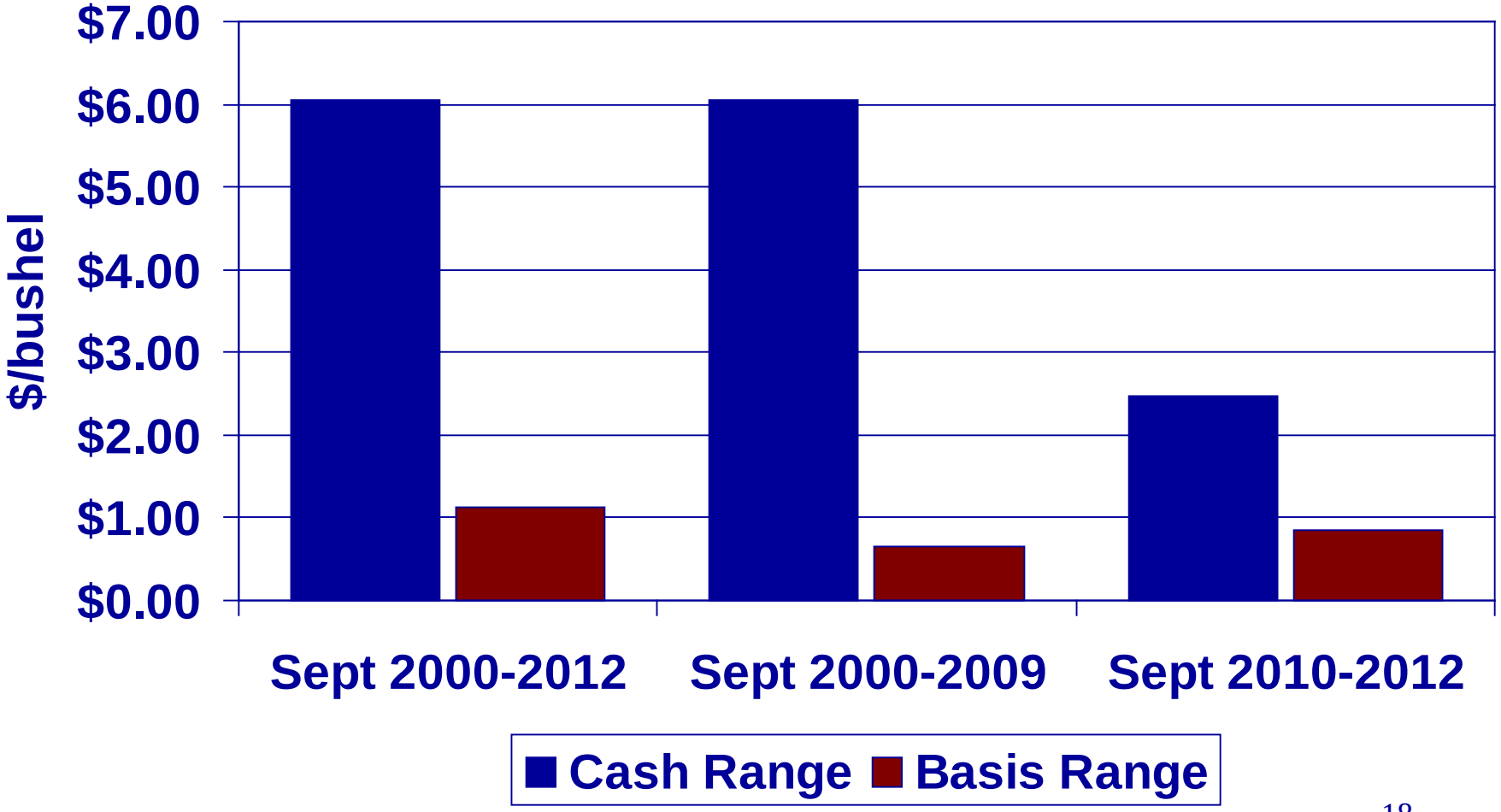
   d. **Risk**

Expected Basis Forecasts

1. **If you can't predict price, why bother trying to predict basis?**
2. **Because the basis varies much less than price**
   a. **Which makes it more predictable**

Price Risk versus Basis Risk

Great Falls, 13.5% Spring Wheat, September



Expected Basis Forecasts

1. **If you can't predict price, why bother trying to predict basis?**
2. **Because the basis varies much less than price**
   a. **Which makes it more predictable**
3. **How do we predict basis?**
   a. **Moving averages**

MT Wheat & Barley Committee

Great Falls 2012			Wheat Futures							
Date	Basis Month		Kansas City	Minneapolis	Hard Red Winter (HRW)					
	HRW	HRS			Ordinary		11.0%		12.0%	
8/2/2012	Sept	Dec	869.00	936.50	709	777	749	797	799	814
8/3/2012	Sept	Dec	896.00	954.00	756	801	796	821	826	841
8/6/2012	Sept	Dec	896.00	954.00	780	801	810	821	831	839
8/7/2012	Sept	Dec	896.00	946.25	780	801	810	821	831	839
8/8/2012	Sept	Dec	903.75	954.50	787	826	817	836	838	843
8/9/2012	Sept	Dec	915.00	968.25	798	838	828	848	850	855
8/10/2012	Sept	Dec	893.00	945.75	776	816	806	826	828	833
8/13/2012	Sept	Dec	868.00	924.00	751	791	781	801	803	808
8/14/2012	Sept	Dec	852.00	913.75	735	775	765	785	787	792
8/15/2012	Sept	Dec	858.00	923.50	761	781	781	791	791	798
8/16/2012	Sept	Dec	872.50	932.00	771	798	791	808	806	815
8/17/2012	Sept	Dec	885.50	940.00	784	811	804	821	819	828
8/20/2012	Sept	Dec	891.00	943.75	791	817	809	827	824	834
8/21/2012	Sept	Sept	908.25	944.75	808	834	826	844	841	851
8/22/2012	Sept	Sept	905.25	941.75	805	832	823	842	838	849
8/23/2012	Sept	Sept	883.00	920.50	787	809	807	819	817	828
8/24/2012	Sept	Sept	876.25	918.50	781	803	801	813	811	822
8/27/2012	Sept	Sept	873.00	912.75	778	800	798	810	808	820
8/28/2012	Sept	Sept	867.50	910.00	773	801	793	811	803	818
8/29/2012	Dec	Dec	922.00	955.00	802	830	822	840	832	847
8/30/2012	Dec	Dec	916.00	955.00	794	824	814	834	826	841
8/31/2012	Dec	Dec	906.00	948.25	786	814	806	824	816	831
9/4/2012	Dec	Dec	907.25	948.75	790	815	812	820	822	832
9/5/2012	Dec	Dec	887.00	929.75	770	795	790	805	805	812
9/6/2012	Dec	Dec	911.50	949.50	794	819	814	829	826	836
9/7/2012	Dec	Dec	923.25	958.00	805	831	825	841	838	848
9/10/2012	Dec	Dec	904.50	935.25	789	812	809	824	819	834
9/11/2012	Dec	Dec	904.00	935.00	789	812	809	824	819	834
9/12/2012	Dec	Dec	912.50	951.50	805	820	825	830	835	842
9/13/2012	Dec	Dec	922.75	962.50	815	830	835	840	845	847
9/14/2012	Dec	Dec	948.00	978.00	835	856	845	866	865	873

Expected Basis Forecasts

1. If you can't predict price, why bother trying to predict basis?
2. Because the basis varies much less than price
   a. Which makes it more predictable
3. How do we predict basis?
   a. Moving averages
   b. Statistical models that are updated frequently
      - Coupled to a website that does the hard work for you

OUTLINE

1. Price Forecasting

2. Expected Basis

3. **Forecasting Basis**

4. WheatBasis.Montana.edu

It’s All About Information

1. Good predictions come from good information

2. What is useful for predicting basis?

   a. Previous basis information

      - Well-researched approach

   b. But, more information may be better

What's Our Approach?

Project funded by Federal State Marketing Improvement Program (FSMIP)

<u>Information Relevant to Basis in Montana:</u>

- **Futures prices**
- **Futures volatility**
- **Price spread between HRW and HRS**
- **Protein level**
- **Seasonal changes**
- **Previous basis**
- **Locational differences**

OUTLINE

1. Price Forecasting
2. Expected Basis
3. Forecasting Basis
4. **WheatBasis.Montana.edu**

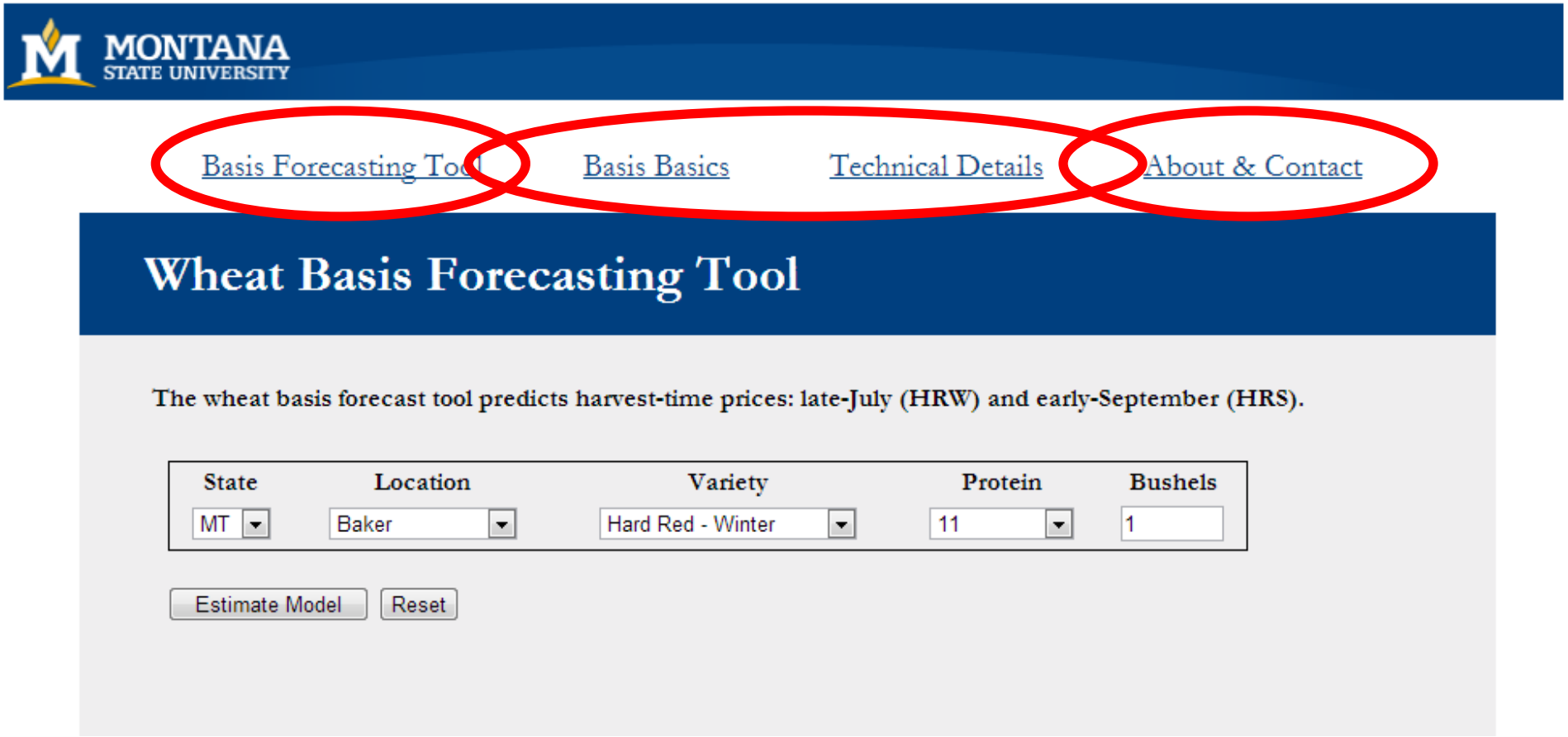
Web Tool Overview

1. Provide easier access to relevant market information

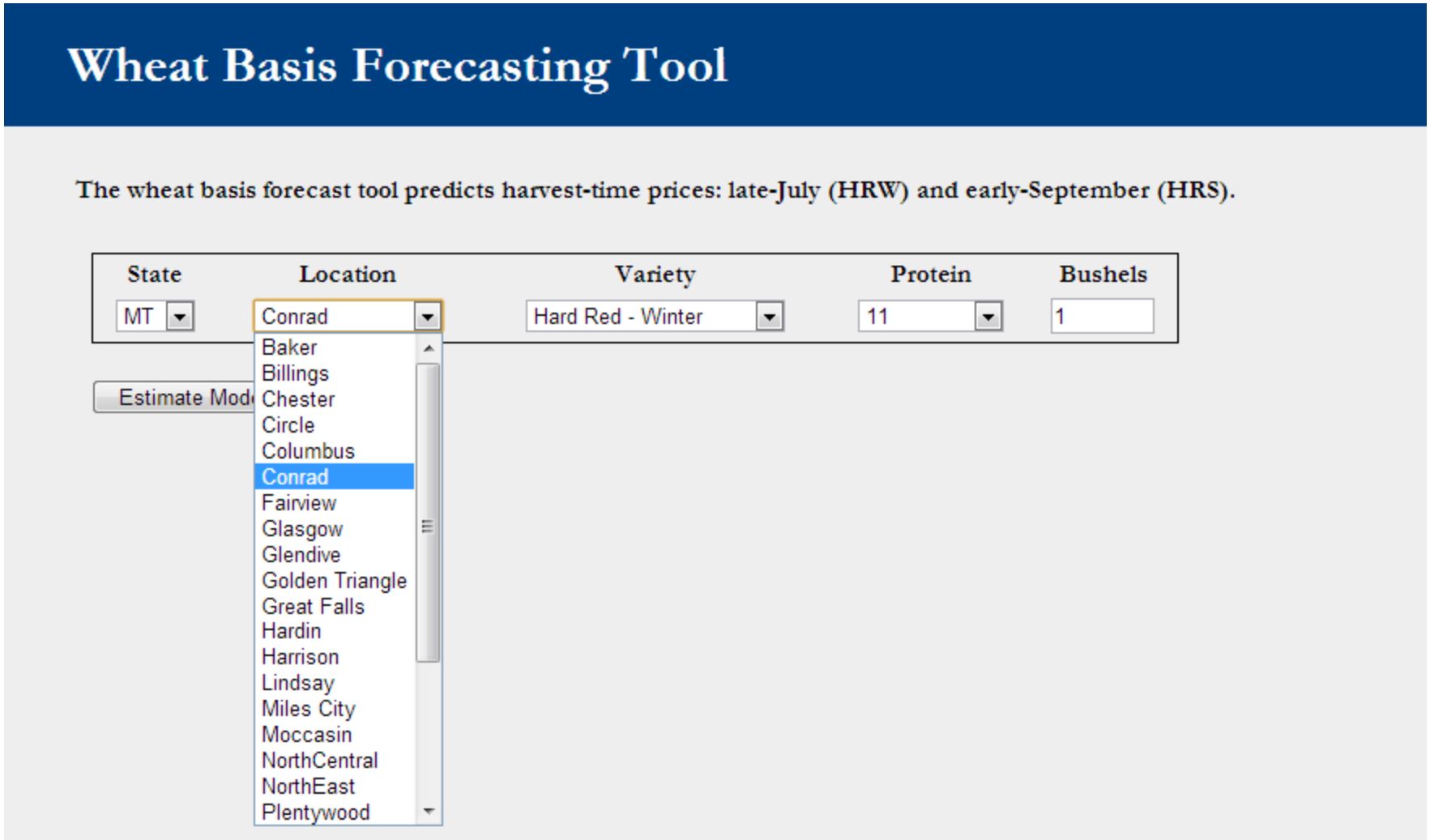
2. Reduce marketing costs

3. Offer information that may reduce exposure to price risks

Show it, already!



What Can I Do With It?



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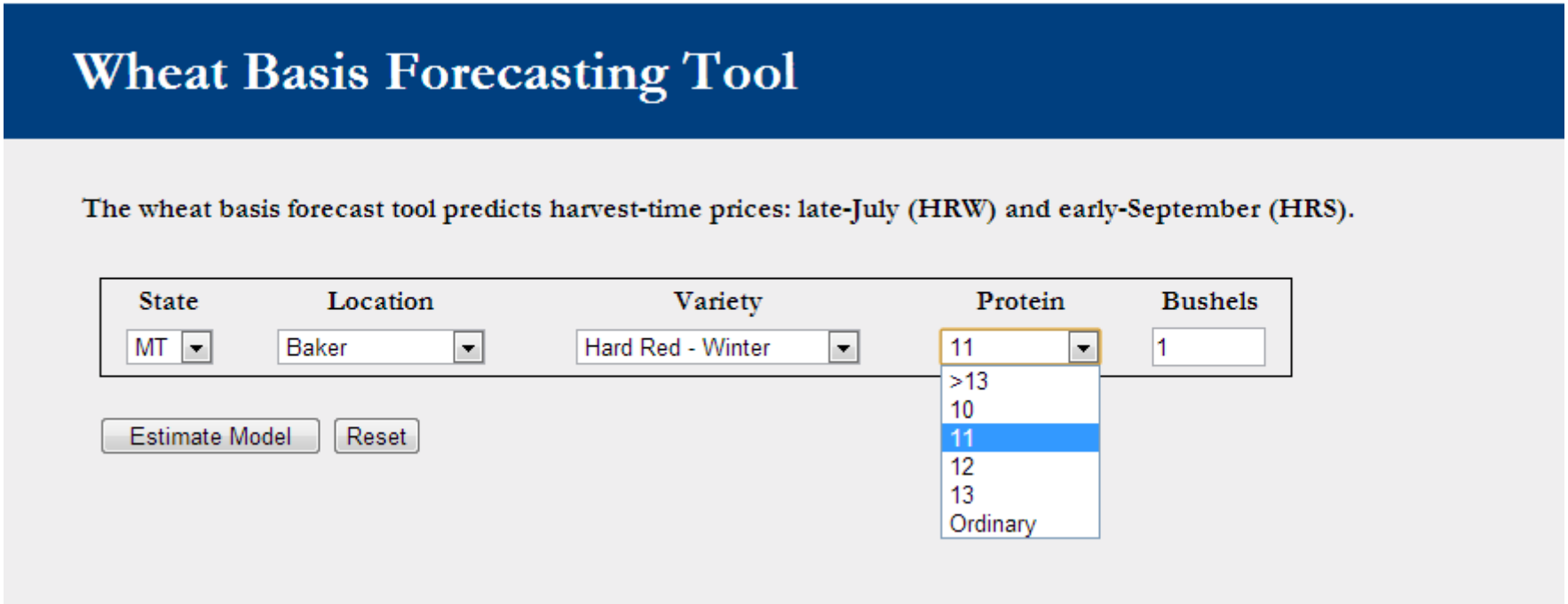

What Does It Do?

State	Location	Variety	Protein	Bushels
MT	Circle	Hard Red - Winter	11	10000

Estimate Model Reset

Basis (Cents per Bushel)	-51.4
Basis 95% Confidence Interval	[-62.1, -40.7]
Expected Cash Price (Dollars per Bushel)	$8.93
Price 95% Confidence Interval	[$8.82, $9.04]
Expected Revenue (Price × Bushels)	$89,300.00
Expected Revenue 95% Confidence Interval	[$88,200, $90,400]

	-51.6	-51.5	-51.4	-51.3	-51.2
$8.44	$7.92	$7.93	$7.93	$7.93	$7.93
$8.64	$8.12	$8.13	$8.13	$8.13	$8.13
$8.84	$8.32	$8.33	$8.33	$8.33	$8.33
$9.04	$8.52	$8.53	$8.53	$8.53	$8.53
$9.24	$8.72	$8.73	$8.73	$8.73	$8.73
$9.44	$8.92	$8.93	$8.93	$8.93	$8.93
$9.64	$9.12	$9.13	$9.13	$9.13	$9.13
$9.84	$9.32	$9.33	$9.33	$9.33	$9.33
$10.04	$9.52	$9.53	$9.53	$9.53	$9.53
$10.24	$9.72	$9.73	$9.73	$9.73	$9.73
$10.44	$9.92	$9.93	$9.93	$9.93	$9.93

0.20 Futures Increment 0.10 Basis Increment

Really Small Screenshot

Wheat Basis Forecasting Tool

The wheat basis forecast tool predicts harvest-time prices: late-July (HRW) and early-September (HRS).

State	Location	Variety	Protein	Bushels
MT	Circle	Hard Red - Winter	11	10000

Estimate Model | Reset

Basis (Cents per Bushel)	-51.4
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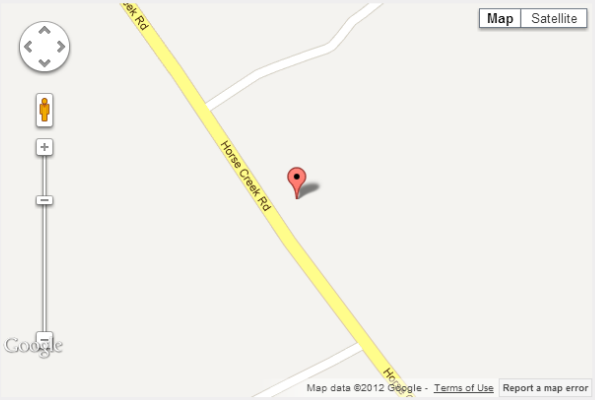
0.20 Futures Increment 0.10 Basis Increment



So When Can I Use It?

1. We are still working out the kinks
2. Projected to go live in mid- to late-January
3. Your feedback is valuable
   a. This is a tool for your use
4. E-mail, call, send a letter, shout, etc.

QUESTIONS?