



Systematic Grain Trading: A Case Study

Systematic Grain Trading: An Example Using CropProphet Modeler

Efficient markets theory suggests that grain futures prices represent the instantaneous market perception of the balance between grain supply and demand. A grain trader with advanced knowledge of supply and/or demand changes could profitably trade with that information. The trader can take positions ahead of supply and/or demand-induced price changes.

CropProphet Modeler provides histories of daily updated, weather-driven corn, soybean, and winter wheat yield forecasts enabling the development of systematic trading algorithms. This study provides an example of testing grain trading strategies using CropProphet Modeler. An example of a subset of the 38-year history of CropProphet soybean cross-validated yield forecasts are shown below in Figure 1. This is the data used, in conjunction with USDA publicly reported data, to explore the trading strategy.

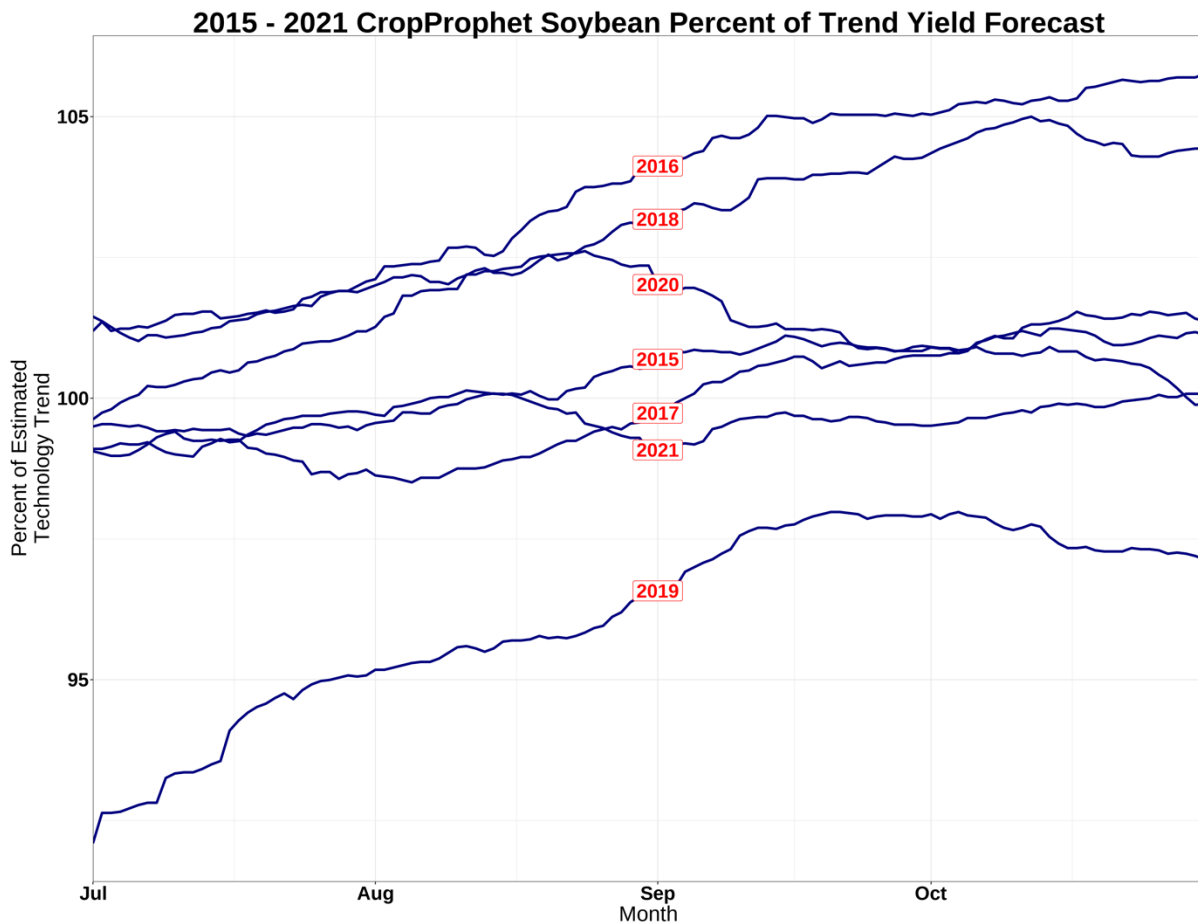




Figure 1. An example of the CropProphet Modeler data. This subset of the data depicts the 2016 to 2021 CropProphet cross-validated US soybean yield forecasts as a percentage of each year's estimated soybean technology trend yield.

The Systematic Grain Trade

Near the middle of each month, from July to December, the USDA releases estimates of its end-of-season corn and soybean yields. These estimates are an important indicator of the current market perception of grain supply.

The estimates, however, are not perfect. For example, the September USDA corn yield estimate had a mean average error of 4.7 bu/ac from 1986 to 2021. Corn and soybean market futures prices can react if market participants perceive the USDA estimates are incorrect. The potential error of the USDA forecasts and the market reaction forms the basis of the trade.

The analysis here compares a history of CropProphet corn and soybean yield forecasts relative to the USDA mid-month estimates. If the CropProphet forecast is greater than the USDA estimate, then we assume that the USDA underestimated crop yield and, therefore, production as well. We hypothesize that prices will fall because the market will eventually perceive greater crop production. In this scenario, we would short corn futures to profit from the expected price change.

Likewise, suppose the CropProphet forecast is less than the USDA estimate. In that case, we assume the USDA has overestimated crop production, and we hypothesize that futures prices will rise because the market will eventually realize that the USDA has overestimated production. In this scenario, we would be long the futures prices.

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An example of the yield forecast comparison for 2020 is shown in Figure 2 below. In each case, the USDA estimated yield is greater than the CropProphet yield

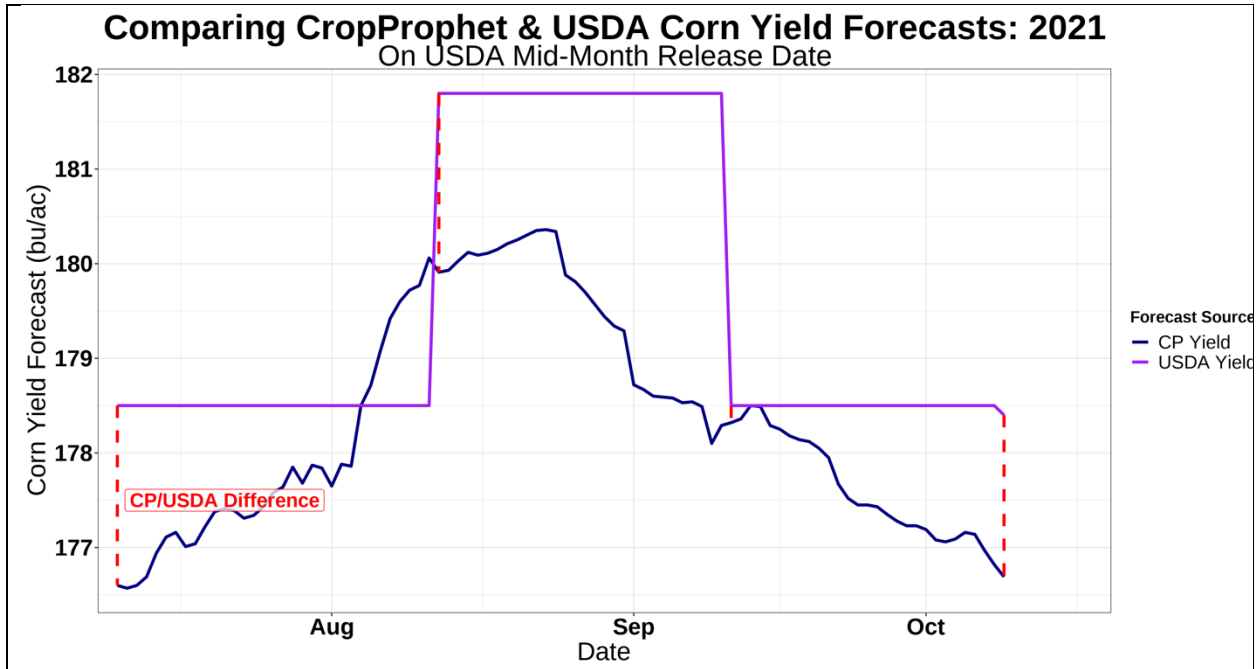


Figure 2. Comparing 2020 CropProphet and USDA corn yield forecasts on the dates of the USDA forecast release. The red dashed lines show the difference between the forecasts, which act as the trigger for the trade.

Our hypothetical trade also includes a rule that the difference between the CropProphet and USDA estimates must be +/- 1% of the USDA estimated crop yield. If the threshold is not met, a breakeven return is recorded.

In both the long and short trade scenarios, the position is entered into on the day of the USDA crop yield forecast and closed out on December 1 or the first open market day in December. No leverage is assumed.

In summary, the criteria of the yield forecast-based grain trade are summarized as:

$$\frac{CP - USDA}{USDA} * 100 > 1\%; \text{ Go Short}$$

$$\frac{CP - USDA}{USDA} * 100 < -1\%; \text{ Go Long}$$

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Where CP and USDA represent their respective yield forecasts on the in-season release date of the USDA estimates.

CropProphet and USDA Corn Yield Forecast Differences

Our model examines the full history of available history of CropProphet corn and soybean yield forecasts from 1986 to 2021. Figure 3, below, shows the history of CropProphet vs. USDA August corn yield forecast differences on the release date of the USDA August corn yield estimates.

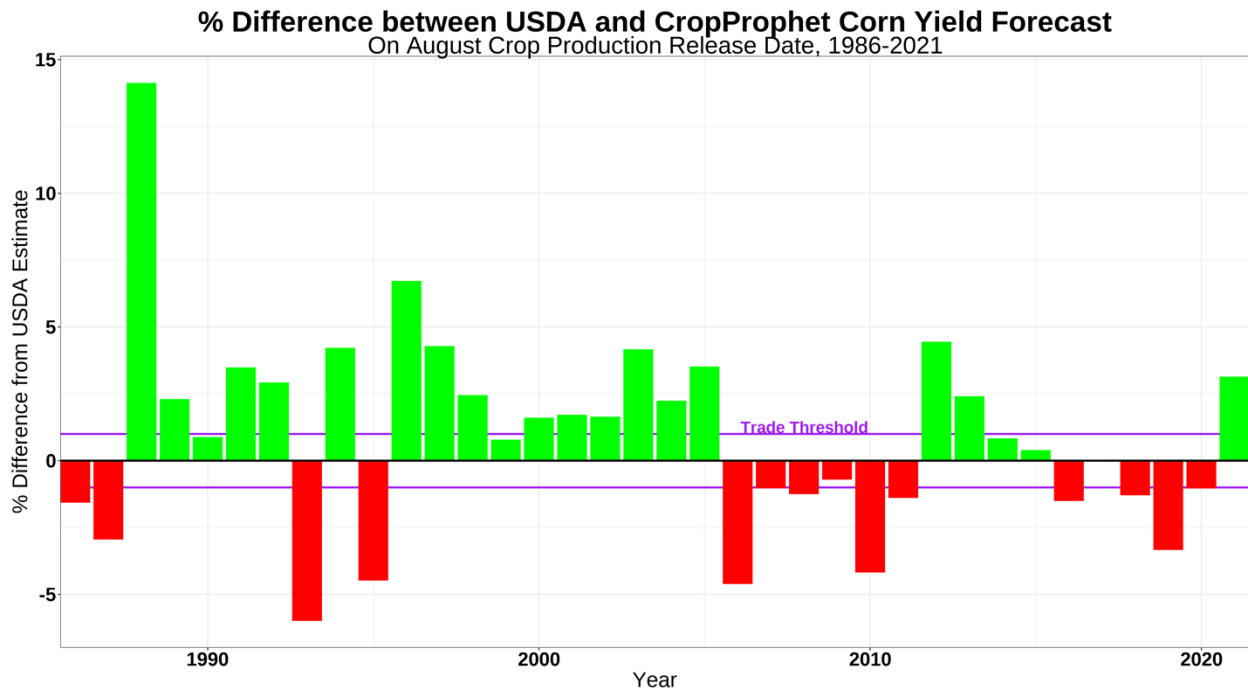


Figure 3. History of the percent difference between mid-August CropProphet corn yield forecasts and the August USDA end-of-season corn yield estimate. The 1% trade threshold is in purple.

The trading algorithm is implemented to estimate the annual return of the August trade strategy for corn and soybeans. The results of the trade are shown below in Figure 4. The results show that the strategy generated an average positive return, even though some years experienced a negative return. The average annual return (not the compound return) is 6.7% and 3.8% for corn and soybeans, respectively.

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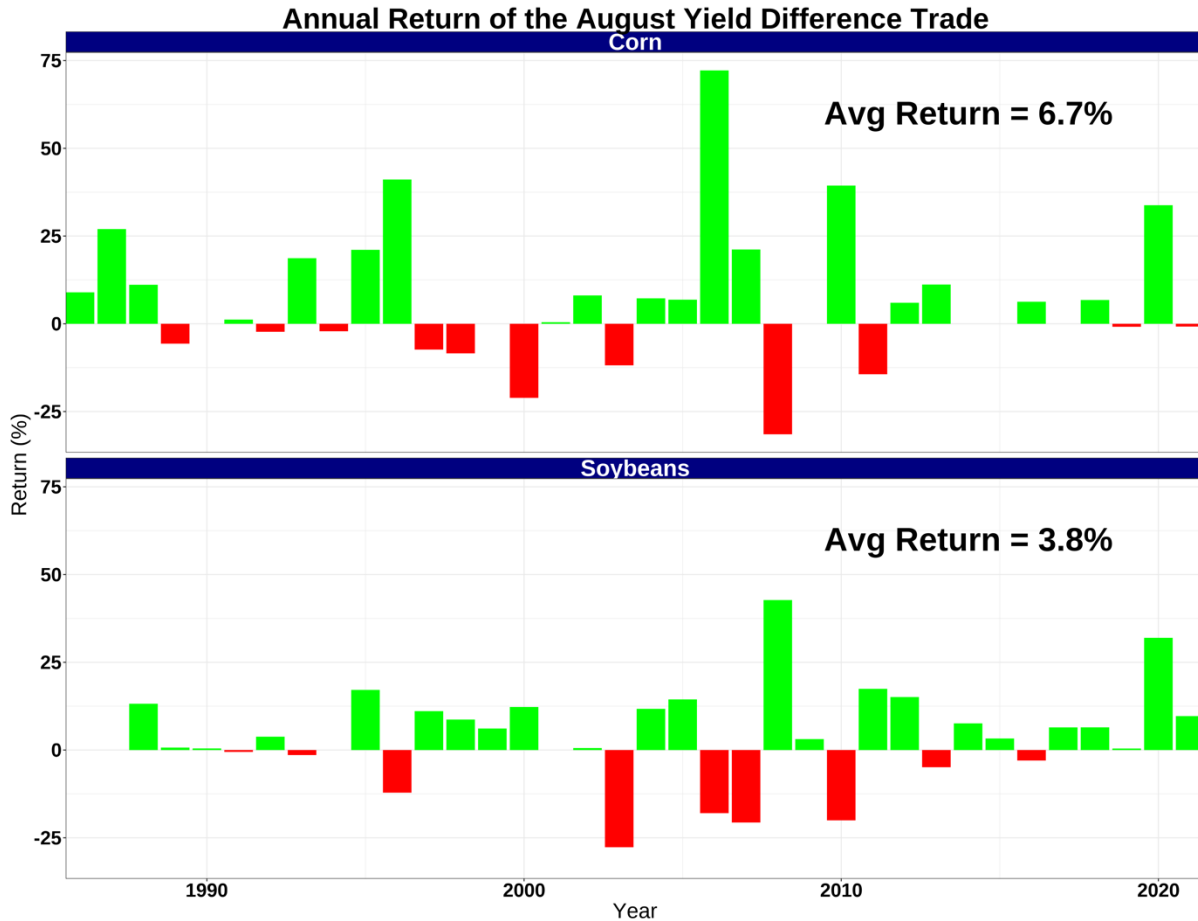


Figure 4. Annual returns of the August USDA yield forecast difference trade strategy.

The results of Figure 4 highlight only the August trade model results. The model can easily be expanded to include July, September, and October USDA yield forecast release dates. The results for the mean and compound returns (over the 36-year period) from 1986 to 2021 are shown in Table 1 below.

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Return of Simple USDA Difference Trade

Based on USDA Monthly Release Date: 1985-2021

Return Type	Month	Corn	Soybeans
Compound Return			
	Jul	2.479	2.199
	Aug	6.281	2.805
	Sep	8.257	1.832
	Oct	2.906	1.043
Mean Return			
	Jul	1.037	1.038
	Aug	1.067	1.038
	Sep	1.066	1.024
	Oct	1.033	1.003

Table 1. Returns of the simple USDA yield forecast difference trade strategy by month.

Trade Model Modifications

While not implemented here, modifications to the trading model could be examined to optimize profitability. For example, our strategy arbitrarily assumes the position is closed on the first trading day of December. This decision could be further optimized by exploring a wider range of position closing dates.

Another strategy modification could optimize the investment allocation weight within a portfolio of corn and soybean trades to maximize return while minimizing downside risk.








Grain Yield and Price Data

The data used for this grain trading study include:

- 1) USDA Corn and Soybean mid-month yield forecasts (available in the CropProphet Modeler data set),
- 2) CropProphet Modeler cross-validated historical corn and soybean yield forecasts. The data is found on the CropProphet SFTP service at [/YYYY/united_states/modeler/crossvalidated/](#)

The SFTP directory is below.

Remote site: [/2022/united_states/modeler/crossvalidated](#)

Filename ^	Filesize	Filetype	Last modified
 corn_yield_uscounty_crossvalidated_1986.csv	2,254,895	Comma S..	04/12/2022 08:11:58
 corn_yield_uscounty_crossvalidated_1987.csv	2,269,281	Comma S..	04/12/2022 08:12:11
 corn_yield_uscounty_crossvalidated_1988.csv	2,217,657	Comma S..	04/12/2022 08:12:23
 corn_yield_uscounty_crossvalidated_1989.csv	2,282,002	Comma S..	04/12/2022 08:12:27
 corn_yield_uscounty_crossvalidated_1990.csv	2,275,703	Comma S..	04/12/2022 08:12:38
 corn_yield_uscounty_crossvalidated_1991.csv	2,270,871	Comma S..	04/12/2022 08:12:45
 corn_yield_uscounty_crossvalidated_1992.csv	2,325,115	Comma S..	04/12/2022 08:12:51



- 3) A continuous corn and soybeans futures price history provided by Macrotrends.net at <https://www.macrotrends.net/2532/corn-prices-historical-chart-data> and <https://www.macrotrends.net/2531/soybean-prices-historical-chart-data>

Systematic Grain Trading: Other Options

This study uses CropProphet's cross-validated historical data set to examine the profitability of a simple grain trading strategy. Other trade strategy possibilities include examining the returns associated with:

- daily and/or weekly updated crop yield forecast changes
- predicting the direction of the change of the USDA mid-month yield forecasts
- impacts of the ECMWF and GEFS weather forecast impacted crop yield forecasts
- advanced information associated with the ensemble spread of the ECMWF and GEFS weather forecast impacted crop yield forecasts

Conclusion

The purpose of this case study is not to demonstrate the most profitable grain strategy possible. Rather, our goal is to demonstrate how CropProphet can be used to explore the profitability of a grain trading strategy. The CropProphet Modeler solution provides a wealth of crop yield and crop yield forecast data to enable systematic grain trading.