Iowa Farm Bureau’s Margin Management Webinar Series presents:

Big Data in Agriculture Webinar
Monday, January 12, 1:00 pm

Speaker:
• Matt Darr, Ph.D., Associate Professor,
  Ag & Biosystems Engineering
  Iowa State University

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Farm Bureau’s Margin Management Webinar Series presents:

Big Data in Agriculture Webinar

Introduction: Ed Kordick, Iowa Farm Bureau

Enter your question here and click

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Big Data in Agriculture

Dr. Matt Darr, Iowa State University

Some material adapted from “The Digital Transformation of Row Crop Agriculture”
Authors: The Hale Group, Ltd & LSC International, Inc.
What is Big Data?

Big Data is data whose scale, diversity, and complexity require new architecture, techniques, algorithms, and analytics to manage it and extract value and hidden knowledge from it.

Digital Agriculture is the new industry which is combining large data sources with advanced crop and environment models to provide actionable on-farm decisions.
Is Big Data New?

Big Data in 1910s
Why the New Emphasis on Data Today?

- Autosteering and swath control technology have driven strong ROI which has led to a proliferation of GPS technology on farm.
  - This leads to ‘free’ machine data.
  - Typical ROI in Iowa:
    - 3.3% Planting Overlap Error, $7.89/ac
    - 7% Tillage Overlap Error, $0.96/ac
Why the New Emphasis on Data Today?

Comparison of Economic Impact of Management Decisions
Based on 180 bu/acre average yield and $4.50/bu corn price

<table>
<thead>
<tr>
<th>Management Decision Outcome</th>
<th>Economic Impact ($/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planter Overlap</td>
<td>$7.89</td>
</tr>
<tr>
<td>1% Yield Gain</td>
<td>$8.10</td>
</tr>
<tr>
<td>3% Yield Gain</td>
<td>$24.30</td>
</tr>
<tr>
<td>5% Yield Gain</td>
<td>$40.50</td>
</tr>
<tr>
<td>7% Yield Gain</td>
<td>$56.70</td>
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</tbody>
</table>
Our goal in agriculture is to make the best management decisions each year to meet our economic, social, and environmental goals.

Every producer enters spring with the best plan for their farm based on the information they have available.

The **Goal of Digital Agriculture** is to help producers **accelerate the natural adoption** of new cultural practices and technology to yield valued added benefits to the farming operation.

What if you could pack 50 years of natural cultural practice change into a 40 year farming career? Would your farm be more financially stable and better suited for growth?
How Can Digital Agriculture Benefit My Farm?

- Improved On Farm Decisions
- Production Benchmarking and Regional Trends
- Integration of Weather, Soil, and Timeliness of Actions into Crop Management Plans
Big Data Also Means New Data Sources

High Resolution Imagery and UAV Imagery

- **Satellite Delivered:**
  - 5m Resolution
  - Timing can be limiting but more options are becoming available

- **Contracted Flight:**
  - 1m Resolution
  - Typically can schedule images within a +/- 3 day window around target date

- **Small Unmanned Aerial Vehicles (sUAV)**
  - ~3 – 10 cm Resolution
  - If weather permits scheduling can be within a few hours of target time
High Resolution Imagery in Agriculture

Red-Green-Blue (RGB) Imagery
High Resolution Imagery in Agriculture

Near Infrared (NIR) Imagery

Complex data and crop health variability are classic examples of Big Data sources. Successful use of Digital Agriculture will root cause these dynamic interactions and lead to culture practice changes to eliminate future deficiencies.
High Resolution Imagery in Agriculture
Can you rank the image resolution of these three fields?
Can you rank the image resolution of these three fields?
Why do rows 7 – 10 appear so much more healthy than 4 – 6?

Is assessment of individual row crop performance big data?
Data Analytics: Field Example

170 Acre Field, Continuous Corn
Data Analytics: Field Example

170 Acre Field, Continuous Corn

Hybrid A

Hybrid B

Estimated Volume (Dry) (bu/ac)
- 185.00 - 249.98 (33.11 ac)
- 158.21 - 185.00 (34.46 ac)
- 131.75 - 158.21 (34.30 ac)
- 106.11 - 131.75 (34.44 ac)
- 40.09 - 106.11 (34.14 ac)
Data Analytics: Field Example

Yield Comparison of Two Hybrids in a Side-by-Side Test

Grain Yield (bu/ac)

Hybrid A: 176
Hybrid B: 131

170 Acre Field, Continuous Corn
Data Analytics: 1995 High Definition

Soil Type
- Canisteo (44.00 ac - 25.0%)
- Clarion (41.26 ac - 23.5%)
- Harps (7.84 ac - 4.5%)
- Nicollet (40.27 ac - 22.9%)
- Okoboji (11.94 ac - 6.8%)
- Storden (18.48 ac - 10.5%)
- Webster (12.03 ac - 6.8%)
Data Analytics: 2014 High Definition
Data Analytics: 2014 High Definition
Data Analytics: 2014 High Definition
Data Analytics: Aggregated Data

Iowa Soybean Association On-Farm Network

- Over 2,500 on-farm trials since 2007.
- Conducted in cooperation with grower partners.
- Data is available in a non-identifiable form through the On-Farm network website.
- Increasing scale of the dataset allows for strong assessment of performance trends.
Data Analytics: Value of Aggregated Data

Yield Response to Corn Management Practices

- Increased Corn Population
- Increased Nitrogen Application

Hundreds of data points for comparison across a broad range of geographic and crop production boundaries.
Data Analytics: Value of Aggregated Data

What if every pass across the field with a machine was an On-Farm trial?

How fast could we progress agriculture if this level of data was collected and shared broadly within grower cooperatives?
Probabilistic Decision Management

• Incorporate probability of events occurring, mainly weather related.

• Utilizes extensive historical data and weather forecasting data to drive model predictions.

• As the season progresses real time weather data in integrated into the model to improve robustness.

Deterministic Model:
Outcome is a single value with no randomness, i.e. soil sample based fertility recommendations.

Probabilistic Model:
Outcome is a range of potential values that represent environmental variability and can be used to manage risk.
Probabilistic Nitrogen Management
Spatially Specific Probabilistic Modeling
Key Value Opportunities in Digital Agriculture

• Increase value derived from traditional on-farm data sources:
  – Leverage knowledge from planting, fertility, and yield maps to make better input decisions.

• Gain new insight into crop production drivers through high resolution aerial imaging services.

• Move more quickly towards the adoption of new cultural practices through the use of regional benchmarking data.

• Utilized crop and weather modeling to build risk assessment into your ag decision matrix.

We don’t have to accept the status quo in terms of crop production.

Digital Agriculture provides tools to ensure that each year we are improving our production plan. Small increases in adopting change on the farm can lead to significant long term success.