Using Publicly Available Data for Decisions in Agricultural Supply Chain

Authors: Satya Dhavala and Derik Smith

Advisor: Dr. Bruce Arntzen

Sponsor: Dow AgroSciences

MIT SCM ResearchFest

May 22-23, 2013

MIT Supply Chain
MANAGEMENT

Agenda

- Key Question
- Introduction
- Methodology
- Results
- Conclusion

Key Question

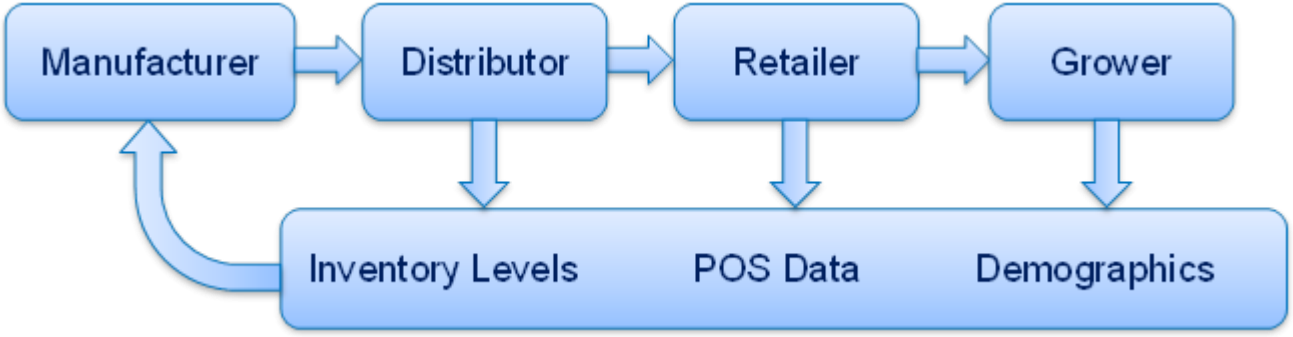
- How can a manufacturer of agricultural chemicals use the variety of available data to improve its forecasts and supply chain decisions?

Data in Agriculture

- Data Types
  - Crop projections and actuals
  - Yield projections and actuals
  - Weather forecasts and reports
- Data Sources
  - United States Department of Agriculture (USDA)
  - Universities – Land-grant and others
  - Meteorological agencies
- Applications of Data
  - Macro economic forecasting
  - Environmental and sustainability related decisions
  - Decisions by growers on various aspects of farming

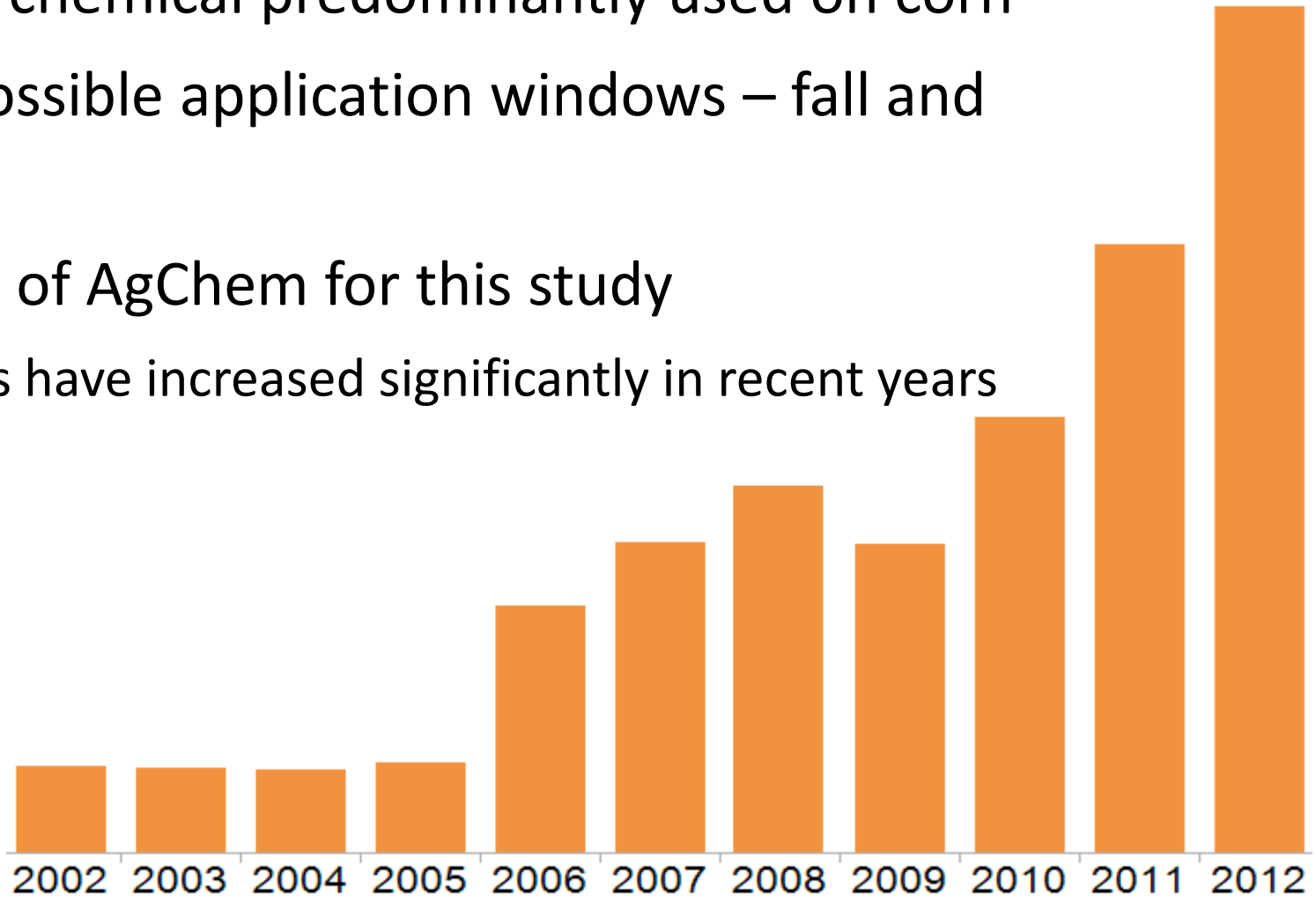
Ag. Chemical Distribution Chain

- Finite manufacturing capacity
- Long production and distribution lead times
- Production is based on forecasts and occurs month in advance of a short, uncertain sales season
- Many factors influence demand



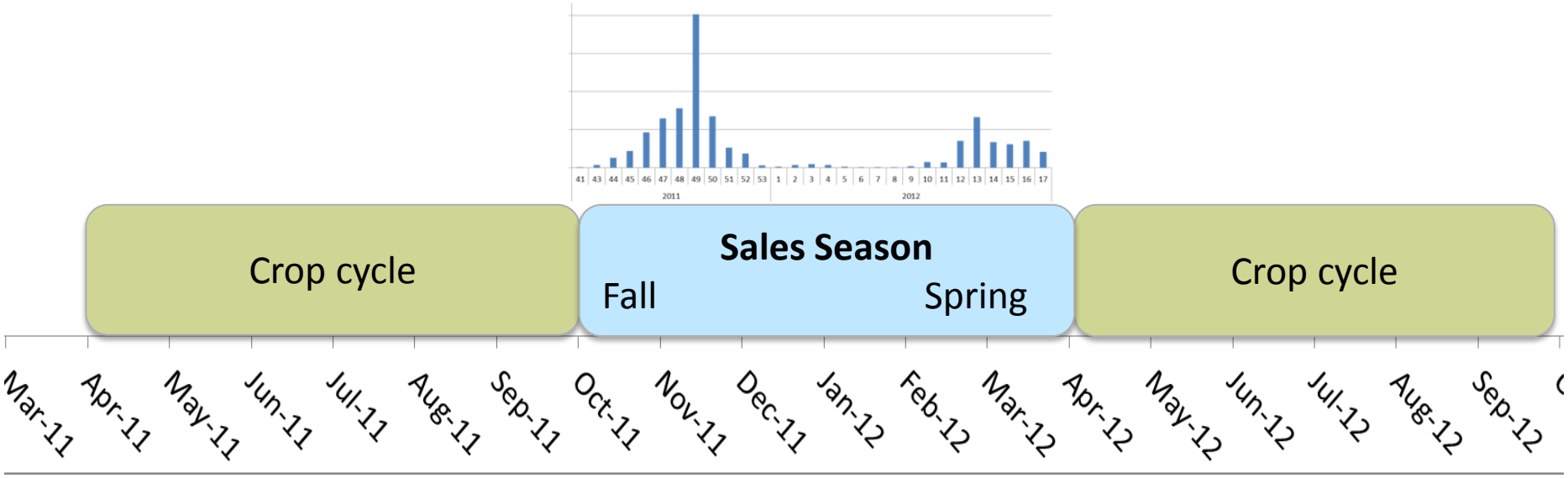
AgChem

- A crop chemical predominantly used on corn
- Two possible application windows – fall and spring
- Choice of AgChem for this study
  - Sales have increased significantly in recent years



AgChem - Application Windows

- Sales occur ahead of the growing season



Methodology

- Identify and analyze the factors
- Structure the problem
- Gather data for each factor
- Develop models (regression) and test significance of each factor
- Eliminate insignificant factors and fine-tune significant factors for better accuracy

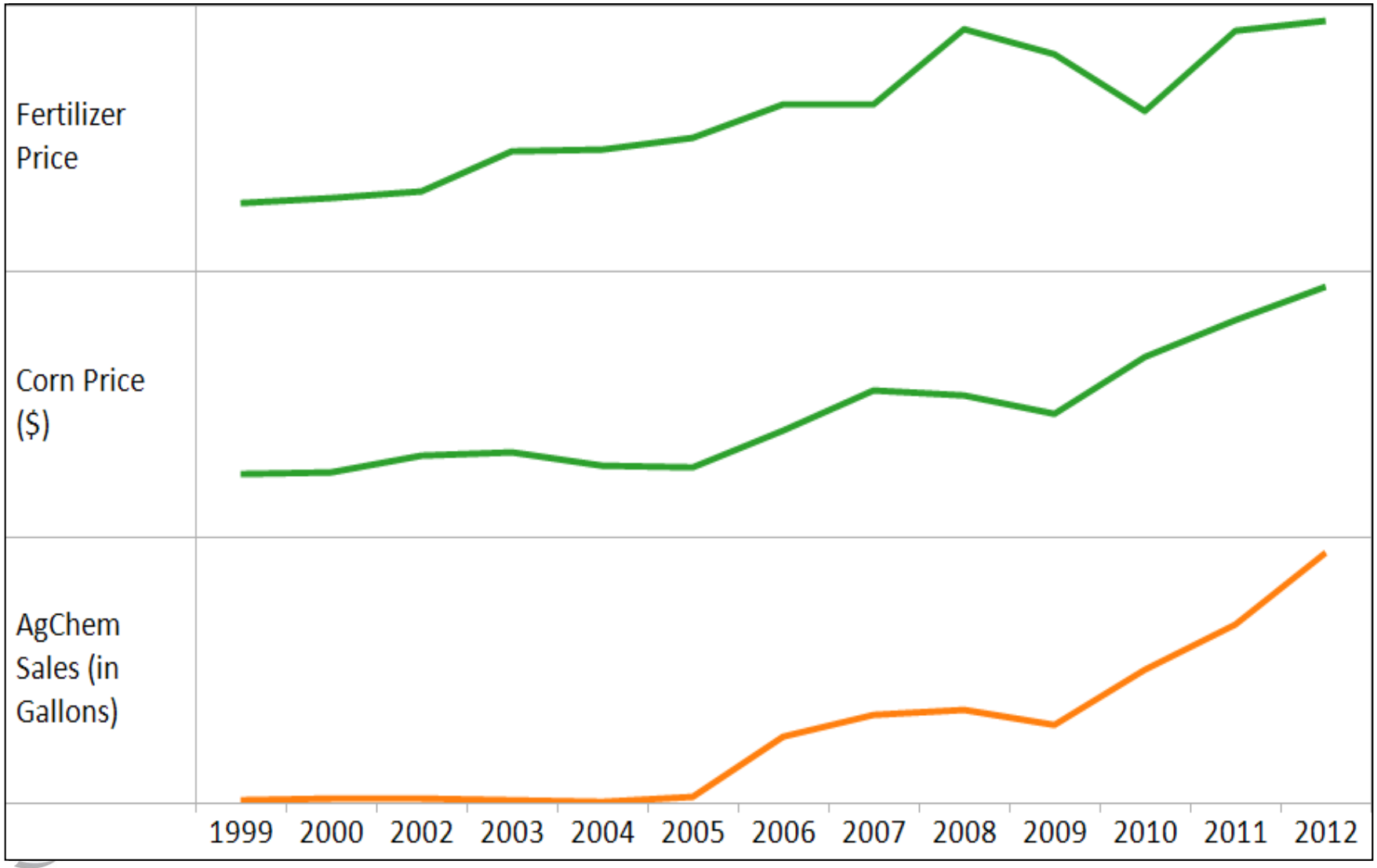
Factors Analyzed

Time Dimension	National	County	City
Annual	• Corn price • Fertilizer usage • Corn acres planted • Corn acres harvested • Average yield • Fertilizer price • AgChem price	• Corn acres planted • Corn acres harvested • Average yield • Increase in yield • Number of retailers • Bulk storage capacity	No relevant variables
Weekly	No relevant variables	No relevant variables	• Temperature • Precipitation • Sales to date
	Geographical Dimension		

Structuring the Problem

- Some of the factors are leading indicators and some are lagging
- Factors differ by the way they influence demand and their granularity
- Divide the problem
  - Annual, nation-wide demand
  - Annual, county-level demand
  - Short-term, city-level demand

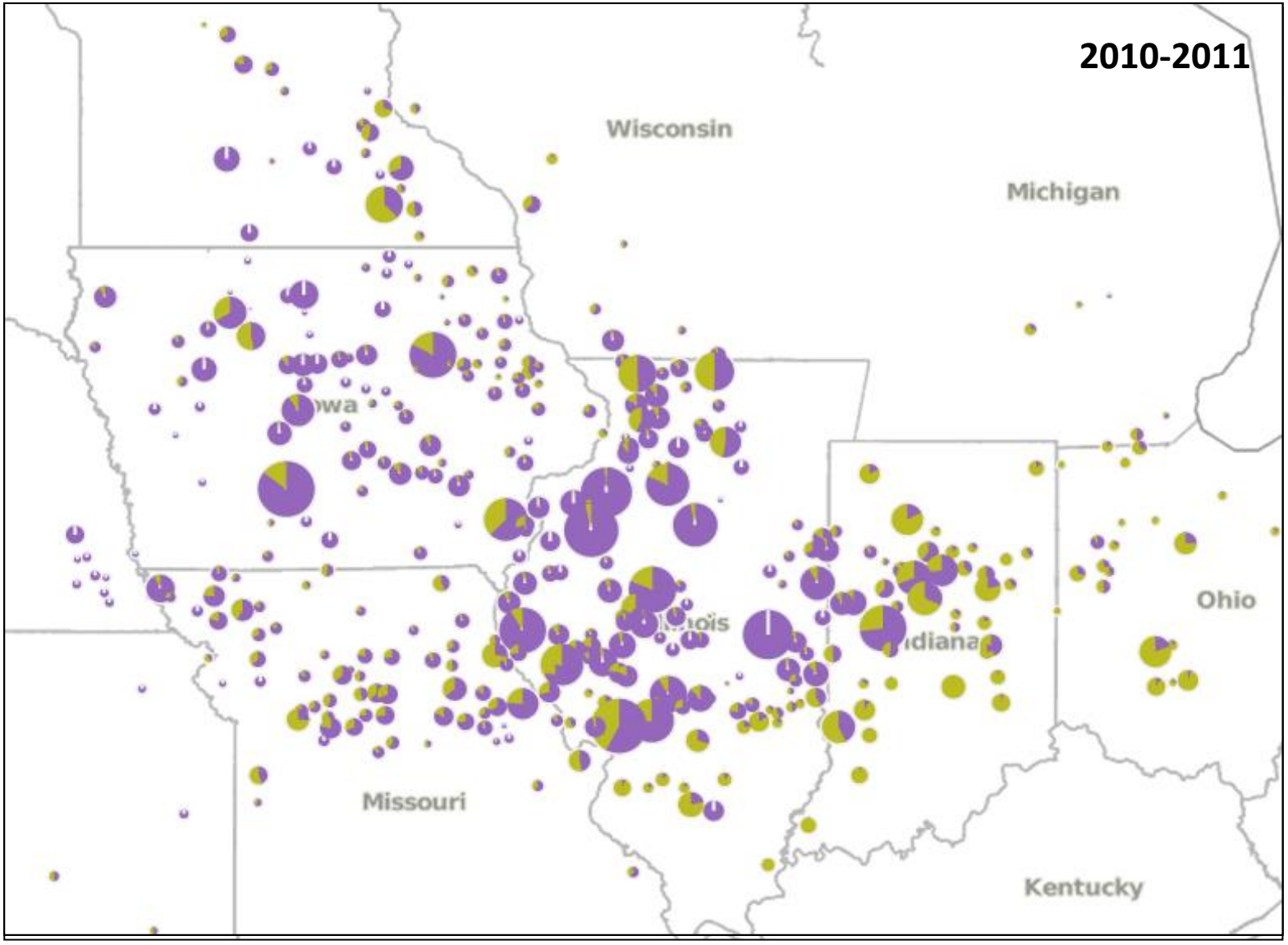
Results: Annual, Nation-wide



Results: Annual, county-level demand

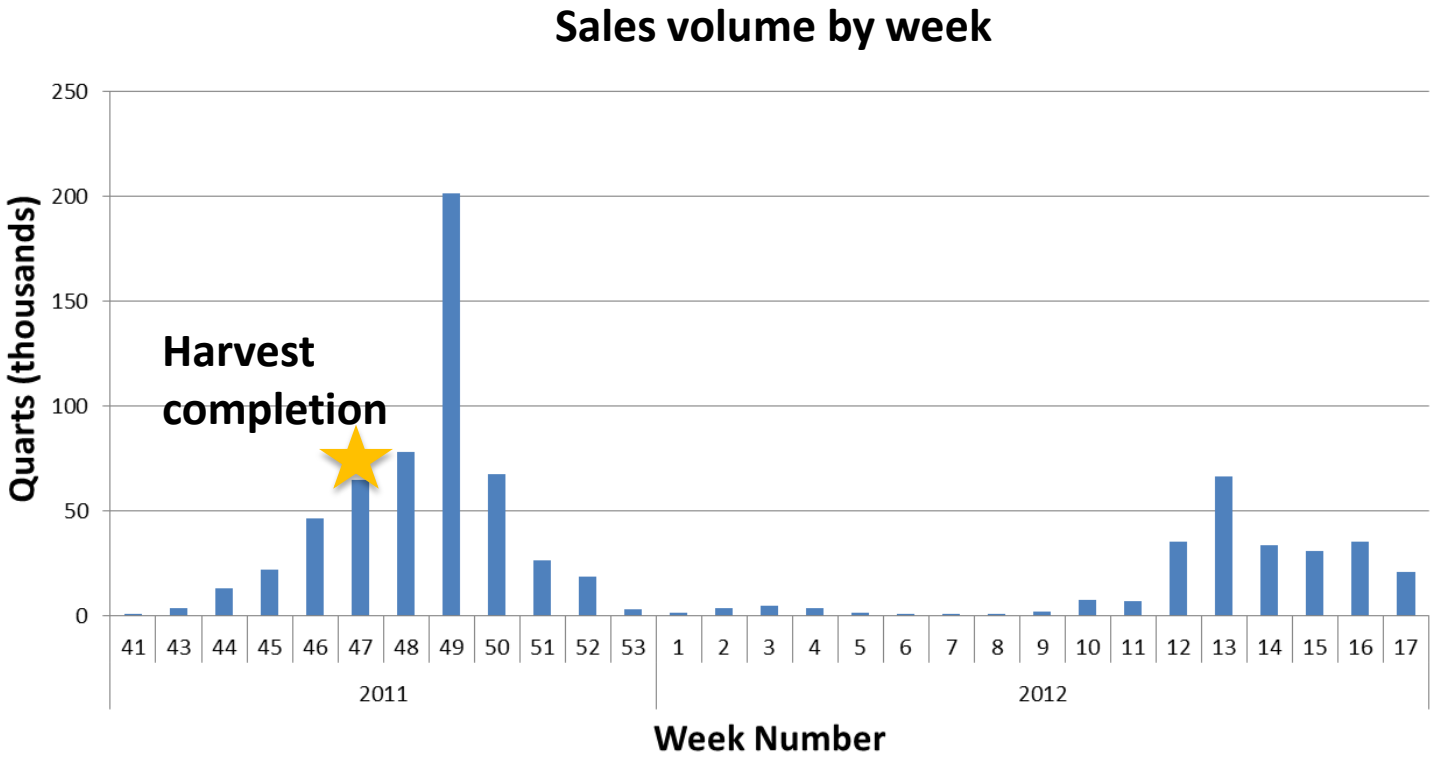
- Significant factors for annual, county-level demand
  - Corn acres harvested
  - Number of local retailers
  - AgChem sales in the first few weeks of the season

Additional Findings



Results: Short-term, city-level demand

- Harvest completion date acts as a trigger point for fall sales
- Average temperature is the only significant factor



Conclusion

- Implications for DAS
  - Better understand the external factors
  - Fine-tune existing forecasting models
  - Position inventory more effectively by tracking trends such as harvest completion
- Limitations and scope for further research
  - Retailer city was used instead of application city, for short-term model
  - Temperature and precipitation were used based on the nearest weather station
  - Period we analyzed experienced only an upward trend in volumes