MTFC Scenario Quest Response 2025-26

Team Name	Better Call Us All
Team ID #	23913

MTFC Scenario Quest Template Use Notes:

- *Refer to the official MTFC Scenario Quest 2025-26 for the 30 prompts and scoring instructions.*
- *The use of this template is OPTIONAL.*
    - *It is provided as an optional resource for teams to keep their Scenario Quest response organized. Teams who wish to use this template should make a copy in order to edit.*
- *The final version of the team's MTFC Scenario Quest Response should be downloaded as a PDF or Word document to submit on the ICS Dashboard. A single file will be submitted.*
- *Additional resources (including the Actuarial Process Guide) can be found on the Modeling the Future Challenge website: https://www.mtfchallenge.org/resources/*
- *Please direct any questions to challenge@mtfchallenge.org.*

Part 1: Project Definition *(Corn Farming Topic Prompts)*

These prompts can be found on page 6 of the 2025-26 Scenario Quest. Additional information on Project Definition can be found in ***Step 1: Project Definition*** in the Actuarial Process Guide.

Team Responses:

#1: Who is at risk?

Besides Farmer Jones, the rest of the farmers in Iowa are at risk in regards to risk of loss in corn farming at a local level. Produce buyers and consumers are also at risk at the state level, given the lack of corn, individuals would not have corn to eat. Also, on a state level, wholesale companies would be at a loss for products to sell. Beyond that, the United States Department would also be at a loss, given that Iowa is the number one corn-producing state.

#2: Defining the risks

Farmer Jones has the risk of a reduced income, a sudden loss of funds, incurring debts from commercial insurance and needs, loss of crop quality, loss of customer trust, and an increase in customer turnover. A reduced income and losses in funds can be measured like debts, through not only a static quantitative monetary figure, but a change in value over time, etc. $lost/month. A loss in crop quality can be measured through many factors, specifically the deviation from expected protein:fiber: carb proportions corn usually has, loss or unhealthy increase in biomass, and scale of microbial and bacterial diversity. Finally, loss of customer trust and increase in customer turnover can be identified by the changes in tipping rates, customer return rates, and frequency of customer visits (per customer).

#3: Identify Risk mitigation strategies

A risk mitigation strategy in the insurance category that Farmer Jones may choose to use is selling her corn for the future, if she is confident that it won't go bad. If she sells her corn for the current price for the future, she will make a profit if the price of corn goes down. A risk mitigation strategy related to modifying outcomes that she may choose to employ could be to warn consumers ahead of time that corn may go bad - this would decrease their negative reactions. She could also stockpile corn in multiple places, which would decrease the loss from corn going bad in one of the places. A behavior change that Farmer Jones could employ would be to make sure that the corn is stored in a secure place, which would decrease the risk of it going bad.

Part 2: Data Identification & Assessment *(Corn Farming Topic Prompts)*

These prompts can be found on pages 7-9 of the 2025-26 Scenario Quest. Additional information on Data Identification and Assessment can be found in ***Step 2: Data Identification & Assessment*** in the Actuarial Process Guide.

Team Responses:

#4: Identifying the type of data

Cause of Loss Smith Co tab - The cause of Loss Smith Co tab shows data that helps categorize risk and potential outcomes. This is because the data shows the causes of the loss, when the loss accrued, and what type of loss it is. This allows insurance companies to categorize the risks and predict potential outcomes.

Corn Planting Costs tab - The corn planting cost table defines the historical range of severity of potential loss. This is seen through the 9-year layout of varying price ranges.

Corn Harvest Costs tab - Historical Frequency. However, it also measures the range of the loss- but it doesn't specify loss ranges per category. The data mostly shows historical data about net losses, though.

#5: Planting Costs for Farmer Jones

- The average total cost per acre for corn production between the years 2016 and 2025 is $548.11. We reached this average total cost by summing the average costs/acre of each year within each category
- The average cost per bushel of corn was $3.06, which was identified through the average bushel cost (total cost/expected bushel count) for each year 2016 through 2025

#6: Assumed yield for Farmer Jones

The average assumed yield from 2016-2025 was 178.5 bushels per acre.

#7: Anticipated total planting costs

If Farmer Jones planted and used all 345 of her farm's acres, she would have to pay costs of $194,030.94.

#8: Range for anticipated costs

The value found in #7 depicts the average value for the anticipated cost per acre seems "about right". Even though the standard deviation of some categories, such as machinery cost per acre and seed/chemical cost per acre, is higher, the magnitude of the numbers is also higher, concluding that the average is " about right" with an anticipated range of $ 430.532 to $665.69 or 548.11 $\pm$ $117.58 (the sum of all the individual characteristic deviations).

#9: Harvest Expectations for Farmer Jones

The projected total yield in bushels is equal to 61,582.5. This is found by multiplying the average number of bushels per year per acre by the total number of acres in the farm that are harvested.

#10: corn sale prices expectations

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
$4.35	$4.43	$4.47	$4.55	$4.65	$4.73	$4.66	$4.46	$4.34	$4.21	$4.20	$4.35

#11: Trends in Corn Prices

The highest average corn prices are in July, and the lowest average prices are in November. Additionally years 2022-23 had a spike in prices, which could indicate a lack in corn harvests at the time. This implies that farmers should sell more in July to get more money, but they might be harder to sell then as well.

#12: Harvest Expectations with October sale

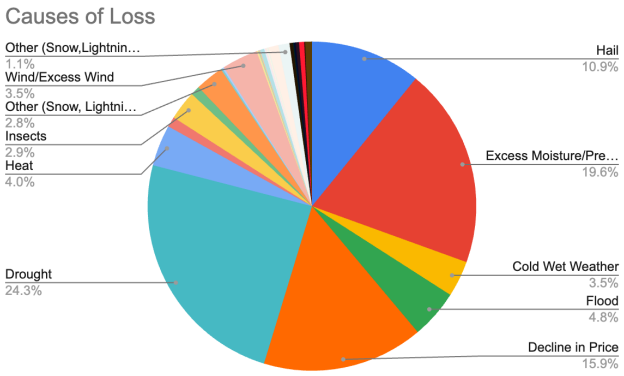
The revenue would be $259,262.33
The planting cost would be $194,030.94.
Given this, the total profit would be $65,201.39

#13: Harvest expectations with optimal sale

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
$4.35	$4.43	$4.47	$4.55	$4.65	$4.73	$4.66	$4.46	$4.34	$4.21	$4.20	$4.35

The best month to sell for maximum revenue would be June, and the revenue amount would be $291,285.23

#14: Creation of a data visual.



#15: Top causes of loss & their impacts

The top three leading causes of loss are excess rain, drought, and decline in price. This is because, based on the season, farms in the Midwest are threatened by both bouts of drought, while very quickly killing crops and overwatering, which can do the same. Declines in investments and prices caused by economic depressions accelerate these damages by reducing a farm's capability to maintain itself. From the year 1984-2024, the data even showed that drought accounted for 288 cases, decline in price 188, and excess moisture 233!

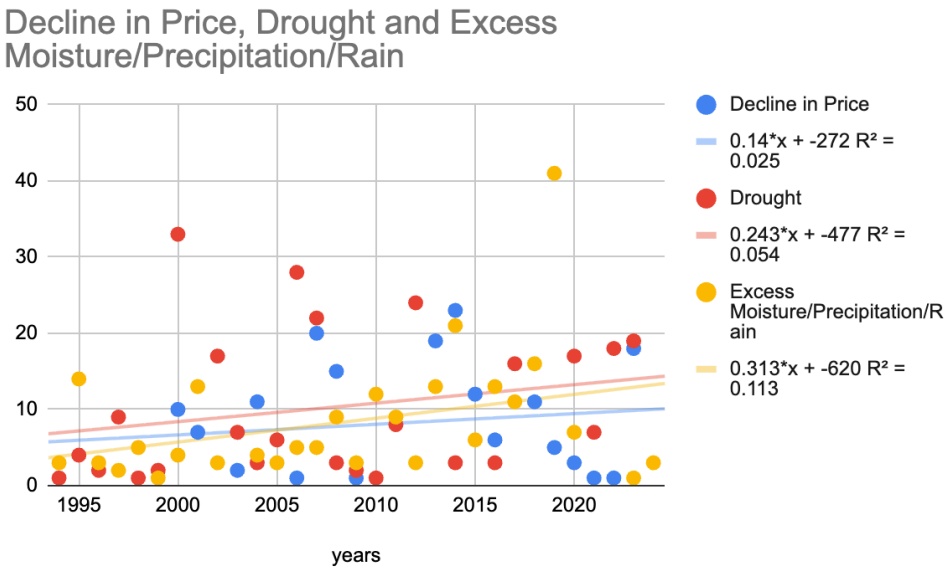
This informs Farmer Jones that preventative measures must be posited towards these three risks, and efforts must be made to save money in the event of an economic depression. Examples of preventative measures can include larger greenhouses, reserve water supplies, and crop shades.

Part 3: Mathematical Modeling *(Corn Farming Topic Prompts)*

These prompts can be found on page 10-11 of the 2025-26 Scenario Quest. Additional information on Mathematical Modeling can be found in ***Step 3: Mathematical Modeling*** in the Actuarial Process Guide.

Team Responses:

#16: Linear regression



#17: Cause of loss trends or patterns

Excess moisture/rain, drought, and decline in price as causes of consistently increase over the course from 1994 to 2024. While there is little linear correlation strength as indicated by the R^2 values, the average figures generally increase allowing us to make this observation. This can be because of an increase in farms resulting in an increase of losses, as the total number of agricultural assets grow

Variability greatly increases as the years increase from 1994 to 2024. This can be attributable an increase in crop concentration, causing local events to have greater spreading damages

Minimum values generally increased over time, which may be a result of both a greater concentration and greater number of crops. With more crops, the probability of any loss is increased. With greater concentrations, those few disasters will spread to nearby crops quickly, specifically occurrences of drought or overwatering. These two factors combined increase the minimum number of crop losses over time.

#18: Assumption evaluation

Assumption: “Nationally, approximately 91% of farm producers have farm insurance. We assume that the rate of farm producers who have farm insurance is the same for Smith County, Iowa. ”
The assumption is reasonable, although it does not account for the change in risks local to Smith Country versus the entire national farming industry, which motivates the acquisition of farm insurance. This assumption, however, is key in the development of a fruitful model, as it allows national farmer insurance data to be used in our local context, increasing the width of further decisions and assumptions we can make.

#19: Assumption development

The environmental causes of crop loss will increase each year in variability, developing a stronger need for environmental protection as a risk-preventative tactic. This assumption is strongly validated by the data pertaining to the three main causes of loss (overwatering, drought, and price decrease) over the years 1984-2024, which displayed an average increase in losses for each variable over time.

#20: Frequency of claims due to drought

The annual average frequency of claims made for drought for farmers in Smith County, Iowa, is 10.28 claims per year.

#21: Expected value of loss due to drought

Given that the expected probability that any given farmer in Iowa will experience a drought is 0.00350, and the planting cost for farmer Jones (severity) is $194,030.94, the expected value of loss is $679.11

#22: Average annual insurance payout due to drought

The average annual insurance payout due to drought would be $36.94, because when you multiply the average annual drought claims per year by the average payout per drought claim, you obtain the annual payout. Then, to find the payout per policy, we would divide by 2936, giving us $36.94.

Part 4: Risk Analysis *(Corn Farming Topic Prompts)*

These prompts can be found on page 12-13 of the 2025-26 Scenario Quest. Additional information on conducting a Risk Analysis can be found in ***Step 4: Risk Analysis*** in the Actuarial Process Guide.

Team Responses:

#23: Risk mitigation strategy: Grain Silo

- Response: Weather damage, pest and insect damage, spoilage, mold, and reduced handling costs. These are modifying the outcome strategies, changing what happens to the corn after harvest. The silos are sturdy, airtight structures that prevent loss of crops. Furthermore more the modern gilo has aeration, ventilation, temperature, and humidity regulation that prevent mold from growing, protecting the crops. Additionally, also protects the crops from rodents and animals. Silos can pose multiple safety hazards, including machinery failures and accidents, dust explosions, and exposure to toxic gases. Owning a silo can also be very expensive, with all the operational costs and maintenance fees.

#24: Risk mitigation Strategy: irrigation system

- Response: Installation Cost: The system would require pumps and permanent piping, which is anticipated to be $1,500 per acre for labor and materials.
  Usage Cost: Once installed, per-acre pumping costs are projected to be $58 per acre for energy usage for the season and an additional $30 per acre per season for maintenance and repairs.
  Projected impact: Based on conversations with neighboring farmers who have installed irrigation systems on their corn farms, also in Smith County, it is projected that Farmer Jones could anticipate a yield of 270 bushels of corn per acre by using the irrigation system.

The irrigation costs $1500/acre to install, and costs $88/acre annually to maintain. If Farmer Jones were to sell her entire crop upon harvesting in October, she would make $389,999.1 in revenue, not profit, from the corn alone (assuming she used all 343 acres of farmland).

Conditions Farmer Jones is considering for a scenario outlining a price decline:
Farmer Jones is considering a policy with 85% coverage that has a premium cost of $25 per acre. For the scenario that Farmer Jones is considering: the approved yield is the same as the actual yield (computed by you in #6), the agreed-upon projected price is $5.20 per bushel of corn, and at harvest, the actual price was $4.39 per bushel of corn.

#25: Characterizing the crop insurance scenario

- Response: Revenue “guarantee per acre”=(projected yield) x (coverage percentage) x (higher of projected or harvest price)=(178.5)*(0.85)(5.2)*=788.97 dollars/acre
  Revenue “Actual revenue”=(actual yield) x harvest price=178.5*4.39=783.62 dollars/acre
  Because the actual revenue is lower than the guarantee per acre, insurance is triggered. The insurance payout=guarantee-actual revenue=788.97-783.62=5.35 dollars/acre

#26: Value of the insurance policy

- Response: The total cost of the annual premium for Farmer Jones' farm for the revenue protection plan=dollars/acre*total acres=25*345=$8625 annually
  However, the total payout is expected to be 1845.75
  So the real cost of Revenue Protection is $6779.25 to the farmer. Based on the data concerning all protections, we know that in the past, the average annual premium for yield protection was $1298.15/policy for an average of 2.26 policies, indicating a total annual cost of $2932.85. Since this is much lower than the real cost of the annual premium to the farmer, and the total expected insurance payout from Revenue protection is lower than this, we can logically conclude that using Yield protection is the best choice.

Part 5: Recommendations *(Corn Farming Topic Prompts)*

These prompts can be found on page 14 of the 2025-26 Scenario Quest. Additional information on making Recommendations can be found in ***Step 5: Recommendations*** in the Actuarial Process Guide.

Team Responses:

#27: Irrigation system impact

- Response: Guarantee per acre = (projected yield) x (coverage percentage) x (higher of projected or harvest price)
  Actual Revenue per acre = (actual yield) x harvest price
  Insurance Payout (only triggered if the guarantee is greater than the actual) = guarantee per acre – actual revenue per acre 0.002*avg drought costs:194,030.94. = **388 dollars**

#28: Comparison of the expected value of loss

- Response:

Expected Value without mitigation

EV = frequency x severity

EV = 0.00350 x 194,030.94 = $679.11

EV with irrigation (probability drop to 0.2%)

EV = 0.002 x 194,030.94 = $388.06

The irrigation system lowers the expected drought loss from $679.11 to $388.06, which is a significant reduction of $291.05 or a 42.9% decrease. The irrigation system allows for the mitigation of drought loss, ensuring the safety of crops and profit.

Total insurance payout: $1,845.75 (Question 25)

Expected Insurance payout without irrigation:

0.0035 x 1,845.75 = $6.46

Expected insurance payout with irrigation

0.002 x 1,845.75 = $3.69

The EV of actual planting loss without insurance is $679.11, which is reduced to $388.06 when the irrigation system is added. The EV of the insurance payout (what the insurance company is expected to pay) is only $6.46, which is further reduced to $3.69 with the irrigation system.

Net expected loss for Farmer Jones if she had insurance:
No irrigation: 676.11 - 6.46 = $672.65
With irrigation: 388.06 - 3.69 = $ 384.37

#29: Profit trajectory with irrigation

- Response: When including installation costs, the farm loses 355053.24 dollars in its first year. From that point, they can profit 49946.76 dollars annually, making them take 8 years to break even and continue profiting at that point. So while it is profitable, even in a minimum loss scenario, it takes close to a decade to break even a moderate amount of profit.

#30: Should the irrigation system be recommended?

- Advantages:
  With the irrigation system recommendation, there is a larger lift in yield with much higher annual operating profit. The irrigated yield (270 bushels per acre) increases the total revenue to about $392,161.50 and yields a yearly profit of 167,770.56, which is higher compared to the baseline profit of $65 231.39 without the irrigation system. Additionally, the irrigation system reduced the drought EV in terms of loss, with the EV dropping from $679.11 to $388.06, saving around $291 for the expected value of loss, and the net expected loss after the expected insurance payout would further drop $388.06 to $384.37 per event ,which reduces the downside risk.

- Disadvantages:
  The high upfront cost of the installation would be $517,500, which creates a large negative cash flow in year 1 if paid upfront (around -349,729.44 within the first year of installation). Additionally, the annual operating cost of the system would add $30,360 per year, which must be paid regardless of the market price and the yield outcome. So, if the market prices fall, the operating cost will reduce the profit made for Farmer Jones in a given year.

- Recommendations
  The Better Call Us All team recommends that Farmer Jones invest in an irrigation system if 1. She can finance the installation at reasonable terms, including loans, subsidy, or cost-share, so the high upfront cost does not create an absurd short-term cash stress, and 2. She expects yields and prices to stay near the averages assumed in the scenario. Under these two conditions, the irrigation yields an incremental annual profit of around $102,539, breaking even in approximately 5 years, which is very reasonable for a multi-year investment for capital agricultural assets.