MTFC Scenario Quest Response 2025–26

Team Name: **Error 404: Human Not Found**
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Contents

Part 1: Project Definition (Corn Farming Topic Prompts)

#1: Who is at risk?

Question. In 3–5 sentences, describe what groups (besides Farmer Jones herself) might be at risk of loss in regards to farming corn. Identifying the scope (boundaries on size) and scale (potential severity or impact) that the risks have is important for understanding what needs to be characterized. Identify 2–3 other groups at different levels (e.g., local, state, national, and international levels) within your response who may have a loss related to corn crops.

Response. At the local level, the people who Farmer Jones hires and pays could see reduced wages and hours if the yields start to worsen. Additionally, local cooperatives and feed mills rely on corn supplies and would lose revenue if the farms start to yield less. At a state and national level, the corn that Farmer Jones makes feeds livestock and helps produce ethanol. Additionally, the federal government, which subsidizes farmers through the Federal Crop Insurance Corporation (FCIC), is at risk. If farmers have a large loss due to insufficient crop yield, the risk is transferred to the federal government, who may suffer substantial losses.

#2: Defining the risks

Question. In 3–5 sentences, describe the risk to Farmer Jones and her farm itself. What kind of quantified values can you identify that could be valuable numerical ways of characterizing the risks of crop loss? You may refer to the available datasets and prompts for ideas, but also consider what kind of data or numbers you would think would be the most helpful (even if that data does not exist in the provided datasets).

Response. Farmers such as Farmer Jones face numerous economic problems such as increasing costs. Some specific risks are a lower yield per acre, increased planting costs, and market fluctuations. Farmers need to buy goods such as fertilizers, seeds, fuel, land, labor, and equipment. If the prices of these items increase, it causes the profit margins to narrow or even turn into a loss, which in turn causes the farm to lose even more money and get quickly into debt. In addition, market volatility can lead to changing prices for corn due to a change in factors such as supply and demand, trade policies, and tariff policies.

#3: Identify risk mitigation strategies

Question. In 3–5 sentences, identify a risk mitigation strategy that Farmer Jones may choose to mitigate risk for her farm in each of the three categories (behavior change, modifying the outcomes, insurance) and describe how you think each of these three strategies might be able to help mitigate those losses. Is there a strategy category that seems to be more or less feasible than another category to pursue? No calculations needed.

Response. We believe that a behavior change strategy such as diversifying crops would help in mitigating risk as it reduces the dependency on a singular crop. For modifying the outcome, investing in an irrigation system can help reduce any drought-related losses. Another example is designing a grain silo which is able to store crops and sell them when it is more profitable. For risk transfer, buying any form of insurance that would pay when yields drop below a certain level protects from any drastic losses.

Part 2: Data Identification & Assessment

#4: Identifying the type of data

Question. In 2–3 sentences each, identify which of the three categories of data identified in the Actuarial Process Guide are provided in each of the tabs of the scenario's attached dataset. Be specific in identifying the column (or description) from the dataset or the scenario description in your response. Explain (at a high level) what information and insights these datasets can provide.

Response.

Cause of Loss Smith Co tab. Data to categorize risk and potential outcomes is present in this tab, including data on the year, commodity name, cause of loss, month of loss, insurance plan name, and stage code, assisting in comparing the data based on scenario. The column for the "# of Policies Paid Out" is data used to define historical frequency, providing the number of claims paid out in a year and hence assisting to evaluate how often the risks occur. Lastly, data is available for the historical range of severity of potential losses, with the average premium per policy and average amount paid out per policy providing quantitative data to identify the typical severity of losses.

Corn Planting Costs tab. All of the columns in this tab focus on categorizing risk and potential outcomes, as no data values for loss are available. The machinery, seeding equipment, and labor costs provide information on how much a farmer invests and set the stage for potential outcomes when given data about the production. The assumed yield helps identify how much is at stake and the potential risk of loss.

Corn Harvest Prices tab. The data in this tab, which includes the average selling price for bushels in a calendar and marketing year, categorizes the economic risks and shows the value at stake. It does not, however, define the historical frequency nor the historical range of severity of losses, since this data by itself does not present any frequency of losses. If data on the bushels lost or insured acres was available in this tab, the historical range of severity of potential losses would be available.

#5: Planting costs for Farmer Jones

Question. What is the average total cost per acre for corn production (2016–2025) and average total cost per bushel (2016–2025)?

Response (text). Using the Corn Planting Costs tab, we compute the average total cost per acre and per bushel for 2016–2025. The average cost per acre is \$548.11 and the average cost per bushel is \$3.06.

Equations.

$$\begin{aligned}
\overline{C}_{\text{acre}} &= \frac{497.52 + 443.42 + 451.81 + 487.98 + 469.55 + 481.27 + 609.71 + 732.38 + 666.73 + 640.75}{10} \\
&\approx 548.11 \text{ dollars/acre}, \\
\overline{C}_{\text{bushel}} &= \frac{3.02 + 2.69 + 2.74 + 2.68 + 2.58 + 2.62 + 3.39 + 3.96 + 3.60 + 3.34}{10} \\
&\approx 3.06 \text{ dollars/bushel}.
\end{aligned}$$

#6: Assumed yield for Farmer Jones

Question. What is the average assumed yield (bushels per acre) for 2016–2025?

Response (text). The assumed yields from 2016–2025 are 165, 165, 165, 182, 182, 184, 180, 185, 185 and 192 bushels per acre. The average assumed yield is 178.5 bushels per acre.

Equation.

$$\overline{Y} = \frac{165 + 165 + 165 + 182 + 182 + 184 + 180 + 185 + 185 + 192}{10}$$
$$= 178.5 \text{ bushels per acre.}$$

#7: Anticipated total planting costs

Question. For Farmer Jones, if all 345 of her farm's acres are planted, using the average cost per acre found above in #5, what is the anticipated total cost for planting in the next season?

Response (text). Multiplying the average planting cost of $548.11 per acre by 345 acres, we get a total cost of $189,097.95.

Equation.

$$\text{Total planting cost} = 548.11 \times 345 = 189{,}097.95 \text{ dollars.}$$

#8: Range for anticipated costs

Question. Realistically, is this value found in #7 higher, lower, or about right for the actual anticipated costs? What might be a realistic range (reasonable minimum and maximum values for the planting costs)? Why? Explain in 1–2 sentences (additional computations optional).

Response. Historically, the minimum cost was $443.42 per acre in 2017 and the maximum cost was $732.38 in 2023. Due to the upwards trends of the cost, a reasonable range for next year's cost per acre would be between the recent years' values, perhaps $600–$700 per acre ($207,000–$241,500 for 345 acres), meaning that the cost found in #7 is below what is anticipated.

#9: Harvest expectations for Farmer Jones

Question. For Farmer Jones, if all 345 acres of her farm are harvested with the average yield found above in #6, what is the projected total yield (in bushels)?

Response (text). We expect 178.5 bushels per acre (the average over 2016–2025) times 345 acres, which is 61,582.5 bushels in total. If the 2025 assumed yield of 192 bushels per acre is used then the harvest would be $192 \times 345 = 66{,}240$ bushels.

Equations.

$$\text{Total yield (average)} = 178.5 \times 345 = 61{,}582.5 \text{ bushels},$$
$$\text{Total yield (2025)} = 192 \times 345 = 66{,}240 \text{ bushels}.$$

#10: Corn sale prices expectations

Question. Find the average cash corn prices for each individual month (Jan–Dec) for 2016–2025 and note them in a table.

Response.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Price ($/bu)	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

Question. Identify 2–3 trends that you notice regarding cash corn prices (over the years, within a calendar year, or within a marketing year) in the Corn Harvest Prices tab that may impact when a farmer wishes to sell their crop. Explain why you believe the trend is noteworthy or why it occurs in 1–2 sentences each (no new computations required).

Response.

- Average cash prices peak in May–July, with June having the highest ten-year average ($4.73/bushel). Prices are lowest in October and November ($4.21/bushel and $4.20/bushel), which is the traditional harvest season. This suggests that holding corn in storage until mid-summer could improve revenue.
- Calendar-year average prices rose steadily from about $3.40/bushel in 2016 to $6.86/bushel in 2022. The spike in 2021–2022 corresponds to an increase in demand.
- The difference between the lowest and highest monthly averages across 2016–2025 is roughly $0.52/bushel. This indicates that risk by price drop is smaller than production risk, but timing sales well can still improve revenue by about 10%.

The projected revenue is not static as the market price varies between years and even between months within the year. Thus, Farmer Jones needs to be strategic as she plans for the sale of her crops.

#12: Harvest expectations with October sale

Question. If Farmer Jones harvests and sells her entire harvest (found in #9) using the 2016–2025 average corn sale price for October (as found above in #10), what would her revenue be? What would her profit be (using planting costs found in #7)?

Response (text). There was an average of 178.5 bushels of corn made, and the average price of corn was \$4.21, getting us \$751.49 in revenue per acre. Multiplying for 345 acres, we get a total revenue of \$258,989. Additionally, the costs are \$548.11 per acre. This means that the profit (revenue minus costs) is \$203.38 per acre. Therefore, the total profits are \$69,890. If we used the 2025 yield of 192 bushels per acre and per-acre cost of \$640.75, the profit becomes \$57,517.

Equations.

$$\begin{aligned}
\text{Revenue per acre} &= 178.5 \times 4.21 \approx 751.49, \\
\text{Total revenue} &= 751.49 \times 345 \approx 258{,}989, \\
\text{Profit per acre} &= 751.49 - 548.11 = 203.38, \\
\text{Total profit} &\approx 203.38 \times 345 \approx 69{,}890.
\end{aligned}$$

#13: Harvest expectations with optimal sale

Question. If Farmer Jones is able to store her harvested corn and wait for the optimal sale (using the 2016–2025 averages found in #10), what could she anticipate for maximum revenue? Identify the month and revenue amount.

Response (text). The highest average monthly cash price between 2016 and 2025 is June at \$4.73/bushel. Selling the entire harvest of 61,582.5 bushels (average yield) at that price yields a revenue of \$291,080. If one were to use the 2025 assumed yield for both, it would become \$4.73/bushel times 66,240 bushels which is \$313,315.20 of revenue.

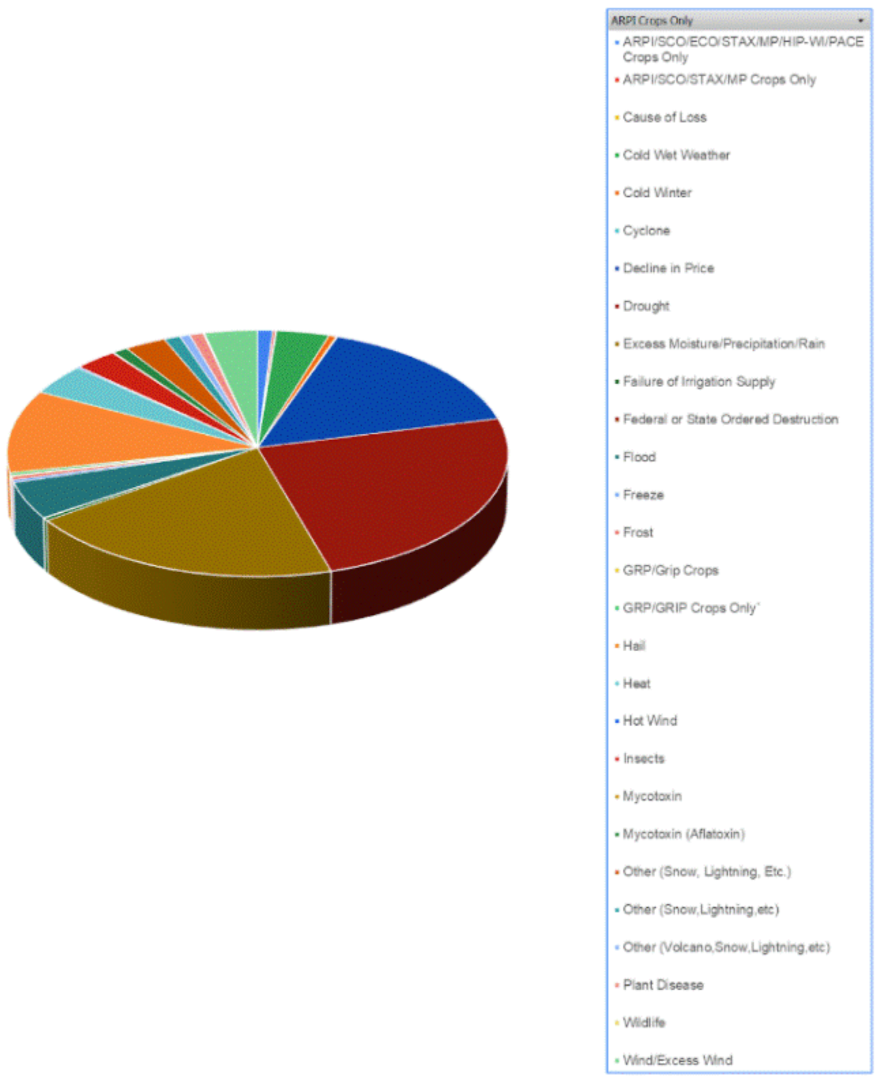
Equations.

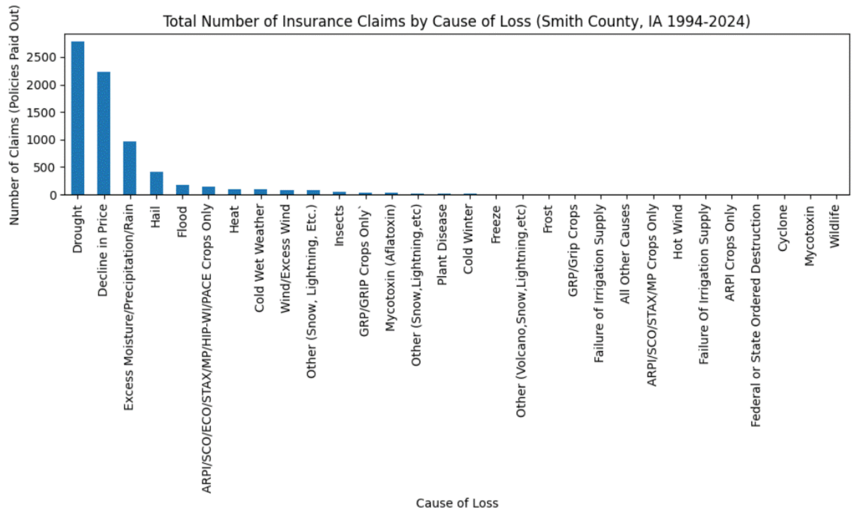
$$\text{Revenue (average yield)} = 61{,}582.5 \times 4.73 \approx 291{,}080,$$
$$\text{Revenue (2025 yield)} = 66{,}240 \times 4.73 = 313{,}315.20.$$

#14: Creation of a data visual

Question. Create a chart (e.g., pie chart, bar chart, etc.) that summarizes, labels, and categorizes the causes of loss for claims for 1994–2024. Include the chart in your response.

Response.





#15: Top causes of loss & their impacts

Question. Based on the data visual you created, what appear to be the top three leading causes for a loss claim? Why? Explain in 1–2 sentences (include the frequency of these claims in your response). How does this information on the top three causes of loss inform Farmer Jones as she plans for future risks to her farm in Smith County? Explain in 2–3 sentences.

Response. The policies across 1994–2024 show that Drought (2,781 claims), Decline in Price (2,233 claims) and Excess Moisture/Precipitation/Rain (972 claims) are the top causes. Drought accounts for 38% of all claims in Smith County. Decline in Price is significant, especially after 2010, when its frequency increased. For Farmer Jones, understanding that both risks during production (drought and excess moisture) and risks during selling (price decline) drive losses helps improve decision making. Drought can be fixed by exploring irrigation, price decline can be mitigated by considering revenue-protection insurance, and excess moisture suggests using proper field drainage or diversification in the choice of crop.

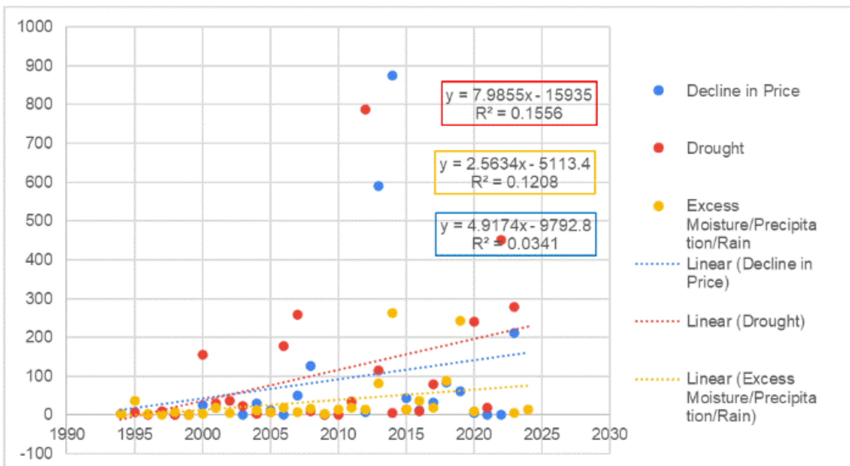
Part 3: Mathematical Modeling (Corn Farming Topic Prompts)

#16: Linear regression

Question. Conduct a linear regression on the frequency of loss claims for the top three causes of loss claims identified in prompt #15 for 1994–2024. Provide the plot (plot all three on the same chart), regression equations, and correlation coefficients in your response.

Sum of # of Policies Paid Out	Column Labels																															
Row Labels	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Grand Total
All Other Causes																									2							2
ARPI Crops Only																					1											1
ARPI/SCO/ECO/STAX/MP/HIP-WI/PACE Crops Only																													62	89		151
ARPI/SCO/STAX/MP Crops Only																							1			1						2
Cold Wet Weather	11	9							4				13		5		2	1	1	3	13	2	6	11	1	11	1		1		2	97
Cold Winter	15																															15
Cyclone														1																		1
Decline in Price					1	1	26	19		2	31	13	1	50	127	1			8	590	875	43	12	32	84	61	5	2	2	211		2197
Drought	4	7	2	9	1	2	156	29	37	24	3	8	177	259	9	2	1	34	787	116	5	14	9	80			240	19	451	279		2764
Excess Moisture/Precipitation/Rain	3	37	3	2	7	1	4	19	5		11	7	19	8	17	3	15	19	15	81	263	15	37	18	89	244	9			6	15	972
Failure of Irrigation Supply										1			1						1										1			4
Federal or State Ordered Destruction																									1							1
Flood	11	2		1				4							3		7	10	2	6	63		1		65	2	2				1	180
Freeze			7								1																					8
Frost			2												1						2			1								6
GRP/Grip Crops																			1	3												4
GRP/GRIP Crops Only											2	4		19	13																	38
Hail	2	19	25	12	3		63	10	6		1	18	1	4	1	26	1		3	12	114	1	7	4	10	2	3	40	1	23	1	413
Heat		1					2	1	2	2		2	12	6	1			11	29	3	1		1	2			3		9	10		98
Hot Wind																													2			2
Insects	5				1	2	1	24	4	1	1									1		3					1	1		4		49
Mycotoxin																			1													1
Mycotoxin (Aflatoxin)														25			2															27
Other (Snow, Lightning, Etc.)																		6	3	35	4			7	2	6	6	1	2	4		76
Other (Snow,Lightning,etc)					3		5	4			2				2		1															17
Other (Volcano,Snow,Lightning,etc)	7																															7
Plant Disease		1												1				1			2	5	1							6		17
Wildlife	1																															1
Wind/Excess Wind				1	9		1	6			1	4	3	4	4		1	10	2		2	4	2	1	1	24	2	1				83
(blank)																				1										#DIV/0!		#DIV/0!
Grand Total	59	76	39	25	25	6	258	116	58	30	53	56	227	377	183	32	30	92	863	851	1345	87	77	156	255	351	272	64	531	#DIV/0!	19	#DIV/0!

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
Decline in Price					1	1	26	19		2	31	13	1	50	127	1			8	590	875	43	12	32	84	61	5	2	2	211		2197
Drought	4	7	2	9	1	2	156	29	37	24	3	8	177	259	9	2	1	34	787	116	5	14	9	80			240	19	451	279		2764
Excess Moisture/Precipitation/Rain	3	37	3	2	7	1	4	19	5		11	7	19	8	17	3	15	19	15	81	263	15	37	18	89	244	9			6	15	972



#17: Cause of loss trends or patterns

Question. Referring to your regression conducted above in #16, describe five trends or patterns you observe in causes of loss over the historical timeframe (e.g., maximums, minimums, patterns, co-occurrence of causes of loss, etc.). Offer a short plausible explanation for why you believe the trend occurs (1–2 sentences each).

Response.

- Trend 1: The amount of loss for all three types of loss has increased over time because farming inputs, crop values, and insured liability have risen alongside the rise of more extreme weather.
- Trend 2: There seem to be large outliers for all three types of loss because droughts, floods, and market crashes cause dramatic and severe losses. Since these events are scarce, they become outliers that greatly increase the trendline.

- Trend 3: All three lines have low R^2 since the loss amount varies unpredictably from year to year due to weather and economic conditions, meaning that time cannot be a great predictor of loss severity.
- Trend 4: If the outliers were removed, the lines would have higher accuracy but very low slope since that would mean taking out many of the largest claims, making the claims per year much lower.
- Trend 5: The amount of loss is very bimodal; it is either near 0 or around 250 because of the volatility of the claim conditions. Extreme drought one year can cause many people to file a claim while the next year may have no drought and almost no claims.

#18: Assumption evaluation

Question. In 1–2 sentences, evaluate and assess the reasonableness and rational basis for the assumption below. Note why the assumption is necessary or reasonable to simplify the topic in order to model or if the assumption goes beyond what is reasonable.

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.”

Response. The assumption is reasonable because Iowa’s agricultural practices and risk profiles are generally similar to national trends, so it is reasonable that Smith County’s insurance rate aligns with the national average. It also simplifies our model by neglecting differences between county-specific insurance rates, which adds unnecessary complexity into the model.

#19: Assumption development

Question. Write your own 1–2 sentence assumption that would pertain to this real-world scenario for math model creation. Provide a 1–2 sentence justification explanation as to why the assumption is needed and reasonable.

Response. The efficiency of machines and all other processes remain relatively constant over the modeling period. This means that any extremely advanced machinery or processes will not be created that completely change the average profits of the industry. This assumption is needed as it relates to both the costs and the possible profits. Advanced machinery may decrease costs while significantly increasing the profit, leading to inconsistent trends.

#20: Frequency of claims due to drought

Question. From the Cause of Loss tab (1994–2024), what is the annual average frequency of claims made for drought for farmers in Smith County, Iowa?

Response (text). On average, from 1994 to 2024, since there are 2,781 total claims for drought over the 31 years, there is an average of 89.71 claims filed per year in Smith County, Iowa.

Equation.

$$\text{Average annual drought claims} = \frac{2{,}781}{31} \approx 89.71 \text{ claims per year.}$$

#21: Expected value of loss due to drought

Question. For Farmer Jones, what is the expected value of crop loss due to drought in a given year (based only on the actual cost for Farmer Jones to plant)? Refer to the planting costs found in #7 for Farmer Jones' severity of loss.

Response (text). The severity of loss if a drought wipes out Farmer Jones' crop is equal to her total planting cost from #7, which we estimate as $189,098.64. Using the probability of drought (drought claims divided by total claims), the expected loss is

$$\frac{2{,}781}{7{,}288} \times 189{,}098.64 \approx 72{,}157.$$

Using the 2025 cost per acre $640.75 instead of the average value would yield an expected loss of about $84,913.

Equations.

$$\begin{aligned}
\text{Total planting cost} &= 548.11 \times 345 = 189{,}098.64,\\
p_{\text{drought}} &= \frac{2{,}781}{7{,}288},\\
\text{EV} &= p_{\text{drought}} \times 189{,}098.64 \approx 72{,}157,\\
\text{EV (2025 cost)} &= p_{\text{drought}} \times (640.75 \times 345) \approx 84{,}913.
\end{aligned}$$

#22: Average annual insurance payout due to drought

Question. What is the average annual insurance payout per policy for farmers in Smith County due to drought (use the Cause of Loss tab)? What could this mean for Farmer Jones as she considers her risks due to drought? Explain in 2–3 sentences.

Response (text). Multiplying the average amount paid per policy by the number of policies and dividing by the total number of policies yields a mean payout of about $26,412. This means that when a drought claim is paid, the insurer typically pays about $26k per policy. Farmer Jones can use this figure to estimate her claims in the case of a loss.

Equation (conceptual).

$$\text{Average payout per policy} = \frac{\sum(\text{avg payout}_i \times \#\text{ policies}_i)}{\sum \#\text{ policies}_i} \approx 26{,}412.$$

Part 4: Risk Analysis (Corn Farming Topic Prompts)

#23: Risk mitigation strategy: Grain silo

Question. Farmer Jones is considering purchasing and installing a grain silo to store harvested corn for long periods of time. She is considering a 100,000-bushel grain storage silo that would cost $250,000 to purchase and install (labor included). What risk(s) might Farmer Jones mitigate by installing a grain silo? What kind of risk mitigation strategy is this (behavior change, modifying the outcomes, insurance)? Explain in 1–2 sentences. Identify 2–3 advantages or "pros" of installing a grain silo as a risk mitigation strategy and 2–3 disadvantages or "cons". Explain and justify in 2–3 sentences each.

Response. By purchasing a 100,000 bushel silo, Farmer Jones makes sure that if the market price of grain goes down, she can still sell her grain later, at a more opportune time such as June or July. This is modifying the outcome, because she is trying to avoid her loss by changing the conditions in which she sells her grain. A grain silo lets Farmer Jones store her crop for longer, reducing risk of loss by low market prices. It gives her flexibility in choosing when to sell, allowing her to earn more profits. The silo also provides more independence from external storage providers, reducing reliance on potentially costly or unavailable third-party facilities. However, the upfront cost is very high, meaning that she must save up a large amount of money that could go to a better use or other risk-aversion method. The expected value of loss might mean that the silo will not make the $250,000 back for many years. If market prices don't vary much or if harvest volumes decline in some years, it might not be possible to use the silo to the fullest extent, reducing the economic value of the investment.

#24: Risk mitigation strategy: Irrigation system

Question. Based on the fact that drought seems to be a major cause of loss, Farmer Jones is exploring the option to install an irrigation system for her entire farm. Installation cost is \$1,500 per acre. Once installed, per-acre pumping costs are projected to be \$58 per acre for energy usage and \$30 per acre per season for maintenance and repairs. Based on neighboring farms, she could anticipate a yield of 270 bushels of corn per acre by using the irrigation system.

Identify the installation costs and annual operating costs of the irrigation system for Farmer Jones' farm. What is the anticipated annual corn harvest yield (in bushels) with the irrigation system? If Farmer Jones were to sell her entire crop upon harvesting in October, what is the anticipated revenue for this harvest (use the 2016–2025 average October price)?

Response (text). Installation costs are $1{,}500 \times 345 = \$517{,}500$. Usage cost per season is $345 \times (30 + 58) = \$30{,}360$. With the irrigation system, it is anticipated that Farmer Jones has a yield of 270 bushels of corn per acre, so there is a total of 93,150 bushels. Using the average October price \$4.21 per bushel, the revenue is $93{,}150 \times 4.21 = \$391{,}250$. Subtracting the annual operating cost of \$30,360 gives \$361,801.50.

Equations.

$$
\begin{aligned}
\text{Installation cost} &= 1{,}500 \times 345 = 517{,}500,\\
\text{Operating cost} &= 345 \times (58 + 30) = 345 \times 88 = 30{,}360,\\
\text{Total yield} &= 270 \times 345 = 93{,}150 \text{ bushels},\\
\text{Revenue} &= 93{,}150 \times 4.21 \approx 391{,}250,\\
\text{Revenue minus operating} &\approx 391{,}250 - 30{,}360 \approx 361{,}801.50.
\end{aligned}
$$

#25: Characterizing the crop insurance scenario

Question. Using the Revenue Protection equations and conditions (85% coverage, premium \$25/acre, projected yield equal to actual yield from #6, projected price \$5.20, harvest price \$4.39), find the revenue guarantee per acre, the actual revenue per acre, and if triggered, the insurance payout per acre and total insurance payout.

Response (text). Guarantee per acre = (projected yield) $\times$ (coverage percentage) $\times$(higher of projected or harvest price) = $192 \times 0.85 \times 5.20$ = \$848.64. Actual revenue per acre is 192×4.39 = \$842.88. The insurance payout is $848.64 - 842.88$ = \$5.76 per acre. The total insurance payout for 345 acres is 5.76×345 = \$1,987.20.

Equations.

$$\begin{aligned} \text{Guarantee per acre} &= 192 \times 0.85 \times 5.20 = 848.64, \\ \text{Actual revenue per acre} &= 192 \times 4.39 = 842.88, \\ \text{Payout per acre} &= 848.64 - 842.88 = 5.76, \\ \text{Total payout} &= 5.76 \times 345 = 1{,}987.20. \end{aligned}$$

#26: Value of the insurance policy

Question. Identify the total cost of the annual premium for Farmer Jones' farm for the Revenue Protection plan outlined above. Based on the analysis conducted here on Revenue Protection, would you recommend that Farmer Jones purchase Revenue Protection crop insurance to protect against a drop in price or potentially rely on Yield Protection insurance only? Why or why not? Explain in 2–3 sentences.

Response (text). Annual premium = 25×345 = \$8,625. Total payout is \$1,987.20. Since the payout is lower than the premium, Farmer Jones should not buy Revenue Protection insurance. The annual premium for Revenue Protection coverage is \$8,625. The expected insurance payout in the price-drop scenario is only \$1,987, so the policy would not be cost-effective for protecting against a modest drop in price. Revenue Protection could still be valuable if Farmer Jones worries about simultaneous yield and price declines, but with the given parameters, Yield Protection may be a more economical option.

Equations.

$$\begin{aligned} \text{Annual premium} &= 25 \times 345 = 8{,}625, \\ \text{Net benefit} &= 1{,}987.20 - 8{,}625 < 0. \end{aligned}$$

Part 5: Recommendations (Corn Farming Topic Prompts)

#27: Irrigation system impact

Question. Based on the data available to Farmer Jones, other corn farmers in Smith County who have installed an irrigation system like the one she is considering have found that their chance of loss due to drought has dropped to 0.2% in any given year. If Farmer Jones installs the irrigation system as outlined in prompt #24 above, what is her expected value of loss due to drought (with severity of loss being the cost of planting found in #7)?

Response (text). With irrigation, neighbouring farmers report a drought-loss probability of 0.2% (0.002). Using the accurate planting cost from prompt #7 ($189,098.64), the expected loss is $189{,}098.64 \times 0.002 = \$378.20$. Even if one were to use the 2025 per-acre cost of $640.75, the expected loss is $221{,}058.75 \times 0.002 = \$442.12$, both under $500.

Equations.

$$\text{EV with irrigation} = 189{,}098.64 \times 0.002 = 378.20,$$
$$\text{EV with irrigation (2025 cost)} = (640.75 \times 345) \times 0.002 \approx 442.12.$$

#28: Comparison of expected value of loss

Question. Compare the expected value of loss with the irrigation mitigation strategy (from #27) to the expected value of loss without mitigation measures computed in #21. Is this expected value of loss a noteworthy improvement or not? Explain in 1–2 sentences and justify your answer with relevant supporting computations.

Response (text). Since the loss went from $72,157 to $378.20, this is a 99.5% drop in loss of risk, which is very significant.

Equation.

$$\text{Percent reduction} = 1 - \frac{378.20}{72{,}157} \approx 0.995 \quad (99.5\%).$$

#29: Profit trajectory with irrigation

Question. What is the anticipated profit for the first year after utilizing the described irrigation system (assuming the planting costs as found in #7)? What implication does this have for a timeframe projection of profitability with an irrigation system? Explain and justify your response in 3–5 sentences with any supporting computations necessary.

Response (text). For without irrigation: Revenue (October sale) = 61,582.5 bu × \$4.21 ≈ \$258,989. Planting cost = \$189,099. Profit ≈ \$69,890. With irrigation (ignoring installation): Revenue = 93,150 bu × \$4.21 ≈ \$391,250. The planting cost remains \$189,099 (cost of seed, machinery and labour). Operating cost = \$30,360. Profit ≈ \$171,791. Profit improvement: 171,791 − 69,890 = 101,901 per year. The irrigation system therefore increases annual profit by about \$100k. The one-time installation cost is \$517,500. Dividing the installation cost by the annual profit improvement suggests a payback period of roughly 5 years (517,500/101,901 ≈ 5.1 years). After that, the system generates additional profit.

Equations.

$$\begin{aligned}
\text{Revenue (no irrigation)} &= 61{,}582.5 \times 4.21 \approx 258{,}989,\\
\text{Profit (no irrigation)} &= 258{,}989 - 189{,}099 \approx 69{,}890,\\
\text{Revenue (irrigation)} &= 93{,}150 \times 4.21 \approx 391{,}250,\\
\text{Profit (irrigation)} &= 391{,}250 - 189{,}099 - 30{,}360 \approx 171{,}791,\\
\text{Improvement} &= 171{,}791 - 69{,}890 \approx 101{,}901,\\
\text{Payback years} &= \frac{517{,}500}{101{,}901} \approx 5.1.
\end{aligned}$$

#30: Should the irrigation system be recommended?

Question. Identify 1–2 advantages or compelling reasons to install the irrigation system and 1–2 drawbacks or possible consequences of installing the irrigation system. Based on your analysis, would you recommend that Farmer Jones invest in the irrigation system for her farm? Why or why not? Explain in 3–5 sentences and justify with any relevant computations and values.

Response. Installing the irrigation system significantly reduces the risk of drought-related losses from \$72,157 to about \$378 annually, a saving of \$71,779. This is a 99.5% decrease. These figures suggest a strong financial incentive to invest. Yields increase from around 178.5 bu/ac to 270 bu/ac, raising the annual profit by around 100 thousand dollars (before insurance). This increased profitability helps pay off the installation cost in roughly five years. However, some drawbacks to installing at this current moment might be that there will be cheaper and more effective irrigation around the corner or that this might incentivise her neighbors to do the same, which might make the entire farmland much more competitive.