COLORADO STATE UNIVERSITY
DEPARTMENT OF AGRICULTURAL AND RESOURCE ECONOMICS

Problem Set 3 **Agricultural and Resource Economics 412** *S.R. Koontz*
Fall 2023 **Agricultural Commodities Marketing**

Fundamental Analysis Using Elasticities

This problem set is to be an independent effort by a team of two students. Write both names and student ID numbers in the top right-hand corner. Partial credit will be awarded only if you show your work and if the work communicates. Round percent calculations to the nearest tenth of a percent. Round hog and cattle prices ($/cwt.) to the nearest cent per cwt., broiler prices (¢/lb.) to the tenth of a cent per pound, and income to the dollar. This problem set is worth 50 points.

The purpose of this problem set is to use information available from the USDA in an applied price forecasting exercise. Basic economic tools called elasticities are used with publicly available supply and demand information to forecast futures prices. This procedure is a good starting point for analyzing prices of any non-storable commodity. The focus in this problem set will be on forecasting hog prices.

Assume it is June 30, 2023. On June 29, the USDA released the June Hogs and Pigs report. This report contains information on current and future hog supplies as of June 1, 2023. You are interested in forecasting prices of the lean hog futures contracts expiring in late 2023 and early 2024. A producer might incorporate this information into decisions of whether or not to hedge expected hog marketings or a speculator might use it to decide whether to take a long or short position. The futures contracts you are to forecast prices for are the contracts which will expire during the months of OCT23, DEC23, and FEB24.

1. The first step involves interpreting supply information. Information on the following two pages are taken from the USDA Hogs and Pigs report. You need to determine which weight groups will be arriving at market during the delivery period of the futures contracts. The following information is available on the hog production process. The average live weight of a finished hog sold in the U.S. is 295 pounds. After a pig reaches 50 pounds, the average rate of gain for hogs on feed is 1.6 pounds per day. Further, there are typically 2 months (60 days) between farrowing (birth of a litter of pigs) and when pigs reach 50 pounds and are ready to go on feed. The USDA Hogs and Pigs report contains the following information. The Market Hogs and Pigs numbers are the numbers of hogs, by weight, which producers plan to market as slaughter hogs. The Sows Farrowing numbers list the number of sows which farrowed pigs during the quarters of the production year. A unique and interesting feature of this report is that in it is reported the number of sows which producers *intend* to farrow in the next two quarters. For example, the June report provides the number of sows producers intend to farrow during the June-August quarter, and during the September-November quarter. The market hogs which will be sold for the next year can be estimated from these groups.

After the Hogs and Pigs report data is one page from the June release of USDA Livestock Slaughter report. Assume that the percent change in slaughter hog weights in the future will be equal to the percent change in average dressed weight of barrows and gilts between May 2022 and May 2023.

Hogs and Pigs Inventory by Class, Weight Group, and Quarter - United States: 2022 and 2023

[May not add due to rounding. Blank data cells indicate estimation period has not yet begun]

Item	2022	2023	2023 as percent of 2022
	---- 1,000 head ----		percent
March 1 inventory			
All hogs and pigs	72,689	73,109	101
Kept for breeding	6,098	6,096	100
Market	66,591	67,014	101
Market hogs and pigs by weight groups			
Under 50 pounds	20,105	20,059	100
50-119 pounds	19,030	18,975	100
120-179 pounds	14,988	15,193	101
180 pounds and over	12,468	12,787	103
June 1 inventory			
All hogs and pigs	72,314	72,394	100
Kept for breeding	6,168	6,146	100
Market	66,146	66,249	100
Market hogs and pigs by weight groups			
Under 50 pounds	20,903	20,939	100
50-119 pounds	18,691	18,748	100
120-179 pounds	13,827	13,863	100
180 pounds and over	12,725	12,699	100
September 1 inventory			
All hogs and pigs	74,125		
Kept for breeding	6,152		
Market	67,973		
Market hogs and pigs by weight groups			
Under 50 pounds	21,893		
50-119 pounds	19,677		
120-179 pounds	14,013		
180 pounds and over	12,390		
December 1 inventory			
All hogs and pigs	74,849		
Kept for breeding	6,104		
Market	68,746		
Market hogs and pigs by weight groups			
Under 50 pounds	21,788		
50-119 pounds	19,130		
120-179 pounds	14,800		
180 pounds and over	13,028		

Sows Farrowing, Pig Crop, and Pigs per Litter - United States: 2021-2023
[December preceding year. Blank data cells indicate estimation period has not yet begun]

Item	2021	2022	2023	2023 as percent of 2021	2023 as percent of 2022
	1,000 head			percent	
Sows farrowing					
December-February	2,929	2,919	2,910	99	100
March-May	3,034	2,967	2,896	95	98
December-May 1/	5,964	5,886	5,805	97	99
June-August 2/	3,050	3,062	2,942	96	96
September-November 2/	3,049	3,092	2,953	97	96
June-November 1/ 2/	6,098	6,154	5,896	97	96
Pig crop					
December-February	32,059	31,947	32,058	100	100
March-May	33,233	32,635	32,891	99	101
December-May 1/	65,292	64,582	64,948	99	101
June-August	33,944	34,096			
September-November	34,123	34,701			
June-November 1/	68,067	68,796			
	number			percent	
Pigs per litter					
December-February	10.94	10.95	11.02	101	101
March-May	10.95	11.00	11.36	104	103
December-May	10.95	10.97	11.19	102	102
June-August	11.13	11.13			
September-November	11.19	11.22			
June-November	11.16	11.18			

1/ May not add due to rounding.
2/ Intentions for 2023.

Federally Inspected Slaughter Average Dressed Weight by Class - United States
[Data may not add to totals due to rounding]

Class	May 2022	April 2023	May 2023	January to May 2022	January to May 2023
	pounds				
Cattle	817	818	816	834	822
Steers 1/	889	892	888	911	899
Heifers 1/	822	826	819	842	827
All cows 1/	629	630	628	646	637
Bulls 1/	881	874	890	877	866
Calves and vealers ...	162	163	172	150	156
Hogs	218	217	215	218	217
Barrows and gilts 2/	216	215	213	217	215
Sows 2/	301	298	300	297	297
Boars 2/	192	192	194	193	193
Sheep	69	62	64	67	64
Mature sheep 3/	63	65	64	63	64
Lambs and yearlings 3/ ..	70	62	64	67	64

1/ Included in cattle average dressed weight.
2/ Included in hog average dressed weight.
3/ Included in sheep average dressed weight.

Calculate which group will be arriving in the slaughter market during each contract expiration month and determine the percent change in supply from the previous year. You should determine when the typical hog that is on the border of two groups will come to market. Lighter hogs will be marketed later and heavier hogs will be marketed earlier. You may need to use sow farrowing intention numbers. If you do then observe the change in pigs per litter. Calculate the average percent change with the two most recent quarters and combine that with your change in sow numbers. Show your calculations clearly below. Use the production information given above, not any personal knowledge. We are analyzing market prices which are influenced by the behavior of all producers, and the average of the U.S. is lower than the better management practices or the targets of efficient producers. Remember, the report information is as of June 1. Do not use the percent changes in the table. Round the percent changes that you calculate to the nearest tenth of a percent.

Lean Hog Contract	Report Group	% Change in Numbers	% Change in Weight	Total % Change
OCT23	_____	_____	_____	_____
DEC23	_____	_____	_____	_____
FEB24	_____	_____	_____	_____

Use the timeline below to support your work.

May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar

2. The second step is to incorporate the supply information with the demand curve for pork. This will be done in three steps. The first step, (a) below, is to examine the own-price effect of the supply change on hog prices, examining a movement along the demand curve. The second step, (b) below, will be to examine how the demand curve for pork may shift in response to changing income, broiler chicken and fed cattle prices. The third step, (c) below, is to incorporate the demand shifts with the movements along the demand curve (supply changes) for a total effect hog price forecast.

Use the following elasticities:

Own-Price Elasticity of Hog Demand = -0.65,
Cross-Price Elasticity between Hog Demand and Broiler Prices = 0.10,
Cross-Price Elasticity between Hog Demand and Cattle Prices = 0.15,
Income Elasticity of Hog Demand = 0.40.

You should use the appropriate month of the previous year as the base when making your projected percent changes. Information on inflation, and past and projected prices and income are as follows.

Hog Prices:

Over the previous year, lean hog futures contracts entered the delivery months at the following prices:

JUL22	AUG	OCT	DEC	FEB23	APR	MAY	JUN
111.25	121.30	91.85	82.00	75.25	73.00	77.00	85.40

Broiler Prices:

Industry sources and an article in the USDA publication Livestock, Dairy and Poultry Outlook suggest there will be changes in broiler production and exports for 2023 and 2024. Production is expected to decrease and exports are expected to be neutral. The USDA publication reports that price forecasts for the broiler price (cents/lb.) will be at the following levels over the coming year:

Jul-Sep23	Oct-Dec	Jan-Mar24
140-144	127-133	122-132

The national composite broiler prices last year were at the following levels:

Jun22	Jul	Aug	Sep	Oct	Nov	Dec	Jan23	Feb	Mar	Apr	May
165.8	153.3	130.4	124.7	121.9	124.7	123.7	122.0	121.7	130.1	140.2	142.4

(Use the midpoint of the forecasted price range for a forecast in the middle of the quarter. However, use a well-known fact about the seasonality of broiler production and the impact on price. Broilers are grown in the southern U.S., are grown in open-air facilities, and are most impacted by summer heat. Production is lowest relative to demand in the summer and higher in the winter.) So, use one end of the range for a forecast at the end of each quarter.)

Cattle Prices:

Because cattle prices are relatively difficult to forecast, you use futures prices as your projections of cattle prices. You read the following live cattle futures prices out of the Wall Street Journal:

AUG23	OCT	DEC	FEB24	APR	JUN
173.75	176.85	180.95	184.65	186.70	179.60

Over the previous year, live cattle futures contracts entered the delivery months at the following prices:

AUG22	OCT	DEC	FEB23	APR	JUN
138.30	145.40	152.75	160.00	171.45	175.50

Inflation and Consumer Income:

After reading information from the Federal Reserve Bank, Wall Street Journal, and USDA Agricultural Outlook publication, you find the outlook for the economy strong but that it will most likely soften during 2022 and 2023. The economy was growing at historically strong rates but the outlook is for slower growth. Inflation has been substantial during the recovery. The most recent month for which you have the consumer price index (CPI) is May 2023 and it is 303.3. The CPI in May 2022 was 291.3. Calculate the current annual inflation rate and assume this rate will continue through 2023 and into 2024.

Below are listed the most recent five quarters of per capita disposable income:

2022:I	2022:II	2022:III	2022:IV	2023:I
54802	55508	56556	57372	59408

You need to forecast nominal income for the quarters of 2023 and 2024 in which the futures contracts expire. (Nominal income has inflation in it.) Calculate the annual percentage change in nominal income based on most recent quarter with which you have information – use income from the most recent quarter and compare that to income in the same quarter of the previous year. Assume nominal income will change at this combined percentage. Next, use this nominal income levels from the different quarters of 2022 and 2023 and that percentage change, and forecast nominal income. You are assuming that the most recent, not current but given and assumed, nominal growth rate will continue into the next year. Show your inflation and income work below.

a. Calculate the own-price effect of the expected changes in future supplies on the futures prices for lean hogs. Use just the own price elasticity.

Futures Contract Month	% Supply Change	% Hog Price Change	Last Year's Hog Price	Hog Price Forecast (real)	Hog Price Forecast (nominal)
OCT23	_____	_____	_____	_____	_____
DEC23	_____	_____	_____	_____	_____
FEB24	_____	_____	_____	_____	_____

Show the % Hog Price Changes and Hog Price Forecasts (real) clearly. You need not show the inflation calculations.

b. The next step is to calculate the extent of the demand curve shifts over the next year. Use the cross price and the income elasticities to calculate how much the demand curves are expected to shift given the projected changes in broiler price, cattle price, and income. Notice, all the work necessary can be done on the table provided below, i.e., % Change multiplied by the Elasticity yields the % Shift in Hog Demand. Be sure to express numbers in the % Change column as changes, i.e., small positive or negative percentages, and not numbers close to 100.

OCT23 Contract	10/23 Forecast	10/23 Forecast Deflated	10/22 Actual	% Change	Elast-icity	%Shift in Hog Demand
Broiler Price	_____	_____	_____	_____	_____	_____
Cattle Price	_____	_____	_____	_____	_____	_____
Income	_____	_____	_____	_____	_____	_____
						_____
			Total Demand Curve Shift			_____

DEC23 Contract	12/23 Forecast	12/23 Forecast Deflated	12/22 Actual	% Change	Elast-icity	%Shift in Hog Demand
Broiler Price	_____	_____	_____	_____	_____	_____
Cattle Price	_____	_____	_____	_____	_____	_____
Income	_____	_____	_____	_____	_____	_____
						_____
			Total Demand Curve Shift			_____

FEB24 Contract	2/24 Forecast	2/24 Forecast Deflated	2/23 Actual	% Change	Elast-icity	%Shift in Hog Demand
Broiler Price	_____	_____	_____	_____	_____	_____
Cattle Price	_____	_____	_____	_____	_____	_____
Income	_____	_____	_____	_____	_____	_____
						_____
			Total Demand Curve Shift			_____

c. Combine the projected changes in supply with the total shifts in demand to calculate the net change in pork quantity which will affect the lean hog price. Use the following formula:

Net % Change in Quantity = % Change in Supply - Total % in Shift in Pork Demand.

Futures Contract Month	% Change in Supply	Total %Shift in Pork Demand	Net Change in Quantity
OCT23	_____	_____	_____
DEC23	_____	_____	_____
FEB24	_____	_____	_____

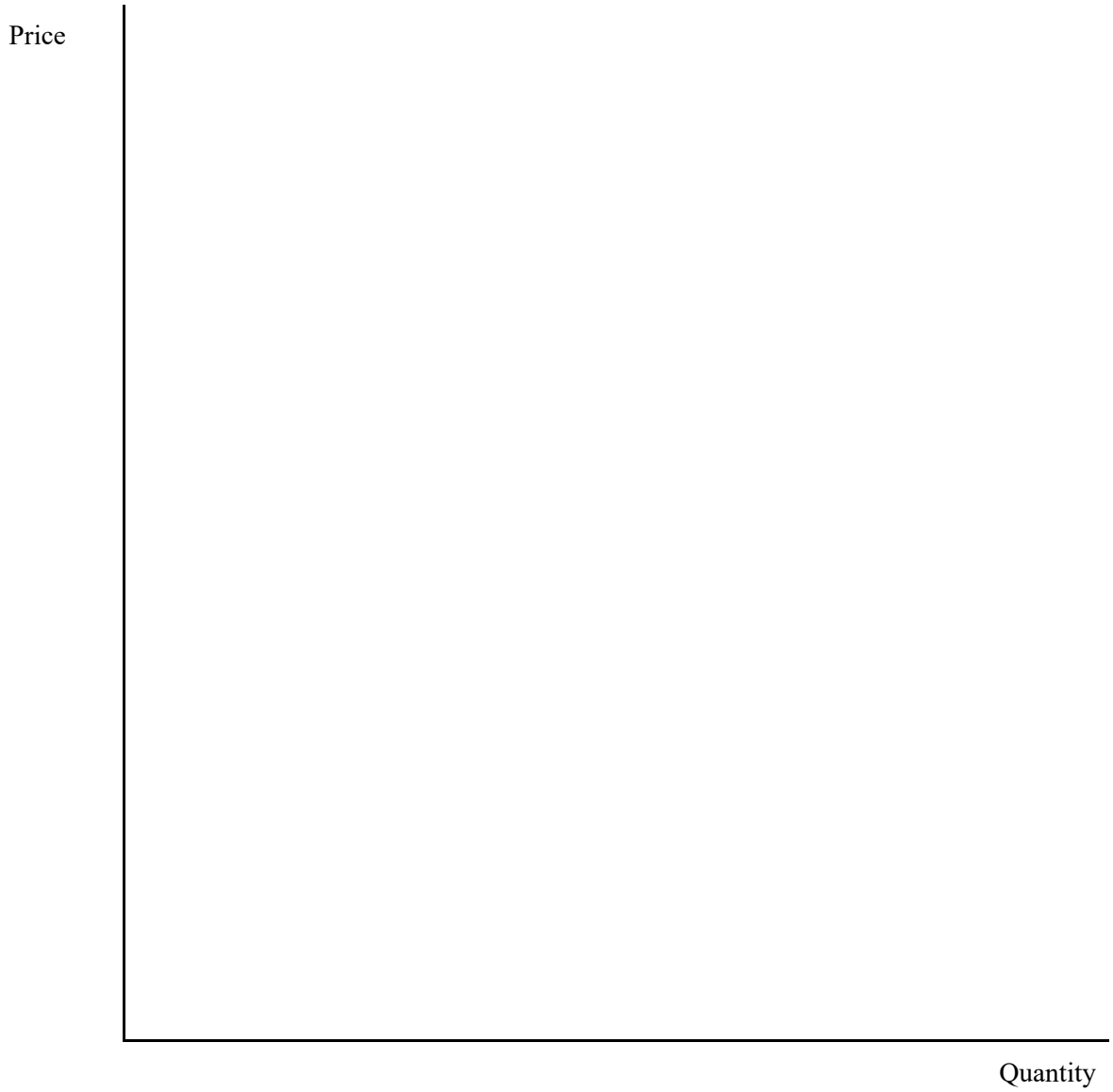
Next, use the Net Change in Quantity and the own-price elasticity to project the prices of the futures contracts.

Futures Contract Month	Net Change in Quantity	% Hog Price Change	Last Year's Hog Price	Hog Price Forecast (real $)	Hog Price Forecast (nominal $)
OCT23	_____	_____	_____	_____	_____
DEC23	_____	_____	_____	_____	_____
FEB24	_____	_____	_____	_____	_____

Show your % Hog Price Changes and Hog Price Forecasts (real).

3. Identify and draw the listed features of your price projection for the contract with the largest supply shift. Make sure the figure communicates. Draw the following:

a. Last year's demand curve, supply curve, and price.
b. The new supply curve, percent change in quantity supplied, and forecasted price (real $).
c. The new demand curve, percent change in demand, the net quantity based on shifted supply and demand, and the forecasted price (real $).



4. Compare your price forecasts to the actual closing futures prices June 30, 2023.

	Actual Prices	Forecast Prices
JUL	$94.60/cwt.	
AUG	$91.45	
OCT	$79.40	_____
DEC	$76.40	_____
FEB24	$81.80	_____
APR	$87.20	
MAY	$90.95	
JUN	$97.00	

If you were involved in hog production and had some hogs to sell in this marketing window, how might this information influence your hedging decisions? What about if you are a speculator?

Why might your forecast not be correct? Evaluate the procedures that you followed. What information might you want to use to qualify your quantitative forecast? (Write down the list and discuss one important thing on the list based on some independent research.)