

OM 380.17 Bagchi & Gutierrez
Group Homework – 4 (worth 2.5% of your course grade)

Names of Group Members and Index Numbers

Name (First, Last)	Index Number	Signature
Aditya Chawla	7	Aditya Chawla
Anvesh Karangula	19	Anvesh Karangula
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***** By signing my name, I am affirming that:**

- I have read the course syllabus.**
- I have contributed as expected toward the fulfillment of this assignment.**
- The work our group is turning in is the work product of our group.**
- Our group did not get outside help in fulfilling this assignment.**

This homework is based on the McCormick Hardware Store described on page 2. Please read the description carefully and answer the questions that follow. **Your submission must have this page as the cover page. Please submit on Canvas by the beginning of class on the day the assignment is due.**

Each year the McCormick Hardware Store places one order for riding lawn mowers in February. The selling season is April-August. The following probability distribution of demand is assumed by McCormick:

Demand	Probability
0	10%
1	15%
2	30%
3	20%
4	15%
5	10%

The lawn mowers are purchased by McCormick from the wholesaler at \$3,000 per unit and sold for \$4,250. McCormick anticipates being able to sell surplus (= not sold during April-August) lawn mowers during the September “end-of-summer” sale. However, the total number of lawn mowers sold during a year (April-August plus September) cannot exceed five. In effect, the maximum number of surplus lawn mowers that can be sold in September is also five. The sales price for a surplus lawn mower is \$2,500.

Upon receipt of the order from McCormick, the wholesaler orders from the factory. The factory price of a lawn mower is \$2,250. McCormick receives the lawn mowers in March.

The purpose of this assignment is to explore incentive alignment in the supply chain consisting of McCormick and its wholesaler. Let us denote the current contractual arrangement between McCormick and the wholesaler, captured above, as Traditional Contract.

Two alternatives to the Traditional Contract are being considered: Revenue-Sharing Contract and Surplus-Refund Contract. In the former, the wholesale price will decline from \$3,000 to \$2,600 but McCormick will have to give 10% of its sales revenue to the wholesaler. In the latter, the wholesaler will pay McCormick \$400 – in effect a refund – for every surplus lawn mower.

Q1. What is the maximum possible (expected) profit for the supply chain (i.e. no matter what the contractual arrangement is between McCormick and its wholesaler)?

Q2. For each of the three contractual arrangements, what is: (1) McCormick’s optimal order quantity? (2) McCormick’s expected profit? (3) Wholesaler’s expected profit? (4) Supply chain’s expected profit?

The table on page 3 summarizes the problem data. Please use the same table to report your answers to the above questions. The table on page 4 provides a template for your use.

Incentive Alignment between McCormick and its Wholesaler

Question		Traditional Contract	Revenue-Sharing Contract	Surplus-Refund Contract
	Retail Price	\$4,250	\$4,250	\$4,250
	Wholesale Price	\$3,000	\$2,600	\$3,000
	Factory Price	\$2,250	\$2,250	\$2,250
	McCormick's Share of Revenue	100%	90%	100%
	Surplus Refund	\$0	\$0	\$400
	McCormick's MP (Marginal Profit)	\$1,250 [4250-3000]	\$1,225 [0.9*4250-2600]	\$1,250 [\$250-3000]
	McCormick's ML (Marginal Loss)	\$500 [3000-2500]	\$350 [2600-(0.9*2500)]	\$100
Q2	McCormick's Optimal Order Quantity	3 (CR=0.71)	4 (CR=0.78)	5 (CR=0.93)
Q2	McCormick's Expected Profit	\$2175	\$2301.25	\$2807.5
Q2	Wholesaler's Expected Profit	\$2250	\$2811.25	\$2730
Q2	Supply Chain's Expected Profit	\$4425	\$5112.5	\$5537.5

Q1. Supply chain's maximum possible (expected) profit is: **\$ 5537.5** (Please show your work).

Marginal Profit of the Supply Chain = \$4250 - \$2250 = \$2000

Because the surplus quantity is being sold at \$2500 and the cost of lawnmower in factory is \$2250 which is less than the surplus selling price, there is no loss in supply chain, hence:

Marginal Loss of the Supply Chain = 0

Therefore, Critical Ratio = $MP/(MP+ML) = 1/(1+0) = 1$

So, the supply chain's optimal order quantity would be 5 (max).

Expected revenue = Expected Demand Value * Retail Price of 1 Lawnmower + Expected Leftover Value * Surplus Selling Price
 $= 2.45*4250 + 2.55*2500 = \16787.5

Expected Cost = $5*2250 = \$11750$

Expected profit = Expected revenue - Expected cost = $\$16787.5 - \$11750 = \$5537.5$

Contract Type: Traditional McCormick's Optimal Order Quantity: 3												
Demand	Probability	Sold during Apr-Aug	Sold as Surplus	McCormick's			Wholesaler's			Supply Chain's		
				Revenue	Cost	Profit	Revenue	Cost	Profit	Revenue	Cost	Profit
0	10%	0	3	7500	9000	-1500	9000	6750	2250	7500	6750	750
1	15%	1	2	9250	9000	250	9000	6750	2250	9250	6750	2500
2	30%	2	1	11000	9000	2000	9000	6750	2250	11000	6750	4250
3	20%	3	0	12750	9000	3750	9000	6750	2250	12750	6750	6000
4	15%	3	0	12750	9000	3750	9000	6750	2250	12750	6750	6000
5	10%	3	0	12750	9000	3750	9000	6750	2250	12750	6750	6000
McCormick's Expected Profit: \$2175 Wholesaler's Expected Profit: \$2250 Supply Chain's Expected Profit: \$4425												

Contract Type: Revenue Sharing McCormick's Optimal Order Quantity: 4												
Demand	Probability	Sold during Apr-Aug	Sold as Surplus	McCormick's			Wholesaler's			Supply Chain's		
				Revenue	Cost	Profit	Revenue	Cost	Profit	Revenue	Cost	Profit
0	10%	0	4	9000	10400	-1400	11400	9000	2450	10000	9000	1000
1	15%	1	3	10575	10400	175	11575	9000	2575	11750	9000	2750
2	30%	2	2	12150	10400	1750	11750	9000	2750	13500	9000	4500
3	20%	3	1	13725	10400	3325	11925	9000	2925	15250	9000	6250
4	15%	4	0	15300	10400	4900	12100	9000	3100	17000	9000	8000
5	10%	4	0	15300	10400	4900	12100	9000	3100	17000	9000	8000
McCormick's Expected Profit: \$2301.25 Wholesaler's Expected Profit: \$2811.25 Supply Chain's Expected Profit: \$5112.5												

Contract Type: Surplus-Refund Contract McCormick's Optimal Order Quantity: 5												
Demand	Probability	Sold during Apr-Aug	Sold as Surplus	McCormick's			Wholesaler's			Supply Chain's		
				Revenue	Cost	Profit	Revenue	Cost	Profit	Revenue	Cost	Profit
0	10%	0	5	14500	15000	-500	15000	13250	1750	12500	11250	1250
1	15%	1	4	15850	15000	850	15000	12850	2150	14250	11250	3000
2	30%	2	3	17200	15000	2200	15000	12450	2550	16000	11250	4750
3	20%	3	2	18550	15000	3550	15000	12050	2950	17750	11250	6500
4	15%	4	1	19900	15000	4900	15000	11650	3350	19500	11250	8250
5	10%	4	0	21250	15000	6250	15000	11250	3750	21250	11250	10000
McCormick's Expected Profit: \$2807.5 Wholesaler's Expected Profit: \$2730 Supply Chain's Expected Profit: \$5537.5												