The Economics of Lemonade Stand

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Hooda Math Lemonade Stand

Play Lemonade Stand on HoodaMath

Easy: Sunny Days only

Medium: Sunny Days and Cloudy Days
–50% reduction in QD on Cloudy Days

Hard: Sunny, Cloudy, and Rainy Days
–demand drops to zero on Rainy Days

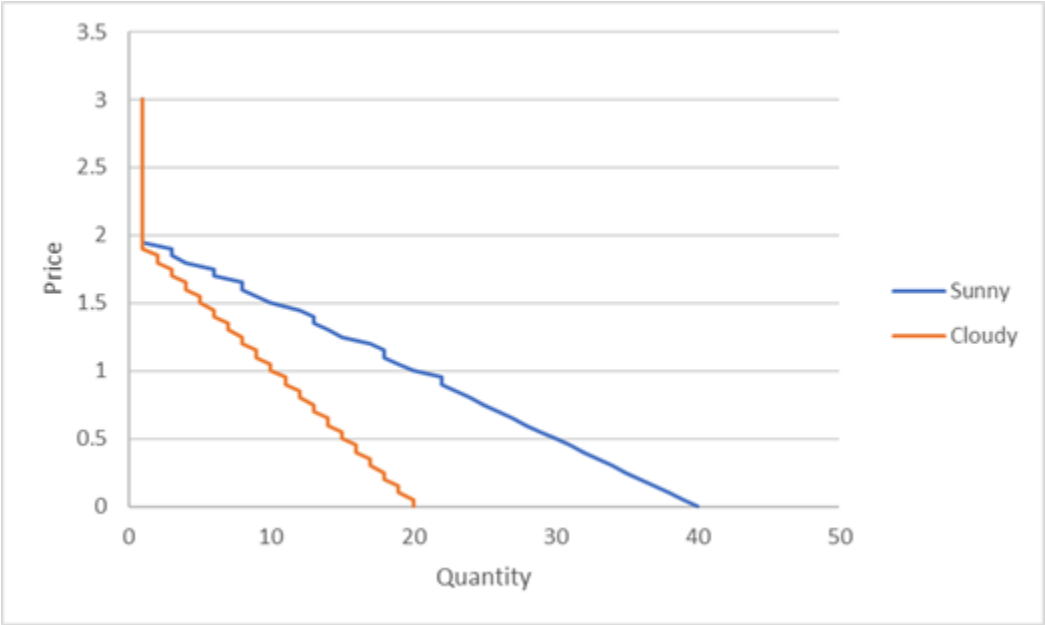

HOODA
LEMONADE
STAND
DAY: 1
WEATHER
REPORT
TODAY'S FORCAST:
CLOUDY
NEXT

Price arrows can be sensitive.


HOODA
LEMONADE
STAND
DAY: 1
CUPS SOLD: 9
PITCHERS: 3
YOUR MONEY: $11.00

Game continues for 10 days.

Graphing Demand



Problems: QD never drops to zero (best to give $0-$2 price range)
Demand not quite linear

Nice example of ceteris paribus.

--When plotting demand, important to not run out of lemonade!
--Tell students to not be concerned about maximizing profits.

Before you pick prices, I want you to think about the direction of the relationship between how many lemonades you sell and the price. If your price increases, will you sell more or less lemonade?

Also, think about how weather impacts sales. The two weather occurrences are sunny days and cloudy days. In other words, do you expect to sell more lemonade during cloudy days compared to sunny days? Or, do you expect to sell more lemonade in sunny days?

Now, use the arrows to increase or decrease the number of pitchers you purchase as well as the price of a cup of lemonade. Use the below table to track your sales:

	Price per cup	Quantity of cups sold	Weather
Day 1			
Day 2			
Day 3			
Day 4			
Day 5			
Day 6			
Day 7			

Now that we have our data, we want to graph it. Create demand curves on the graph of the back of the page. Remember which variables go on the axes and you also need to take into account the weather (the ceteris paribus var)

Calculating Price Elasticity of Demand using Midpoint Formula

Easy follow-up activity once students plot points for the demand curve.

Choosing optimal price to maximize profits

NEED TO PROVIDE $0-$2 RANGE DUE TO DEMAND PROBLEM.

1) “Plug and Chug” method

–works well for Principles students
–can provide full demand schedule to save time
–calculate TR, TC, and profits
–MR = MC rule tough due to nonlinear demand

Price	Q sunny	TR	MR	MC	TC	Profit
3	1	3		0.285714	2	1
2	1	2	#DIV/0!	0.285714	2	0
1.95	1	1.95	#DIV/0!	0.285714	2	-0.05
1.9	3	5.7	1.875	0.285714	2	3.7
1.85	3	5.55	#DIV/0!	0.285714	2	3.55
1.8	4	7.2	1.65	0.285714	2	5.2
1.75	6	10.5	1.65	0.285714	2	8.5
1.7	6	10.2	#DIV/0!	0.285714	2	8.2
1.65	8	13.2	1.5	0.285714	4	9.2
1.6	8	12.8	#DIV/0!	0.285714	4	8.8
1.55	9	13.95	1.15	0.285714	4	9.95
1.5	10	15	1.05	0.285714	4	11
1.45	12	17.4	1.2	0.285714	4	13.4
1.4	13	18.2	0.8	0.285714	4	14.2
1.35	13	17.55	#DIV/0!	0.285714	4	13.55
1.3	14	18.2	0.65	0.285714	4	14.2
1.25	15	18.75	0.55	0.285714	6	12.75
1.2	17	20.4	0.825	0.285714	6	14.4
1.15	18	20.7	0.3	0.285714	6	14.7
1.1	18	19.8	#DIV/0!	0.285714	6	13.8
1.05	19	19.95	0.15	0.285714	6	13.95
1	20	20	0.05	0.285714	6	14
0.95	22	20.9	0.45	0.285714	8	12.9
0.9	22	19.8	#DIV/0!	0.285714	8	11.8
0.85	23	19.55	-0.25	0.285714	8	11.55
0.8	24	19.2	-0.35	0.285714	8	11.2
0.75	25	18.75	-0.45	0.285714	8	10.75
0.7	26	18.2	-0.55	0.285714	8	10.2
0.65	27	17.55	-0.65	0.285714	8	9.55
0.6	28	16.8	-0.75	0.285714	8	8.8
0.55	29	15.95	-0.85	0.285714	10	5.95
0.5	30	15	-0.95	0.285714	10	5
0.45	31	13.95	-1.05	0.285714	10	3.95
0.4	32	12.8	-1.15	0.285714	10	2.8
0.35	33	11.55	-1.25	0.285714	10	1.55
0.3	34	10.2	-1.35	0.285714	10	0.2
0.25	35	8.75	-1.45	0.285714	10	-1.25
0.2	36	7.2	-1.55	0.285714	12	-4.8
0.15	37	5.55	-1.65	0.285714	12	-6.45
0.1	38	3.8	-1.75	0.285714	12	-8.2
0.05	39	1.95	-1.85	0.285714	12	-10.05
0	40	0	-1.95	0.285714	12	-12

Choosing optimal price to maximize profits cont.

2) Profit equation

–works well for Intermediate students
–uses a linear estimate of demand found by point-slope formula
–uses TC = MC*q
–can use calculus to take derivative of profit equation or use MR = MC

$m = \frac{1.5-.5}{10-30} = -\frac{1}{20} = -0.05$ *calculating slope of demand

$P - 0.5 = -0.05(Q - 30)$
$P = 2 - .05Q$ * using point-slope formula to get inverse demand equation

$\Pi = (2 - 0.05Q)Q - 0.29Q$* maximizing profits to solve for optimal price

$\frac{d\pi}{dQ} = 2 - 0.1Q - 0.29 = 0$

$Q = 17.1 \quad P = 2 - 0.05(17.1) = \$1.145 = \$1.15$

Cool Math Lemonade Stand

—more complex than Hooda Math game (purchase ingredients and choose recipe)
–more detailed weather conditions (temp and weather)
–customer satisfaction and popularity measurements

Cool Math Lemonade Stand game


Inventory/Purchasing
You have:
0 Paper Cups
Buy More Cups
0 Lemons
Buy More Lemons
0 Cups of Sugar
Buy More Sugar
0 Ice Cubes
Buy More Ice
Bankrupt!
OK
Help!
Day: 1
Money: $20.00
High Temperature: 97 degrees
Weather Forecast: Clear and Sunny


Price/Quality Control
Price per Cup:
- 25 +
Cents
Lemons per Pitcher:
- 4 +
Lemons
Sugar per Pitcher:
- 4 +
Cups
Ice per Cup:
- 4 +
Cubes
Back to Store!
Bankrupt!
OK
Help!
Day: 1 of 7
Money: $17.07
Temperature: 90°F / 32°C
Weather: Cloudy


Coolmath's
Lemonade Stand
Day: 1 of 7
Money: $17.07
Fast Forward
Temperature: 90°F / 32°C
Weather: Cloudy


End of Day Reports
You managed to sell 38 cups to 103 potential customers.
Considering the weather, I'd say this is Good.
Your Customer Satisfaction:
73%
Your Popularity:
3%
OK
Day: 1
Money: $13.61
High Temperature: 57 degrees
Weather Forecast: Hazy

Using regression to estimate demand

–works well for statistics/econometrics students
–can have students gather their own data outside of class or provide them with a dataset.
–guess the impact of the variables on quantity sold (price, temp, weather, lemons, ice, sugar, popularity, satisfaction)
–could also tie in tests of classical assumptions
–advanced topic: censored observations (occurs when sell out of lemonade during the day)

MODEL	(1)	(2)	(3)	(4)	(5)
Dep Var	quantitysold	quantitysold	quantitysold	quantitysold	quantitysold
price	-120.7***	-136.4***	-176.5***	-179.7***	-172.8***
	(23.51)	(21.52)	(17.81)	(17.88)	(18.04)
temp	1.185***	1.271***	1.088***	1.085***	1.061***
	(0.17)	(0.15)	(0.12)	(0.12)	(0.12)
cloudy		-12.26**	-10.37**	-10.80**	-8.959*
		(5.82)	(4.68)	(4.78)	(4.80)
overcast		-13.59***	-17.88***	-17.20***	-17.70***
		(4.94)	(3.96)	(3.95)	(3.97)
hazy		3.237	-3.9	-3.558	-3.876
		(5.17)	(4.26)	(4.34)	(4.27)
rain		-24.74***	-27.25***	-28.19***	-27.69***
		(5.36)	(4.34)	(4.35)	(4.40)
lemonsperpitcher			6.819***	12.46***	6.525***
			(0.99)	(3.72)	(1.02)
sugarperpitcher			3.824***	5.139	3.642***
			(1.02)	(3.60)	(1.05)
icepercup			-2.591**	4.282	-2.425*
			(1.29)	(5.59)	(1.30)
lemonsquare				-0.689	
				(0.44)	
sugarsquare				-0.155	
				(0.38)	
icesquare				-1.112	
				(0.89)	
satisfaction					13.23
					(11.09)
popularity					1.171
					(5.73)
Constant	-27.57***	-22.26**	-39.40***	-59.98***	-47.51***
	(10.43)	(9.60)	(8.90)	(13.31)	(10.91)
Observations	107	107	107	107	107
R-squared	0.339	0.512	0.705	0.719	0.71
Adj R-squared	0.327	0.483	0.677	0.683	0.677
Standard errors in parentheses					
*** p<0.01, ** p<0.05, * p<0.1					

QR code for copy of working paper (worksheets in appendix) and data set:

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