

## When to stock a little more?

Some material adapted from Doug Thomas, Penn State

## Let's run a donut store

- Suppose we are running a donut store that sells two kinds of donuts: **plain** and **chocolate covered**.
- Furthermore, suppose that demand for each type of donut is 1, 2, 3, 4, 5 or 6, equally likely.
- It costs us \$0.50 to produce a donut. We sell one for \$2.00.
- How many of each kind of donut should we produce?
- One die per team.



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<http://media.thestate.com/smedia/2010/03/04/23/kkreme.standalone.prod.affiliate.74.jpg>

## Donut example

Period	Production (Units)	Demand (Units)	Sales (\$)	Cost (\$)	Profit
1	4	6	8.00	2.00	6.00
2	5	4	8.00	2.50	5.50

Sales = minimum (production, demand)

Profit = \$2.00 x sales - \$0.50 x production

...or you can just look up profit in the table on the cheat sheet.

## Donut profit cheat sheet

Unit price	\$ 2.00
Unit cost	\$ 0.50

		Production Quantity (decision)					
		1	2	3	4	5	6
Demand (roll)	1	\$ 1.50	\$ 1.00	\$ 0.50	\$ -	\$ (0.50)	\$ (1.00)
	2	\$ 1.50	\$ 3.00	\$ 2.50	\$ 2.00	\$ 1.50	\$ 1.00
	3	\$ 1.50	\$ 3.00	\$ 4.50	\$ 4.00	\$ 3.50	\$ 3.00
	4	\$ 1.50	\$ 3.00	\$ 4.50	\$ 6.00	\$ 5.50	\$ 5.00
	5	\$ 1.50	\$ 3.00	\$ 4.50	\$ 6.00	\$ 7.50	\$ 7.00
	6	\$ 1.50	\$ 3.00	\$ 4.50	\$ 6.00	\$ 7.50	\$ 9.00

## Your turn...

Play in teams of two. Each period:

1. Make a production decision for both types of donut for the current period
2. Roll dice to determine your demand for both types
3. Record Sales:  $\text{MIN}(\text{Production}, \text{Demand}) \times \$2.00$
4. Record Cost:  $\text{Production} \times \$0.50$
5. Record Profit:  $\text{Sales} - \text{Cost}$
6. Return to 1.

*Please complete all steps, including the profit calculation, before moving on to the next period.*



Period	Production (Units)	Demand (Units)	Sales (\$)	Cost (\$)	Profit
1 Plain					
1 Choc					
2 Plain					
2 Choc					
3 Plain					
3 Choc					
4 Plain					
4 Choc					
5 Plain					
5 Choc					



## Let's change the price

- Suppose we are running a donut store that sells two kinds of donuts: **plain** and **chocolate covered**.
- Furthermore, suppose that demand for each type of donut is 1, 2, 3, 4, 5 or 6, equally likely.
- It costs us \$0.50 to produce a donut. We sell one for **\$1.00**.
- How many of each kind of donut should we produce?
- One die per team.



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Period	Production (Units)	Demand (Units)	Sales (\$)	Cost (\$)	Profit
1 Plain					
1 Choc					
2 Plain					
2 Choc					
3 Plain					
3 Choc					
4 Plain					
4 Choc					
5 Plain					
5 Choc					

## Donut profit cheat sheet

Unit price	\$ 1.00
Unit cost	\$ 0.50

		Production Quantity (decision)					
		1	2	3	4	5	6
Demand (roll)	1	\$ 0.50	\$ -	\$ (0.50)	\$ (1.00)	\$ (1.50)	\$ (2.00)
	2	\$ 0.50	\$ 1.00	\$ 0.50	\$ -	\$ (0.50)	\$ (1.00)
	3	\$ 0.50	\$ 1.00	\$ 1.50	\$ 1.00	\$ 0.50	\$ -
	4	\$ 0.50	\$ 1.00	\$ 1.50	\$ 2.00	\$ 1.50	\$ 1.00
	5	\$ 0.50	\$ 1.00	\$ 1.50	\$ 2.00	\$ 2.50	\$ 2.00
	6	\$ 0.50	\$ 1.00	\$ 1.50	\$ 2.00	\$ 2.50	\$ 3.00

## Make one more donut?

- This inventory decision comes down to balancing the **cost** of making one more donut with the **value** (expected revenue) of making one more donut.
- In this simple example, there are no economies of scale, and making one more donut costs \$0.50 no matter how many donuts we are currently making.
- The expected revenue of the last donut we choose to make is the selling price of the donut (\$2.00) **times the probability that we sell it.**

## Let's improve the donut store

- Suppose instead of making both plain and chocolate covered donuts at the beginning of the day, we can dip plain donuts in chocolate **on demand** (assume for no extra cost).
- Now, we must decide how many plain donuts to make at the beginning of the day to **satisfy both plain and chocolate covered demand**.



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## Donut postponement profit cheat sheet

Unit price	\$ 2.00
Unit cost	\$ 0.50

		Production Quantity (decision)											
		1	2	3	4	5	6	7	8	9	10	11	12
Demand (roll)	2	\$ 1.50	\$ 3.00	\$ 2.50	\$ 2.00	\$ 1.50	\$ 1.00	\$ 0.50	\$ -	\$ (0.50)	\$ (1.00)	\$ (1.50)	\$ (2.00)
	3	\$ 1.50	\$ 3.00	\$ 4.50	\$ 4.00	\$ 3.50	\$ 3.00	\$ 2.50	\$ 2.00	\$ 1.50	\$ 1.00	\$ 0.50	\$ -
	4	\$ 1.50	\$ 3.00	\$ 4.50	\$ 6.00	\$ 5.50	\$ 5.00	\$ 4.50	\$ 4.00	\$ 3.50	\$ 3.00	\$ 2.50	\$ 2.00
	5	\$ 1.50	\$ 3.00	\$ 4.50	\$ 6.00	\$ 7.50	\$ 7.00	\$ 6.50	\$ 6.00	\$ 5.50	\$ 5.00	\$ 4.50	\$ 4.00
	6	\$ 1.50	\$ 3.00	\$ 4.50	\$ 6.00	\$ 7.50	\$ 9.00	\$ 8.50	\$ 8.00	\$ 7.50	\$ 7.00	\$ 6.50	\$ 6.00
	7	\$ 1.50	\$ 3.00	\$ 4.50	\$ 6.00	\$ 7.50	\$ 9.00	\$ 10.50	\$ 10.00	\$ 9.50	\$ 9.00	\$ 8.50	\$ 8.00
	8	\$ 1.50	\$ 3.00	\$ 4.50	\$ 6.00	\$ 7.50	\$ 9.00	\$ 10.50	\$ 12.00	\$ 11.50	\$ 11.00	\$ 10.50	\$ 10.00
	9	\$ 1.50	\$ 3.00	\$ 4.50	\$ 6.00	\$ 7.50	\$ 9.00	\$ 10.50	\$ 12.00	\$ 13.50	\$ 13.00	\$ 12.50	\$ 12.00
	10	\$ 1.50	\$ 3.00	\$ 4.50	\$ 6.00	\$ 7.50	\$ 9.00	\$ 10.50	\$ 12.00	\$ 13.50	\$ 15.00	\$ 14.50	\$ 14.00
	11	\$ 1.50	\$ 3.00	\$ 4.50	\$ 6.00	\$ 7.50	\$ 9.00	\$ 10.50	\$ 12.00	\$ 13.50	\$ 15.00	\$ 16.50	\$ 16.00
	12	\$ 1.50	\$ 3.00	\$ 4.50	\$ 6.00	\$ 7.50	\$ 9.00	\$ 10.50	\$ 12.00	\$ 13.50	\$ 15.00	\$ 16.50	\$ 18.00

## Donut example

Period	Production (Units)	Demand (Units)	Sales (\$)	Cost (\$)	Profit
1	10	6	12.00	5.00	7.00
2	7	11	14.00	3.50	10.50

Sales = minimum (production, demand)

Profit = \$2.00 x sales - \$0.50 x production

...or you can just look up profit in the table on the previous slide.

Period	Production (Units)	Demand (Units)	Sales (\$)	Cost (\$)	Profit
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					