Mathematics in Industry and Technology (MIT) Challenge 2018
# The Jolly Baker

27th June 2018

Introduction

Who doesn't love doughnuts? Especially fresh cinnamon doughnuts straight from the bakery... mmmmm.

The Jolly Baker sells fresh cinnamon doughnuts daily. The packs of 12 claim "*Freshly Baked!*", however what they don't say is that they're freshly baked at an industrial bakery a few blocks away, and the "Jolly Baker" is not a baker at all, just an on-seller.

A year ago, the so-called baker (let's call him JB for short) entered into an agreement with the industrial bakery to buy 80 packs each day. It turned out this quantity was more than he could sell, and each day he's had to throw away the leftovers, so he wants to re-negotiate the agreement to a new quantity in order to save money.

He has collected 12 months of data on how many packs of doughnuts are sold each day *(this data can be found in the excel spreadsheet "12pk Sales 2017.xlsx")*, and he has approached you to help him maximise his profits.
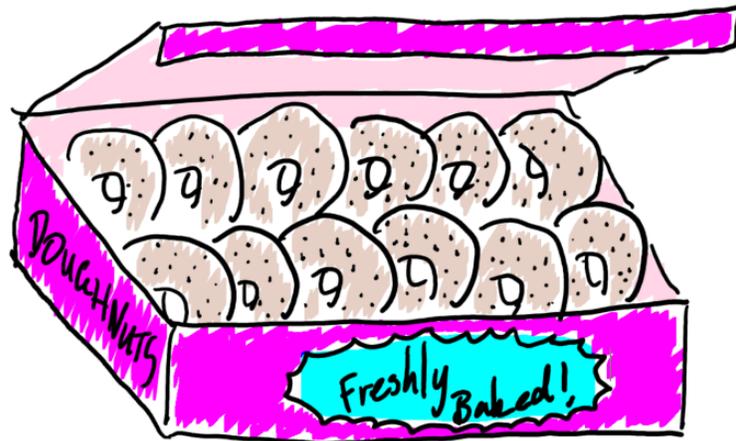
In summary, this is the situation:

- JB must decide on the quantity Q of packs of doughnuts to buy from the bakery each day.

- Any packs that aren't sold on a particular day have to be thrown away, because no-one loves stale doughnuts. So each day, JB will find himself either throwing away doughnuts, or closing when he runs out of doughnuts, which means having to turn away potential customers.

- The price of packs from the bakery is \$$c$ per pack, and he sells them at \$$p$ per pack. Naturally $p > c$.

- He has approached you to tell him what Q should be, given the sales data that he's collected over the last 12 months, in order to maximise his profits.

- He also wants to know if he can improve profits by changing p.

Task

1. The supplier's price is $c = 2.6$, and during 2017 JB has been selling at $p = 6$. Work out the optimal value of Q if all the prices remain constant, and predict JB's sales profit over the next year.

2. During 2016 JB sold the packs at $p = 5.8$. He didn't keep the sales data from that year but he knows that at that price, the average quantity he sold per day was 64. He's thinking about increasing his price again, to $p = 6.2$.

   (a) Forecast the distribution of demand at a price of $p = 6.2$. **Note:** *Make sure to explain and justify any choices or assumptions you make.*

   (b) Should he change his price? Justify your response.

3. (a) In 2019 the supplier will increase their price from $c = 2.6$ to $c = 3$. Give your recommendation for what quantity Q he should buy from the supplier and what price p he should set.

   (b) JB wants you to also give him a way to work out the optimal quantity and price in the case that the supplier puts their price up again in the future, so that he doesn't have to come back to you for another consultation.

Marking criteria

- Highest profits
- Methodology
- Justification of methods, assumptions and choices
- Communication