

THE BECKHAM EFFECT: FOOTBALL SHIRT SALES AT PARIS SAINT-GERMAIN

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INTRODUCTION

In January 2013, French *Ligue 1* football club *Paris Saint-Germain* (PSG) signed international football star David Beckham, at a cost to the club of around £8.5 million per year. This case study examines the impact this signing had on the club's merchandise revenue – in particular, its sales of replica football shirts, including the famous No. 32 shirt worn by Beckham. In this report, we demonstrate the use of simple linear functions as a tool to model PSG's merchandise revenue. We use such functions to estimate the club's pre- and post-Beckham profits – from sales of replica football shirts – and compare these figures to assess the monetary impact of the Beckham signing. In summary, we conclude that sales of replica football shirts increased by about £400,000 per month after Beckham joined the club – but can this increase be completely attributed to the Beckham signing? And do these extra earnings eclipse the cost of having Beckham on the team?

A SIMPLE MODEL FOR REVENUE

It is clear from the report that revenue increases as more football shirts are sold. This implies a *positive*, or *direct*, relationship between revenue and sales. If we let x represent the number of shirts made and sold, then we have:

- (1) Pre-Beckham revenue: £45 x (since each shirt used to sell for £45)
- (2) Post-Beckham revenue: £50 x (since each shirt now sells for £50)

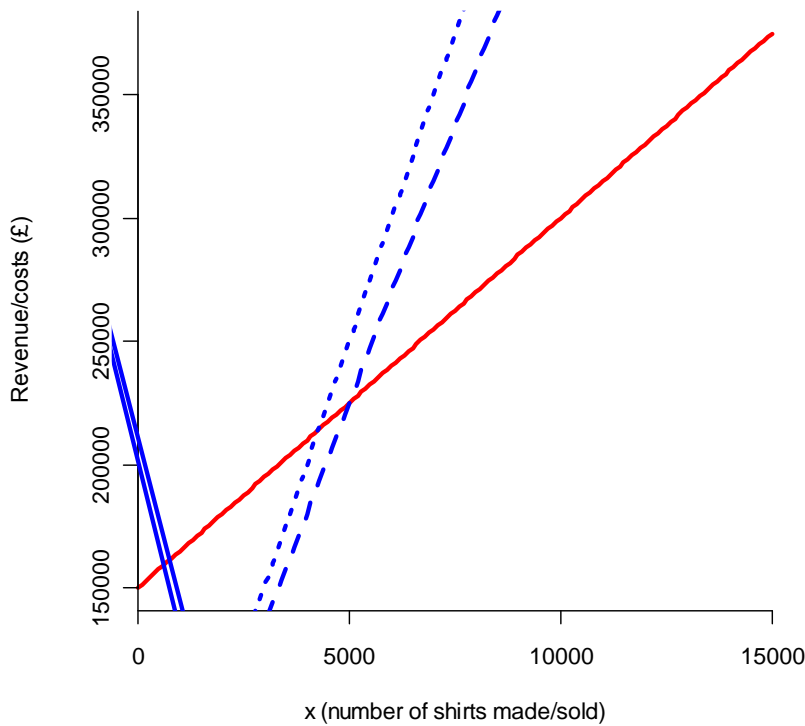
Of course, these linear expressions for revenue assume that the revenue on shirt sales will remain constant, and will not vary between shops/outlets – perhaps unrealistic, as we might expect “end-of-season sales” where prices are reduced. Such constant revenue streams also rely on other factors – for example, the success of the club.

A SIMPLE MODEL FOR COSTS

We are told that, each month, PSG have fixed costs of £150,000 for heating, electricity and other such overheads. Additionally, production costs are £15 per shirt. Thus, overall costs per month can be written according to the following linear cost function:

- (3) Costs: £(15 x + 150,000).

Figure 1 overleaf shows this linear cost function plotted over a range of values for x . From this graph, we can clearly see the fixed costs as the y -intercept. On the same graph we also see the pre- and post-Beckham revenue functions from equations (1) and (2).



This graph shows how costs vary with the number of shirts made/sold. The fixed costs can be seen clearly as the y -intercept, and the gradient obviously represents the cost per unit produced. Such visual representations are a succinct and effective way of displaying cost functions, and are easy for non-mathematicians to interpret. The points at which the cost line intersects the revenue lines represent PSG's

break-even points.

Figure 1: Linear functions to show how revenue/costs vary with the number of units made/sold. The red line shows costs and the blue lines revenue (dashed: pre-Beckham, dotted: post-Beckham)

BREAK-EVEN POINTS

PSG might not always see consistent sales. As we discussed earlier, sales figures will depend on other factors, such as the continued success of the club, as well as the spending power of the general public. In fact, we might easily expect sales to fluctuate month-to-month. However, regardless of this fluctuation, the club will have minimum sales targets for replica shirts – there will be designated “break-even points”, beyond which the club will make a profit or a loss. These can be seen in the graph in Figure 1. More mathematically, the club would like revenue (equations (1) and (2)) to exceed costs (equation (3)), giving the following linear inequalities:

$$\text{Pre-Beckham:} \quad 45x \geq 15x + 150000$$

$$\text{Post-Beckham:} \quad 50x \geq 15x + 150000$$

Re-arranging these inequalities and solving for x , we get $x \geq 5000$ and $x \geq 4285.7$; in other words, sales targets might have been around 5000 shirts per month before Beckham and around 4286 after Beckham. These are the x co-ordinates of the points of intersection on the graph in figure 1.

PROFIT

If we consider monthly profit to be monthly revenue minus monthly costs, then we can calculate the pre- and post-Beckham profit by substitution of sales figures into the following equations:

(4) Pre-Beckham profit: $45x - (15x + 150000)$

(5) Post-Beckham profit: $50x - (15x + 150000)$

We are told that, in the month before Beckham was signed, shirt sales reached 10,000; in the month *after* Beckham was signed, sales doubled to 20,000. Substitution of $x = 10,000$ and $x = 20,000$ into equations (4) and (5), respectively, gives profits of:

Pre-Beckham: $45 \times 10000 - (15 \times 10000 + 150000) = \text{£}150,000$

Post-Beckham: $50 \times 20000 - (15 \times 20000 + 150000) = \text{£}550,000$

This shows a post-Beckham increase in monthly profits of £400,000.

STATISTICAL MODEL

Figure 2 shows the profit functions in Equations (4) and (5) with the data from table 1 in the case study handout superimposed. There are clearly discrepancies between most of the data and the suggested post-Beckham profit function. We can use these data to build a statistical model for profit, based on the number of shirts sold, via *simple linear regression*. We have

(6) $S_{xy} = 4956360$; $S_{xx} = 175121$; $S_{yy} = 147155600$,

giving

$$\hat{\beta}_1 = 28.30 \text{ and } \hat{\beta}_0 = -78.81,$$

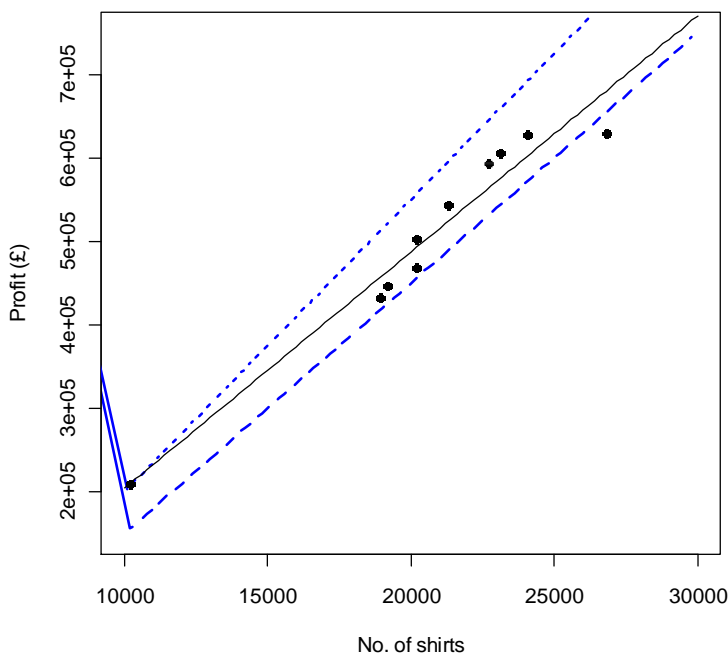
For the estimated slope and intercept, respectively, and so we have

(7) $y = -78.81 + 28.30x + \varepsilon$, $\varepsilon \sim N(0, \sigma^2)$,

where x is the number of shirts sold (in thousands) and y is monthly profits (in thousands of pounds); this line is also shown in Figure 2 for comparison with the functions derived in Equations (4) and (5). We find that the simple linear regression model lies somewhere in between the suggested pre- and post-Beckham profit functions suggested earlier in Equations (4) and (5).

Further analysis shows that the 95% confidence interval for the slope term in the simple linear regression model is (23.87, 32.73). This is significantly different from zero, being wholly positive, and does not capture the post-Beckham slope of 35 suggested by Equation (5). The figures in (6) can also be used to estimate the correlation coefficient, giving $r = 0.973$ ($p = 1.3 \times 10^{-6}$), suggesting a significant association between the number of shirts sold and the profit made.

We must proceed with caution here: there might be evidence of non-linearity from the data shown in Figure 2.



This graph shows how our statistical model for profit, based on the data shown, compares to the simple mathematical models constructed using information from income and fixed costs only. The slope term in the statistical model, given by Equation (7), is statistically significant, although there may be evidence of non-linearity from the data. Further work could include the investigation of non-linear regression models for profit.

Figure 2: Linear functions for profit. *Blue dashed line: pre-Beckham (January 2013); Blue dotted line: post-Beckham (February 2013); Black line: post-Beckham linear regression model, with data shown as points*

SO IS BECKHAM WORTH IT?

From independent research, we have found that Beckham's annual salary is around £8.5 million per year; figures from *The Independent*, 31st January 2013, accessed online:

<http://www.independent.co.uk/sport/football/transfers/david-beckham-to-give-4m-psg-salary-to-childrens-charity-8476098.html>

If this figure is accurate, this represents a monthly cost of just over £708,000 per month – completely overshadowing the post-Beckham profits on replica shirt sales as suggested by the data and the regression line. However, it is very likely that PSG will earn revenue from sources other than shirt sales. It is also likely that PSG's economists would have done their homework before recommending the signing of David Beckham, forecasting *total* profits from club merchandise and other sources of income, not just profits from sales of football shirts.

Also, although football shirt sales increased after Beckham was signed, can we really say the arrival of Beckham *caused* this increase? Other factors may have contributed to this increase in sales, including a month-on-month increase in the club's overall performance in games.



"One last piece of magic from the dead-ball master. One last corner, one last caress. And then the tears, the embraces, the standing ovation.

Even if David Beckham had scored — rather than providing one final, inch-perfect assist — it could not have been more dramatic. And as he left the field for the last time at the Parc des Princes, the tears would not be denied.

An emotional Beckham hid his face on the shoulders of Paris Saint-Germain team-mates as they embraced him. He wiped his face on his shirt, waved to his family in the stands and fell into a hug from the bear-like figure of manager Carlo Ancelotti." *Daily Mail*, 18th May 2013.