PAM Analytics Projects: Forecasting

Introduction

PAM Analytics has carried out forecasting projects in the retail and wholesale sectors, and in transport planning.

Retail and Wholesale Demand Forecasting

PAM Analytics has developed a number of retail and wholesale demand forecasting models. Most forecasting models assume that the sales profiles are well defined and repeat themselves at constant frequency (this includes seasonal profiles). These traditional models fail when the sales profiles show unusual or unexpected patterns and occur because even though the drivers of sales may be the same, the way in which they combine to determine sales is different. Two examples of when the normal sales forecasting models break down are during Christmas and during promotions. PAM Analytics has developed sales forecasting models for these periods, and they are described below.

Daily Sales Forecasting at Christmas

The sales profiles just before Christmas differ from the sales profiles during the rest of the year (assuming that the products are not promoted) for at least three reasons:

- the huge increase in sales at Christmas
- shops are closed for at least one day during the Christmas holiday
- people shop on a need to top-up basis rather than on a planned basis during the Christmas holiday.

PAM Analytics has developed a model for forecasting the daily sales of perishable products between 18th and 24th December for a major UK retailer. The model establishes how the daily shopping profile during this period differs from that during non-holiday periods and then adapts the non-holiday daily sales forecasting models to form a model for the run-up to Christmas.

Figure 1 shows the daily percentage week sales between 18th and 24th December for a perishable product when Christmas falls on a Monday and when it falls on a Wednesday. Figure 2 also shows the daily percentage sales during non-holiday periods. The data used in the figures are the same but they

are plotted in different ways. In Figure 1 they are plotted against the date and in Figure 2 they are plotted against the day of the week.

Figure 1

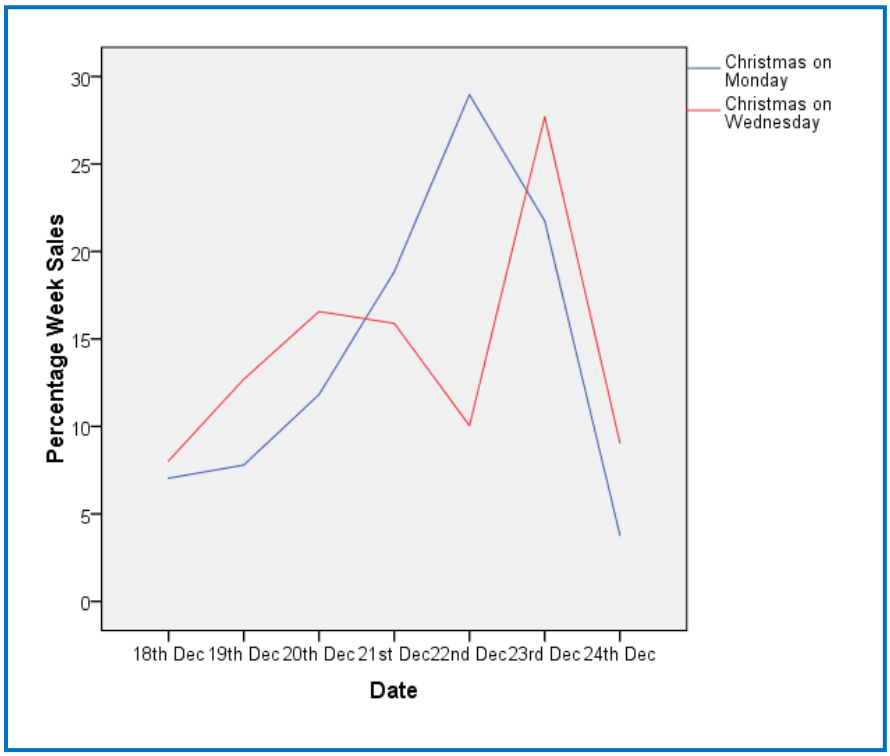
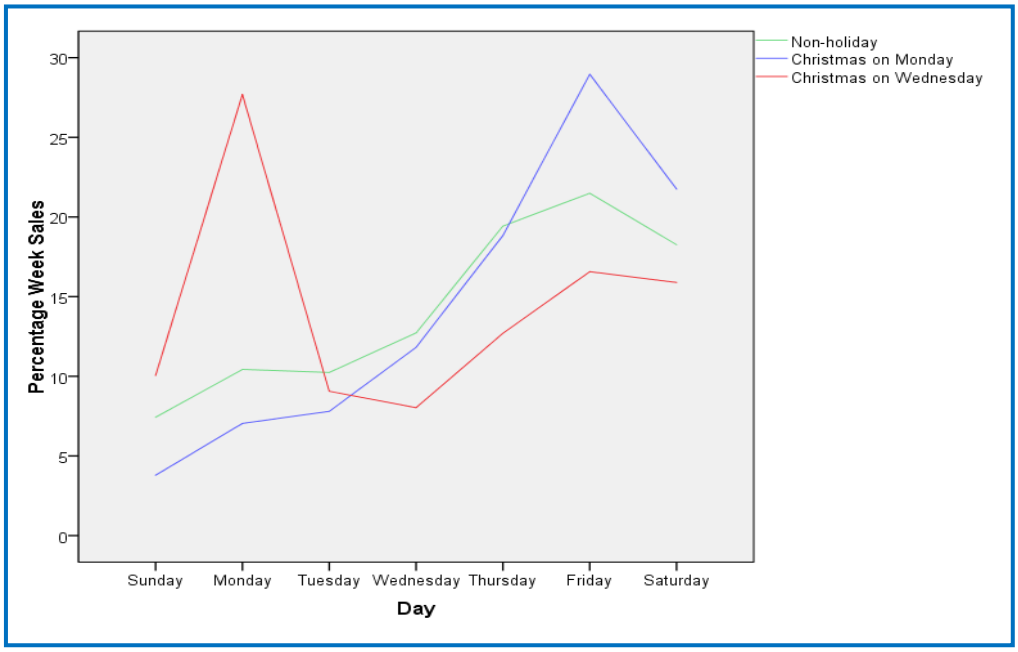


Figure 2



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The graphs show that the non-holiday daily sales profile cannot be applied on its own to the period 18th to 24th December and that the daily sales profile on any day during this week is influenced by a complex interaction of the date and the day of the week on which Christmas Day falls. The daily sales during the week 18th to 24th December are determined by:

- the non-holiday daily sales profile
- the day of the week on which Christmas Day falls
- the position of each day relative to Christmas Day.

Promotions

PAM Analytics has carried out promotion modelling projects for a major UK brewery and a Greek manufacturer of olive oil and derived products.

The immediate and obvious effect of promotions is to cause a sudden large increase in sales at the start of the promotions. As the promotions progress, the rate of increase in sales decreases, and only towards the end of the promotions do sales start to decrease. At the end of the promotions sales are sometimes lower than they were before the promotions began. This profile is particularly true for non-perishable products when the effect of a promotion is to bring forward people's purchases so that they rather than the retailers stock the product. After people have used their stocks, they resume their normal purchasing behaviour and sales then return to their profile before the promotion began.

The sales profiles of promoted perishable products are different from the sales profiles of promoted non-perishable products. The perishable nature of the products means that people cannot stock at home such large quantities as they can with non-perishable products. This results in people resuming their normal purchasing behaviour much sooner after the end of promotions of perishable products than they do after the end of promotions of non-perishable products.

Another important factor to consider when modelling the effects of promotions is the type of promotion. Examples of different types of promotion are multi-buys, larger pack size for the same price, same pack size for lower price and temporary price reductions. Since each type of promotion has a different effect on sales, each one must be modelled separately.

Promotions should be modelled using non-linear regression rather than linear regression because sales profiles during promotions are non-linear, typically a sharp non-linear rise followed by a gradual non-linear decay. Additionally, since linear models can easily predict negative sales, they are not suitable for modelling promotions.

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Before the effects of promotions on sales can be modelled, sales in the absence of promotions must be modelled. This will give the base sales level and the effects of any seasonality, and it is relative to the sum of the base sales and seasonal sales that the effects of promotions must be measured.

Transport Planning

The number of passengers using public transport and airports shows great variation at all time levels. The peak season is the summer and Christmas, the shoulder season is late spring and early autumn, and the low season is the rest of the year.

Consider an airport that handles mostly holiday (charter) flights.

- The weekly number of passengers in July is much greater than the weekly number of passengers in November.
- The daily number of passengers in July shows much greater variation than the daily number of passengers in November.
- The hourly number of passengers shows daily variation.

Thus, the number of passengers using airports depends on the hour of the day, the day of the week and the week of the year. This variation has major implications for the scheduling of essential services such as passport control and security at airports and similar places.

PAM Analytics has modelled the number of passengers at two of the UK's largest airports using nested time series decomposition models.

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