WITH THIS BAD WEATHER,
WHERE WILL MY GUESTS HAVE DINNER TONIGHT?

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Abstract

The aim of this paper is to present a case study on the number of customers of the main restaurant in a five-star hotel in Geneva. The management of the hotel claims that rain or snow has an impact on that number, so there is a need to test this hypothesis.

The results of the study show that this effect is only significant in the low winter season (November, March and April), whereas other factors seem to indicate that dinner with Room Service is preferred only in the low summer season (May, September, October.)

The Structural Time Series (STS) has been applied to figures relating to the number of rooms occupied in the hotel and to the daily precipitation of rain and snow, in 0.1 millimeters, during 2000 and 2001.

This paper illustrates not only how the use of Time Series analysis can confirm general beliefs arising from within the establishment - which is obviously useful for the operational organization of the hotel - but also provides a tool which can be used to evaluate the gap between perception and reality in those responsible for the management of the operation.

The importance of certain costs (especially salaries in Switzerland) encourages this type of analysis, which can result in improvements to the staff rotas and productivity.

This research is a part of a project supported by the Hautes Ecoles de la Suisse Occidentale network concerning “The Perception of Productivity in 5-star hotels.”

1. INTRODUCTION

One of the main problems of the deluxe hospitality industry during the past decade has been high production costs and labor intensive employment, especially in Switzerland. The research carried out by the Ecole hôtelière de Lausanne (EHL) addresses this particular issue.

Two aspects, profitability and productivity, are interrelated and the dynamic of their interrelation must be clarify. For this sector of the industry, another aspect must be taken into account, namely quality.

Though productivity has an extensive theoretical background in manufacturing industry, service industry has not received the same attention. The reason are various, and some are discussed below.

One of the aims of EHL’s research is to build tools which allow a diagnosis and also a prognosis of the productivity situation, based, on one hand, on measurement of the gap between the perception and the
reality of some relevant management fact, and, on the other, on the statistical analysis of operational data.

Senior and middle managers frequently have the feeling that they are aware of the most important facts in the running of their businesses. Very often some of these beliefs are only partially true, i.e. they apply only under particular circumstances (as this paper shows); or, when such beliefs seem to correspond to reality in every case, they cannot be quantified. To cite one example, every manager knows that the room occupancy of the hotel is seasonal, but they very seldom know either the percentage by which the trend affects each day of the week, or whether this seasonal component is fixed over the year or whether it is stochastic.

Another interesting aspect, directly related to human resources management, is the study of the number of meals served for breakfast either in the restaurant or in room service.

Studies carried out by our team show that, in 5-star hotels which are business-oriented there is a transfer of the number of breakfasts served from the restaurant to room service on Thursdays. Once the Food & Beverage managers are aware of this kind of fact, they can work out a much better planning of the human resources necessary, by allocating the right number of staff to each task depending of the day of the week, and therefore either reducing labor costs or optimizing them without decreasing quality; on the contrary, they increase it.

In order to analyze the operational data, time series chronological analysis was applied, not only to improve forecasting in the outlets but also as a diagnostic tool. This study proves, in the event, to be very useful and shows certain interesting facts closely related to organizational matters. A performance index can therefore be constructed from the historical operational index. Almost all the examples found remain confidential, but to give one idea of the method used, the influence of rainfall on the number of meals served is presented.

The author wishes to thank the General Manager of the Mandarin Oriental Hotel du Rhône, Mr Marco R. Torriani, who kindly agreed to operational results being made public. The author also thanks MeteoSuisse for the meteorological data.

This study was carried out to test the hypothesis held by some of the hotel staff, who claimed that the weather had a certain influence on the number of dinners served.

The Structural Times Series model provides an analysis of the phenomenon in the following components: a trend (long-term evolution, with and without the influence of explanatory variables); seasonal components (the features that over time are repeated constantly); sometimes the model needs a slope component (the average rate of variation of the variable during the period studied.) Finally, it allows the evaluation of explanatory variables. Such a tool is shown to be useful for improving financial planning over a period of a year or more, facilitating either the evolution of several possible scenarios or a closer analysis of past and future profitability.

The following section describes the Structural Time Series analysis applied here. It shows, on one hand, the statistical features relevant for the analysis, and, on the other, gives an idea of the power of such analysis.

2. THE VARIABLES AND THE STATISTICAL MODEL

The model used is known as the Structural Time Series (STS). The aim of this type of model is to capture the salient characteristic of stochastic phenomena, usually in the form of trends, seasonal or other irregular components, explanatory variables, and intervention variables. This can reveal components of a series which would otherwise be unobserved, greatly contributing to thorough comprehension of the phenomena. A STS multivariate model like the following
Observed variables= trend + seasonal + explanatory variables + autoreg. component + intervention + irregular

may be written respecting the preceding order as:

\[ y_t = \delta_t + \hat{\delta}_t + \sum_{j=0}^{r} \hat{\alpha}_j x_{t-j} + \theta_t + \hat{\theta}_t \omega_t + \hat{\epsilon}_t \]

where \( \delta_t \) is the stochastic trend composed of two elements, namely the level and the slope. It has the following form:

\[ \delta_t = \delta_{t-1} + \hat{\delta}_t + \epsilon_t \]

\[ \hat{\delta}_t \sim NID(0, \hat{\delta}_t^2) \quad t = 1, L, T \]

\[ \epsilon_t \sim NID(0, \epsilon_t^2) \quad t = 1, L, T \]

where \( x_t \) is a \( K \times 1 \) vector of explanatory variables and \( w_t \) is a \( K' \times 1 \) vector of interventions. Elements in the parameter matrices, \( \hat{\alpha} \) and \( \hat{\theta} \), may be specified to be zero, thereby excluding certain variables from particular equations.

The autoregression component has the following form:

\[ \theta_t = \hat{\theta}_t + \hat{\epsilon}_t \]

\[ \hat{\epsilon}_t \sim NID(0, \hat{\epsilon}_t^2) \quad t = 1, L, T \]

The trend is intended to capture the long-trend movements in the series. The stochastic trend described below allows the model to handle other trends than linear ones, which is the only possibility of standard classical regression models with trend variables (see Harvey, 1990). The seasonal pattern is expected to repeat itself more or less regularly. The explanatory variables are used in order to show the influence of one or more exogenous variables on the trend (i.e. the effect of rainfall on the number of dinners served.) Finally, the intervention term component is a stochastic process which is intended to represent known events that can modify the pattern of the series. In order to adjust the model, the STAMP (Koopman et al. 2000) software was used.

The intervention variables are not presented in the present study, because they are beyond the objective of the presentation, but they are very useful to measure the impact of some important event, whether repeated annually like Easter, or other unexpected.

In this way, it can be shown that the impact of Easter on room occupancy changes in percentage from one year to another. Another interesting feature was the identification and measurement of the World Trade Centre attack on 9/11. The study made of the Mandarin Oriental Hotel du Rhône shows that its impact was only effective after 16 September 2001, and either the date of recovering and the measure of the impact could be fixed.
3. PERCEPTION OF THE INFLUENCE OF WEATHER ON NUMBERS OF DINNERS SERVED AND STATISTICAL EVIDENCE

The Mandarin Oriental Hôtel de Rhône has two restaurants, one, named the Le Neptuno, being a fine-dining restaurant which has a maximum capacity of 33 place settings. The other restaurant, is the Café Rafael, which has the capacity of from 87 to 137 places, including the terrace in summer. This restaurant is a more relaxed alternative to Le Neptuno. Other outlets are the Lobby and Le Bar, and of course there is 24-hour room service. The room service menu is a combination of the items from both Le Neptuno and the Café Rafael.

The staff suggested that bad weather affected occupancy of the Café Rafael for dinner. They claimed that guests are more willing to remain at the hotel for dinner than under circumstances of good weather.

Firstly, a descriptive statistical analysis was carried out. The distribution of millimeters of rainfall (scaled 0.1) daily was classified following the method of letter values using Minitab professional software (Minitab (2000) section 8-2)

Table 2 shows the mean of the number of dinners served in the Café Rafael, classified in classes of the numbers of millimeters listed in the first column.

<table>
<thead>
<tr>
<th>mm</th>
<th>MeanCR Dinner</th>
<th>SDerrCR Dinner</th>
<th>Variance CR Dinner</th>
<th>Q1CR Dinner</th>
<th>Median CR Dinner</th>
<th>Q3CR Dinner</th>
<th>IQR</th>
<th>Minimum CR Dinner</th>
<th>Maximum CR Dinner</th>
<th>RangeCR Dinner</th>
<th>NCR Dinner</th>
<th>Percent CR Dinner</th>
</tr>
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<tbody>
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<td>17.6292</td>
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<td>54</td>
<td>65</td>
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<td>17</td>
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<td>132</td>
<td>555</td>
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<td>44</td>
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<td>12</td>
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<tr>
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<td>14</td>
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Table 1

<table>
<thead>
<tr>
<th>mm</th>
<th>Mean CR+RS Dinner</th>
<th>SDerr CR+RS Dinner</th>
<th>Variance CR+RS Dinner</th>
<th>Q1CR+RS Dinner</th>
<th>Median CR+RS Dinner</th>
<th>Q3CR+RS Dinner</th>
<th>IQR</th>
<th>Minimum CR+RS Dinner</th>
<th>Maximum CR+RS Dinner</th>
<th>Range CR+RS Dinner</th>
<th>NCR+RS Dinner</th>
<th>Percent CR+RS Dinner</th>
</tr>
</thead>
<tbody>
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<td>87</td>
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<td>31</td>
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<td>696</td>
<td>660</td>
<td>554</td>
<td>75.7866</td>
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<td>92.2568</td>
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<td>71</td>
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<td>98.5</td>
<td>27.5</td>
<td>51</td>
<td>586</td>
<td>535</td>
<td>85</td>
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</tr>
<tr>
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<td>23.257</td>
<td>540.89</td>
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<td>105</td>
<td>29.25</td>
<td>44</td>
<td>147</td>
<td>103</td>
<td>44</td>
<td>6.0192</td>
<td></td>
</tr>
<tr>
<td>34-66</td>
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<td>19.4229</td>
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<td>81</td>
<td>97</td>
<td>110</td>
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<td>54</td>
<td>130</td>
<td>76</td>
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<td>22.0248</td>
<td>485.09</td>
<td>80</td>
<td>94.3</td>
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<td>1.6416</td>
<td></td>
</tr>
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<td>110-278</td>
<td>97.2727</td>
<td>34.0479</td>
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<td>103</td>
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<td>30</td>
<td>146</td>
<td>116</td>
<td>11</td>
<td>1.5048</td>
</tr>
</tbody>
</table>

Table 2

In Table 2, the same as in Table 1 was calculated, on the basis of the sum of meals served in the Café Rafael and in room service.

From this table, it is not quite clear whether the weather affects the number of meals served either in Café Rafael or according to the sum of the two variables. For instance, in Table 1 the mean in the last highest categories for the rainfall is lower that the one of the lowest one (0mm= no rain).

In order to work out the hypothesis concerning the increasing numbers of meals served during bad weather, three models were built, having as explanatory variables the depth of precipitation in millimeters. The analysis was carried out over two complete years, 2000 and 2001.
The study of the number of dinners could only be carried out for the Café Rafael and the for sum of the number of meals served there and in room service for dinner. The figures of the dinner room service do not follow a Gaussian distribution, so this model cannot be applied.

In all the models the variables were transformed in Log, which means that they are all multiplicative models, and therefore all the coefficients represented elasticity.

3.1. Model 1: Café Rafael and room service meals served using a non-periodic model for rainfall

In this model the sum of the numbers of meals served for the Café Rafael and the room service dinners is calculated, having as explanatory variable the rain measured on a 0.1 mm scale.

The regression coefficient is very low (2E-4) and is not significant (p-value 0.37).

Figure 1 shows the overlap plot of the trend without the effect of the variable of rain (solid triangle), and the trend with the effect of explanatory variable (circles). It is clear that the effect is nil, as the two patterns are very similar. It also shows the rain (0.1 mm and in broken line); it can be appreciated that the evolution of both trends, with and without the effect of rainfall, are similar. The two graphs are superimposed.

The diagnosis of the model is acceptable: the normality test (3.78), the Durbin-Watson test (1.82) and the Box-Ljung Q-statistic, which is a test of residual serial correlation (45.6**) over 26 observations which is the only one which is significant. The standard deviation error in log is 0.29 (≈ 1.3 meals)

Therefore, from this first model, there is insignificant evidence that the rainfall has any effect on the numbers of meals served, either in the restaurant or in room service.

Figure 1
3.2. Model 2: Café Rafael and room service meals served using a periodic model for rainfall

In this section the results of a new model on the same series is shown. The rainfall explanatory variable has been decomposed into 4 variables, named a periodic model which follows the time of year (winter, summer and each one in its low season).

Therefore, a periodic model which has as explanatory variables the number of millimeters of rain but which is distributed in four different variables, is produced:

Lw = low winter season (March, April and November)
Hw = high winter season (December, January, February)
Ls = low summer season (Mai, September, October)
Hs = high summer season (June, July, August)

Table 3
The indigenous variables are the sum of Café Rafael and room service meals served for dinner.

Table 3 shows the results of the regression coefficients.

The coefficients of low winter season and low summer season are positive, though only one of the former has enough evidence to be different from zero but to a very little degree, only 0.13%. The interpretation matches with the perception observed by hotel staff about the influence of rain on restaurant attendance, but only at this particular period.

Figure 2 shows the trends in log for 2000 and 2001 (with the explanatory periodic variable – full black line - and without the explanatory variable – solid triangle in dots line-) where the series of the millimeters of precipitation has overlapped (in bar form). The rectangles show that at those periods the trend follows the peak of the precipitation, that is in the low winter season (week 10 to week 18 and week 45 to week 49).

Table 4 lists the observations for the low winter season, whose influence on the number of additional meals served is the greatest; the first column is the date, the second column is the number of millimetres of rainfall in Geneva between 11:40 am and 5:40 pm scaled by 0.1; the column “percentage of increasing couverts” (place settings) is the effect of the precipitation on the trend; finally the last column shows the increasing number of meals served in absolute terms.

The percentage of the increasing number of meals served was obtained by the difference of the trend with the explanatory variable minus the trend without it; the percentage is then expressed on that difference.
Another calculation can be carried out using the mean of the trend calculated using in a non-causal model of the sum of the dinners served either in the restaurant or in room service is approximately 86, the first value on the 3 March 2001, 65% of increasing that average trend, the second one, on the 12 March 2001, the 18% of that average trend.

<table>
<thead>
<tr>
<th>Dates</th>
<th>0.1mm rainfall</th>
<th>percentage increasing couverts</th>
<th>real increasing number</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-mars-01</td>
<td>229</td>
<td>57.2</td>
<td>31</td>
</tr>
<tr>
<td>12-mars-01</td>
<td>155</td>
<td>28.6</td>
<td>16</td>
</tr>
<tr>
<td>23-avr-00</td>
<td>126</td>
<td>22.7</td>
<td>13</td>
</tr>
<tr>
<td>4-mars-01</td>
<td>120</td>
<td>21.5</td>
<td>12</td>
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<tr>
<td>4-avr-01</td>
<td>93</td>
<td>16.3</td>
<td>9</td>
</tr>
<tr>
<td>08.11.2001</td>
<td>95</td>
<td>16.6</td>
<td>9</td>
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<td>21-mars-01</td>
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<td>20-nov-00</td>
<td>54</td>
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<td>1-mars-01</td>
<td>54</td>
<td>9.1</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 4

Low winter season and the influence of precipitation in the couvert number for dinner (LW = November, March and April)

Figure 3 : Influence of the rainfalls in increasing percentage of meals served in Low Winter Season

1 The model is not presented here because is beyond the goal of the present study.
The diagnostic of the model is acceptable: the normality test (369), Durbin-Watson test (1.98) and Box-Ljung Q-statistic 26.01 over 26 observations, are all not significant. The standard deviation error in log is 0.23 (≈ 1.25 meals).

Therefore, for the sum of the dinners at both outlets, the perception of the staff members turns out to have statistical significance only in the low winter season.

3.3. Model 3: Café Rafael meals served studied using a periodic model for rainfall

Another periodic model was built in order to see the influence of rain on the number of meals served at dinner in Café Rafael; it can be observed in Table 6 that the only season when the coefficient is significant is the low winter season. The same consideration as made above in the preceding model can apply also to this case.
Table 6

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>R.m.s.e.</th>
<th>t-value</th>
<th>p-values</th>
</tr>
</thead>
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<tr>
<td>hw</td>
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<td>-0.97009</td>
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<tr>
<td>lw</td>
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<td>hs</td>
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<td>0.7618</td>
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<tr>
<td>ls</td>
<td>0.0012814</td>
<td>0.000793</td>
<td>1.6159</td>
<td>0.1065</td>
</tr>
</tbody>
</table>

Figure 3 shows the trends for 2000 (with – “plus sign” line - and without the explanatory variable – black line) where the series of the millimeters of precipitation overlaps (scaled). The rectangles show those periods where the trend follows the peak of the rainfall, that is in the low winter season (week 10 to week 18 and week 45 to week 49).

The diagnosis of the model is acceptable: normality test (9.0*), Durbin-Watson test (1.77) and Box-Ljung Q-statistic 49.2 over 25 observations, and only the normality tests is significant*. The standard deviation error in log is 0.23 (≈ 1.25 meals)

Figure 3: The y-axis is the number of meals served at the Café Rafael in actual values. Rainfall series is in actual value and in the form of bars. (Year 2000).

Therefore, for the numbers of meals served at Café Rafael, the perception of the staff members about the influence of bad weather turns out to have statistical significance only in the low winter season.
3.4. **Final remarks about the models**

A final consideration must be noted. Model No 2, built having as indigenous variable the sum of the meals served in the Café Rafael and in room service for dinner, and the periodic variable of precipitation for the low summer season has as p-value 0.075, whereas the same variable in model No 3, which has as indigenous variable the Café Rafael’s dinners only, has a p-value of 0.106. A hypothesis can be posited, though not proved, that there exists an increasing effect on the number of meals served in room service only in the low summer season.

4. **CONCLUSION**

One of the definitions of productivity accepted worldwide is the relationship between production within the services sector and the factors implemented to obtain it. Productivity is defined as the efficient use of resources for the production of goods and/or services.

Nevertheless, when a service industry is the primary focus, one of the most important aspects is often forgotten, because is not central in manufacturing industry: the client’s involvement in the production process. One of the most obvious examples is the self-service buffet for breakfast in hotels, which is fashionable today. In such cases, a part of the time and the production process is transferred to the client. This role of the client, with other characteristics like the intangibility of the service product, the simultaneity of the process (the client is there during the process of service production), perishability (the issues of immediacy of consumption, making it almost impossible to use buffering to cope with the imbalance between demand and supply) has to be taken into account as a central aspect of the evaluation of productivity (cf. Fraenkel, S & Iunius, R (2002)).

Therefore, the use of statistical tools for the diagnosis and to forecast the level of service becomes central.

Of course, there is a gap between the traditional training of managers and the improvement of productivity. They have been encouraged to think that their presence is important (“be where the customer is”) and discouraged to analyse the situation and plan the resources needed accurately, on the basis of forecasting and historical analysis. If the introduction of yield management has already caused some changes in the importance given to tools for prediction, very little has been done in other, very important areas, such as forecasting for outlets and the programming of rotas on the basis of the needs predicted at a horizon of one or two weeks.

As Gummesson (1998) pointed out, quality, productivity and profitability are like triplets; separating one from the other creates an unhappy family, and seeking to separate them will only lead to a problematical situation.

How is one to link these three aspects? Our proposal is that profitability is closely related to productivity, but in order to make the correct management decisions needed to improve both aspects, an effort either in diagnosis (the analysis of historical data) and prognosis (forecasting, that also includes the study of several scenarios) should be made. This kind of approach would have the result of increasing both, productivity and profitability, without any loss in the level of quality, in fact quite the contrary.

Finally, given that performance can be defined as the way in which or the efficiency with which the staff react to the most important aspects of the situation and, that such aspects can be grasped or forecast from a careful analysis of operational historical data, this approach points to a way of fulfilling that task. Whereas the operational index gives only a historical view, performance analysis helps to take management decisions and afterwards to evaluate their success, or otherwise. Moreover, by the comparison of the evolution over time of the performance index, i.e. Rooms Occupied and guests per room, some conclusions about the kind of product the hotel is offering, depending on the day, can be drawn. Some evidence shows that business-oriented 5-star hotels in cities like Geneva
increase the number of guests per room during the week-end; therefore, from Monday to Thursday the hotel mainly sells rooms, whereas during the week-end other services, such as food-and-beverage, should be the main focus.

The example presented in this study shows one particular example of how accurate statistical tools can improve productivity in the hospitality industry, even if the subject is not central to the management of restaurants. Of course, when applied to other operational index, i.e. Revenue per Rooms, or average meals served over time, the comparison over time of such different features give a precious insight into the management of the business. Unfortunately, those results belong to the client and, as a most important element of business strategy, must of course remain confidential.

5. BIBLIOGRAPHY


Acknowledges: They author would like to thank Mr Marco Torriani, Mr Henri Vergnaud, respectively CEO and RH Manager of the Mandarin Oriental Hôtel du Rhône, Prof Dr Ray Iunius, Prof Stefan Fraenkel, Mme Noelia Rodriguez Alvarez, Mr Andrew Mungall, all members of the Productivity project team, Mr Merrick Fall, and the groups of Master in Hospitality Administration students for their devoted cooperation.