

# Application of the Booking.com Analytics Software Tools in Reliable Processing of Big Data in Hotels Management

Vladimir Sklyar, Vyacheslav Kharchenko

National Aerospace University “KhAI”, Kharkiv, Ukraine  
v.sklyar@csn.khai.edu, v.kharchenko@csn.khai.edu

**Abstract.** The paper contains results obtained in area of big data analysis for hotel revenue management. Authors challenge the area of hotel management since they have and still improve skills in this area. The paper presents the new results obtained for previously developed Advanced Hotel Management Framework. We use comparatively the new tool “Booking.com Analytics” developed by the company Booking.com B.V. in 2016 for hotels involved in a global partnership program. We learned available features and data from the “Booking.com Analytics”. The performed case study is associated with a mini-hotel situated in Cambodia. We studied data related with booking percentage depending from tourists’ countries of origin, book window percentage, cancellation of reservation percentage, guests’ review rating, as well as special genius guests’ program percentage. After that we tried to find statistical dependencies between a managed value of room daily rate and available big data. In conclusion, the obtained results are discussed.

**Keywords:** Hotel Management, Big Data, Revenue Management.

## 1 Introduction

Tourism including hotel industry consists 10% of the world economy in a sense of GDP (Gross Domestic Product) as it is stated in United Nations World Tourism Organization (UNWTO) Report 2018 [1,2]. Big data collected at booking systems sites could help to organize a competitive strategy for cost-effective hotel management system and hospitality industry development [3,4]. However, opportunities provided by big data request careful using since any prognosis models have to be completely tested before its implementation for business decision-making [5]. So we need to define reliability of big data in sense of its supporting of hotel business sustainability [6].

The tasks related with revenue management systems have been specified and partly solved before the “big data” term became a hot topic. For example, a framework for revenue hotel management has been developed in [7]. The paper [7] was published in 2009 and predicted the main components of the modern tools for big data analysis, including forecasting module which scans and analyzes of historical booking and occupancy patterns and current reservations and fits a quantitative forecasting, and optimization module for predictions and decisions allocation.

A detailed literature review in area of hotel revenue management (RM) is provided in [8]. The elements of the hotel system discussed in the paper include hotel RM centers, data and information, the pricing and non-pricing RM tools, the RM software, and the RM team. The stages of RM process have been identified as goal setting, collection of data and information, data analysis, forecasting, decision making, implementation and monitoring. Special attention was paid to ethical considerations in RM practice, the connections between RM and customer relationship management, and the legal aspect of RM. The paper [8] provides a review of forecast mathematical models based on big data that produce recommendations for the optimal levels of prices, rate structures, overbookings and help the revenue manager take proper decisions [9]. These mathematical models include the following: deterministic linear programming, integer programming, dynamic programming, Markov model, bid-price methods, price setting method, expected marginal revenue technique, stochastic programming, probabilistic rule-based framework, Monte Carlo simulation, fuzzy goal programming, and robust optimization [10].

There are some important and successful researches in area of big data using for hotel management. In [11] authors discuss how to convert data into knowledge by investigation the perceptions that managers have of the value and reliability of using big data to manage of hotel revenue on the base of pricing decisions [12]. The paper [11] represents some general findings which entail the following barriers in big data application: data overload, tensions between automated and manual decision making, fast and frequent decision making, managers behavior based on belief in local insights and instincts. It provides a clear message concerning a need for automated revenue systems to be flexible enough for managers to import the local data, information, and knowledge that they believe leads to revenue growth [13]. Whilst the academic literature has shown to place its faith in the increasing automation of revenue management decision-making using big data and analytics which should require no user input, the research [11] has placed this under a question.

The paper [14] states that the advent of the era of large data is the development of the hotel industry transformation opportunities, but also for the construction of the wisdom of the hotel made a series of new problems, the use of large data will fundamentally change the current status of hotel management, the birth of a new model of hotel management.

An alternative approach for operational hotel management which is based on dependability has been proposed in paper [15]. Advanced Hotel Management Framework (AHMF) [15] contains three the following main parts: strategic planning, operation and maintenance, as well as infrastructure management and assets management. More issues related with safety and security assurance in critical areas, including hospitality industry, can be found in [16,17].

Based on the above analysis we can observe the present gap between academic investigations targeted to design some ideal hotel big data analysis tools and already existing industrial products [18,19]. The most impressive results in area of big data analytics for hotel management are obtained by the company Booking.com B.V.

In this paper we discuss features of the “Booking.com Analytics” tools provided by the company Booking.com B.V. The main feature of the “Booking.com Analytics” is representation of collected statistic to support decision making in hotel management. To use big data from the “Booking.com Analytics” we hypothesize and check some

dependencies between management decisions and rooms revenue amount. We are going to understand opportunities which are provided by modern big data analysis tools in area of hotel revenue management. The paper objective is to get decision making strategy for hotel management with support of the “Booking.com Analytics” tools. To achieve this paper objective, the following sections are included.

Firstly, in Section 2, we learn features of global reservation services focusing on Booking.com. Features of the “Booking.com Analytics” are analyzed in details.

Secondly, in Section 3, we make case study of a mini-hotel operation in Cambodia. We analyze big data available from the “Booking.com Analytics” and extract statistics which can be directly appropriate for managerial decision making.

After that, in Section 4, we hypothesize some dependencies related with decision making (stated room daily rate) and hotel revenue. Another checked hypothesis is about dependency between hotel revenue and number of tourists looking for a hotel in your area.

Conclusions made at the final part of the paper are directed to support of hotel managerial decision making and demonstrate some constrains in big data using for reliable and sustainable decisions making.

## 2 Analysis of Opportunities Provided by Global Booking Platform

### 2.1 Hotel Analytics Tools

Booking.com is the global leader in connecting travellers which contains more than one million of properties in one database. “Booking.com Analytics” has been released in 2016 [20]. This software tool is based on Big Data collected by Booking.com during many years of operation. “Booking.com Analytics” empowers property owners to grow their businesses with bespoke, actionable data and advice that is delivered in real time, powered by a customizable dashboard. This product is available globally as just one of the standard perks of partnership with Booking.com (as named Booking.com extranet).

Other global booking services (for example, AirB&B [21]) provide not so mature platform for Big Data analysis, so in this paper we will consider only “Booking.com Analytics”. “Booking.com Analytics” menu contains the following parts:

- **Home** includes only the main performance information;
- **Rates & Availability** supports the calendar with room daily rates broken down into specific dates and types; rooms occupancy and availability also are taken into account;
- **Promotions** allow to creating discount actions in addition to **Rates & Availability**;
- **Reservations** contain details of booking made by the past and future guests;
- **Property** supports description of hotel in respect with user interface reflected when guests come to your hotel page at the Booking.com system;

- **Opportunities** should encourage hotels managers to provide some discounts to guests, for example, in the framework of Genius frequent guests program;
- **Inbox** supports correspondence with guests as well as management of Booking.com;
- **Guest Reviews** aggregates scores of written guests feedbacks and ratings;
- **Finance** contains the base for calculation of commission which a hotel has to pay monthly to Booking.com;
- **Analytics** supports the “Booking.com Analytics” tools which is discussed in details below;
- **Marketplace** provides opportunities to integrate additional analytic tools, some tools are free, but some tools are not free.

## 2.2 Features of “Booking.com Analytics”

The “Booking.com Analytics” currently features the following parts of menu:

- The **Analytics Dashboard** aggregates the main performance overview including number of booked room nights, room revenue (the total amount paid by guests), and average daily rate what is room revenue divided to room nights; also the Analytics Dashboard contains links to the main reports briefly discussed below;
- The forward-looking **Pace Report** enables partners to benchmark their sales on Booking.com versus the previous year and compare their performance with aggregated data from their competitors;
- The **Sales Statistics** report provides an easy-to-digest snapshot of a property’s sales performance over the past year;
- The **Booker Insights** provides in-depth insights into country of origin, device used to book, and travel purpose;
- The **Bookwindow Information** is focusing on how far in advance Booking.com customers are booking their accommodation;
- The **Cancellation Characteristics** gives details about percentage of canceled guests bookings;
- The **Guest Review Score** provides data concerning property’s reviews rates written by guests;
- The **Manage Competitive Set** option allows to choosing up to ten hotel in your region to compare your Key Performance Indicators (KPIs) with the KPIs of the closest competitors;
- The **Genius Report** demonstrates percentage of booking made in accordance with Booking.com Genius program of frequent travellers;
- The **Ranking Dashboard** shows how you perform when guests search for properties in your area.

For an even deeper dive into the data, partners can compare their data with the following:

- Last year (own data);
- Peer group including all properties of the same type and star rating (if applicable) in a partner’s destination;

- Competitive set including ten properties of the partner’s choosing;
- Market including all properties in the partner’s destination, regardless of type or star-rating.

Partners can further slice and dice the data for deeper insights on:

- Ranking with their different custom and pre-defined groups of competitors;
- Delta changes over time;
- Date ranges (7, 14, 30, 60, 90, or 365 days).

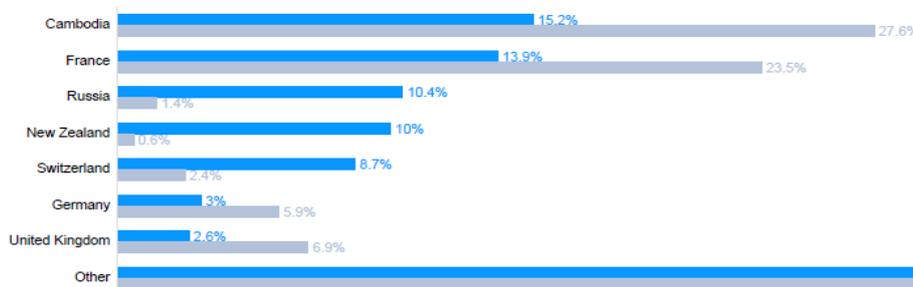
The next Section provides examples related with analytics reports generation.

### 3 Case Study: Details of Big Data Provided by “Booking.com Analytics”

In this Section we consider case study based on the real experience of a mini-hotel “Chateau Puss in Boots” operated in Kep city, Cambodia [22]. The considered hotel started to operate in December 2018, so in March 2019 we have available data only for four months. We do not represent financial data in this paper. It is necessary to introduce several important assumptions to understand the limitations of the study:

- We consider a private mini-hotel with capacity up to 15 room operating activities s (30-40 people), in which there are no corporate procedures, and everything is simplified to the limit in order to reduce overhead costs; therefore, all operating activities are concentrated on the hands of the owners without the participation of any structural units;
- We do not consider the structure of the room daily rate and additional revenue points (bar and restaurant, rent of bicycles and motorbikes, sale of tickets and excursions, spa etc.);
- We do not consider a general approach to hotel management; however, this is an important framework, which is discussed, for example, in [15].

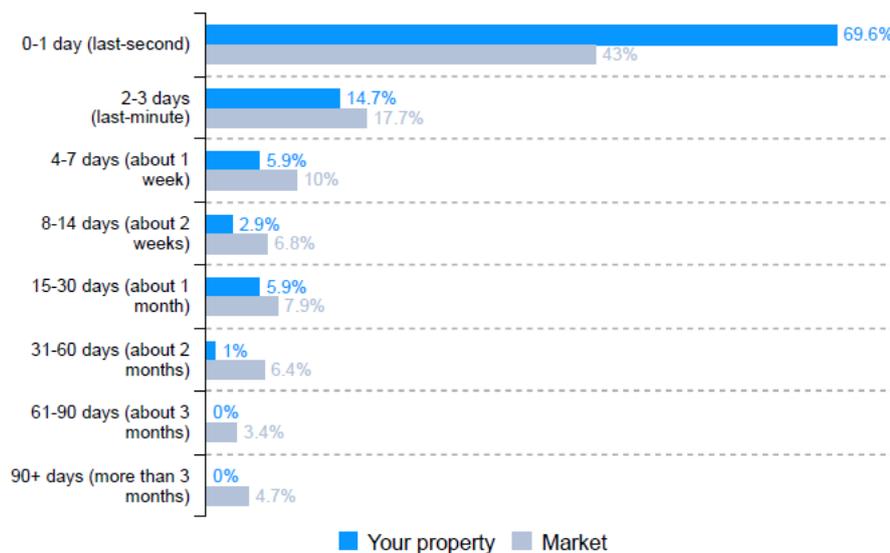
Fig. 1 provides a part of the Booker Insights concerning distribution of bookings between tourists’ countries of origin. The studied hotel is operated by owner with Ukrainian citizenship what is important from the point of view of nationals’ distribution.



**Fig. 1.** Case Study: Booking percentage depending from tourists' countries of origin (the studied hotel against the market)

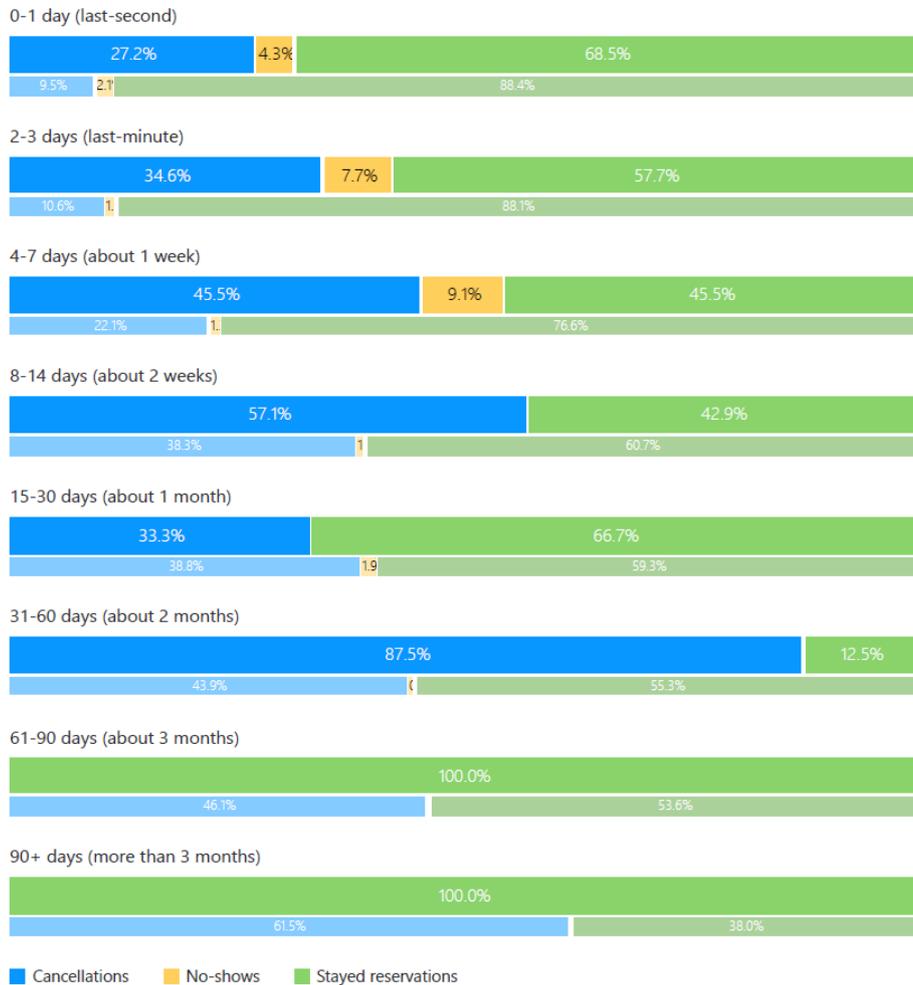
Fig. 1 demonstrates countries distribution different from the market. Tourists from Cambodia and France represent about 50% of tourist market in Kep, however, in the considered case study they take only 15% and 13% respectively. It can be explained by conservatism of local Cambodian tourists who like to stay at the hotel operated by local Cambodian owners. The same explains the lower percentage of French tourists many of whom are sensitive from the point of view of French language. Russian tourists also like when hotel staff can speak in Russian and it explains why they submit more than 10% of bookings against 1.4% at the market. Concerning New Zealand (10% of booking against 0.6% at the market) and Swiss (8.7% against 2.4% at the market) tourists the higher percentage can be explained by good value for money since tourists from these countries are conservative from the point of view of unnecessary spending of money. The detailed Booker Insights report provides also information separated by countries concerning average daily rate, average length of stay, and cancellation rate. These data are important for prognosis of behavior of tourists depending from a country of origin.

Fig. 2 represents the Bookwindow Information related with percentage of reservations depending from a book window (how many days in advance a room has been booked). A large book window provides more opportunities from a point of view of a room daily rate specification. Also, room daily rate shall take into account local and global festivals and days off. General analytics say that only few guests make reservation for more than 30 days in advance. A diagram on Fig. 2 shows that about 70% of all bookings have been made just before guests check-in. It is not perfect since risk of empty rooms is increased, but from the other hand it pushes to more precise setting of room daily rate for the actual date. Also, the Bookwindow Information report represents a diagram with average daily rate per a book window.



**Fig. 2.** Case Study: Book window percentage

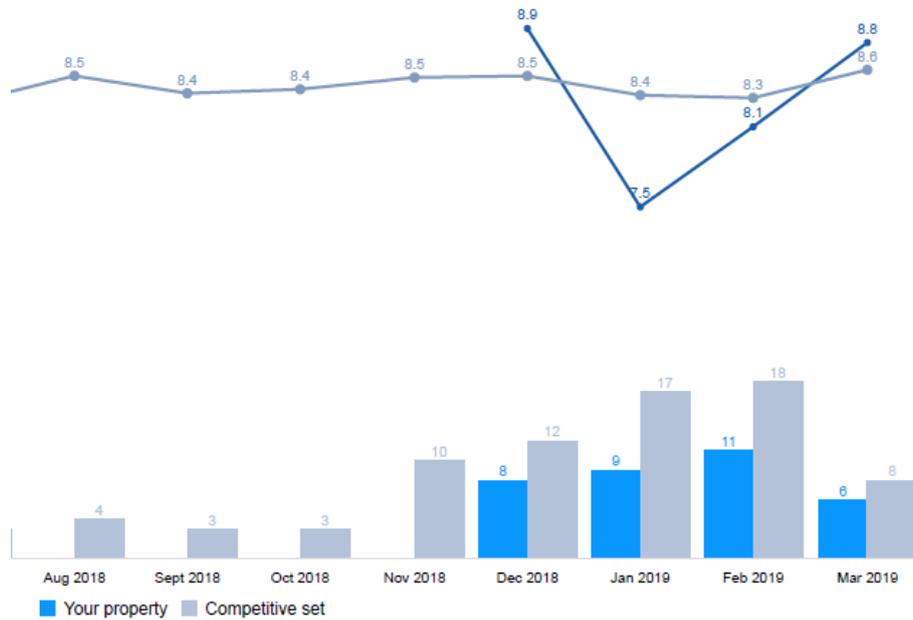
An important metric which affects any hotel business is cancellation percentage (see Fig. 3). The last-minute cancellation is usually stressful since it essentially decreases a book window and it increases a risk that a canceled room will not be sold out. Unfortunately for the analyzed case study we have 34% of cancellation rate while cancellation rate for the considered market is 28%. The most part of cancellations is explained by reservation with a book window more than one month. It is difficult to elaborate an effective strategy of cancellations number decreasing. People often change plans, or they can find that some another hotel proposal is more attractive. We try to communicate with guest as soon as we get a reservation but this strategy is also not completely successful.



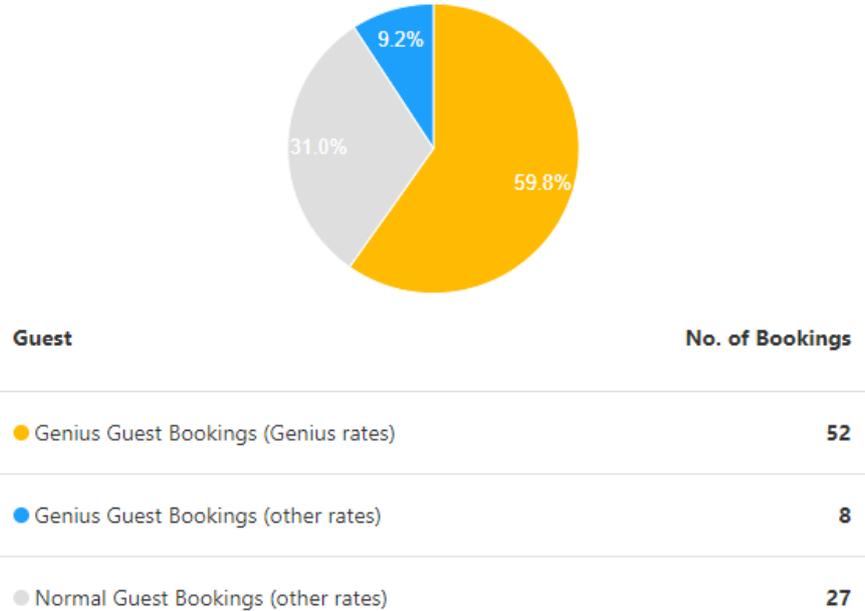
**Fig. 3.** Case Study: Cancellation of reservations percentage

A hotel business highly depends from a reputation what is supported at the Booking.com with guest reviews. Guest review is based on rating (from 2.5 to 10) of the following hotel features: cleanliness, comfort, location, facilities, staff, and value for money. The Guest Review Score report contains integrated values of hotel rating (see Fig. 4).

Booking.com supports loyalty program for frequent travelers with the name Genius. Registered Genius users of Booking.com get discounts for reservations from 10% and more. To get Genius travellers the hotel has to support this program (see Fig. 5).



**Fig. 4.** Case Study: Guests' review rating



**Fig. 5.** Case Study: Genius guests percentage

But an issue is the hotel has to provide discounts for its own expenses. It means that the price for Genius guest is only 90% (sometimes even 85%) from the stated at the Booking.com daily room rate. From the one hand it entails a general hotel revenue decreasing. But from the other hand many Booking.com users are involved in Genius program and these users appreciate when a hotel supports this program. So involvement of a hotel in Genius program can increase the total hotel revenue despite the fact that daily room rate decreases. What is important to remember, daily room rate shall take into account a risk of 10% or 15% decreasing for Genius guests. For the considered case study (Fig. 5) Genius guests consist about 70% of all guests what is a great amount for reservations.

The Ranking Dashboard (Fig. 6) presents the following factors influencing to the hotel revenue score in comparison between your hotel and average rate at the market:

- Conversion is the percentage of the hotel page views that converted into reservations;
- Average Daily Rate combined revenue earned from sold rooms divided by the number of sold rooms;
- Cancellations shows the percentage of all reservations that were canceled (Fig. 3);
- Review Score is calculated using the ratings left by guests (Fig. 4);
- Property Page Score shows how complete the hotel page is in regards to information and pictures;
- Reply Score takes into account the hotel answering guests as soon as possible.

### Factors influencing your score



**Fig. 6.** Case Study: Ranking for revenue influencing factors

Taking into account the above six factor can affect the hotel revenue amount, it makes a sense to consider the associated dependency. However, cancelation percentage, review score, property page score, and reply score can affect only indirectly to revenue. So it looks impossible to find dependencies between revenue score and indirect factors. What seems prospective for big data analysis are conversion percentage and average daily rate. In the next Section we consider hypothesis related with dependency of the hotel revenue score from conversion rate and daily rate.

## 4 Case Study: Checking of Big Data Based Hypothesis

So we can get big data from the “Booking.com Analytics”, and it we would like to understand how Big Date using can help in the statement of the daily room rate. Economic science suggests that there are supply and demand curves, and consequently, there is a certain optimal price that allows you to extract the maximum revenue from the sale of a product or a service. Type I errors (a price increase above the optimum) lead to the refuse of customers to purchase, while type II errors (a price reduction below the optimum) lead to a decrease in a potential revenue amount.

Thus, we state the *Hypothesis 1 (H1)*: There is a relationship between the rooms’ revenue  $S$  and daily room rate  $C$ .

Formally, for each calendar day for one of the room, this can be described by the following minimax criterion:

$S = \max(c) \wedge f = 1$ , where  $S$  is room revenue numerically equal to daily room rate  $c = \{c_{\min}..c_{\max}\}$  (room daily rate belongs to a certain range);  $f = \{0;1\}$  is a binary sale indicator:  $f = 0$  if the room is not sold and  $f = 1$  if the number is sold.

If there are several rooms of the same type, then not all rooms can be booked every day, in addition, the daily rate  $c_i$  for the same rooms may change during the book window, and the minimax criterion looks like:

$S = \max(\sum c_i) \wedge F = (\sum f_i) \rightarrow N$ , where  $c_i$  is daily room rate (the rate for the same room category can change),  $f_i = \{0;1\}$  is a binary sale indicator,  $F = \{0..N\}$  is the number of rooms sold in one category, the total number of which is  $N$ .

If the hotel has several categories of rooms, then each of them applies the above criterion, and the total rooms’ revenue is formed as the sum of sales of all categories of rooms, or everything can be reduced to a general formula, if you increase the dimension by adding another index. In our study we will focus on double rooms’ cate-

gory, as the most representative. The considered mini-hotel has five double rooms, so  $N = 5$ ,  $F = \{1..5\}$ .

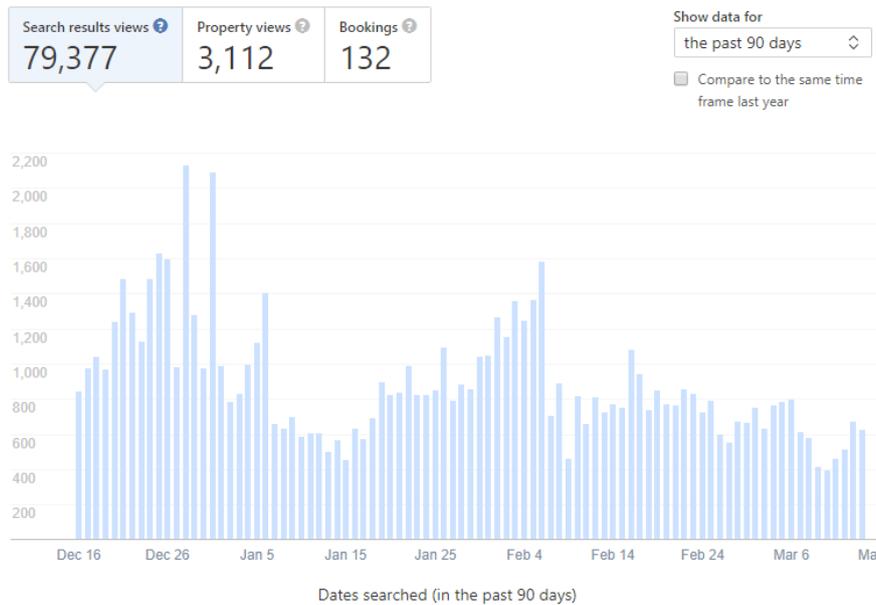
Now let's analyze the mutual dependence between rooms' revenue and room daily rate ( $H1$ ). Linear regression does not make a sense because the higher room daily rate obviously produces the higher revenue. Therefore, we calculate a regression coefficient as a measure of relation between two arrays of values of two random variables (relation of covariance value to product of standard deviations):

$$r(S, C) = \text{Cov}(S, C) / [\sigma(S) \cdot \sigma(C)] =$$

$$= (s_i - s_{Avg}) \cdot (c_i - c_{Avg}) / \sqrt{(s_i - s_{Avg})^2 \cdot (c_i - c_{Avg})^2}.$$

Values of daily room rate  $c_i$  and daily room revenue  $s_i$  are defined for every day during four months (120 pairs of values). Performed calculation gives us  $r(S, C) = 0.354$ . It means that there is not a statistical co-relation between revenue amount  $S$  and room daily rate  $C$ . However, our perception is still there should be a relationship.

One more perception is than more guests are looking for a room in your than more guest will you get in your hotel. The "Booking.com Analytics" supplies us with such data (Fig. 7). Fig. 7 represents numbers of daily search results for Kep (Cambodia). The conversion ratio is  $132 / 79\,377 = 0.16\%$  that means only 16 people booked the hotel from every 10 000 people looking for accommodation.



**Fig. 7.** Case Study: Daily search results

Let's state the *Hypothesis 2 (H2)*: There is a relationship between the rooms' revenue  $S$  and daily search results  $R$ .

Values of daily search results  $r_i$  and daily room revenue  $s_i$  are defined for every day during four month (120 pairs of values). Performed calculation gives us  $r(S,R) = -0.172$ . It means that there is not a statistical co-relation between revenue amount  $S$  and daily search results  $R$ .

## 5 Conclusions

In this paper we analyzed features and data provided by “Booking.com Analytics” which is modern powerful tools for hotels big data analysis. There are the following important data which can be extracted by Booking.com partners from extranet:

- Daily search results;
- Number of property page views;
- Number of booking;
- Room daily rates and average room daily rate;
- Revenues and average revenue;
- Percentage of booking cancelations.

Aggregated are available for different date ranges (7, 14, 30, 60, 90, or 365 days). Data can be compared with your hotel results during the last year as well as with average market data of average data of the hotels from your nearest pre-defined competitors set.

In the paper we tried to get decision making strategy for hotel management with support of the “Booking.com Analytics” tools. In fact, the hotel manager has only one “control button” which is room daily rate on the specific date. We stated two hypotheses:

- *Hypothesis 1 (H1)*: There is a relationship between the rooms’ revenue  $S$  and daily room rate  $C$ ;
- *Hypothesis 2 (H2)*: There is a relationship between the rooms’ revenue  $S$  and daily search results  $R$ .

Despite our perception both hypotheses turned out not true, what is confirmed by low values of regression coefficients ( $r(S,C) = 0.354$  and  $r(S,R) = -0.172$ ).

However, Booking.com states, that data contained in the “Booking.com Analytics” is harnessed by a proprietary logic that converts it into a prioritized list of actionable business advice. Also, Booking.com thinks that partner hotels can quickly peruse the opportunities, select the most relevant options for their property, and instantly implement them to enhance their listing and grow their business through Booking.com. After making the suggested adjustments, partners can then return to the analytics dashboard to easily monitor the results of their efforts, track their progress over time, and identify new areas for potential growth. In practice there are not any models which support the above statements.

Our conclusion is that big data for hotel management can be used only as a starting point for basic analysis. Reliable and sustainable decision making strategy shall additionally take into account experience, perception and intuition together with macro and micro economic trends. Discussing the hotel decision making strategy, we should remember the manager has only one the real tool to affect the revenue amount. This

tool is the daily rate per room. Of course, there are many issues affecting the daily rate, but all the hotels activities are concentrated in this variable.

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