Timeshare Resorts and Exchanges, Inc.

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A. Timeshare Business Overview

Timeshare Resorts and Exchanges, Inc. (TRE) is a timeshare management company that manages the exchanging activities among their own properties and has a mission to provide its owners with a better exchange. Timeshare is purchased vacation time at a shared resort property. TRE has 20,000 registered owners who have about 47,000 timeshare intervals at around 60 resorts in North America. TRE is responsible to manage their resorts, such as collecting annual maintenance fee, paying insurance and other fees, maintaining and staffing their properties, and managing the exchange mechanism. In order to accommodate its owners with more options for exchange outside the company, TRE associates with RCI and II. TRE also offers some advantages that are not offered by RCI and II, such as giving a lower exchange fee (about $75) and also free membership for those who are doing business with TRE.

Once a year TRE provides a regular ongoing exchange and organizes an annual exchange fair event around May/ June. In this event, owners will submit (by phone, by mail, or online) their existing timeshare intervals and their preferences on the resort weeks they wanted to obtain. The owners have to submit their requests before the deadline and after that TRE will come up with the exchange schedule to each owners.

B. Factors that influence the functioning of the exchange

1. Quality of interval (ownership)

   The quality of interval is assigned to owners by categorizing them into 3 color codes, such as red for the highest quality, white for medium quality, and blue for standard quality.

2. Owner Type (Status)

   Most owners would generally be classified with the color based on their submitted intervals. However, TRE has two exceptions to this rule. First, an owner who presents several color intervals possessed all the colors. Second, there is a gold status that can be purchased by any color owners that is used to request any color intervals and give them privilege to get one of their preferred choices or get his/her submitted interval back.

3. Intervals and Color Conversion

   TRE values the ownership of a resort based on the time of year. It categorizes special occasion and public holidays as more valuable day than the regular days.

4. Types of units available
There are various kinds of units available in most resorts, such as hotel-style rooms, condominium apartments, or detached bungalows.

5. Owner’s requests

Owners have to request the location, unit type, and interval their wants when submitting their resort week on the exchange fair system.

6. Allowed requests

A non-gold owner is limited by the color that they possessed. Besides, upgrading or downgrading is not allowed because of the fairness and brand equity issues among owners.

7. Traders’ perspective

There are two traders’ perspectives in this company, which are maximizing the number of owners who get their first choices and maximizing the total number of owners who get any of their requests.

C. Problems

Before using Linear Programming, the company’s problem is the non-optimal and inefficient schedule, which is believed to affect not only the company’s revenue but also the satisfaction from its clients. Based on observation, the owners’ requests were not uniformly distributed: only 25% of the properties were requested by nearly 75% of the owners and the most popular interval had 60 requests per available week. Thus, many requests from the owners could not be fulfilled that later on, it affects the owners’ satisfaction of the company. In addition, from all properties, the average of requests per available week is 11 but on average there are 18 submitted requests by the owners. To solve the problems, our team uses the linear programming system that comes out with decision variable, objective function, and constraints.

D. Linear Programming

1. Decision variable:

\[ X_{i,j,k} \] = where i is the owner’s number, j is the resort type, k is the season.

<table>
<thead>
<tr>
<th></th>
<th>Horseshoe</th>
<th>orlando</th>
<th>san diego</th>
</tr>
</thead>
<tbody>
<tr>
<td>owner</td>
<td>winter</td>
<td>spring</td>
<td>Summer</td>
</tr>
<tr>
<td>1</td>
<td>X1,1,1</td>
<td>X1,1,2</td>
<td>X1,1,3</td>
</tr>
<tr>
<td>2</td>
<td>X2,1,1</td>
<td>X2,1,2</td>
<td>X2,1,3</td>
</tr>
<tr>
<td>3</td>
<td>X3,1,1</td>
<td>X3,1,2</td>
<td>X3,1,3</td>
</tr>
<tr>
<td>4</td>
<td>X4,1,1</td>
<td>X4,1,2</td>
<td>X4,1,3</td>
</tr>
<tr>
<td>5</td>
<td>X5,1,1</td>
<td>X5,1,2</td>
<td>X5,1,3</td>
</tr>
<tr>
<td>6</td>
<td>X6,1,1</td>
<td>X6,1,2</td>
<td>X6,1,3</td>
</tr>
<tr>
<td>7</td>
<td>X7,1,1</td>
<td>X7,1,2</td>
<td>X7,1,3</td>
</tr>
</tbody>
</table>
The total number of decision variable is 180 since there are 15 owners, 3 types of resort and 4 seasons.

2. Objective Function:

For our first assumption, we determine the objective function is to maximize the total number of fulfilled request without concerning them getting the first or second choices. By doing this, TRE will make more owners getting their requests and at the same time, also maximizing the company’s profit.

The objective function in this first assumption is: \( \text{max total}(X_1 + X_2 + \ldots + X_{15}) \). The value of \( x \) is either 1 or 0. The value of 1 means that the owner gets his/her choice and the value of 0 means that the owner’s request is not fulfilled or there is no request for that particular resort and time. That means that an owner can only get one of his/her choice, either the first or second choice.

In our second assumption, we change our objective function from maximizing the satisfaction rate to maximize the number of owners getting their first choices.

The objective function in here is: \( \text{max total}(X_1 + X_2 + \ldots + X_{15}) \). However, the value of \( x \) for this assumption is either 10 or 5. The value of 10 means that the owners get their first choice and very satisfied and the value of 5 indicates that we could provide the owners with their second preferable choice. And the value of 0 means that there is no request at all or the request is not fulfilled.

In our third assumption, the objective function is similar with our first assumption except we consider color-code possessed by each owner. Before inputting the data, we have to differ each owner based on the color and ability to exchange the resorts within the same color they possessed.

3. Constraints:

The constraints are determined based on the supply and the demand, where the supply is the total number of submitted timeshares and the demand is the total number of requested timeshares. The total number of the demand fulfilled has to be less or equal to the number of supply of each resort for each season.
Horseshoe Winter $X_{1,1,1} + \ldots + X_{15,1,1} \leq 1$
Horseshoe Spring $X_{1,1,2} + \ldots + X_{15,1,2} \leq 1$
Horseshoe Summer $X_{1,1,3} + \ldots + X_{15,1,3} \leq 4$
Horseshoe Fall $X_{1,1,4} + \ldots + X_{15,1,4} \leq 0$
Orlando Winter $X_{1,2,1} + \ldots + X_{15,2,1} \leq 2$
Orlando Spring $X_{1,2,2} + \ldots + X_{15,2,2} \leq 0$
Orlando Summer $X_{1,2,3} + \ldots + X_{15,2,3} \leq 1$
Orlando Fall $X_{1,2,4} + \ldots + X_{15,2,4} \leq 2$
San Diego Winter $X_{1,3,1} + \ldots + X_{15,3,1} \leq 1$
San Diego Spring $X_{1,3,2} + \ldots + X_{15,3,2} \leq 1$
San Diego Summer $X_{1,3,3} + \ldots + X_{15,3,3} \leq 0$
San Diego Fall $X_{1,3,4} + \ldots + X_{15,3,4} \leq 1$

<table>
<thead>
<tr>
<th>owner</th>
<th>Total demand</th>
<th>≤</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total $X_1$</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Total $X_2$</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Total $X_3$</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Total $X_4$</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Total $X_5$</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Total $X_6$</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Total $X_7$</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Total $X_8$</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Total $X_9$</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>Total $X_{10}$</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>Total $X_{11}$</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>Total $X_{12}$</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>Total $X_{13}$</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>Total $X_{14}$</td>
<td>1</td>
</tr>
<tr>
<td>15</td>
<td>Total $X_{15}$</td>
<td>1</td>
</tr>
</tbody>
</table>

We also consider other constraints because an owner’s request can only be fulfilled or not, but there can only be 1 fulfilled request for each owner. Therefore, these following constraints are also applied.

- $0 \leq X_{i,j,k} \leq 1$ (binary)
- The total result ≤ Total supply
- The resort with no request has to stay 0 (to indicate that it is not fulfilled)

4. Result of Solver:

After deciding all the decision variables, choosing the objective function, and inserting the data to the Excel and constraints to the Solver, the result for the first assumption shows 12 matched requests. When we use our second assumption and change our objective to maximize the number of owners getting their first choices, we could satisfy
11 owners; 8 owners get their first choices and 3 owners get their second choices. However, when we consider color-code, we came up with only 6 owners getting their requests.

<table>
<thead>
<tr>
<th></th>
<th>1st assumption</th>
<th>2nd assumption</th>
<th>3rd assumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fulfilled Request</td>
<td>80%</td>
<td>73.33%</td>
<td>40%</td>
</tr>
<tr>
<td>Profit</td>
<td>$900</td>
<td>$825</td>
<td>$450</td>
</tr>
</tbody>
</table>

**E. Recommendations**

We recommend the company to use our second assumption, which is to maximize the owners’ satisfaction by prioritizing their first choices. Based on our result, we could provide 11 owners with their requested resorts; 8 of them are very satisfied while 3 of them are still getting their request.

In our first assumption, we could maximize the company’s profit and also the number of owners getting their requests, which is 12, but we could not determine how satisfied the owners will be because we do not prioritize their first choices. Even though the second assumption’s result is lower than our first one, we believe that it would benefit the company in the long run since owner’s satisfaction is our first priority. And owner’s satisfaction will eventually lead a company to have more customers in the future.

We also suggest the company to allow different color owners to be able to request the different color class of resorts because when we consider the color code and do not allow them to upgrade or downgrade, we can only fulfill 6 owners’ requests.

In conclusion, our second assumption which prioritize the owners’ first choices would give what the owners really want and our recommendation to not consider the color-code would give more flexibility.

**F. Implementation plan and the risks**

Our new recommendations for TRE are to prioritize owners’ satisfaction and avoid the company using color-codes. By using this new plan, the advantage is that TRE can increase the owner’s satisfaction rate and still gain profit. On the other hand, for now, the company’s profit would be less than when the company do not differ the first or second choices of the owners. Moreover, the risk of eliminating color-code system would also be existed because it allows the owners to switch from one class to another. This could lead the customers to think that they could exchange the resort to a higher class later on. They would believe that purchasing a higher quality resort is unprofitable; therefore, no one would submit higher quality resort. For example, many people would request for higher quality resort, which would result in high demand, while the supply is limited.
G. Appendix