

Audit trail – Customer Reward Programme

The following audit trail should be read alongside the model provided.

Objective

The management of an airline want to review their customer reward programme to better understand how changes made to the programme rules will impact the proportion of members in each of its membership tiers. The customer reward programme has 4 tiers (Blue, Bronze, Silver and Gold) for which each customer’s membership status is determined by how many miles they have flown within the past year.

The airline have provided a set of sample set of passenger flight history data with which we have been asked to determine the proportion of customers in each membership tier based on the current programme rules as well as under two alternative options.

The purpose of the model is to perform the following:

- Calculation of the proportion of customers in each membership tier, as observed in the sample data provided, under each of the following programme rules:
 - The current programme rules, where membership level is based on the total number of miles flown in the past year.
 - Option 1, where membership tier is based on the total number of flights taken in the past year
 - Option 2, where membership tier is based on the total number of miles flown in the past year, but the thresholds for qualifying for a higher tier have been adjusted by targeting a 15% proportion of members reaching the gold tier.
- A graphical representation of the number of members in each membership tier is produced for each of the three scenarios described above

Assumptions

The following assumptions were made in the model:

- Assume that data provided contains a full year of flight data for each passenger
- Assume zero values in the data do not contribute to the number of flights taken
- Assume sample data provided is representative of all customers’ travel experience
- Assume that the data provided is complete and accurate
- Assume that no additional rules apply to calculation of membership levels (flights are not subject to any mileage minimums, no bonus mileage accrual is applied for particular routes of membership tiers etc.)

“Data” worksheet

This worksheet contains the raw data provided by the airline.
The airline has provided a sample set of passenger travel data.

Each row of the data represents the flight history for an individual passenger. Each column of the data represents the miles flown on each flight taken in the past year.

“Data Validation” worksheet

This worksheet applies a number of checks on the data provided by the airline. The checks are used to demonstrate that the data is suitable for use in the model. No adjustments to the data have been applied.

In column "I" checks are included to ensure:

- 200 rows of data are included, as we are told this is the number of customers included in the sample data.
- 100 columns of data are included, as we are told this is the maximum number of flights included in the sample data.
- Minimum distance in the data is equal to zero for all customers, which we would expect for cells which contain no flight history.
- Maximum distance in the data is reasonable, at 13,422 which is long but potentially a reasonable flight distance.
- Number of zero entries in data and non zero entries in data sum to total (20,000). Confirms all entries are numeric and within range considered by above checks.

"Parameters" worksheet

This sheet sets out all the parameters used within the calculations. Each of these is given a named range highlighted in *red* below:

The current customer reward programme membership level parameters

Current_parameters: where each passenger's customer reward programme membership level is based on the total number of miles they have flown with the airline within the past year as follows:

Total number of miles flown		Customer reward Club Membership Level
From	To	
0	74,999	Blue
75,000	149,999	Bronze
150,000	299,999	Silver
300,000 +		Gold

Option 1 customer reward programme membership level parameters *Option1_parameters*: where the customer reward membership level based on the number of flights taken with the airline in the past year as follows:

Total number of flights taken		Customer reward Club Membership Level
From	To	
0	9	Blue
10	19	Bronze
20	29	Silver
30 +		Gold

For Option 2, the membership rules are determined using a similar approach to the current rules, based on number of miles flown however the mileage thresholds for determining

customers' membership level is determined so that based on the sample passenger history data 15% of customers are in the 'Gold' membership level. The 15% target is stored here as the *gold_target*.

The thresholds for membership level under option 2 are determined within the 'Alternative Distance Travelled' tab and described in more detail below.

"Distance Travelled" worksheet

In this worksheet we calculate the membership level for each customer in the sample data provided based on the current membership rules in order to determine the proportion of members at each level.

Cells E6 to CZ205 in this worksheet are linked to the flight history information in the "Data" tab.

The total distance travelled for each passenger, each represented by a row of the data, is determined by calculating the sum across all columns of data. The total distance travelled for each passenger is given in column DB

Checks are included in column DB to confirm that all passengers have at least one flight (as passengers need to have at least one flight to be a customer of the airline), a maximum less than 100*max distance flown (at most a customer can only have flown the longest flight 100 times given we have only been provided 100 data points per customer). The number of flights value is also checked against the non-zero entry check on the data validation tab to ensure that these values are consistent.

On column DC the membership level of each customer is determined using a VLOOKUP function. The total distance travelled by each passenger, as calculated in column DB is used to lookup the membership level, as determined by the current programme rules, defined in parameter *Current_parameters*. The calculation returns the membership level for each passenger.

Spot checks were applied to individual members to ensure the values returned by the calculation were consistent with the programme rules.

Cells DE to DG provide a summary of the customer membership data calculated above.

For each of the membership levels (Blue, Bronze, Silver and Gold) the frequency is determined in column DF using the COUNTIF function to count the number of passengers in each membership level.

Cell DF10 calculates the sum of members in each of the four membership levels. A check is provided to ensure this equals 200 (the total number of customers in the data provided).

The proportion of members at each level is determined in column DG, by dividing the frequency in each membership level by the total number of members.

A check is included to ensure the proportion in each membership level add to 100%.

"Number of Flights" worksheet

In this worksheet we calculate the membership level for each customer in the sample data provided based on the first alternative approach proposed under 'Option 1' in order to determine the proportion of members at each level.

Cells E6 to CZ205 in this worksheet are linked to the flight history information in the "Data" tab.

The total number of flights for each passenger, each represented by a row of the data, is determined as follows. For each row, the COUNTIF function is used to count all entries with a mileage greater than zero in columns E to CZ. The total number of flights for each passenger is given in column DB

Checks are included in column DB to confirm that all passengers have at least one flight (as passengers need to have at least one flight to be a customer of the airline), a maximum of 100 flights (as we have only been given 100 columns of data). The number of flights value is also checked against the non-zero entry check on the data validation tab to ensure that these values are consistent.

On column DC the membership level of each customer is determined using a VLOOKUP function. The number of flights taken for each passenger, as calculated in column DB is used to lookup the membership level, as determined by the Option 1 rules, defined in parameter **Option1_parameters**. The calculation returns the membership level for each passenger.

Spot checks were applied to individual members to ensure the values returned by the calculation were consistent with the programme rules.

Cells DE to DG provide a summary of the customer membership data calculated above.

For each of the membership levels (Blue, Bronze, Silver and Gold) the frequency is determined in column DF using the COUNTIF function to count the number of passengers in each membership level.

Cell DF10 calculates the sum of members in each of the four membership levels. A check is provided to ensure this equals 200 (the total number of customers in the data provided).

The proportion of members at each level is determined in column DG, by dividing the frequency in each membership level by the total number of members.

A check is included to ensure the proportion in each membership level add to 100%.

"Alternative Distance Travelled" worksheet

In this worksheet we calculate the membership level for each customer in the sample data provided based on the 'Option 2' membership rules in order to determine the proportion of members at each level.

Under option 2, the the customer reward membership level based on the total number of miles they have flown with the airline within the past year as follows:

Total number of miles flown	Customer reward Club Membership
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		Level
From	To	
0	$x-1$	Blue
x	$2x-1$	Bronze
$2x$	$3x-1$	Silver
$3x +$		Gold

The value of x is determined so that based on the sample passenger history data 15% of customers are in the 'Gold' membership level. The 15% level is taken from the parameters tab, by the named range **gold_target**

Cells D6 to D10 in this worksheet set out the parameters in the table above and given a named range **Option2_parameters**. Initially the value of x is set to 75,000 miles but this parameter will be changed in order to solve for the value which results in a proportion of gold members in line with the **gold_target**.

The total distance travelled for each passenger, is taken from column DB in the 'Distance Travelled' and presented in column I.

The flying club status for each passenger is initially determined using a VLOOKUP function. The total distance travelled for each passenger, as shown in column I is used to lookup the membership level, as determined by the Option 2 programme rules, defined in parameter **Option2_parameters**. The calculation returns the membership level for each passenger.

Spot checks were applied to individual members to ensure the values returned by the calculation were consistent with the programme rules.

Cells L to N provide a summary of the customer membership data calculated above.

For each of the membership levels (Blue, Bronze, Silver and Gold) the frequency is determined in column M using the COUNTIF function to count the number of passengers in each membership level.

Cell M10 calculates the sum of members in each of the four membership levels. A check is provided to ensure this equals 200 (the total number of customers in the data provided).

The proportion of members at each level is determined in column DG, by dividing the frequency in each membership level by the total number of members.

A check is included to ensure the proportion in each membership level add to 100%.

The difference between the target percentage of gold members (15% as defined by **gold_target**) and the actual gold proportion of gold members calculated in cell M9 is calculated in cell Q9.

Goalseek is used to adjust the value x given in cell C7 in order to set this difference to zero.

A check is included in cell R9 to confirm that a solution has been found and if not provide a warning to users of the model.

“Charts” worksheet

This sheet summarises the results of the analysis in the above worksheets in a series of charts.

Summaries of the proportion of members in each level under each of the three options considered are presented in columns C and D, taken directly from the summary tables in the underlying tabs.

For each, a pie chart is constructed to highlight how the proportion of members is split between the four membership levels.