

Table 2 Top 10 sentiment phrases based on occurrence

Phrase	Type	Occurrence
not worth	NOA	26329
not go wrong	NOA	15446
not bad	NOA	15112
not be happier	NOA	14892
not good	NOA	12919
don't like	NOV	42525
didn't work	NOV	38287
didn't like	NOV	21806
don't work	NOV	10671
don't remember	NOV	9670

$$ss(t) = \frac{\sum_{i=1}^5 i \times \gamma_{5,i} \times Occurrence_i(t)}{\sum_{i=1}^5 \gamma_{5,i} \times Occurrence_i(t)} \quad (2)$$

$Occurrence_i(t)$ is t 's number of occurrence in i -star reviews, where $i=1, \dots, 5$. According to Figure 3, our dataset is not balanced indicating that different number of reviews were collected for each star level. Since 5-star reviews take a majority amount through the entire dataset, we hereby introduce a ratio, $\gamma_{5,i}$, which is defined as:

$$\gamma_{5,i} = \frac{|5-star|}{|i-star|} \quad (3)$$

In equation 3, the numerator is the number of 5-star reviews and the denominator is the number of i -star reviews, where $i = 1, \dots, 5$. Therefore, if the dataset were balanced, $\gamma_{5,i}$ would be set of 1 for every i . Consequently, every sentiment score should fall into the interval of $[1, 5]$. For positive word tokens, we expect that the median of their statement scores should exceed 3, which is the point of being neutral according to figure 1. For negative word tokens, it is to expect that the median should be less than 3.