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# A Utility Function for the Music Consumer Based on Emotions

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*Article*

# A Utility Function for the Music Consumer Based on Emotions

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**Abstract:** The objective of this research is to propose a utility function that calculates the possible level of satisfaction that a music consumer would achieve after listening to a song according to the emotional response obtained from a song. Assuming that the consumer's musical preferences are satisfied if the predominant emotions of his current emotional state increase; the probabilistic emotional-musical model (Lugos Abarca, 2023) is used to construct such a utility function. By posing a hypothetical scenario, realistic results were obtained, which guarantee, in principle, its use in theoretical practice. The originality of this research lies in proposing a mathematical tool to study, quantitatively, the decision making of a musical consumer influenced by his emotions. The main conclusion being its importance in the music industry, since the function could predict, theoretically, whether a song will be accepted or rejected by the consumer in comparison with the competition.

**Keywords:** single equation model; mathematical; expected utility theory; probability; neuroeconomics

**JEL** classification: C2; C65; D81; D87

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## 1. Introduction

In microeconomics, perfect substitute goods are those that can satisfy the same need of a consumer, making them interchangeable due to factors such as price, quality, design, etc. (Rubinfeld & Pindyck, 2009). Some examples include: Coca-Cola or Pepsi, Heineken or Corona Extra, Chevrolet, Honda or Tesla, etc.

In this sense, by definition, a song is a perfect substitute good, as a consumer can satisfy their musical preference or taste in the same way with different songs in the market (Casillas et al., 2014; Faure et al., 2020); with factors of choice such as genre (López Herrera & Oropeza Tena, 2013; Frith, 2001), artist (Ochoa, 2020; Rivera Macías, 2018), duration, or the emotions that such songs provoke (Benaisa & Torres, 2014; Díaz, 2016; Martínez, 2003). For example, if it's by genre, one may have preferences between Willie Colón or Héctor Lavoe, Linkin Park or Korn, Bad Bunny or Raw Alejandro, etc.

Given how interchangeable songs can be in this field, it causes the music market to be highly competitive, as music producers or labels seek to ensure that their musical products (songs) satisfy the majority of consumers in order to generate higher sales. To address this issue, the music industry has developed empirical formulas within musical composition and production with the purpose of ensuring the commercial success of a song (Abeillé, 2013; Cobo, 2021; Fernández Gómez, 2005; Novillo, 2014), meaning that the song is most preferable for the music consumer.

Although such formulas have shown positive results, consumer preference for a song remains somewhat random since the music consumer is an emotional consumer (Bigné & Andreu, 2004; Raiteri & Ocaña, 2016; SIMó, 2003) as musical preferences or tastes are indeed influenced by emotions (Alaminos Fernández, 2014; Betancur & Quiceno, 2020). While it is true that the emotional consumer is not irrational or devoid of logic in their decision-making (Barboza, 2012; Raiteri & Ocaña, 2016), as behavioral economics has found that consumer decision-making influenced by emotions follows a

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logical pattern (DellaVigna, 2009; Vázquez, 2017), the level of utility that a music consumer obtains from a song is mathematically unpredictable, as there has not previously been a mathematical tool capable of quantitatively measuring the levels of emotion corresponding to an individual, at least in the musical context, which complicates its theoretical prediction.

However, in a recent study (Lugos Abarca, 2023), an emotional-musical probabilistic model PE-M was proposed with the task of quantitatively determining the possible emotional responses that a specific individual would obtain after listening to a song. Such a model presents a work opportunity in order to give a first response to the following question: What will be the level of utility that the music consumer will achieve when listening to a specific song compared to other songs in the market?

Therefore, the objective of the present research will be to use the mathematics employed in the PE-M model to develop a function capable of calculating the level of utility that a music consumer could obtain after listening to a song according to the emotional responses provoked by such a musical stimulus (song or musical work). In other words, we seek to propose an emotional utility function.

## 2. Methodology

### *2.1. Emotional Utility Function*

Based on the above, the following utility function is derived, which is used to express the utility of perfect substitute goods (Walter, 2005):

$$U_{(X,Y)} = (x \times \alpha) + (y \times \beta) \tag{2.1}$$

Where $x$ and $y$ represent the quantity of goods, $\alpha$ and $\beta$ represent the level of preference that the consumer has for goods $x$ and $y$, such that $\alpha, \beta \in \mathbb{Q}$ and $\alpha + \beta = 1$.

The function will not undergo alterations in its form; rather, the variables $x$, $y$, $\alpha$, and $\beta$ will be exchanged in order to express the potential utility that a music consumer would have after listening to a song in accordance with their emotional responses. The music consumer to be considered in this article is one who achieves higher utility if the predominant emotions of their emotional state increase after listening to a song; otherwise, their utility is lower. In other words, if the consumer feels happy before listening to the song, and if the musical stimulus makes them feel much happier afterward, their utility will be high.

According to the above, it is interpreted that the quantity of goods $x$ and $y$ are analogous to the "yes feel" and "no feel" modules of the Possible Internal Emotional State Modules (MEEPI) of the consumer after listening to the song (Lugos Abarca, 2023). As the MEEPI quantitatively represent the possible emotional responses that the music consumer would have after the musical stimulus.

In this context, these modules can be reinterpreted as the emotional goods that the consumer obtained after listening to a song; therefore, replacing the variables:

$$U_{\left(\overrightarrow{P_{\vdash}^{E}}, \overrightarrow{P_{\dashv}^{E}}\right)} = \left(\overrightarrow{P_{\vdash}^{E}} \times \alpha\right) + \left(\overrightarrow{P_{\dashv}^{E}} \times \beta\right) \tag{2.2}$$

Where $\overrightarrow{P_{\vdash}^{E}}$ is the "yes feel" module of the MEEPI for any emotion after the musical stimulus, and $\overrightarrow{P_{\dashv}^{E}}$ is the "no feel" module of the MEEPI for any emotion after the musical stimulus.

In their complete notation, such modules are:

$$\overrightarrow{P_{\vdash}^{E}} = |\vdash \left(E = \frac{K_E}{2}\right)\Big\rangle_0^i, \quad \overrightarrow{P_{\dashv}^{E}} = |\dashv \left(E = \frac{K_E}{2}\right)\Big\rangle_0^i \tag{2.3}$$

Note that now the utility is a function of the "yes feel" and "no feel" modules of an emotion $E$.

### *2.2. Levels of Emotional Preference*

On the other hand, as indicated, the consumer achieves higher utility if the predominant emotions of their emotional state increase after the musical stimulus. Therefore, it can be concluded that the level of preference is directly related to the MEEPI before listening to a song. That is, if the predominant emotions of the music consumer before listening to a song are sadness and anger, then those are the emotional preferences that the consumer expects from the song.

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Having said that, it is determined that to calculate the consumer's preference levels according to their emotional state, or as it will be referred to in this article, "emotional preference levels", they are calculated with:

$$\alpha = \frac{\overleftarrow{P_{\vdash}^{E}}}{K_E}, \quad \beta = \frac{\overleftarrow{P_{\dashv}^{E}}}{K_E} \tag{2.4}$$

Where $\alpha$ is the consumer's preference level for a certain emotion in the song "yes feel", $\beta$ is the consumer's preference level for a certain emotion in the song "no feel", $\overleftarrow{P_{\vdash}^{E}}$ is the "yes feel" module of the MEEPI for any emotion before the musical stimulus, $\overleftarrow{P_{\dashv}^{E}}$ is the "no feel" module of the MEEPI for any emotion before the musical stimulus, and $K_E$ is the probability of the MEEPI for any emotion.

In this way, the complete utility function is written, which will be called the "emotional utility function."

$$U_{\left(\overrightarrow{P_{\vdash}^{E}},\overrightarrow{P_{\dashv}^{E}}\right)} = \left(\overrightarrow{P_{\vdash}^{E}} \times \frac{\overleftarrow{P_{\vdash}^{E}}}{K_E}\right) + \left(\overrightarrow{P_{\dashv}^{E}} \times \frac{\overleftarrow{P_{\dashv}^{E}}}{K_E}\right) \tag{2.5}$$

It is interesting that the emotional utility function requires the values of how the consumer feels before and after the musical stimulus, which the PE-M model (Lugos Abarca, 2023) allows to know in a probable and theoretical way. In the following section, a theoretical scenario will be proposed in order to explain the resolution process and discover if function 2.5 behaves realistically.

### *2.3. Brief Resolution and Data*

To facilitate the exercise, we will use the abbreviated version of the PE-M model, and the data to be used will be simulated numerically through assumptions.

Let's suppose that we are the producer of a music label, and we have been tasked with producing a reggaeton song for release on streaming platforms in the summer. The label has specified that the song must be good enough for people to play it at summer parties.

### *2.4. The MEEPI That the Music Consumer Probably Feels before Listening to Any Song*

Based on the above, we deduce that the music consumer targeted by our song (song C) is a person who is at parties, nightclubs, etc. Therefore, it is deduced that his satisfaction or utility will be higher if the song increases the emotion of happiness even more.

Having said that, we can mathematically simulate the possible emotional state (MEEPI) that the consumer (at a party) feels before listening to any song:

$$|E|^{i} = \left\{\left[|\vdash\left(\varsigma F = \frac{1}{\mathbf{765}}\right)\rangle_0^{i} + |\dashv\left(\varsigma F = \frac{1}{3{,}060}\right)\rangle_0^{i}\right] + \right. \tag{2.6}$$

$$\left[|\vdash\left(\varsigma T_z = \frac{1}{3{,}120}\right)\rangle_0^{i} + |\dashv\left(\varsigma T_z = \frac{\mathbf{3}}{\mathbf{1{,}040}}\right)\rangle_0^{i}\right] +$$

$$\left[|\vdash\left(\varsigma M_i = \frac{1}{12{,}600}\right)\rangle_0^{i} + |\dashv\left(\varsigma M_i = \frac{\mathbf{7}}{\mathbf{1{,}800}}\right)\rangle_0^{i}\right] +$$

$$\left[|\vdash\left(\varsigma I_{ra} = \frac{1}{9{,}300}\right)\rangle_0^{i} + |\dashv\left(\varsigma I_{ra} = \frac{\mathbf{2}}{\mathbf{775}}\right)\rangle_0^{i}\right] +$$

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$$\left[|\vdash\left({}_{\varsigma}S_{or}=\mathbf{\frac{3}{650}}\right)\rangle_{0}^{i}+|\dashv\left({}_{\varsigma}S_{or}=\frac{7}{3{,}900}\right)\rangle_{0}^{i}\right]+$$

$$\left[|\vdash\left({}_{\varsigma}A_{co}=\frac{1}{13{,}200}\right)\rangle_{0}^{i}+|\dashv\left({}_{\varsigma}A_{co}=\mathbf{\frac{3}{400}}\right)\rangle_{0}^{i}\right]\}$$

As observed, the emotions that predominate in the "yes feel" modules are happiness and surprise, whereas the rest of the emotions are less predominant, as they have their highest levels in the "no feel" modules. Emotions that predominate in the "yes feel" modules have been highlighted in red, while those in the "no feel" modules are highlighted in blue.

This means that the consumer prefers songs that make them feel happy and surprised, while for the rest of the emotions, they prefer not to feel them.

*2.5. The Probable MEEPI That the Consumer Will Likely Feel after Listening to Songs A and B*

It is known that song C will be in competition with the songs currently trending (for this exercise, A and B), so part of our work is to study them musically and emotionally. Therefore, we calculate the possible MEEPI that the consumer would feel after listening to the two reggaeton songs that are currently trending. Thus, the following MEEPI are resolved:

According to the PE-M model, these are the MEEPI that the consumer could feel after listening to song A.

$$|E|^{i}=\{[|\vdash({}_{\varsigma}F\quad=\mathbf{0.4675887582})\rangle_{f}^{i}+|\dashv({}_{\varsigma}F\quad=-0.4659547712)\rangle_{f}^{i}]+ \tag{2.7}$$

$$[|\vdash({}_{\varsigma}T_{z}=\mathbf{0.4903961355})\rangle_{f}^{i}+|\dashv({}_{\varsigma}T_{z}=-0.4871910073)\rangle_{f}^{i}]+$$

$$[|\vdash({}_{\varsigma}M_{i}=\mathbf{0.002984126984})\rangle_{f}^{i}+|\dashv({}_{\varsigma}M_{i}=0.000984126984)\rangle_{f}^{i}]+$$

$$[|\vdash({}_{\varsigma}I_{ra}=-0.04486291398)\rangle_{f}^{i}+|\dashv({}_{\varsigma}I_{ra}=\mathbf{0.04755108602})\rangle_{f}^{i}]+$$

$$[|\vdash({}_{\varsigma}S_{or}=0.001776556777)\rangle_{f}^{i}+|\dashv({}_{\varsigma}S_{or}=\mathbf{0.004633699634})\rangle_{f}^{i}]+$$

$$[|\vdash({}_{\varsigma}A_{co}=\mathbf{0.004787878788})\rangle_{f}^{i}+|\dashv({}_{\varsigma}A_{co}=0.002787878788)\rangle_{f}^{i}]\}$$

Based on the results of each module in 2.7, it is estimated that song A makes the consumer feel happier, sadder, more afraid, and more disgusted than angry and surprised.

Regarding song B, according to the PE-M model, these are the probable MEEPI that the consumer could feel after listening to it.

$$|E|^{i}=\{[|\vdash({}_{\varsigma}F\quad=\mathbf{0.002448582})\rangle_{f}^{i}+|\dashv({}_{\varsigma}F\quad=-0.000815)\rangle_{f}^{i}]+ \tag{2.8}$$

$$[|\vdash({}_{\varsigma}T_{z}=\mathbf{0.003031136})\rangle_{f}^{i}+|\dashv({}_{\varsigma}T_{z}=0.000174)\rangle_{f}^{i}]+$$

$$[|\vdash({}_{\varsigma}M_{i}=\mathbf{0.002301587302})\rangle_{f}^{i}+|\dashv({}_{\varsigma}M_{i}=0.001666666667)\rangle_{f}^{i}]+$$

$$[|\vdash({}_{\varsigma}I_{ra}=-0.016734555)\rangle_{f}^{i}+|\dashv({}_{\varsigma}I_{ra}=\mathbf{0.0194})\rangle_{f}^{i}]+$$

$$[|\vdash({}_{\varsigma}S_{or}=-0.005915751)\rangle_{f}^{i}+|\dashv({}_{\varsigma}S_{or}=\mathbf{0.012326})\rangle_{f}^{i}]+$$

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$$\left[|\vdash(\ {}_{\varsigma}A_{co} = 0.000606060606)\rangle_f^i + |\dashv(\ {}_{\varsigma}A_{co} = \mathbf{0.00696969697})\rangle_f^i\right]\}$$

Similar to song A, song B makes the consumer feel happier, sadder, and more afraid than angry, surprised, and disgusted.

*2.6. The Probable MEEPI That the Consumer Will Likely Feel after Listening to Song C*

To be able to emotionally compare song C with A and B, the PE-M model is solved using the musical parameters of C.

According to the PE-M model, this is the possible MEEPI that the consumer could feel after listening to song C:

$$|E|^i = \{\left[|\vdash(\ {}_{\varsigma}F\ = \mathbf{0.01535342204})\rangle_f^i + |\dashv(\ {}_{\varsigma}F\ = -0.01371943511)\rangle_f^i\right] + \tag{2.9}$$

$$\left[|\vdash(\ {}_{\varsigma}T_z = -0.2596038645)\rangle_f^i + |\dashv(\ {}_{\varsigma}T_z = \mathbf{0.2628089927})\rangle_f^i\right] +$$

$$\left[|\vdash(\ {}_{\varsigma}M_i = 0.000714285714)\rangle_f^i + |\dashv(\ {}_{\varsigma}M_i = \mathbf{0.003253968254})\rangle_f^i\right] +$$

$$\left[|\vdash(\ {}_{\varsigma}I_{ra} = -0.0131665361)\rangle_f^i + |\dashv(\ {}_{\varsigma}I_{ra} = \mathbf{0.01585470814})\rangle_f^i\right] +$$

$$\left[|\vdash(\ {}_{\varsigma}S_{or} = \mathbf{0.005448717949})\rangle_f^i + |\dashv(\ {}_{\varsigma}S_{or} = 0.000961538462)\rangle_f^i\right] +$$

$$\left[|\vdash(\ {}_{\varsigma}A_{co} = 0.0000757575758)\rangle_f^i + |\dashv(\ {}_{\varsigma}A_{co} = \mathbf{0.0075})\rangle_f^i\right]\}$$

As it is notable, C makes the consumer's corresponding feelings of happiness and surprise feel more than sadness, fear, anger, and disgust.

At this point, it is possible to make conjectures about the results of the MEEPI and their relationship with the expected preference levels of the consumer. The three songs present results that could suggest a positive satisfaction to the consumer described above. However, it will not be until using the emotional utility function where the panorama will be quantitatively clearer.

*2.7. The Emotional Preference Levels of the Consumer*

Having calculated the MEEPI before and after the musical stimulus (songs A, B, and C), we proceed to calculate the emotional preference levels $\alpha$ and $\beta$ of the consumer.

Recalling both formulas:

$$\alpha = \frac{\overleftarrow{P_{\vdash}^{\ {}_{\varsigma}F}}}{K_{\ {}_{\varsigma}F}}\ ,\ \beta = \frac{\overleftarrow{P_{\dashv}^{\ {}_{\varsigma}F}}}{K_{\ {}_{\varsigma}F}} \tag{2.10}$$

Note that only the variable $E$ has been changed to ${}_{\varsigma}F$, symbolizing the levels of preference for the emotion happiness of the consumer. The values to be used in $\overleftarrow{P_{\vdash}^{\ {}_{\varsigma}F}}$ and $\overleftarrow{P_{\dashv}^{\ {}_{\varsigma}F}}$ will be those found in the happy modules of 2.6, as 2.6 represents the MEEPI (emotional state) of the consumer before listening to the songs, hence:

$$\alpha \in {}_{\varsigma}F\ = \left[\frac{\left(\frac{1}{765}\right)}{\left(\frac{1}{612}\right)}\right],\ \beta \in {}_{\varsigma}F\ = \left[\frac{\left(\frac{1}{3{,}060}\right)}{\left(\frac{1}{612}\right)}\right] \tag{2.11}$$

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Remember that $K_{\varsigma^F} = \frac{1}{612}$ (Lugos Abarca, 2023). Therefore, the levels of preference for the emotion happiness of this consumer are:

$$\alpha \in {}_{\varsigma}F = \mathbf{0.8},\ \beta \in {}_{\varsigma}F = 0.2 \tag{2.12}$$

Following the same methodology, the rest of the consumer's emotional preference levels are calculated. The highest emotional preference level is highlighted in red.

Emotional preference levels for the emotion sadness of the consumer:

$$\alpha \in {}_{\varsigma}T_z = \left[\frac{\left(\frac{1}{3{,}120}\right)}{\left(\frac{1}{312}\right)}\right] = 0.1,\ \beta \in {}_{\varsigma}T_z = \left[\frac{\left(\frac{3}{1{,}040}\right)}{\left(\frac{1}{312}\right)}\right] = \mathbf{0.9} \tag{2.13}$$

Emotional preference levels for the emotion fear of the consumer:

$$\alpha \in {}_{\varsigma}M_i = \left[\frac{\left(\frac{1}{12{,}600}\right)}{\left(\frac{1}{252}\right)}\right] = 0.02,\ \beta \in {}_{\varsigma}M_i = \left[\frac{\left(\frac{7}{1{,}800}\right)}{\left(\frac{1}{252}\right)}\right] = \mathbf{0.98} \tag{2.14}$$

Emotional preference levels for the emotion anger of the consumer:

$$\alpha \in {}_{\varsigma}I_{ra} = \left[\frac{\left(\frac{1}{9{,}300}\right)}{\left(\frac{1}{372}\right)}\right] = 0.04,\ \beta \in {}_{\varsigma}I_{ra} = \left[\frac{\left(\frac{2}{775}\right)}{\left(\frac{1}{372}\right)}\right] = \mathbf{0.96} \tag{2.15}$$

Emotional preference levels for the emotion surprise of the consumer:

$$\alpha \in {}_{\varsigma}S_{or} = \left[\frac{\left(\frac{3}{650}\right)}{\left(\frac{1}{156}\right)}\right] = \mathbf{0.72},\ \beta \in {}_{\varsigma}S_{or} = \left[\frac{\left(\frac{7}{3{,}900}\right)}{\left(\frac{1}{156}\right)}\right] = 0.28 \tag{2.16}$$

Emotional preference levels for the emotion disgust of the consumer:

$$\alpha \in {}_{\varsigma}A_{co} = \left[\frac{\left(\frac{1}{13{,}200}\right)}{\left(\frac{1}{132}\right)}\right] = 0.01,\ \beta \in {}_{\varsigma}A_{co} = \left[\frac{\left(\frac{3}{400}\right)}{\left(\frac{1}{132}\right)}\right] = \mathbf{0.99} \tag{2.17}$$

It is observed that for all six results, $\alpha + \beta = 1$ holds true. On the other hand, it is noteworthy that the emotional preference levels obtained are directly proportional to the "sí se siente" and "no se siente" modules of the consumer's MEEPI before the musical stimulus. This satisfies the consumer's preferences described in the previous section. For example, in 2.6, the predominant emotions are happiness and surprise, which happen to be the highest preferences for "sí se sienta" emotion as seen in 2.12 and 2.16.

*2.8. The Levels of Consumer Emotional Utility for Song A, B and C*

Having calculated the emotional preference levels of the potential consumer of song C, the next step is to solve the emotional utility function of the three songs. We begin with the happiness emotion of song A, its formula would be:

$$U_{({}_{\varsigma}F)} = \left(\overrightarrow{P_{\vdash}{}^{\varsigma F}} \times \frac{\overleftarrow{P_{\vdash}{}^{\varsigma F}}}{K_{\varsigma^F}}\right) + \left(\overrightarrow{P_{\dashv}{}^{\varsigma F}} \times \frac{\overleftarrow{P_{\dashv}{}^{\varsigma F}}}{K_{\varsigma^F}}\right) \tag{2.18}$$

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For the sake of simplification $U_{(\ _{\varsigma}F\ )} = U_{\left(\overrightarrow{P_{\vdash}^{\varsigma F}}, \overrightarrow{P_{\dashv}^{\varsigma F}}\right)}$.

It simplifies:

$$U_{(\ _{\varsigma}F\ )} = \left(\overrightarrow{P_{\vdash}^{\varsigma F}} \times \alpha \in\ _{\varsigma}F\ \right) + \left(\overrightarrow{P_{\dashv}^{\varsigma F}} \times \beta \in\ _{\varsigma}F\ \right) \tag{2.19}$$

The values to be used in $\overrightarrow{P_{\vdash}^{\varsigma F}}$ and $\overrightarrow{P_{\dashv}^{\varsigma F}}$ will be those found in the MEEPI 2.7 since they represent the potential levels of happiness that the consumer could feel after the musical stimulus, that is, after listening to song A.

Therefore, being $\overrightarrow{P_{\vdash}^{\varsigma F}} = 0.4675887582$ y $\overrightarrow{P_{\dashv}^{\varsigma F}} = -0.4659547712$:

$$U_{(\ _{\varsigma}F\ )} = [(0.4675887582 \times 0.8) + (-0.4659547712 \times 0.2)] \tag{2.20}$$

Recall that, $\alpha \in\ _{\varsigma}F\ = 0.8$, $\beta \in\ _{\varsigma}F\ = 0.2$ (2.7).

Doing the operation we obtain that the happy emotional utility of the song A is:

$$U_{(\ _{\varsigma}F\ )} = 0.2808800523 \tag{2.21}$$

Through this resolution process, the possible levels of utility that the consumer could obtain after listening to songs A, B and C are presented:

Possible utility that the consumer could obtain after listening to songs A:

(2.22)

$$U_{(\ _{\varsigma}F\ )} = [(0.4675887582 \times 0.8) + (-0.4659547712 \times 0.2)] = \mathbf{0.2808800523}$$

$$U_{(\ _{\varsigma}T_z)} = [(0.4903961355 \times 0.1) + (-0.4871910073 \times 0.9)] = \mathbf{-0.389432293}$$

$$U_{(\ _{\varsigma}M_i)} = [(0.002984126984 \times 0.02) + (0.000984126984 \times 0.98)]$$

$$= \mathbf{0.001024126984}$$

$$U_{(\ _{\varsigma}Ira)} = [(-0.04486291398 \times 0.04) + (0.04755108602 \times 0.96)]$$

$$= \mathbf{0.04385452602}$$

$$U_{(\ _{\varsigma}S_{or})} = [(0.001776556777 \times 0.72) + (0.004633699634 \times 0.28)]$$

$$= \mathbf{0.002576556777}$$

$$U_{(\ _{\varsigma}A_{co})} = [(0.004787878788 \times 0.01) + (0.002787878788 \times 0.99)]$$

$$= \mathbf{0.002807878788}$$

Since the resolutions of the PE-M model give negative results, some utilities should be expected to be negative.

Possible utility that the consumer could obtain after listening to song B:

$$U_{(\ _{\varsigma}F\ )} = [(0.002448582 \times 0.8) + (-0.000815 \times 0.2)] = \mathbf{0.0017958656} \tag{2.23}$$

$$U_{(\ _{\varsigma}T_z)} = [(0.003031136 \times 0.1) + (0.000174 \times 0.9)] = \mathbf{0.00045971359999999993}$$

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$$U_{(\varsigma M_i)} = [(0.002301587302 \times 0.02) + (0.001666666667 \times 0.98)]$$

$$= \mathbf{0.00167936508}$$

$$U_{(\varsigma Ira)} = [(-0.016734555 \times 0.04) + (0.0194 \times 0.96)] = \mathbf{0.0179546178}$$

$$U_{(\varsigma Sor)} = [(-0.005915751 \times 0.72) + (0.012326 \times 0.28)]$$

$$= \mathbf{-0.0008080607199999998}$$

$$U_{(\varsigma Aco)} = [(0.000606060606 \times 0.01) + (0.00696969697 \times 0.99)]$$

$$= \mathbf{0.006906060606}$$

Possible utility that the consumer could obtain after listening to the song C:

$$U_{(\varsigma F)} = [(0.01535342204 \times 0.8) + (-0.01371943511 \times 0.2)] = \mathbf{0.00953885061}$$

$$U_{(\varsigma Tz)} = [(-0.2596038645 \times 0.1) + (0.2628089927 \times 0.9)] = \mathbf{0.210567707}$$

$$U_{(\varsigma M_i)} = [(0.000714285714 \times 0.02) + (0.003253968254 \times 0.98)] \quad (2.24)$$

$$= \mathbf{0.003203174603}$$

$$U_{(\varsigma Ira)} = [(-0.0131665361 \times 0.04) + (0.01585470814 \times 0.96)] = \mathbf{0.01469385837}$$

$$U_{(\varsigma Sor)} = [(0.005448717949 \times 0.72) + (0.000961538462 \times 0.28)]$$

$$= \mathbf{0.004192307693}$$

$$U_{(\varsigma Aco)} = [(0.0000757575758 \times 0.01) + (0.0075 \times 0.99)] = \mathbf{0.007425757576}$$

**3. Results and Discussion**

Calculating emotional utilities, we continue with the interpretation of the results. In the following table, the values of each "yes feel" module of the consumer's MEEPI after listening (separately) to songs A, B, and C can be observed from highest to lowest.

As it is evident, where the emotion of happiness is most felt (in contrast with the three songs) is in A, as well as the emotions of sadness, fear, and disgust, while in C is where the emotion of anger and surprise are most felt. In other words, the happiest, saddest, most fearful, and disgusting song for music consumer 2.7 would be A, while the song that most elicits anger and surprise for the consumer is C.

Now the emotional utilities of the 3 songs are ordered from highest to lowest:

As observed in Tables 1 and 2, song A has the highest levels of happiness and anger utility, meaning that compared to the three songs, A elicits more happiness and less anger, consistent with the results highlighted in Table 1, along with the levels of emotional preference (highlighted in red). Therefore, the proposed emotional utility function in this article yields realistic results in the scenario presented, demonstrating its potential theoretical efficiency.

On the other hand, song C has the highest levels of sadness, fear, surprise, and disgust utility (highlighted in blue). Regarding B, its emotional utility falls between medium and lower levels (highlighted in green). According to the above, the song that could theoretically satisfy the consumer

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the most would be C, followed by A, and lastly B, as song C has the highest utility for 4 emotions, A for two emotions, while B does not.

Therefore, based on everything seen, it can be concluded that our song (song C) could theoretically compete with certain advantages against A and B.

**Table 1.** Values from highest to lowest of the "yes feel" modules of the consumer after listening to the musical stimulus.

| Module "sí se siente feliz" | Module "sí se siente triste" | Module "sí se siente miedo" |
|---|---|---|
| $A = 0.4675887582$ | $A = 0.4903961355$ | $A = 0.002984126984$ |
| $C = 0.01535342204$ | $B = 0.003031136$ | $B = 0.002301587302$ |
| $B = 0.002448582$ | $C = -0.2596038645$ | $C = 0.000714285714$ |
| Module "sí se siente ira" | Module "sí se siente sorpresa" | Module "sí se siente asco" |
| $C = -0.0131665361$ | $C = 0.005448717949$ | $A = 0.004787878788$ |
| $B = -0.016734555$ | $A = 0.001776556777$ | $B = 0.000606060606$ |
| $A = -0.04486291398$ | $B = -0.005915751$ | $C = 0.0000757575758$ |

**Table 2.** Values from highest to lowest of the emotional utilities of songs A, B, and C.

| Happy utility | Sad Utility | Fear Utility |
|---|---|---|
| $A = 0.2808800523$ | $C = 0.210567707$ | $C = 0.003203174603$ |
| $C = 0.00953885061$ | $B = 0.00045971359$ | $B = 0.00167936508$ |
| $B = 0.0017958656$ | $A = -0.389432293$ | $A = 0.001024126984$ |
| Anger Utility | Surprise Utility | Disgust Utility |
| $A = 0.04385452602$ | $C = 0.004192307693$ | $C = 0.007425757576$ |
| $B = 0.0179546178$ | $A = 0.002576556777$ | $B = 0.006906060606$ |
| $C = 0.01469385837$ | $B = -0.000808060719$ | $A = 0.002807878788$ |

## 4. Conclusion

The objective of this article is to present a utility function that uses the emotional probability modules "yes feel" and "no feel" of the PE-M model as variables, allowing the calculation of the possible utility that a consumer would achieve after listening to a song. Furthermore, through a brief resolution, referring to a theoretical scenario, it was observed that realistic results were obtained.

This emotional utility function opens the door to a new theoretical tool to quantitatively investigate consumer decision-making influenced by their emotions within the music industry, as the utility level can be interpreted as the likelihood that the consumer would choose a song. Additionally, a broader resolution would enable producers to create songs with greater certainty of satisfying their consumers' musical preferences and thus increase their sales.

It should be noted that the results provided by function 2.5 are currently theoretical due to the nature of the PE-M model, which uses empirical values regarding musical parameters. However, what is significant is that we have an initial tool to begin studying the emotional consumer quantitatively within the music industry. Therefore, future research will continue to investigate the utility function proposed here in order to increase its efficiency in theoretical practice.

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