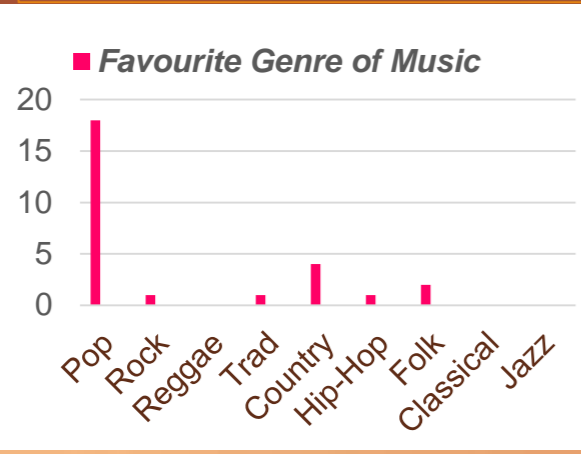


# How do you write a piece of Chart topping music?

### Introduction

How do we write a piece of chart topping music? We chose this problem to research when asked by our Music teacher to compose a short piece of music that could be entered into the charts, as a homework exercise. We both play musical instruments and as such felt we would easily be up for the task. However, what would make our composition stand out from the others? We felt there were various mathematical elements to the task and wanted to investigate these further to come up with that winning formula. We felt the following factors were key to our research:

- What genres of music are there and how do they affect people?
- What genre of music is the most popular?
- Is there a mathematical basis to composing a piece of music?
- Are there variables and constants we need to be aware of?
- Have there been trends in recent chart topping hits?
- Does the tempo of a tune influence its duration in the charts?



Our rest rate was below the 60-100 beats but athletes have a resting heart rate ranging from 40-60 beats per minute and this seemed possible as we both dance 5/6 times a week.

### Calculations

$$65 - 59 = 6/59 \times 100 = 10.19\%$$

$$64 - 55 = 9/55 \times 100 = 16.36\%$$

$$59 - 54 = 5/59 \times 100 = 8.47\%$$

There was a 10.19% increase in one of our heart rate with 16.36% increase in the other after listening to fast music. There was an 8.47% decrease in one of our heart rates with the other not experiencing any difference after listening to slow music (after a rest period). We tried this activity on 10 people in our dance class and they all recorded an increase in heart rate after the piece of fast music with only 5/10 showing a decrease in their heart rate after listening to slow music. This indicated that fast music did raise people's heart rate. They also said they felt much more ready to dance and excited after the fast music rather than the slow music. Music has been shown to stimulate the release of dopamine that makes us feel rewarded. It also activates areas of the brain for movement, tension and memory. This is further evidenced with the amount of people that can be seen exercising whilst listening to music.

	Jaz z	Coun try	Rock	Pop	Hip-Hop	Folk	Clas sical	Reggae	Trad
	73	138	99	138	153	143	61	160	143
	65	112	130	121	160	117	65	108	108
	73	86	130	134	112	134	121	134	143
	138	95	104	160	121	104	104	121	125
	104	86	138	121	151	145	91	164	104
	65	125	108	125	190	145	108	121	102
	86	99	125	112	173	78	112	130	108
	78	86	147	121	190	125	73	160	142
	121	82	190	134	181	108	99	125	143
Mean	88	101	131	129	160	125	91	137	123
Range	73	56	91	48	78	73	60	52	41
Mode	73	86	130	121	190	125	73	160	143

### Our Assumptions

- There are different types of genres of music that appeal to different age demographics
- Each genre has different characteristics that appeal to these age groups
- Music is either fast or slow and faster songs are the most popular
- Music affects peoples' mood
- Music that is fast lasts longer in the charts.
- The tempo of the music would have an influence

### Most popular Genre of Music

6.7% of the sample group favoured pop music and gave reasons such as it made them feel happy, it was fast, lively or made them want to dance

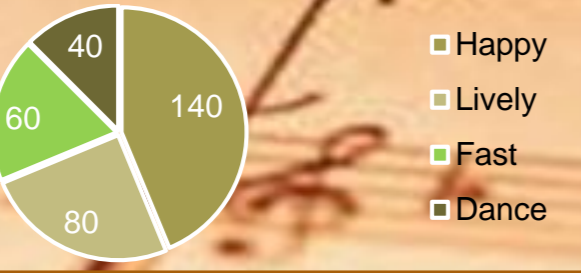
4.8% of the sample liked Country Western best and gave reasons such as it made them feel happy, it was good for dancing and made them feel like socializing. The 7.4% that liked folk music the most gave reasons of it being easy to listen to or it's relaxing. 3.7% liked traditional music best and said it was because they play a traditional musical instrument and it made them feel alive. The 3.7% who ticked hip-Hop described it as being their favourite because it is the type of music whereby people can express their feelings through the lyrics of the music while 3.7% liked rock because it had a good beat.

### Tempo

We needed to research the tempo of music to see how fast it needs to be to make a difference. Tempo is a measurable component of music. It can be measured in beats per minute. This unit of measurement is suitable because all music has a background beat, music is usually a few minutes in length and it can be used to compare different pieces of music. We listened to several pieces of music to calculate the beats per minute and see if there was any error in our calculation. We did not listen to full pieces of music but rather in order to calculate the beats per minute we took the beats for 15 seconds and multiplied by four (y=4x). We trialed 6 pieces of music and found that we had an error in calculation in all of the fast pieces of music but there was no error of calculation in the one slow piece of music.

### Calculations

Happy  $7/18 \times 360^\circ = 140^\circ$   
 Fast  $3/18 \times 360^\circ = 60^\circ$   
 Lively  $4/18 \times 360^\circ = 80^\circ$   
 Dance  $2/18 \times 360^\circ = 40^\circ$



### Steps we took

- Researched the number of and different types of genres of music
- Researched the characteristics of different genres of music particularly, the different variables involved
- Investigated one specific variable i.e. tempo
- Surveyed individuals to establish how they reacted to different types of music
- Researched the trends in music over the years
- Analysed raw data to observe patterns that developed
- Represented data visually through charts/graphs and tables.
- Evaluated our findings in context of the problem posed

### Genres of Music

Our initial assumption through informal discussion that there were only a few genres of music quickly dissipated as soon as we began our research. In fact there are 41 primary categories and 337 sub-categories. For this project we decided to just constrain our selves to the fundamental music genre list that includes Rock, Pop, Hip-Hop, Folk, Classical, Jazz, Traditional, Country and Reggae. We undertook a survey of 27 people ranging in ages from 10-75 to investigate if any of the genres appealed most to them. The results were overwhelmingly in favour of pop music

Genre of music	Number of people
Pop	18
Rock	1
Reggae	0
Trad	1
Country	4
Hip-Hop	1
Folk	2
Classical	0
Jazz	0

### Fast Vs Slow Music

Pop music was described as being fast and we investigated how fast music vs slow music physically affects people. We needed to calculate the reactions through the change in heart rate, an activity which we have used before in Science class. The calculation first involves taking your pulse rate at rest to get a base line measurement. Pulse rate is calculated in beats per minute (BPM). For your resting heart rate the target is between 60-100 beats per minute. We tested the activity on our selves first.

Activity	Pulse Rate	Pulse rate
At rest	55 beats per minute	59 beats per minute
After fast music	64 beats per minute	65 beats per minute
After slow music	55 beats per minute	54 beats per minute

BPM	Actual BPM	Error	Decimal
108	95	13	0.14
90	92	2	0.02
112	110	2	0.02
84	80	4	0.05
92	92	0	0
108	85	23	0.27

We took the mean of the errors and applied it to the survey of the tempos of the different genres of music.

### Calculations

$$\frac{0.14 + 0.02 + 0.05 + 0 + 0.27}{6} = 0.08$$

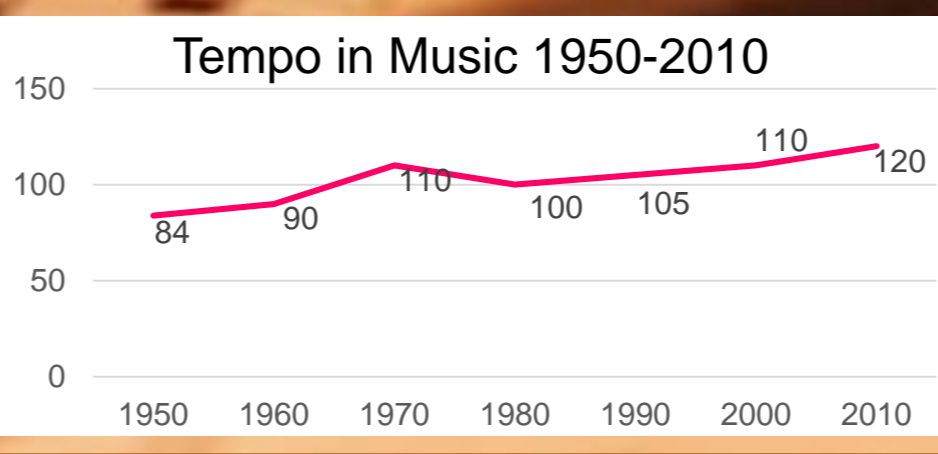
We surveyed 10 pieces of music under each genre and calculated the BPM of each piece taking into account our 0.08 error.

From our results we can conclude the following:

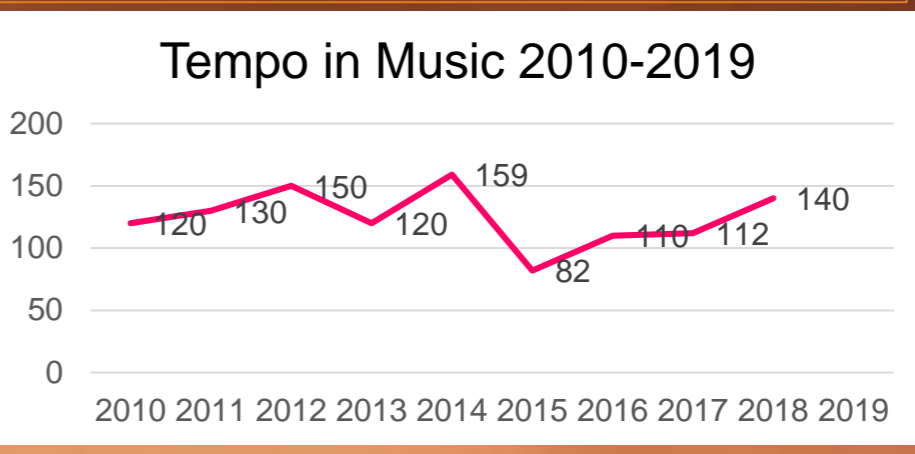
- Hip-Hop has the highest mean of 160 BPM while Jazz has the lowest at 88 BPM. If we discount the two lowest means the fastest are Country, Pop, Hip-Hop, Folk, Rock and Reggae.
- The range tells us that Rock music varies the most widely while the least variation occurs with the Country, Pop and Reggae and this may be a reason why two of these were shown to be the most popular in our survey.
- Classical and Jazz have the lowest modal values while Hip-Hop and Reggae have extreme high modal values with traditional coming in quite high and although they are well known genres it might explain why they are not the most popular.
- Our results pointed towards Country, Pop and Folk as being the ideal genres and this corroborates our survey results. The tempos are 101 BPM, 129 BPM and 125 BPM respectively and if we take into account the fact that Folk has a large range of 73 BPM it leaves us with reasons why Country and Pop are the favourite genres of music in our survey. We can conclude that the ideal tempo for a piece of music is between 101 BPM and 129 BPM.

### Trends in music

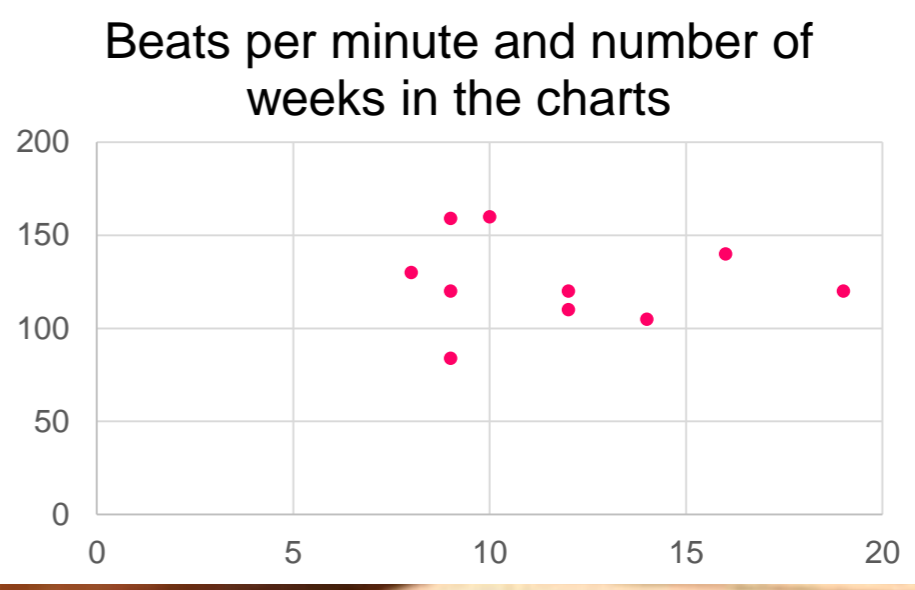
We looked at the trend in music over recent decades and then at a more closer look at this decade to see if music has gotten faster. We measured the BPM of the song that was the longest at the number 1 position in the charts in a decade and found the following



The trend graph shows that music has steadily been becoming faster since the 1950s when Frankie Laines "I Believe" was at the top of the Number 1 position of the charts for 10 weeks with a BPM of 84 whereas by 2010 Keshas "Tik Tok2" held the Number 1 position for a similar time with a BPM of 120.



Even within the most recent decade music that has held the top spot in the charts is on average 121 BPM's. The only exception to this rule has been Ed Sheeran's "Thinking Out Loud" outlying value of 84 BPM's in 2015. We decided to investigate further by investigating if there was a relationship between BPMs and the number of weeks at the number one position in the charts. The results are shown on the scatter graph below.



Ed Sheerans "Thinking Out Loud" is again an outlier in the data. However, the graph shows that there is a correlation between the BPM and the number if weeks spent at the number one position in the charts. The song that held the number one spot for the longest time of 19 weeks was "Old Town Road" by Lil Nas X with a BPM of 120 in 2019. This catchy song has been described as a history maker and a genre redefining hit as it has its origins in both country and pop. Through conducting this specific investigation we identified the relevant variables of tempo measured in beats per minute and genres of music. The constant in our investigation was chart topping music

### Conclusions

Our research has shown us that there is a clear connection between Maths and Music. In order to complete the investigation the two methods we used were measuring beats per minute and a statistical analysis. From the investigation we have found that

1. Music is made up of many variables working together and when we like a tune all those variables must be working well together.
2. It will not be easy to come up with a winning piece of music. We would have to investigate all other variables such as voice style or instrumentation but by focusing on tempo alone we have found the following:
  - The tempo of a tune can influence a persons mood
  - The ideal tempo is to be found in the Country or Pop genres
  - The ideal tempo ranges between 100 to 120 BPM
  - The tempo in popular tunes has become faster.
  - There is a relationship between the tempo of a tune and the length of time it stays at number one in the charts.
  - The longest at number one in the charts was a song that had had origins in both country and pop.
  - We both now know why our dance teachers always play fast songs for our drills at the beginning of class, why gyms play fast music and why restaurants play slow music in order to help create a particular atmosphere.
  - Having completed this investigation we now know we have a starting point to begin composing a winning piece of music. We know what genres it must lie in and the range of values for its tempo we must stick to in order to appeal to the masses.

### Revisiting and commenting on the solution

In conclusion, we think that most of our assumptions were proven correct, however we were incorrect to state in our assumption that different genres are specific to a particular age demograph. We have found that pop music appeals to a broad spectrum of ages.

### Strengths and weaknesses of the solution

- We looked at different genres of music but having found out that there were 411 primary categories and 337 sub-categories, we had to confine our research to just fundamental categories. If we had more time investigating those subcategories in the country and pop genres may direct us to an exact ideal tempo rather than a range.
- We surveyed 27 people to investigate their favourite genre of music and there was a range of age groups surveyed. We think the strength of using a survey was that we got an immediate response.
- We think that although we had practiced taking our pulse rate in class it was not easy. We think that it was hard to keep track of the count and that a pulse rate app might be more accurate.
- We looked at only one variable in music and that was the tempo because it could be measured.
- We know that when counting the BPM of music there can be errors in calculation because some pieces of music have a more obvious beat to count than others.
- Our sampling techniques were reliable because of the wide range of ages of those surveyed, the fact that we took into consideration of more than one genre and the use of a music app to random sample tunes.

