Team 1049

If you had a million dollars to spend on online marketing, what percentage of the NZ population can you persuade to sign a petition that you wanted championed?

Summary

In this report, we addressed the methods through which we would be able to spend a million dollars on online marketing, how effective this marketing would be at persuading the audience to sign our petition, and what factors could affect the number of signatures. Our marketing strategy involved advertising through Facebook advertisements, continually advertising until our budget was expended. This allowed us to harness the viral nature of social media to expand our reach. We used Python to create an algorithm that would allow us to test the effect of different variables on the number of signatures. Using this, we calculated that we would be able to persuade $3\%(\pm 3\%)$ of the population to sign our petition. We also created a flowchart to illustrate this algorithm. The uncertainty was calculated by investigating the effects of different petition topics on the result. We realised that this was a variable that would have the largest impact on our result. Calculating this gave us a potential range of 1% to 6%.

Introduction

In our society, the development and widespread adoption of the internet has allowed activism and awareness of issues to be spread of a never before seen scale. The ease of information distribution and accessibility has allowed online petitions to achieve impressive levels of influence and reach.

Online petitions have the ability to make large scale changes in society, and often achieve viral levels due to social media sharing. Online marketing has also become a huge industry. Corporations spend billions in an attempt to persuade potential customers. This is unsurprising, considering how high internet usage is in our time.

If an individual or group wanted to make a significant change in society, an online petition is a very good way to do this. With an online marketing budget of $1 million, the petition could be promoted, and its success greatly increased.

Definition of the question

We have defined online marketing to be the practice of leveraging web-based channels to spread a message about a company's brand, products, or services to its potential

customers.[1] Online marketing includes web marketing, social media marketing and search engine optimisation.[2] A petition is a formal written request appealing to authorities in respect of a particular cause[3].

Assumptions

1. The US Dollar is the most traded currency both globally and online[4]. Since we are trading with international online corporations, we have made all calculations using USD and assumed that we are given one million USD.

2. We have defined the New Zealand population to be NZ citizens or permanent residents, excluding international students.

3. We assumed that the population is not affected by any unpredicted changes such as natural disasters.

4. We assumed that New Zealand does not experience any major changes such as a sudden development on the technology that will affect the population accessing the internet during the period the petition is advertised.

5. This investigation is only based on the currently available technology, such as online marketing tools and strategies.

Population

The current population of New Zealand is estimated at around 4,786,693 million as of 3rd August 2019 with a growth rate of 0.84%, which is a daily growth rate $d = 0.0023\%$. So, the population P of New Zealand can be modelled by $P = 4786693 * 1.000023^{d}$.
Our marketing model will have a duration of less than a month. Within a month ($d = 30$), the population would grow by $1.000023^{30} = 0.0069\%$, which is negligible. Hence, we have assumed that the New Zealand population is 4.787 million.

[1] Optimizely. (n.d.). Online marketing. Retrieved from https://www.optimizely.com/anz/optimization-glossary/online-marketing/
[2] Beal, V. (n.d.). Internet marketing. Retrieved from https://www.webopedia.com/TERM/I/internet_marketing.html
[3] Encyclopedia.com. (n.d.). Petition. Retrieved from https://www.encyclopedia.com/social-sciences-and-law/law/law/petition
[4] Hall-Smith, W. (2018, September 04). The top 10 most traded currencies in the world. Retrieved from https://www.ig.com/au/trading-strategies/the-top-ten-most-traded-currencies-in-the-world-180904

Our Marketing Strategy

Our team decided to market the petition using social media because these platforms are used by 74% of the New Zealand population[5]. Of all the social media platforms, Facebook is by far the most popular within the country, with 2.3 million daily NZ users.

An optimal marketing strategy would require extensive professional experience in the field, along with market research for the product to be promoted. This would exceed the given timeframe and available skills. Consequently, we chose to solely use Facebook to advertise and promote the petition.

Facebook Advertising Costs

It costs money to advertise using Facebook: Advertising is priced based on a Cost Per Mille (Cost per 1000 views) system, along with a Cost Per Click (CPC). Each time the advertisement is clicked or viewed, the advertiser is charged.

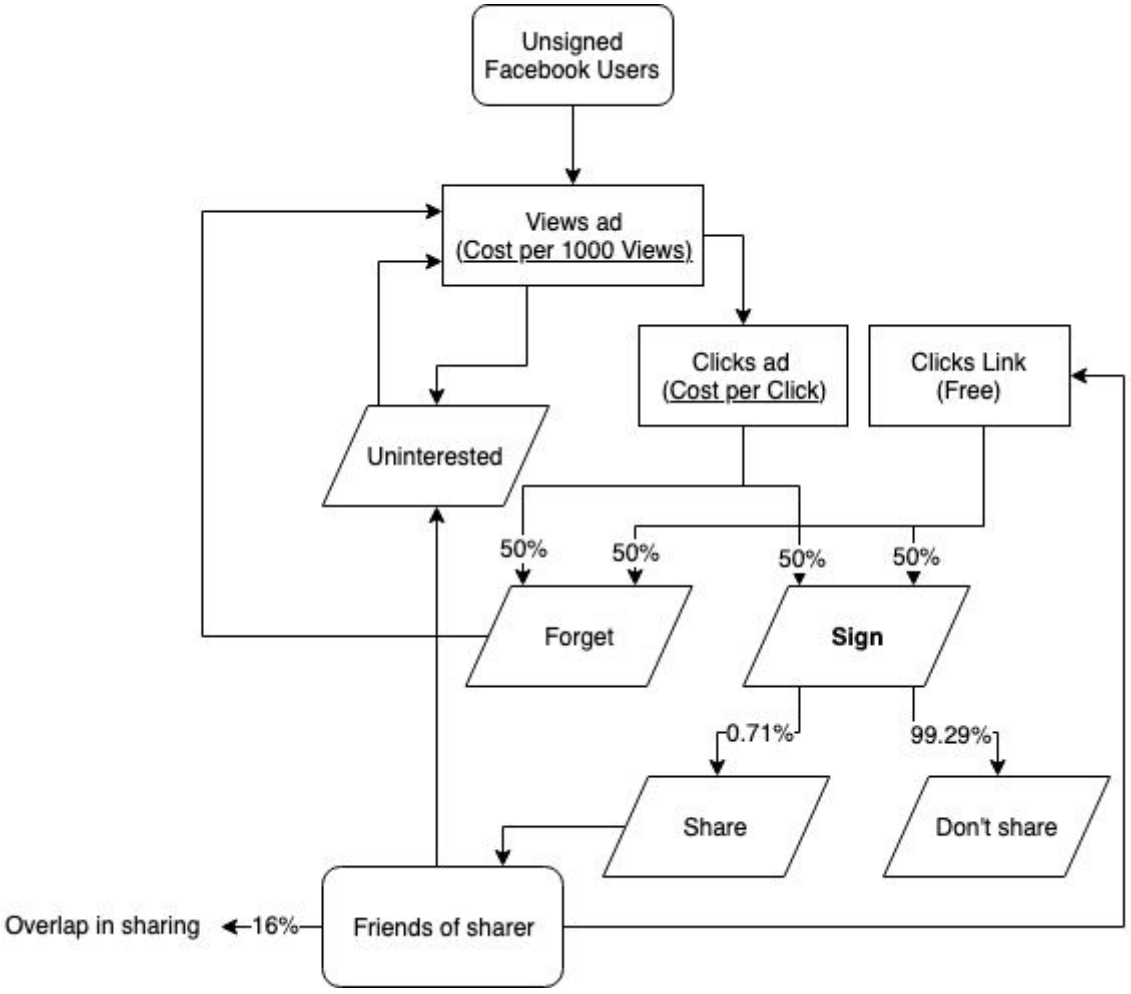
Modelling our Marketing Strategy

Flow Chart

The flowchart below shows the marketing strategy process that our team expects to get signatories to the petition. The process is further explained below the diagram.

5 https://www.socialites.co.nz/single-post/2018/02/12/Social-media-has-Kiwis-enraptured-and-these-new-stats-spell-great-news-for-businesses

Figure 1: Flowchart showing the algorithm used to calculate the number of signatories gained on the petition



We expect that all daily Facebook users in NZ will receive and view the advertisement to our petition. Facebook charges an average of $11.2 per 1000 views for advertisements[6]. This is an average cost per view of $0.0112.

Furthermore, viewers may be either uninterested or interested in the ad, where they would then click on the ad to our petition. This is determined by the Click-through rate, which is typically 0.9%[7] - however, this varies depending on the topic of the petition. Facebook also has a cost-per-click when viewers click through an ad; the average cost-per-click charged by Facebook is $1.72.

After people that are interested click into the link to the petition, often some people do leave it for later and forget to sign it. According to Stubren 2004, 50% of people may forget to sign the petition even though they are interested[7].

There is also a small percentage of signatories that will also share the petition with other

[6] Facebook Ad Benchmarks for YOUR Industry [Data]. (n.d.). Retrieved from https://www.wordstream.com/blog/ws/2017/02/28/facebook-advertising-benchmarks

[7] Struben, J. (2004). Technology transitions: identifying challenges for hydrogen vehicles. In Proceedings of the 22nd international conference of the system dynamics society (pp. 25–29).

friends. From the empirical data given in a Jalali MIT report, the fraction of signatories who share the petition is 0.71%. In NZ, a Facebook user on average has 124 friends[8].
In reality, it is likely that there are overlaps for two people' friends lists. So in order to prevent the same people to be shared twice and be counted as different people were presented with the advertisement of the petition, the fraction of overlap in sharing is found. According to the empirical data included in the Jalali MIT report, the fraction of overlap in sharing is 0.16[9]. So, the number of friends that will receive the advert to our petition again is $(1 - 0.16) * 124 = 104$ friends. Of these, some will be interested and some will not.

For our marketing strategy, we will keep sending advertisements on a regular (daily) basis to unsigned Facebook users until our budget is spent. We have assumed that the click-through rate is again 0.9%, as there will be a mix of interested people that forgot to sign (who have a high click-through rate) and uninterested people (who have a lower click-through rate)

Computer Simulation

The Python program shown in figure 2 depicts the coding used to obtain the average number of signatures a petition advertised on facebook will be obtained given $1 million to spend on marketing. This uses the average cost per click of an advertisement on Facebook ($1.72) and the average click-through rate (0.9%). These two values are dependent on the topic of the petition, thus we vary these later on in the report to calculate uncertainty.

[8] NZ Herald. (2017, August 30). Average Kiwi has 124 Facebook friends. Retrieved from https://www.nzherald.co.nz/technology/news/article.cfm?c_id=5&objectid=10722880
[9] Information Diffusion. (2016, 10). *Strategic Social Media,* 23-43. doi:10.1002/9781119370680.ch2 retrieved from https://jalali.mit.edu/sites/default/files/documents/Jalali-2016-Information_Diffusion.pdf

Figure 2: Computer program in Python

Program enacting the flowchart in Python

```
#variables:
costpc=1.72      # cost per click of the ad on facebook
costpv=0.0112    # cost per view of the ad on facebook
popfb=2300000    # NZ daily facebook users
fracpopint=0.009    # fraction of population interested
fracpopnot=1-fracpopint # fraction of population not interested or pending
forgetful=0.5      # people interested but forgetful
unforgetful=1-forgetful  # people interested and not forgetful
peopleshare=0.0071 # people who will share
overlap=0.16       # overlap of sharing
friendsonfb=124     # average number of friends someone has on facebook

# initial conditions:
money=1000000 # initial money given
views=popfb # initial number of people who view the ad
signed=0    # initial number of people who have signed the petition
days=0      # initial number of days - used to see how fast the money runs out

# loop subtracting money per view and per click of the ad on facebook and counting the signatures collected:
while days<16:
    money-=costpv*views            # subtracting costs per view from total money
    interested=fracpopint*views     # people who view the ad and are interested in the petition
    money-=costpc*interested        # subtracting costs per click from total money
    uninterested=(1-fracpopint)*views   # people who aren't interested in the petition
    sign=unforgetful*interested         # people signing each day
    share=peopleshare*sign               # people who have signed who share with facebook friends
    effshare=share*friendsonfb*(1-overlap) # people who the petition has been shared to
    sign+=fracpopint*effshare*fracpopint*unforgetful # adding the people who signed because it was shared to them
    signed+=sign                         # calculating the total number of people who have signed the petition
    views-=sign          # subtract people who have signed the petition from people who will view the ad again
    days+=1              # increase the number of days by 1

print(signed)  # total number of people who have signed the petition
print(money)   # money left over
```

```
160131.3063287109
50627.711991310454
```

Variables

M_0	The amount of money we begin with. This will be 1 million USD as given in the question.
P_f	The initial number of people who were presented with the petition advertisement. In this investigation, we are sending the advertisement to all NZ daily Facebook users. According to our research, 2.3 million people of NZ daily Facebook users.
C_v	The cost per view of the advertisement.
C_c	Parameter of the cost per click of the advertisement.
I_f	Parameter of the proportion of the viewers from the Facebook advertisements interested in the petition (who click on the advertisement).
F_r	The rate of people interested in the petition but who forget to sign it. According to our research, this possibility is 0.5.[10]
c	Parameter of the fraction of signatories who share the petition. From our research, the fraction of signatories who share the petition is 0.71%.

[10] Struben, J. (2004). Technology transitions: identifying challenges for hydrogen vehicles. In Proceedings of the 22nd international conference of the system dynamics society (pp. 25–29).

v	The fraction of overlap in sharing.
f	The average number of friends on facebook. In NZ, a Facebook user on average has 124 friends.
P_s	The number of signatories. This will be the final answer obtained from the Python model.

We assume that when people view an advertisement, there are two types of people: people who are interested and click on the ad straight away (click-through rate 0.9%) and uninterested people who will not click on the ad. However, we believe that through further exposure, uninterested people may change their mind and become interested. The people who are interested may also be divided into two sub-groups: those who click on the ad but forget to sign the petition and those who sign straight away (according to Struben 2004, on average, 50% of the interested people will forget to sign).[8] The uninterested and forgetful population will receive the advertisement again after 1 day.

The people who have signed the petition will be encouraged to share the petition with their friends and we have found that the rate of people who share the petition after signing is 0.71%.[11] We will assume that the act of signing the petition after it has been shared will not incur any additional cost.

Estimation of the answer

By using the values the average cost per click of an advertisement on Facebook ($1.72) and the average click-through rate (0.9%), we worked out that the percentage of the NZ population we can get to sign a petition is: $\frac{160131}{4786693} = 3.3\%$. Using popular petition topics such as education, employment, home improvement, legal and technology (shown in figures 3 and 4), we worked out the uncertainty in our answer as shown below.

Figure 3: The number of signatories for different petition topics predicted by the Python computer program above

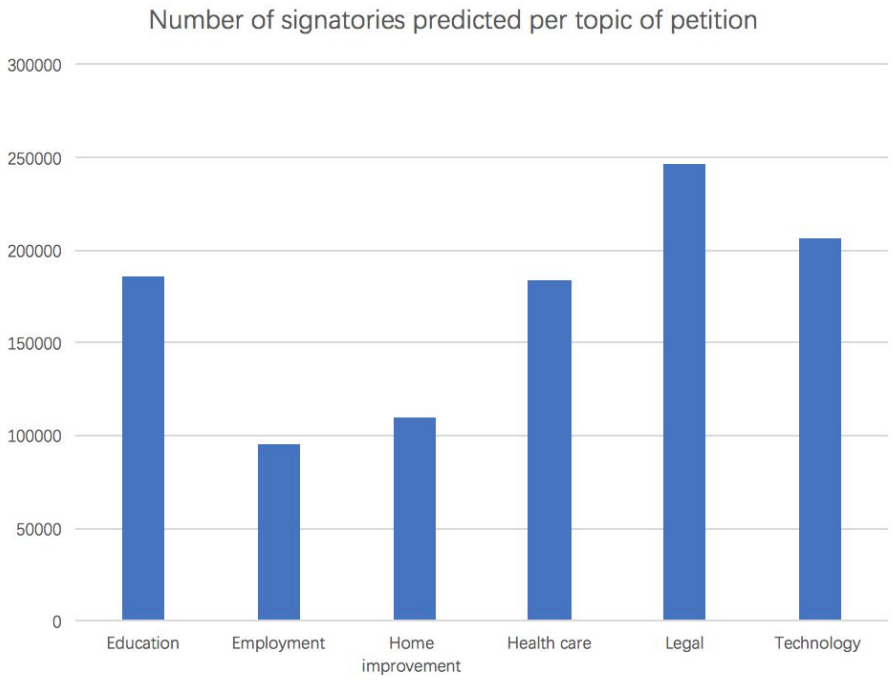
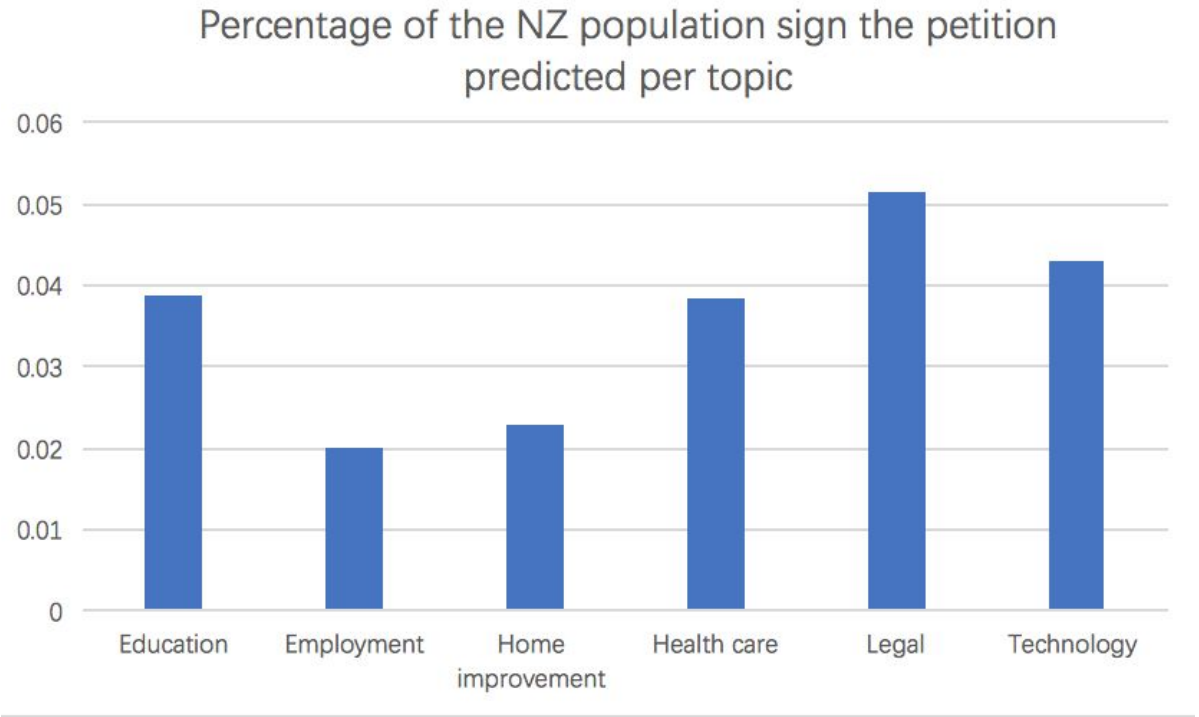


Figure 4: The percentage of the NZ population who will sign the petition for different topics predicted by the Python computer program above



Uncertainty in Answer

The minimum percentage of the NZ population that signs the petition would most likely occur if it was about employment issues - only 2% of the population would be signatories.
The maximum percentage that signs the petition would most likely occur if it was about legal issues - 5% of the population would be signatories.
Using the half range rule to find an uncertainty in our answer:
$\frac{5\%-2\%}{2} = 3\%$
Hence, our final answer is $3\%(\pm 3\%)$, giving uncertainty to one significant figure.

Conclusion

Based on our calculation using average values, we will be able to convince 160,131 people to sign our petition. This is around $3\% \pm 3\%$ of New Zealand's total population. We were able to look at different petition topics to estimate a range of values from 1% to 6%. We realised that the largest factor in our answer would be the type of petition we advertised, as this would have a huge influence on our rates of interest and rates of signing. More popular issues or topics could gain far greater numbers of signatures than unpopular ones as shown in Figure 3 and 4. The choice of the topic would also influence the marketing strategy. We believe that the range of results we arrived at are realistic based on the assumptions we made.

In addition, money is one of the key limiting factors of our solution. The model in this investigation is dependent on the amount of money available to be spent. The advertisements were stopped when the given money was totally expended. However, if the amount of money were to be greater, the number of possible signatures would be much larger before other limiting factors could come into effect.

There are also many other forms of social media available on the online market to advertise through. We have assumed that Facebook is the most efficient way for promoting this petition. However, in the future, we can also consider marketing through a combination of different social media in order to maximise our audience exposure to the petition. The answer would likely be affected by this composite marketing strategy.