

TEAM 1079

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

SUMMARY

In trying to achieve the maximum proportion of the NZ population signing our petition, we strove to determine the most effective avenues of online marketing, including addressing which channels of social media New Zealanders are most active on, and how much the average user participates in advertisement links. We chose to focus on Youtube, Facebook, and Instagram as our advertisement channels, as they stood out as the main social media outlets that the New Zealand population uses. For a petition to be successful, it needs signatures, which we modelled to be the same as website clicks, along with the click-through-rate (proportion in which visitors to a website actually take action). We discovered from a case study, as well as from our own audience participation model, that petitions do not follow an S-curve in terms of growth and exposure in popularity, and in fact experience the most exposure at the petition's initial launch. Hence, we devoted the majority of our budget into the initial advertising campaign, with the rest of our budget invested into external design (advertisement graphics and video production and design). With the outreach and budget figures for advertisement from the social media platforms themselves, we were able to conclude that, with what we deem as the most optimal online marketing, **we can ensure 29.0% of the population of New Zealand will sign this petition.**

INTRODUCTION

We are answering this question with the aim of a “successful” online marketing campaign - that is, to achieve the maximum possible amount of signatures. It is important to recognise that the term “online marketing” is very broad - to approach a maximum we are using the advertising programs on the most popular social media sites (in the forms of Facebook, Youtube, Instagram). According to a Socialites article¹, these three sites were the most popular ones as of January 2018. We’ve decided to model and demonstrate online marketing in three different platforms to increase spread, as different markets occupy the different social media platforms. People also use the platforms for different reasons, which further demonstrates the need for multiple platforms.

Our approach to calculating the percentage of NZ population persuaded was to predict the number of people who interacted with these forms of social media, in the form of “signatures”, in proportion to the rest of the population of NZ.

DEFINING THE PROBLEM

To interpret this question, we need to define multiple parameters to produce a quantifiable answer. Since we are dealing with a “NZ population”, it is logical to assume that the “million dollars” is in NZD currency (and all currency conversions will be done as of the current date). We are setting the creation date of this petition as the 3rd of August, 2019, in the third quarter of the year, which is also when we begin our online marketing campaign. We are assuming that the population of NZ is constant at 4,974,989², as significant population change is negligible due to small time frame of the petition, as well as the fact that the two extreme age groups of the population most likely to affect the population (newborns and the very elderly) are also unable to participate in the signing of the petition (due to inability to access the internet). We consider the actual content of the petition to be negligible - we assume it to be a topic that New Zealanders are interested in and popular (i.e. Petition to ban plastic bags³). We assume the petition is an online petition, so we are using “Change.org” as the site for petition.

WHAT CONSTITUTES A SIGNATURE?

It can be very difficult to effectively measure the amount of “signatures” gained from online advertisements, as it refers to the individual interacting with the site which contains a petition (filling out name and email details). Social media sites can give us values of “post clicks” in the case of Facebook, “views” in the case of Youtube, and “reach” in the case of Instagram. The problem with this data is that a “view” or does not directly translate into a “signature”, and only shows interest. Ideally, we would multiply the number of views with a constant

¹ Article:

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

² As of August 3rd, 2019, according to StatsNZ:

http://archive.stats.govt.nz/tools_and_services/population_clock.aspx

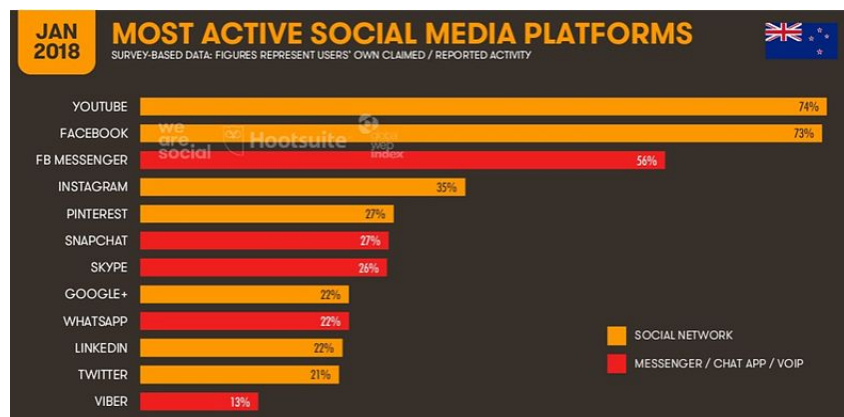
³ Link to site: <https://www.change.org/p/jacinda-ardern-make-new-zealand-plastic-bag-free>

which represents the probability of a viewer actually signing the petition. However, there is no data available which can be used to estimate the value of this constant.

Considering this, we are forced to assume that every view on a petition will translate to a signature. Because a potential viewer can see the title of the petition before clicking on it, it is very likely that someone clicking on the petition will already be interested in the cause that is being championed. The probability of someone viewing on a petition, then deciding not to sign is therefore fairly low.

AUDIENCE OVERLAP

The majority of people will have multiple social media accounts on different platforms. These people may be exposed to the petition on more than one social media platform. The chart⁴ pictured right shows the percentage of the New Zealand population that uses different social media



platforms. Assuming the probability of an individual having an account on a specific social media platform is independent of their other social media accounts, we can estimate the size of the overlap between the userbases of different social media platforms. The table shows the calculated size of the overlap between the userbases of the three largest social media platforms.

Platform 1	Platform 2	Platform 3	Percentage overlap
Youtube	Facebook	None	35
Youtube	Instagram	None	7
Facebook	Instagram	None	7
Facebook	Instagram	Youtube	19

⁴ Chart:

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

Assuming an individual who owns accounts on multiple social media platforms has an equal chance of being first exposed to the petition on any of these platforms, we can estimate the percentage of people on each platform who will first view the petition on a different platform.

By dividing the size of the overlap by the number of platforms this overlap is shared between, then adding together all the overlaps a specific platform is involved in and multiplying by the total number of New Zealanders using that platform, we can calculate the chance that an individual on a specific platform will first view the petition on a different platform.

This leads to our final result that 20% of Facebook users, 20% of Youtube users, and 5% of Instagram users will be first exposed to the petition on a different platform.

ATTENTION AND DECAY OF PETITIONS

In order to maximise the effectiveness of our marketing investments, a case study⁵ of popularity in e-petition trends was analysed. The case study tracks 21,000 separate petitions from the UK government and the US White House, of which a minute proportion had gained significant traction of earning at least 100,000 signatures (the milestone that triggers a parliamentary debate). Assuming 100,000 signatures is the success benchmark from this model, we can conclude that the growth model of the petitions that reach this benchmark can be translated into the growth of our own petition. Of the proportion of petitions that successfully reached 100,000 signatures, the growth was tracked hourly, and it is evident that significant

growth of petition signings begins to decrease approximately 300 hours upon launching of

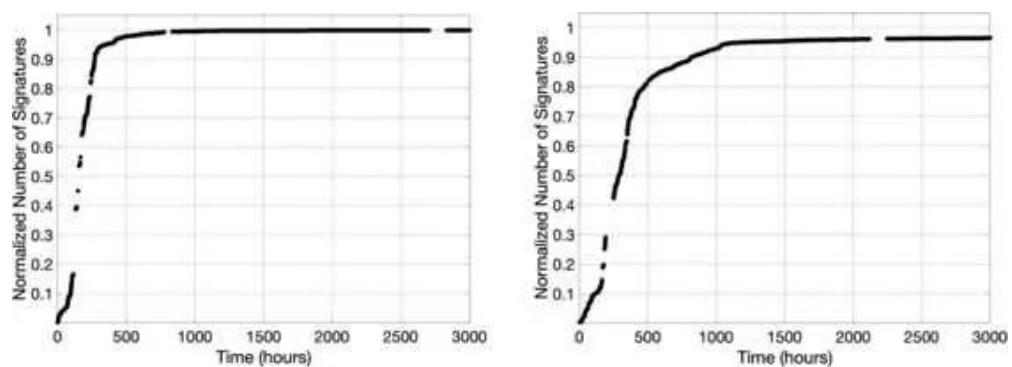


Fig. 1.0

petition as shown by Fig. 1.0. The case study also implements a Wu and Haberman model upon the hourly growth of the petitions to demonstrate that petitions decrease to 0.1% outreach after approximately 10 hours in the UK, and 30 hours in the US. This contradicts the conventional S-curve model, hence indicating that the most effective marketing investment strategy would be succeeding the initial launch of the petition in the period of 12.4 days - we are setting it as 15 days for convenience in our social media campaign calculations.

MODELLING AUDIENCE PARTICIPATION ON SOCIAL MEDIA

⁵ Case Study: <https://epjdatascience.springeropen.com/articles/10.1140/epjids/s13688-017-0116-6>

We developed an equation to predict the number of people who have seen an advertisement on a social media platform after a given number of days have passed.

$$S_D = S_{D-1} + N - \frac{NS_{D-1}}{P}$$

where P is the number of New Zealanders using a certain social media platform, N is the number of people who see the advertisement on that platform in one day, D is the number of days that have passed, and S_D is the total number of people who have seen the advertisement at least once after D days have passed.

Assuming on a given day a social media platform randomly shows the advertisement for the petition to N people out of a possible P, the number of people who will have already seen the advertisement is equal to $\frac{NS_{D-1}}{P}$. Hence the number of people who are seeing the advertisement for the first time is equal to $N - \frac{NS_{D-1}}{P}$. Adding this to S_{D-1} , which is the number of people who have already seen the advertisement on a previous day, results in the above formula.

By calculating the value of S_D for small values of D we observed that the coefficients of the terms in the equation were equal to the coefficients of the terms in the expansion of $(x - y)^D$ when D was odd, and $-(x - y)^D$ when D was even. Assuming this pattern holds for larger values of D, we can obtain S_D in terms of P, N, and D.

$$S_D = P \left[\left(1 - \frac{N}{P}\right)^D - 1 \right] \text{ when D is odd, and}$$

$$S_D = -P \left[\left(1 - \frac{N}{P}\right)^D - 1 \right] \text{ when D is even.}$$

We were not able to prove that this model holds true for all values of D, however given that it holds true for $D \leq 10$ it is likely that the equation is valid.

The cost per click can be found with $C = \frac{M}{kS_D}$ where C is the cost per click for a certain social media platform, M is the amount of money spent on advertising for that social media platform, and k is a constant representing the percentage of people who see an advertisement who will actually click on it.

ONLINE MARKETING BUDGET

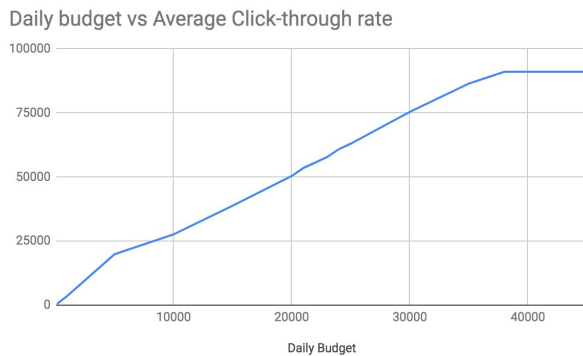
Our budget has been allocated according to both necessity and maximum possible outreach. Using the projections from Facebook, Youtube and Instagram, we can calculate the average daily expenditure proportional to the number of website clicks obtained. The website also

gives a range of clicks (as indicated by the maximum and minimum), where the average is calculated.

Instagram

The maximum daily budget is \$1,000 for Instagram - this is a very small proportion of our budget, however the potential outreach is significant. Maximum and minimum estimated reach is given⁶, and the average is calculated. The total number of Instagram users in New Zealand is 1,570,000⁷. Within our period of 15 days, and using the cost of \$1,000 per day and the Audience Participation Equation, the final cost from Instagram equates to \$15,000 and the estimated people reached is 1,042,000. Taking note that unlike the Youtube or Facebook values, Instagram only provides us with “views”, we are estimating that the proportion of actual “clicks” or “signatures” is around 0.52%⁸, which gives us a total of 54,159 signatures.

Fig. 2.0



Youtube

The maximum daily budget is \$38,000 for Youtube⁹ - a much more significant cost to our overall budget than other sources. According to our model of the outreach of video-ads on Youtube, our data shows that, by spending the maximum 38000 dollars daily, Google is able to help us accrue 90000 signatures daily via Youtube and other video platforms offered by Google.

We assumed a clickthrough rate of 1.84%¹⁰, as is modelled as the estimate click-through-rate for video advertisement media. The total number of Youtube users in New Zealand is 3,700,000¹¹. Therefore, using the Audience Participation Equation, the final cost from Youtube equates to \$570,000, and the estimated clicks are 1,142,687 total clicks, which is exactly the same number of signatures.

Facebook

The daily budget for Facebook is more versatile than Instagram and Youtube, however clearly has diminishing returns.

Daily budget ⓘ

The actual amount spent daily may vary. ⓘ
Estimated 9,982-24,647 website clicks per day ⓘ

⁶ Instagram app.

⁷ <https://socialmedia.org.nz/nz-instagram-statistics-2019/>

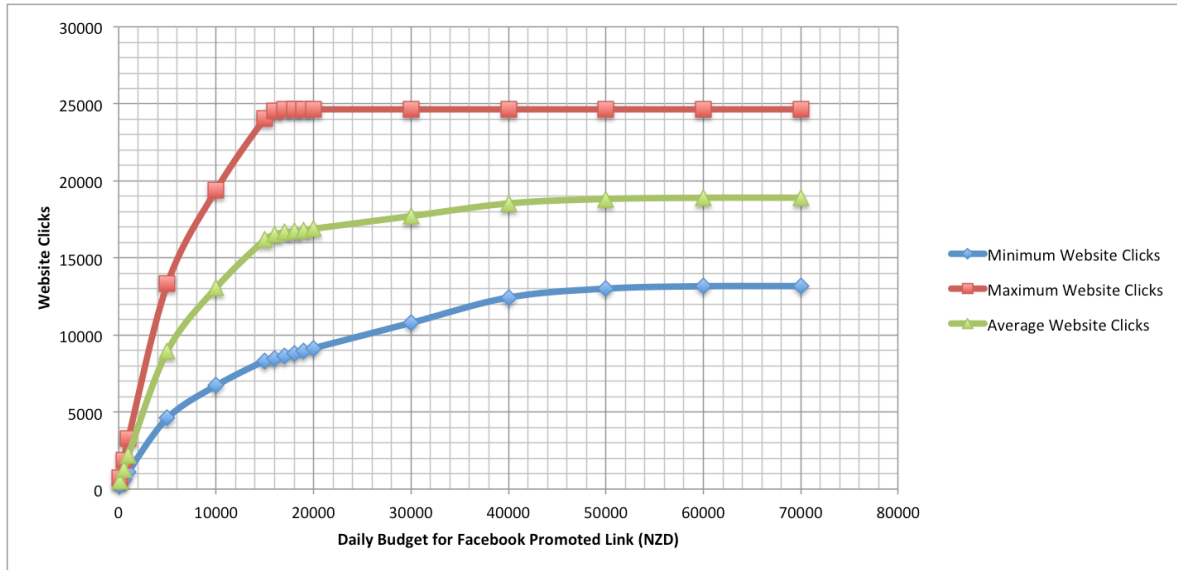
⁸ <https://blog.adstage.io/instagram-ads-cpm-cpc-ctr-benchmarks>

⁹ <https://ads.google.com/aw/video/signup>

¹⁰ <https://www.invespro.com/blog/online-video-advertising/>

¹¹ <https://www.socialites.co.nz/single-post/2018/02/12/Social-media-has-Kiwis-enraptured-and-these-new-stats-spell-great-news-for-businesses>

We are using the remainder of the budget (\$378,000) to use on Facebook advertisements, specifically through the method of running an ad continuously. This results in an expenditure of approximately \$25,200 per day (using Fig 3.0), which gives us a daily click rate of 17315.



The number of total Facebook users in New Zealand is 3,300,000¹². Using the Audience Participation Equation, the total number of clicks gained is 250,399, which translates into the exact same number of signatures.

Taking into account audience overlap, the Facebook and Youtube values will be multiplied by a factor of 0.8, and the Instagram values will be multiplied by 0.95. Examining the cost breakdown below;

<i>Expenditure</i>	<i>Cost (\$)</i>	<i>Signatures</i>
Facebook	378,000	250,399
Youtube	570,000	1,142,687
Instagram	15,000	51,451
Design	37,000	-
Total:	1,000,000	1,444,537

Giving the total number of signatures as **1,444,537**, giving us a final percentage when divided by the population of 4,974,989 as 29.0%.

¹² <https://www.facebook.com/business/>

EVALUATIONS AND FURTHER ASSUMPTIONS

A significant difficulty we faced in calculating the total number of people we could convince to sign our petition rose in considering that not each link click could be guaranteed to translate into a petition signature. While it seems sensible to assume that a link click (which we *have* been able to calculate, to at least a better degree of accuracy) will only occur if the user is interested in the petition and should therefore constitute a signature, we understand that being able to factor this into the final value would likely lead to a decrease.

If given more time, we would also consider the amount of money most likely dedicated to graphic design or video production in more detail -- while we recognised these as important to our overall advertising campaign, the estimates produced were quite vague and only found through averaging rates from external companies, instead of careful consideration for the material we would actually need produced.

In our analysis we also did not consider other alternative forms of online marketing such as advertising through emails, search engines, and popular websites, which are other mediums that can increase the number of signatures. This could have increased the number of signatures as well.

In terms of all our social media advertisements, we have tried to ensure maximum effectiveness through large expenditure in graphic and video design.

CONCLUSION

There were several factors that were impossible to accurately quantify the effects of, due to a lack of data and human nature being difficult to predict. Examples of these factors include the effects of prominent celebrities and politicians expressing support for the petition, and people sharing the petition with their friends. We believe that, because of the omission of these factors, our final estimated percentage of 29.0% is an underestimate.

Regardless, we are proud to have come up with a theoretical answer.