COVID-19 VACCINE LOTTERY FIELD EXPERIMENT

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1. Introduction 492

Coronavirus disease 2019 (COVID-19) has caused the largest public health crisis, and economic disaster of the 21st century so far (Kadkhoda, 2021: 471). According to the World Health Organisation (2021), COVID-19 has directly resulted in 4,859,277 deaths worldwide[1], and its impact on the global economy has been severe (World Bank, 2020). Policymakers are in urgent need of evidence-based strategies to contain the pandemic. As Fontanet & Cauchemez (2020: 583) report, one critical mechanism through which epidemics are controlled is through herd immunity. Herd immunity arises when a sufficiently large proportion of the population achieves individual immunity to an infectious disease such that the transmission chain of the disease is halted (Kadkhoda, 2021: 471). One method of establishing herd immunity is through vaccination programs (Fontanet & Cauchemez, 2020: 583). Preliminary empirical evidence shows that infection detection and vaccination strategies could be critical tools in subduing COVID-19, for example the study by Aldila, Samiadji, Simorangkir, Khosnaw & Shahzad (2021) finds COVID-19 vaccines to be effective in Jakarta, Indonesia. Leaders of other countries have also implemented vaccine programs and the World Health Organisation (2021) reports that a total of 6,364,021,792 vaccine doses have been administered globally as of 10 October 2021.

In line with the international approach, South Africa has opted to issue vaccines in addition to social distancing and lockdown measures. The South African government has stated that it aims to have 67% of the population vaccinated by the end of 2021 (Department of Health, 2021a). However, many South Africans are hesitant to get the COVID vaccine; Department of Health (2021b) records that only 25% of South Africa's adult population has been fully vaccinated as of 11 October 2021. Burger, Maughan-Brown, Köhler, English & Tameris (2021) compiled a report, based on data from wave 5 of the NIDS-CRAM survey, and find that that around 20% of South Africans are concerned that COVID-19 vaccines are not safe. The report also shows that relatively few people in the sample registered to be vaccinated within two months after registration opened. Burger, Maughan-Brown, Köhler, English & Tameris (2021) conclude that a significant portion of South Africans still have to be convinced to take the vaccine[2]. While there are different ways to encourage vaccine uptake, such as mandatory vaccination or lump-sum transfers, insights from behaviourial economics could provide a more cost-effective solution: a vaccine lottery.

This essay[3] proposes a field experiment to investigate whether a vaccine lottery could improve vaccination rates in South Africa. The experiment explores the effect of three different lottery types - standard, regret and referral - on the take up of vaccines. This essay is structured as follows. Section 2 briefly reviews the relevant literature on behavioural economics and health incentives. Section 3

[1] As of 13 October 2021

[2] A sentiment report from Department of Health (2021c) shows an interesting break down of different communities' beliefs surrounding the vaccine

[3] This essay was written using the package Texevier by Katzke (2017)

elaborates on the South African context. Section 4 describes the design of the experiment and outlines the three types of treatment groups. Section discusses how the treatment will be administered and how the data will be collected. Lastly, section 6 gives a pre-analysis plan of the empirical analysis that will be performed on the data, and the final section (7) concludes.

- a clear statement of the research question and motivation for why this is interesting and important;

2. Behavioural Economics and Health Incentives

Health professionals and policymakers are increasingly turning to behavioural economics to understand how people make health decisions and how behavioural insights can be used to improve public health outcomes (Loewenstein, Asch, Friedman, Melichar & Volpp, 2012: 1). While neoclassical economics assumes that people are perfectly rational agents, behavioural economics relaxes this assumption and uses psychology and economic theory to create more realistic models of human decision-making (Rabin, 2002). As Khaneman and Tversky show, people are subject to certain biases and often make use of heuristics in their decision-making process, which can lead to predictable errors in judgment Kahneman & Tversky (1979). A large literature has developed in the field of behavioural economics to investigate how these biases can be combated and sub-optimal choices overcome to improve welfare. Thaler & Sunstein (2008) introduced the idea of a nudge[4] as a way to guide people to make better choices. For example, Thaler & Sunstein (2008: 176) proposed changing the default option for organ donation in America to opt-in as opposed to explicit consent. They found that many people who were willing to be organ donors did not take the necessary steps, and that the registration process appeared to deter otherwise willing donors. By changing the choice architecture to presumed consent (with an easy opt-out option), there would be more registered donors and more lives saved.

There are other empirical studies that Madrian (2014)

Nudges can be effective because people are influenced by stimuli that are visible and new; thus, at least in theory, small changes can lead to behavior modification. Several studies have found that simply prompting (nudging) individuals to make a plan increases the probability of the subject eventually engaging in the prompted health behavior, such as immunizations, healthy eating, and cancer screening.25

For example, one study found that e-mailing patients appointment times and locations for their next influenza vaccination increased vaccination rates by 36%.26 Another intervention was even simpler. Rather than assigning a date and time for the patient to be vaccinated, patients were simply mailed a

[4]Nudge: an intervention that alters behaviour towards a desired action. In order for an intervention to qualify as a nudge, it should be cheap and easy to avoid Thaler & Sunstein (2008)

card that asked the patient to write down the day or day and time they planned to get the influenza vaccine (they were also sent the day and time of the free influenza vaccine clinics).27 Relative to a control condition (people who only received the information about the day and time of the clinics), those prompted to write down the day and time they planned to get the influenza vaccine were 4.2 percentage points (12.7%) more likely to receive the vaccine at those clinics. Those prompted to write down the date but not the time were not significantly more likely to be vaccinated at the clinics.

A lottery system can be a cost-effective mechanism for changing behaviour compared to direct transfers because people tend to overweight small probabilities. Due to this nonlinear probability weighting, an individual overestimates her chances of winning a lottery.

chance for regret, which behavioral scientists have found to be particularly motivating. Specifically, our "regret lottery" capitalizes on people's general desire to avoid losses to a greater degree than seeking equivalent gains (12) and to avoid anticipated regret (20-25).

It is not unprecedented to use lotteries in public health interventions. To the best of my knowledge, this experiment would be the first randomized field experiment to assess the impact of lotteries on COVID-19 vaccine take-up in South Africa. Several papers show that regret lotteries can improve health outcomes, such as Husain, Diaz, Schwartz, Parsons, Burg, Davidson & Kronish (2019) and Humphrey, Small, Jensen, Volpp, Asch, Zhu & Troxel (2019)

Loss aversion, regret avoidance, social preferences referral incentives

Individuals have a tendency to overweight small probabilities and this overestimate their chances of winning a lottery. behavioural economics theory and

research gap your experiment will address;

This paper addresses the gap pf vaccine lotteries in SA.

3. The South African Context

There are currently four vaccines which have been approved by the South African Health Products Regulatory Authority for use in South Africa: Johnson & Johnson (J&J), Pfizer, Sinovac and AstraZeneca. The two main vaccines being rolled out in South Africa are the J&J and Pfizer, which are both available for free. Vaccines are currently only available to individuals over the age of 18. The J&J vaccine only requires 1 dose; and the Pfizer vaccine requires two doses, 6 weeks apart. For the purposes of this field experiment, *fully vaccinated* refers to an individual who has had either 1 J&J shot, or both shots of the Pfizer vaccine. *Vaccinated* refers to an individual who has had 1 shot of either vaccine.

According to Department of Health (2021b), 34% of South Africans are vaccinated, while only 25% are fully vaccinated.

Province	Total Adults Vaccinated	Adult Population	Percentage Vaccinated
Eastern Cape	1 603 045	4 099 543	39%
Free State	735 696	1 914 521	38%
Gauteng	3 523 373	11 311 326	31%
KwaZulu-Natal	2 170 526	7 219 795	30%
Limpopo	1 437 846	3 695 801	39%
Mpumalanga	831 759	3 039 520	27%
North West	835 206	2 693 247	31%
Northern Cape	290 962	847 545	34%
Western Cape	2 141 933	4 976 903	43%
Total	13 570 346	39 798 201	34%

Table 3.1: Vaccination Statistics

gambling in SA

4. Experiment Design

- a clear description of the experimental design and the theory of change;

The field experiment is designed to address the research question: could a vaccine lottery improve vaccination rates in South Africa?

The sample used will be the same sample used for the Coronavirus Rapid Mobile Survey (NIDS-CRAM). NIDS-CRAM was created in response to the pandemic as a way to build a representative data set of the South African population to inform decision-making (Ingle, 2021). Thus far, there have been five waves of NIDS-CRAM surveys, with wave 5 comprising a sample of 5,862 people being surveyed during 6 April to 11 May 2021 (Ingle (2021) p.14). Wave 3 consisted of a total of 8,157 potential participants, of which 6,130 were successfully interviewed. For the purposes of this field experiment, the 8,157 people from Wave 3 will be contacted and asked to participate in the experiment. It seems reasonable to expect between 5,500 and 6,200 people to participate, given the previous rates of attrition experienced in NIDS-CRAM.

The NIDS-CRAM sample will then be split into 4 groups of equal size. Assuming a conservative sample size of 5,500, each of the 4 groups will comprise 1,375 individuals. Duflo, Glennerster &

Kremer (2007) which will be randomised using the randomisation technique as proposed by @. The first group is the control group, where individuals will not be entered into any vaccine lottery. The other 3 groups are will receive different lottery treatments, which are explained below. There will be 3 monthly lotteries for each treatment group, which will run simultaneously. Thus, in total there will be 9 lotteries for this field experiment, with 3 lotteries every month. Each lottery will award a cash prize of R1,000,000.

NIDS-CRAM is a special follow-up survey of a subsample of adults from households that were part of the last wave (2017) of the National Income Dynamics Study (NIDS). NIDS was a large-scale longitudinal survey, run by the Southern Africa Labour and Development Research Unit (SALDRU), that tracked the social and economic well-being of South Africans from 2008 up to 2017. SALDRU (based at the University of Cape Town) was responsible for the NIDS-CRAM survey data collection, quality assurance and production. The NIDS-CRAM survey instrument includes a wide range of questions on income and employment, sociodemographic characteristics, and household welfare. This paper draws on questions about vaccine acceptance that were included in Waves 4 and 5 of the NIDS-CRAM survey. Wave 4 was conducted from 2 February to 10 March 2021 with a sample of 4,792 individuals, and Wave 5 was conducted from 6 April to 11 May 2021 with a sample of 4,996. Compared to NIDS-CRAM Wave 1 (May and June 2020), Wave 4 had 31% attrition and Wave 5 had 28% attrition.

For the first treatment group, if an individual has received a vaccination shot[5] within a given month, she will be entered into that month's vaccine lottery. At the end of the month, a winner is randomly selected from the lottery pool. Once it is verifed that the winner has been vaccinated, she will be privately contacted and will receive a cash prize. It will then be announced via sms to everyone in the treatment group (group 1) that the lottery has been won, the amount of the lottery prize, and the winner's province.

Following the approach of Gandhi, Milkman, Ellis, Graci, Gromet, Mobarak, Buttenheim, Duckworth, Pope, Stanford, Thaler & Volpp (2021), the second lottery is a "regret lottery". Every individual in the sample is entered into a monthly lottery but an individual may only claim her prize if she has been vaccinated (i.e. had at least 1 shot of any vaccine). At month end, a winner is randomly drawn from the lottery pool. If the winner has been vaccinated, she will be privately notified and will receive a cash prize. It will then be announced via sms to everyone in the treatment group (group 3) that the lottery has been won, the amount of the cash prize, the winner's province and a reminder that only vaccinated individuals are eligible to win the lottery.

The final treatment is a "referral lottery". An individual is entered into the monthly lottery if 2

[5] An individual only need a receive one shot of any vaccine - receiving the first shot of the Pfizer qualifies an individual for that month's lottery

conditions are met: he is vaccinated, and he refers a friend to get vaccinated and the friend gets vaccinated. Both the individual from the sample and his friend are entered into the lottery. At the end of the month, a winner is selected, verified to be vaccinated and privately informed. An SMS is sent out to the treatment group with the same information as for group 2 and group 3, in addition to a message thanking the sample for protecting their friends as well as a reminder that they can refer more friends to be eligible for the following month's lottery.

Including an SMS after the lottery has won serves as a reminder that there is a

Table 4.1 summarises the different treatments administered.

Group	Treatment
Control	No lottery
Group 1	Individual is entered into a lottery once they are vaccinated
Group 2	Everyone in the group is entered into a lottery; only vaccinated individuals can claim the prize
Group 3	Individual is entered if she is vaccinated and refers a friend, who gets vaccinated

Table 4.1: Treatment Summary

Many South Africans are hesitant to get the COVID vaccine. As STATSA shows, amount of people have received the vaccine so far. Critical to reach herd immunity is improving vaccination rates. In order to improve the take-up of vaccinations, a field experiment designed around a vaccination lottery is proposed. While some governments have considered and experimented with lump-sum payments, behavioural economics could provide a more cost-effective solution. Individuals have a tendency to overweight small probabilities and this overestimate their chances of winning a lottery. In South Africa,

Theory: overweight small probabilities, gambling, social preferences, regret avoidance Empirical: vaccine field designs, lottery incentives, regret lottery incentives Several authors have experimented with lotteries as an incentive for vaccinations, although there have been no studies as of yet on the South African population. Probles with vaccine studies: too few participants. A larger study could fill this gap in the literature.

5. Treatment and Data

- an explanation of how the treatments will be administered and data gathered (including proposed partner institutions);

The CRAM survey exists to provide monthly nationally-representative data on key outcomes such as

unemployment, household income, child hunger and access to government grants.

Partner with NIDS, department of health, vaccine administer, funding data collected at vaccine add 3 questions to NIDS data cram

6. Pre-analysis plan

- a pre-analysis plan of the empirical analysis that will be performed on the data.

Overview In this field experiment, a person who refers his/her friend to receive a vaccine would be entered into a lucky draw, with a monetary prize, created by the government. The purpose behind this nudge is to encourage people who would otherwise not have got a Covid vaccine, to do so. The hypothesis is that there should be an increase in the total number of people receiving a Covid vaccine after the nudge is implemented. Increasing the number of vaccinations is important as medical research shows that vaccines decrease the probability of contracting Covid-19 and are also effective at reducing the severity of the symptoms of the virus for those who do contract it. The Nudge The nudge addresses behaviour by creating an environment where there is social pressure to get a vaccine (if I wanted to enter the lucky draw, I would pressure my friend into getting the vaccine). It is also likely that if a person asks her friend to get the vaccine so she can enter the lucky draw, she will reciprocate and get the vaccine as well so that her friend may enter the draw, which will also increase the number of people getting vaccinated. For the vaccines that require two doses (e.g. Pfizer), a person's name could be withdrawn, if the second shot is not given within a certain amount of time. This makes use of loss aversion, where people who already have their names in the draw feel the pain of having their names withdrawn more intensely than the pleasure of having their names added a second time to the draw for getting their second shot. Target Group The lucky draw is anticipated to attract people who are risk-on (they enjoy gambling, and are less worried about getting vaccinated), and poorer individuals for whom winning money is more attractive. These target groups are desirable as they are less likely to get the vaccine, and the government would like to maximise the number of vaccinated people. Additionally, if there are individuals who want to be vaccinated but procrastinate getting the vaccine (e.g. naïve hyperbolic discounters), setting a deadline for the lucky draw could increase the utility of getting the vaccine earlier enough to overcome the procrastination problem. There is no downside or extra cost for having people enter the lucky draw who would otherwise still have got the vaccine. Proposed Partner Institutions This field experiment would be in collaboration with the South African government and facilities that conduct vaccinations (e.g. Clicks). The government would be where the data is centralized and the administers of vaccines would all be data collection nodes. After a person has received a vaccine, the administer would ask if the person received a referral for the shot, and then note the ID number of the friend in addition to the individual's details.

Data Collection There is a data collection system already set up at the vaccination sites so this

extra data point would not be difficult to collect within the current tracking system. Depending on costs, the referral friend could be sent an sms thanking her for caring about others and getting them vaccinated, and letting her know that she has been entered into the draw. This is a positive reinforcement technique and shows people that the government is following up on their promise. This acknowledgement and transparency is expected to encourage more referrals. Once the lucky draw has been concluded, the data can be analysed, the purpose of which is to uncover whether the nudge increased vaccinations.

> I suggest renaming the top line after @article, as done in the template ref.bib file, to something more intuiti

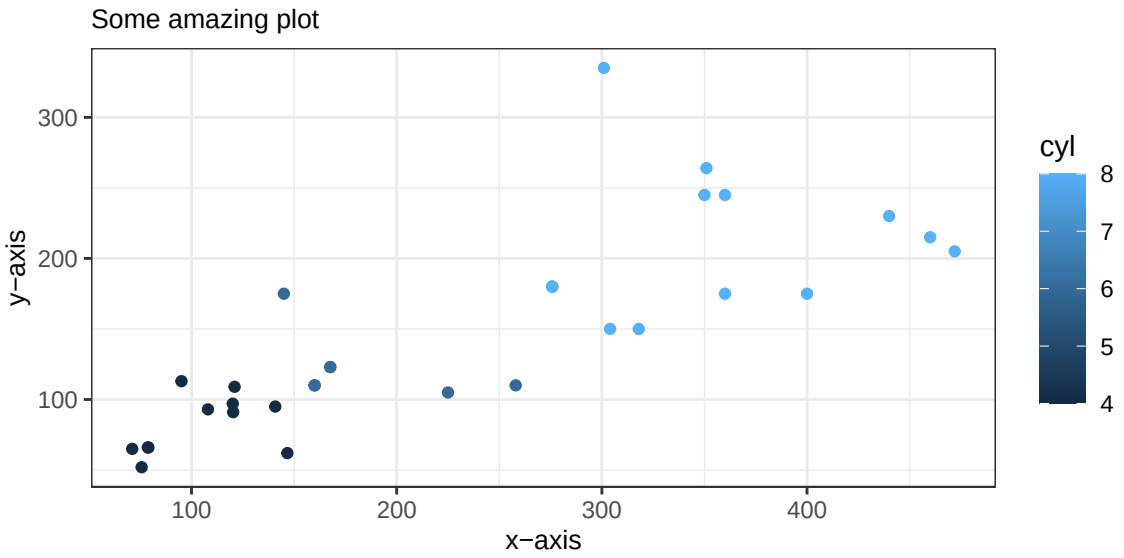

Figure 6.1: Caption Here

To reference calculations **in text**, *do this:* From table 3.1 we see the average value of mpg is 20.98.

Table 6.1: Long Table Example

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
	21.00	6.00	160.00	110.00	3.90	2.62	16.46	0.00	1.00	4.00	4.00
	21.00	6.00	160.00	110.00	3.90	2.88	17.02	0.00	1.00	4.00	4.00
	22.80	4.00	108.00	93.00	3.85	2.32	18.61	1.00	1.00	4.00	1.00
	21.40	6.00	258.00	110.00	3.08	3.21	19.44	1.00	0.00	3.00	1.00
	18.70	8.00	360.00	175.00	3.15	3.44	17.02	0.00	0.00	3.00	2.00

Continued on next page

Table 6.1: Long Table Example

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
	18.10	6.00	225.00	105.00	2.76	3.46	20.22	1.00	0.00	3.00	1.00
	14.30	8.00	360.00	245.00	3.21	3.57	15.84	0.00	0.00	3.00	4.00
	24.40	4.00	146.70	62.00	3.69	3.19	20.00	1.00	0.00	4.00	2.00
	22.80	4.00	140.80	95.00	3.92	3.15	22.90	1.00	0.00	4.00	2.00
	19.20	6.00	167.60	123.00	3.92	3.44	18.30	1.00	0.00	4.00	4.00
	17.80	6.00	167.60	123.00	3.92	3.44	18.90	1.00	0.00	4.00	4.00
	16.40	8.00	275.80	180.00	3.07	4.07	17.40	0.00	0.00	3.00	3.00
	17.30	8.00	275.80	180.00	3.07	3.73	17.60	0.00	0.00	3.00	3.00
	15.20	8.00	275.80	180.00	3.07	3.78	18.00	0.00	0.00	3.00	3.00
	10.40	8.00	472.00	205.00	2.93	5.25	17.98	0.00	0.00	3.00	4.00
	10.40	8.00	460.00	215.00	3.00	5.42	17.82	0.00	0.00	3.00	4.00
	14.70	8.00	440.00	230.00	3.23	5.34	17.42	0.00	0.00	3.00	4.00
	32.40	4.00	78.70	66.00	4.08	2.20	19.47	1.00	1.00	4.00	1.00
	30.40	4.00	75.70	52.00	4.93	1.61	18.52	1.00	1.00	4.00	2.00
	33.90	4.00	71.10	65.00	4.22	1.83	19.90	1.00	1.00	4.00	1.00
	21.50	4.00	120.10	97.00	3.70	2.46	20.01	1.00	0.00	3.00	1.00
	15.50	8.00	318.00	150.00	2.76	3.52	16.87	0.00	0.00	3.00	2.00
	15.20	8.00	304.00	150.00	3.15	3.44	17.30	0.00	0.00	3.00	2.00
	13.30	8.00	350.00	245.00	3.73	3.84	15.41	0.00	0.00	3.00	4.00
	19.20	8.00	400.00	175.00	3.08	3.85	17.05	0.00	0.00	3.00	2.00
	27.30	4.00	79.00	66.00	4.08	1.94	18.90	1.00	1.00	4.00	1.00
	26.00	4.00	120.30	91.00	4.43	2.14	16.70	0.00	1.00	5.00	2.00
	30.40	4.00	95.10	113.00	3.77	1.51	16.90	1.00	1.00	5.00	2.00
	15.80	8.00	351.00	264.00	4.22	3.17	14.50	0.00	1.00	5.00	4.00
	19.70	6.00	145.00	175.00	3.62	2.77	15.50	0.00	1.00	5.00	6.00
	15.00	8.00	301.00	335.00	3.54	3.57	14.60	0.00	1.00	5.00	8.00
	21.40	4.00	121.00	109.00	4.11	2.78	18.60	1.00	1.00	4.00	2.00

7. Conclusion

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Appendix

Appendix A

Some appendix information here

Appendix B