Online Appendix for

"The Optimal Allocation of Covid-19 Vaccines"

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A Appendix

A.1 Physical Proximity Scores

O*NET asks a number of questions about individuals' working conditions and day-to-day tasks of their job. To evaluate proximity, the question asks, "How physically close to other people are you when you perform your current job?". Respondents provide a response on a scale between one and five, one indicating that the respondent does not work near other people (beyond 100ft.), while five indicating that they are very close to others (near touching). More information on these questions is provided in the Instructions for Work Context Questionnaire (Q 21), published by O*NET.

The responses to this question are standardized by Mongey et al. (2020) to a scale ranging from 0 to 100 as follows. First, O*NET reports the answers to the survey using the fine occupation SOC-code. Mongey et al. (2020) calculate an employment-weighted average, $\bar{m}_i$, of the response to this question that corresponds to each occupation, i, classified according to the 3-digit Census OCC code. Second, Mongey et al. (2020) follow the procedure used by O*NET and re-scale the survey answer to the interval $[0, 100]$ using the following equation:

$$x_i = \frac{(\bar{m}_i - \bar{m}_i^{\min})}{\left(\bar{m}_i^{\max} - \bar{m}_i^{\min}\right)} * 100,$$

where x_i is the final physical proximity standardized score for occupation i.

A.2 Work-from-Home Occupations

The work-from-home classification of occupations has been developed by Mongey et al. (2020) and Dingel and Neiman (2020) using O*NET survey answers from the Work Activities Questionnaire and Work Context Questionnaire. The Work Context Questionnaire includes questions aiming to capture the "physical and social factors that influence the nature of work" such as interpersonal relationships, physical work conditions, and structural job characteristics. The Work Activities Questionnaire includes questions aiming to capture the "general types of job behaviors occurring on multiple jobs" such as the input of information, mental processes, and work output.

We use the classification of Mongey et al. (2020) because they provide an employment-weighted aggregation at the 3-digit Census OCC codes. In particular, they aggregate 18 occupational attributes based on answers to the questions Q4, Q14, Q17, Q18, Q29, Q33, Q37, Q43, Q44, in the Work Context Questionnaire, and Q4A, Q16A, Q17A, Q18A, Q20A, Q22A, Q23A, Q32A in The Work Activities Questionnaire. The responses to these questions are standardized to a work-from-home score ranging from 0 to 1 following the same procedure as the one used to calculate the physical proximity score. In the next step, an occupation is classified either as that it can be done from home if its work-from-home score is above the median, or that it cannot be done from home if its work-from-home score is below the median.

We use this classification to derive the optimal allocation of vaccines when a stay-at-home order is used, and some occupations can be done from home (exercise 3). However, we acknowledge that this classification has limitations, as some occupation categories may be too coarse. For instance, physicians and surgeons have been classified as work-from-home occupations. While for many physicians telemedicine seems feasible for limited periods of time, as has been evident during the lockdown in the U.S., we understand that telemedicine is not applicable for surgeons or critical care doctors. Another example is teachers, who are also classified as work-from-home occupations. At the same time, our approach is flexible, and an optimal vaccine allocation can be derived under

various specifications, including fractional ones, for which occupations are done from home. Thus, as some physicians return to hospitals and some teachers return to teach in person, these occupations can be re-classified partly as occupations that are not done from home, and our model will assign vaccines accordingly.

A.3 Essential Occupations

We have designated occupations to be essential based on the guidelines issued by the Cybersecurity and Infrastructure Security Agency (CISA). Our classification is inherently subjective and is also subject to the limitation that some occupations are very coarse. For instance, we have classified network and computer systems administrators as an essential occupation according to the guidelines issued by CISA. However, we acknowledge that it is likely that not all system administrators are essential workers. It is re-assuring that designating an occupation as essential plays no role when a simple vaccination policy is considered, as in exercise 1.

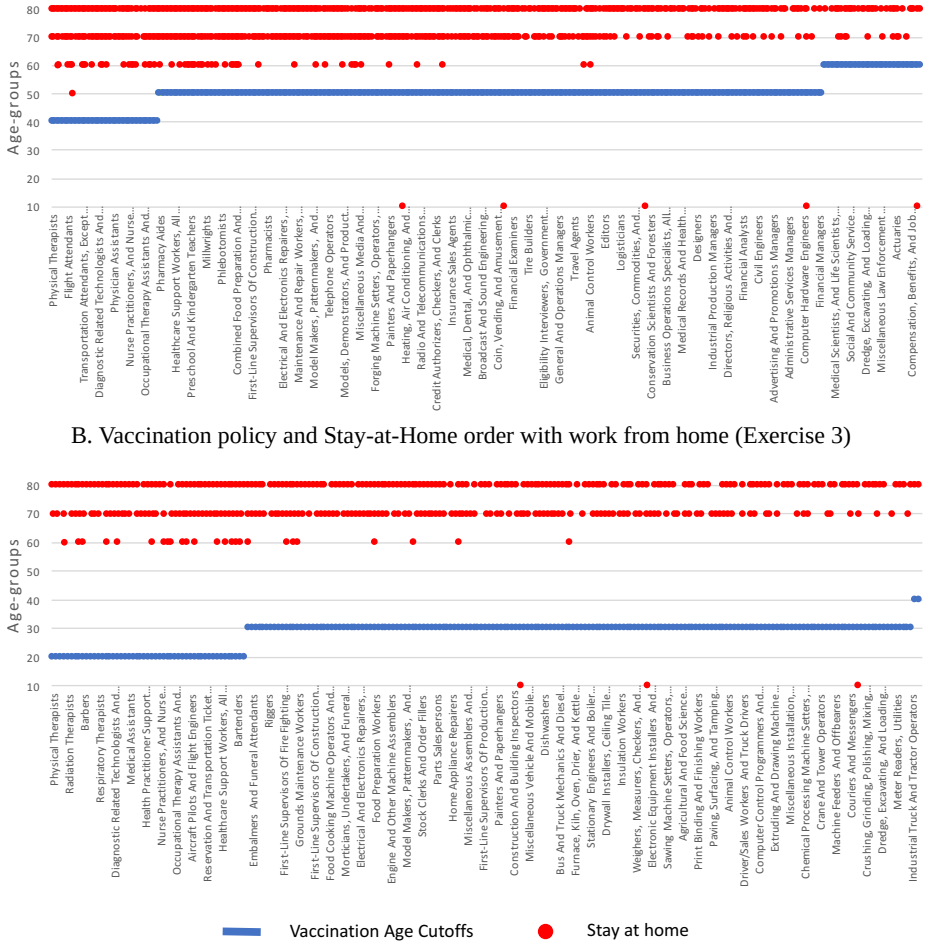
Table A.1: Vaccine Distribution by Ages.

	20-29	30-39	40-49	50-59	60-69	70-79	80+
Exercise 1	0	0	2,518,118	26,165,823	24,040,335	6,094,810	1,180,914
Exercise 2	0	0	3,664,572	30,441,166	21,867,803	3,659,431	367,028
Exercise 3	2,994,988	16,111,831	15,109,864	15,223,264	8,768,288	1,567,305	224,460

Table A.2: The Infection Fatality Rate by age-groups reported in South Korea.

Age group	Infection fatality rate (%)
< 19	0
20-29	0
30-39	0.08
40-49	0.14
50-59	0.41
60-69	1.29
70-79	6.32
80+	20.05

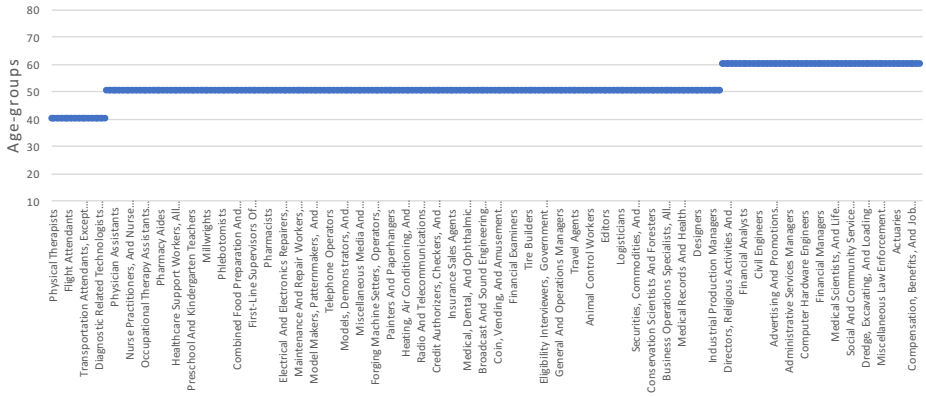
A. Vaccination policy and Stay-at-Home order without work from home (Exercise 2)



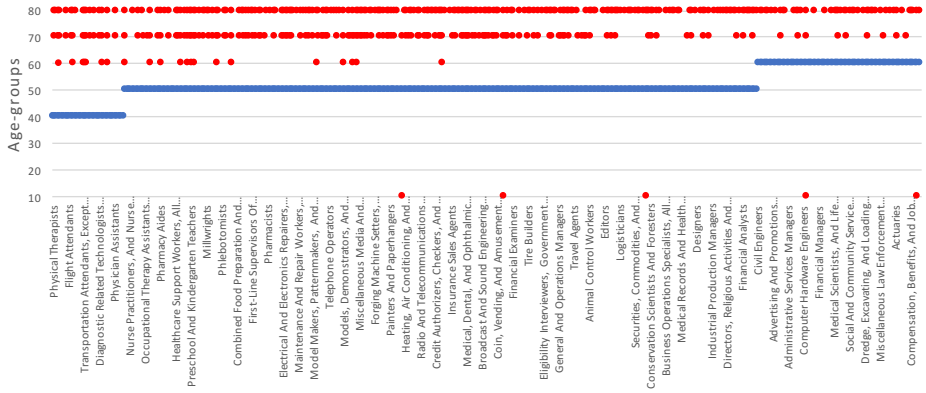
B. Vaccination policy and Stay-at-Home order with work from home (Exercise 3)

Figure A.1: Age cutoffs for vaccinations and age groups staying at home when no occupations are designated to be essential. Occupations on the x-axis are ordered based on their infection risk. (A) The optimal vaccination policy showing the youngest age for each occupation that is eligible to receive the vaccine, together with the occupation-age groups that are mandated to stay at home. (B) The optimal vaccination policy showing the youngest age for each occupation, which cannot be done from home that is eligible to receive the vaccine, together with the occupation-age groups that are mandated to stay at home. Occupations that can be done from home do not receive a vaccine.
Note: We omit exercise 1, which remains the same as in Fig. 1A. Exercise 1 requires workers of all occupations to return to work regardless of being vaccinated or not. Designating an occupation to be essential does not affect the optimal vaccine allocation in this case.

A. Simple Vaccination policy (Exercise 1)



B. Vaccination policy and Stay-at-Home order without work from home (Exercise 2)



C. Vaccination policy and Stay-at-Home order with work from home (Exercise 3)

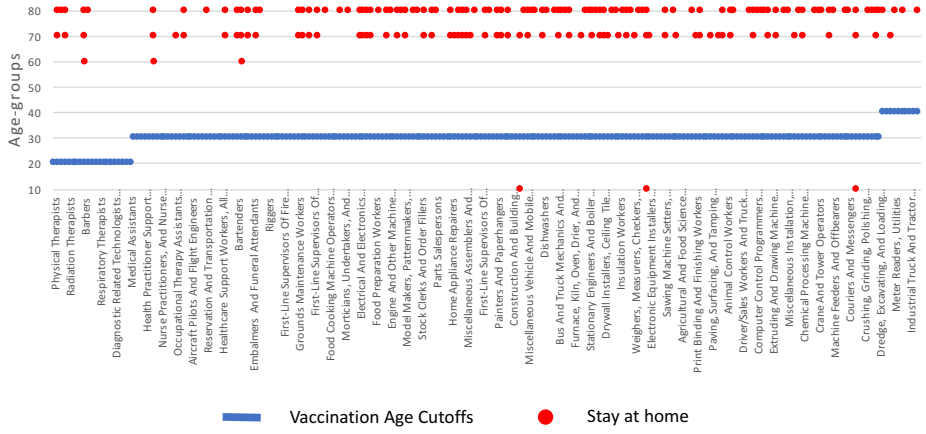
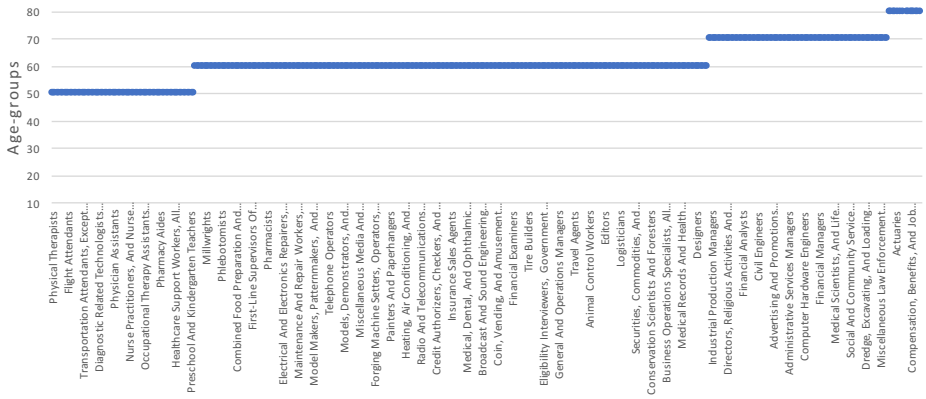
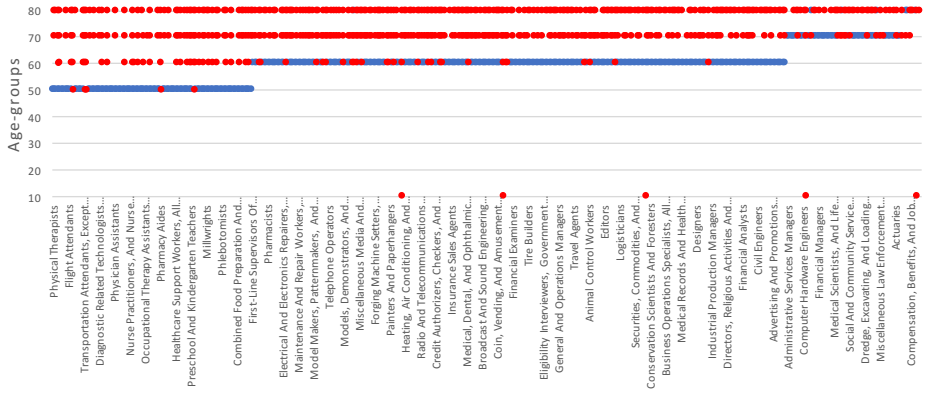


Figure A.2: Age cutoffs for vaccinations and age groups staying at home when vaccine effectiveness is 0.7. Occupations on the x-axis are ordered based on their infection risk. (A) The optimal vaccination policy showing the youngest age for each occupation that is eligible to receive the vaccine. (B) The optimal vaccination policy showing the youngest age for each occupation that is eligible to receive the vaccine, together with the occupation-age groups that are mandated to stay at home. (C) The optimal vaccination policy showing the youngest age for each occupation which cannot be done from home that is eligible to receive the vaccine, together with the occupation-age groups that are mandated to stay at home. Occupations that can be done from home do not receive a vaccine.

A. Simple Vaccination policy (Exercise 1)



B. Vaccination policy and Stay-at-Home order without work from home (Exercise 2)



C. Vaccination policy and Stay-at-Home order with work from home (Exercise 3)

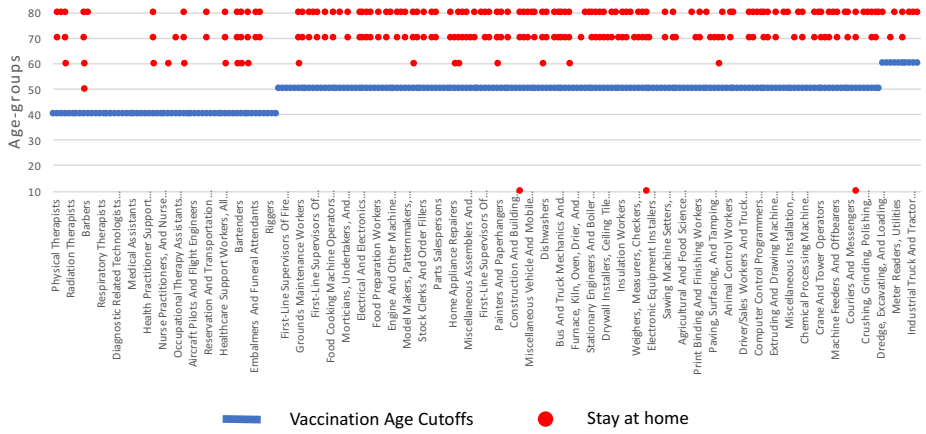


Figure A.3: Age cutoffs for vaccinations and age groups staying at home, when the supply of vaccines is 30mil doses. Occupations on the x-axis are ordered based on their infection risk. (A) The optimal vaccination policy showing the youngest age for each occupation that is eligible to receive the vaccine. (B) The optimal vaccination policy showing the youngest age for each occupation that is eligible to receive the vaccine, together with the occupation-age groups that are mandated to stay at home. (C) The optimal vaccination policy showing the youngest age for each occupation which cannot be done from home that is eligible to receive the vaccine, together with the occupation-age groups that are mandated to stay at home. Occupations that can be done from home do not receive a vaccine.

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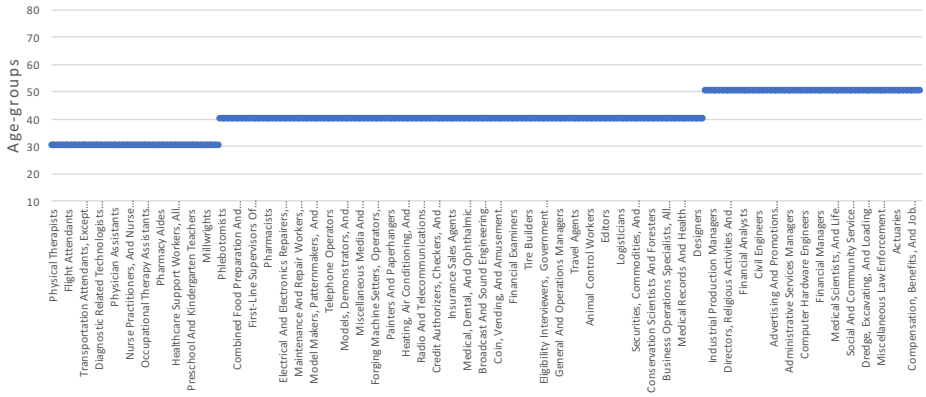
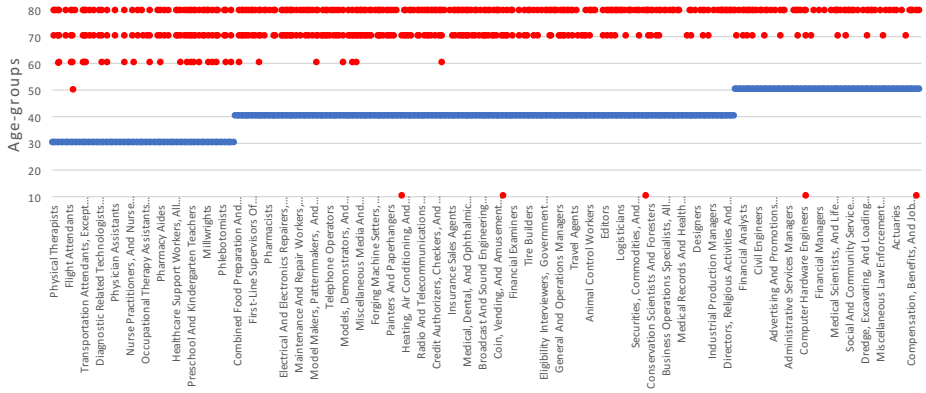


B. Vaccination policy and Stay-at-Home order without work from home (Exercise 2)



C. Vaccination policy and Stay-at-Home order with work from home (Exercise 3)

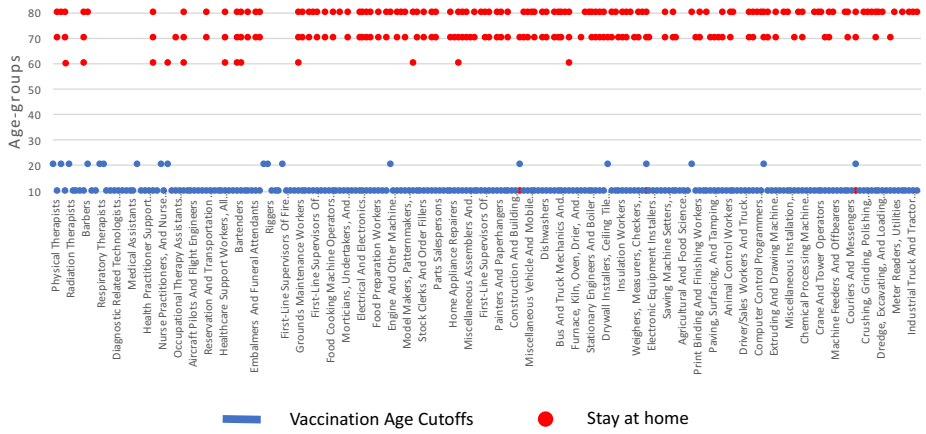
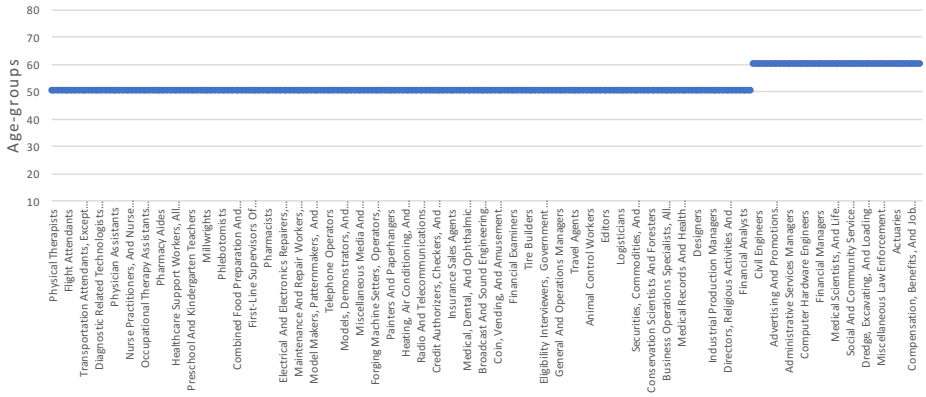
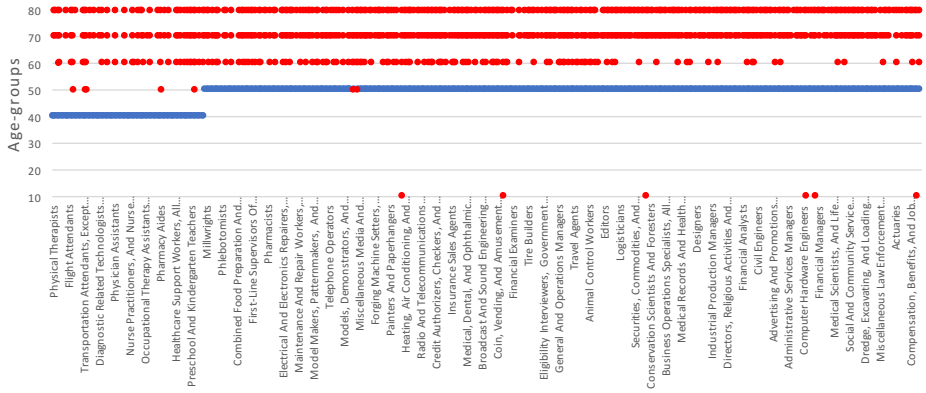


Figure A.4: Age cutoffs for vaccinations and age groups staying at home, when the supply of vaccines is 100mil doses. Occupations on the x-axis are ordered based on their infection risk. (A) The optimal vaccination policy showing the youngest age for each occupation that is eligible to receive the vaccine. (B) The optimal vaccination policy showing the youngest age for each occupation that is eligible to receive the vaccine, together with the occupation-age groups that are mandated to stay at home. (C) The optimal vaccination policy showing the youngest age for each occupation which cannot be done from home that is eligible to receive the vaccine, together with the occupation-age groups that are mandated to stay at home. Occupations that can be done from home do not receive a vaccine.
Note: While, in exercise 3, the vaccination cutoffs may appear to be non-monotonic in occupations' risks, that is only because some occupations have no teenage workers.

A. Simple Vaccination policy (Exercise 1)



B. Vaccination policy and Stay-at-Home order without work from home (Exercise 2)



C. Vaccination policy and Stay-at-Home order with work from home (Exercise 3)

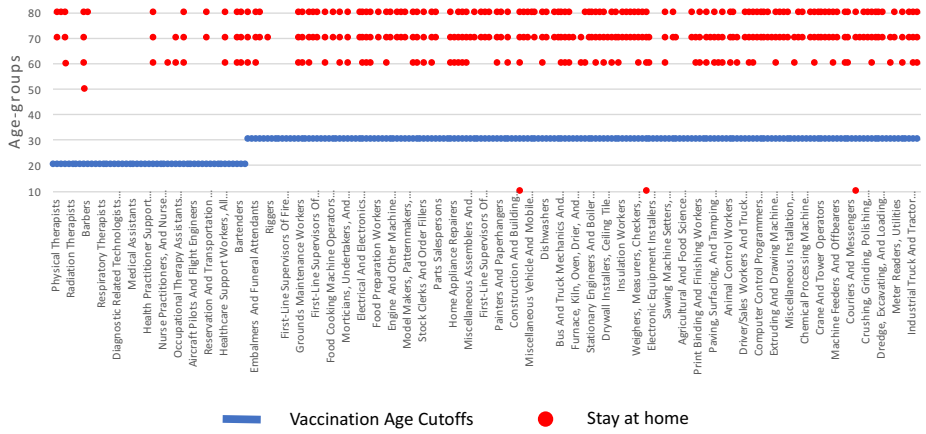


Figure A.5: Age cutoffs for vaccinations and age groups staying at home (probit estimation including all ages mortality risk, α=-1.152288 and β=0.0037667). Occupations on the x-axis are ordered based on their infection risk. (A) The optimal vaccination policy showing the youngest age for each occupation that is eligible to receive the vaccine. (B) The optimal vaccination policy showing the youngest age for each occupation that is eligible to receive the vaccine, together with the occupation-age groups that are mandated to stay at home. (C) The optimal vaccination policy showing the youngest age for each occupation which cannot be done from home that is eligible to receive the vaccine, together with the occupation-age groups that are mandated to stay at home. Occupations that can be done from home do not receive a vaccine.

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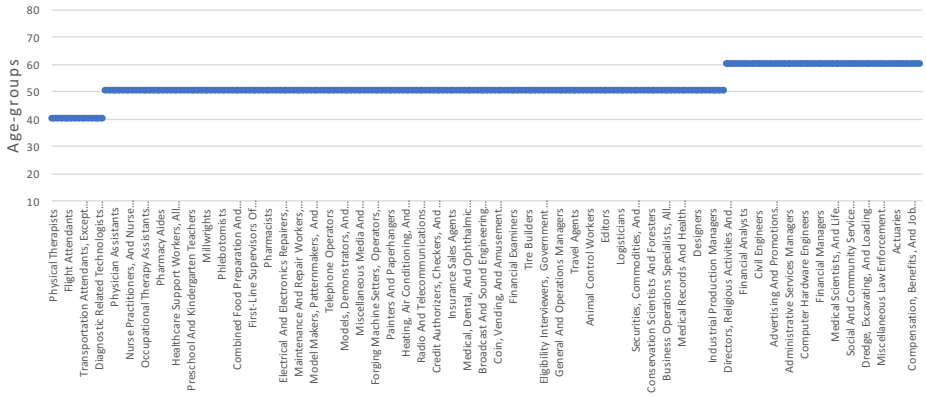
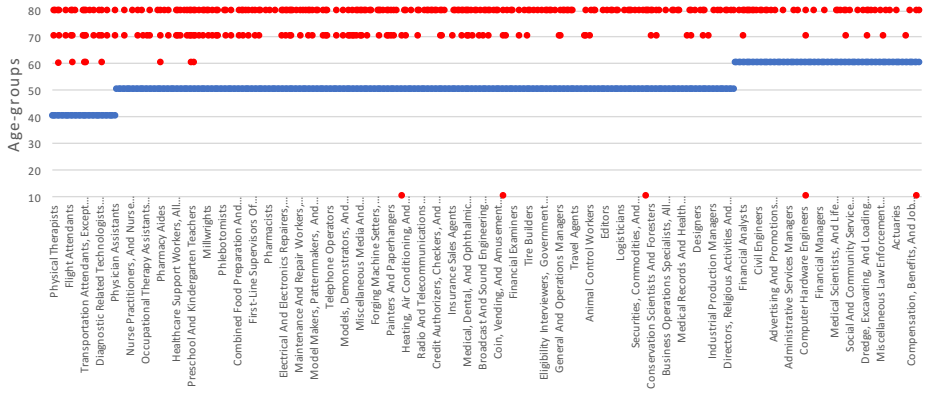


B. Vaccination policy and Stay-at-Home order without work from home (Exercise 2)



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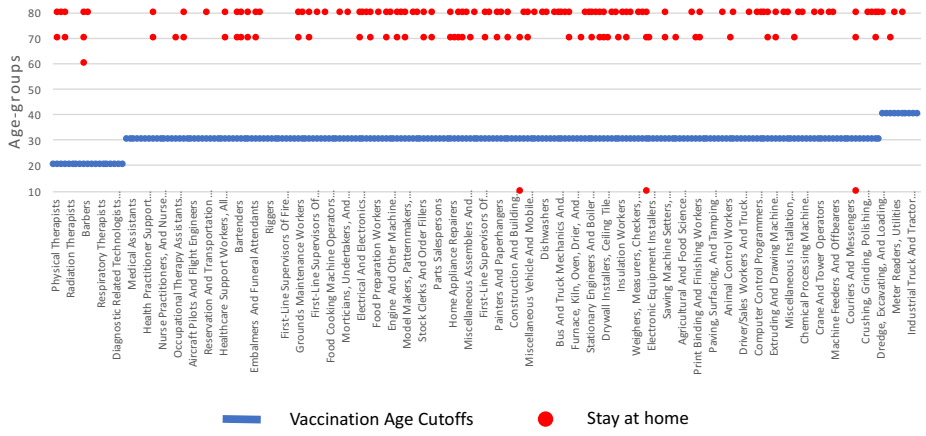

Figure A.6: Age cutoffs for vaccinations and age groups staying at home based on South-Korean infection fatality rates from Table A.2. Occupations on the x-axis are ordered based on their infection risk. (A) The optimal vaccination policy showing the youngest age for each occupation that is eligible to receive the vaccine. (B) The optimal vaccination policy showing the youngest age for each occupation that is eligible to receive the vaccine, together with the occupation-age groups that are mandated to stay at home. (C) The optimal vaccination policy showing the youngest age for each occupation which cannot be done from home that is eligible to receive the vaccine, together with the occupation-age groups that are mandated to stay at home. Occupations that can be done from home do not receive a vaccine.