UNDERSTANDING COVID-19 RELATED ANXIETY

AROUND THE WORLD

NEELESH VASNANI

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ASSESSMENT 2

178.724 APPLIED ECONOMETRIC METHODS

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1. INTRODUCTION AND MOTIVATION

The end of the year 2019 marked the outbreak of COVID-19 – a highly contagious novel coronavirus disease that was first detected in Wuhan, China. Within a couple of months, the virus received global attention as it rapidly spread all around the world killing 4.4% of infected individuals (Lee, 2020). Health organizations around the world made it clear that the COVID-19 pandemic was a severe physical health threat to the global population. This inevitably led to countries imposing lockdowns, community quarantines, travel bans, social distancing measures, and other restrictions aimed at eradicating the virus within few months of its onset. As of this writing, 17 months have passed since the virus was discovered and COVID-19 continues to pose a major threat to public health amidst ongoing vaccination efforts.

As the pandemic has progressed, its health impact has been increasingly recognized as twofold in that it poses a major threat to mental health as much as it does to physical health. While interventions such as lockdowns, quarantines, and social distancing have proven effective to protect physical health, several studies such as Tang et al. (2020) have shown evidence that these restrictions introduce unprecedented changes to daily life resulting in psychological and emotional distress. Wang, Kala, and Jafar (2020) noted that the pandemic has several adverse effects on mental health and well-being, including increased anxiety, depression, insomnia, and post-traumatic stress. They also found that one in three adults reported being anxious or depressed as a result of COVID-19. Similarly, an early study in China indicated that 25% of the population experienced severe anxiety or stress as a result of the pandemic (Asmundson et al, 2020). These statistics illuminate the importance of addressing the mental health risks of the pandemic in addition to the physical health risks. Understanding pandemic-related mental health risks is important for developing mental health support programs and preventive strategies and can serve as a key input in designing policies related to COVID-19 or even future pandemics.

The relatively unsaturated literature on COVID-19 has so far shown that the pandemic impacts mental health and well-being in a multitude of ways. This analysis is specifically focused on understanding anxiety in response to COVID-19. In psychological terms, anxiety is an emotion related to tension, worrisome feelings, and stressful thoughts which may lead to physical changes such as heightened blood pressure (Kazdin, 2000). In this context, the analysis is carried out to investigate how COVID-19 impacts different types of anxiety in individuals and what risk factors underpin these types of anxieties. The data used for the analysis is primarily obtained from a large global survey that was conducted by Fetzer et al. (2020) at the onset of the pandemic (March – April 2020) when most countries around the world had some sort of restrictions in place to curb the spread of the virus. The data covers respondents from all around the world and includes

variables related to demographics, personality traits, perceptions about government, lifestyle behaviors, and general metrics about COVID-19 cases in the respondents' country. Logistic regression analysis is used to understand the effects of these variables on the five types of COVID-19 related anxiety. Specifically, the analysis is hinged on the following research questions:

- How prevalent are the five different types of COVID-19 related anxiety?
- What type of individuals - as characterized by their demographics, behaviors, perceptions about government, and personality traits – are associated with a higher risk of COVID-19 related anxiety?
- Are there interaction effects between demographic variables such as income, marital status, gender, and age? For instance, is the effect of income on COVID-19 related anxiety different for married and unmarried individuals?

2. STATISTICAL METHODOLOGY

Prior to modeling, the data is first explored by examining descriptive summary statistics, subsamples, and correlations to get a better feel of the data. This step is crucial as it points out any possible outliers or missing values and provides a high-level picture of possible effects and hypotheses that may need to be tested further for statistical significance. Next, logistic regression is used to build seven different binary response models (Models 0 to 6) that estimate the probability of an individual feeling a certain type of COVID-19 related anxiety ($\rho_i = 1$) as opposed to not feeling COVID-19 related anxiety ($\rho_i = 0$). All the models assume the general form of a Logit model as shown below:

$$\text{Logit}\,(\rho_i = 1) = \log\left(\frac{\rho_i}{1 - \rho_i}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 \cdots + \beta_i X_i$$

In each of the models, the dependent variable for the different types of COVID-19 related anxiety is modeled as ρ_i while the independent variables are denoted by X_i. The coefficients $\beta_0, \beta_1, \ldots \beta_i$ are the parameter estimates for the predictor variables. However, these coefficients do not provide much value beyond their sign as far as economic interpretation is concerned (Wooldridge, 2016). To remedy this, marginal effects for each of the predictor variables are calculated to capture the change in probability due to one unit increase in the predictor variables. Additionally, effect plots are generated to visualize the impact of selected independent variables on COVID-19 related anxiety. These procedures are performed to make clear insights and implications regarding factors that are most associated with COVID-19 related anxiety and to what degree.

Finally, all the logit models used in this analysis are ran using the SAS Enterprise Guide 8.2 software and may be replicated using the codes found in Appendix B. Where applicable, the outputs from SAS are manually simplified and beautified for reporting purposes.

3. PRELIMINARY DATA EXPLORATION

3.1. DEFINITION OF VARIABLES

Table 1. Summary of Variables in Dataset

Variables	Definition	Type
Binary Dependent Variables for Covid-19 related Anxiety		
anxiety_1	1 if respondent feels nervous about current circumstances, else 0	Binary
anxiety_2	1 if respondent does not feel calm/relaxed, else 0	Binary
anxiety_3	1 if respondent feels worried about personal health, else 0	Binary
anxiety_4	1 if respondent feels stressed about leaving house, else 0	Binary
anxiety_5	1 if respondent feels worried about family health, else 0	Binary
anxiety_any (*calculated*)	1 if respondent feels at least 1 out of the 5 types of anxieties, else 0	Binary
anxiety_all (*calculated*)	1 if respondent feels all the five types of anxieties, else 0	Binary
Independent Variables Related to Personal Information		
age	Age of respondent in years	Continuous
education	Number of years in education of respondent	Continuous
income	Monthly family income of respondent	Continuous
male	1 if male, 0 if female	Binary
married	1 if married, 0 otherwise	Binary
hhmember	Number of household members of the respondent	Continuous
poorhealth	1 if respondent reports poor physical health, else 0	Binary
Independent Variables Related to Personality Traits		
depression	Score measuring respondent's level of general depression	Continuous
extroverted	Score measuring respondent's level of extroversion	Continuous
critical	Score measuring respondent's level of critical thinking	Continuous
selfdisciplined	Score measuring respondent's level of self-discipline	Continuous
anxious	Score measuring respondent's level of general anxiousness	Continuous
newexperiences	Score measuring respondent's level of openness to new ideas/thinking	Continuous
reserved	Score measuring respondent's level of reserved thinking	Continuous
sympathetic	Score measuring respondent's level of sympathy/warmth	Continuous
calm	Score measuring respondent's level of calmness/emotional stability	Continuous
conventional	Score measuring respondent's level of conventional/uncreative thinking	Continuous
Independent Variables Related to Government Perceptions		
perceivreacinsuf	1 if respondent thinks his or her government's response to Covid is insufficient, else 0	Binary
govdistrust	1 if respondent does not trust his or her country's government, else 0	Binary
govfactuntruth	1 if respondent thinks his or her country's government is untruthful, else 0	Binary
pubperceivreacinsuf	1 if respondent deems his/her country's public response to Covid as insufficient, else 0	Binary
socdistmeasne	1 if respondent deems his country's social distancing measures as insufficient, else 0	Binary
Independent Variables Related to Past Behaviors		
beh_stayhome	Score measuring respondent's tendency of staying home during Covid-19	Continuous
beh_socgathering	Score measuring respondent's tendency of not socializing during Covid-19	Continuous
beh_distance	Score measuring respondent's tendency of keeping 2m safe distance during Covid-19	Continuous
beh_tellsymp	Score measuring respondent's tendency of reporting Covid19 symptoms to government	Continuous
beh_handwash	Score measuring respondent's tendency of washing hands during Covid-19	Continuous
Independent Variables Related to Future Behaviors		
chkleavehome	1 if respondent has to leave home within 5 days of answering survey, else 0	Binary
leavehome_reason_work	1 if respondent has to leave home for work, else 0	Binary
leavehome_reason_pet	1 if respondent has to leave home to walk a pet, else 0	Binary
leavehome_reason_physical	1 if respondent has to leave home for physical exercise, else 0	Binary
leavehome_reason_food	1 if respondent has to leave home to purchase food, else 0	Binary
leavehome_reason_pharmacy	1 if respondent has to leave home to drop by the pharmacy, else 0	Binary
leavehome_reason_hospital	1 if respondent has to leave home to go to the hospital, else 0	Binary
leavehome_reason_care	1 if respondent has to leave home to care for a family member, else 0	Binary
leavehome_reason_friends	1 if respondent has to leave home to visit his or her friend(s), else 0	Binary
leavehome_reason_tired	1 if respondent has to leave home because of tiredness at home, else 0	Binary
leavehome_reason_bored	1 if respondent has to leave home because of getting bored at home, else 0	Binary
leavehome_reason_adrenaline	1 if respondent has to leave home because of adrenaline from staying at home, else 0	Binary
leavehome_reason_freedom	1 if respondent has to leave home to feel free from lockdown, else 0	Binary
leavehome_reason_other	1 if respondent has to leave home for other reasons, else 0	Binary
Independent Variables Related to Covid-19 Cases		
covid_confirmed	Confirmed Covid-19 cases in the respondent's country as of survey response date	Continuous
covid_death	Confirmed Covid-19 deaths in the respondent's country as of survey response date	Continuous
covid_recovered	Confirmed Covid-19 recoveries in the respondent's country as of survey response date	Continuous
covid_recoveryrate (*calculated*)	Covid-19 recovery rate in the respondent's country as of survey response date	Continuous
stringencyindex	Overall restriction level index in the respondent's country as at survey response date	Continuous

As summarized in Table 1 above, the data contains seven potential dependent variables and 44 potential independent variables across different themes. The dependent variables *anxiety_1* through *anxiety_5* represent binary variables that capture different types of COVID-19 related anxiety. Three calculated variables are added to the original data. First, the dependent variable *anxiety_any* represents whether an individual feels at least one out of the five types of anxiety. Second, the dependent variable *anxiety_all* represents whether an individual feels all five types of anxieties. Third, the independent variable *covid_recoveryrate* represents the ratio of recovered cases to total confirmed cases in the respondent's country when the response was recorded. The recovery rate of cases is arguably a more indicative measure compared to the raw number of confirmed cases or recoveries as it measures how efficiently a country is coping up with the pandemic at any point in time.

3.2. HIGH-LEVEL SUMMARY STATISTICS

The table below summarizes the overall descriptive statistics of the variables. Notable values are highlighted in pale red.

Table 2. Overall Summary Statistics

Variable	Mean	Std Dev	Minimum	Maximum	N	Missing
anxiety_1	0.74	0.44	0	1	113083	0
anxiety_2	0.42	0.49	0	1	113083	0
anxiety_3	0.55	0.50	0	1	113083	0
anxiety_4	0.89	0.31	0	1	113083	0
anxiety_5	0.53	0.50	0	1	113083	0
anxiety_any	0.96	0.21	0	1	113083	0
anxiety_all	0.21	0.41	0	1	113083	0
age	38.85	13.04	18	110	113083	0
education	16.36	4.67	0	25	113083	0
income	1469868	44427442	0	10000000000	113083	0
male	0.43	0.50	0	1	113083	0
married	0.57	0.49	0	1	113083	0
hhmember	2.93	1.72	0	30	113083	0
poorhealth	0.00	0.00	0	0	113083	0
depression	5.73	5.12	0	24	113083	0
extroverted	3.40	1.79	0	6	113083	0
critical	2.77	1.77	0	6	113083	0
selfdisciplined	4.44	1.33	0	6	113083	0
anxious	2.68	1.84	0	6	113083	0
newexperiences	3.12	1.81	0	6	113083	0
reserved	4.56	1.23	0	6	113083	0
sympathetic	2.03	1.71	0	6	113083	0
calm	3.99	1.52	0	6	113083	0
conventional	2.08	1.60	0	6	113083	0
perceivreacinsuf	0.59	0.49	0	1	113071	12
govdistrust	0.45	0.50	0	1	113059	24
govfactuntruth	0.41	0.49	0	1	113050	33
pubperceivreacinsuf	0.68	0.47	0	1	113083	0

socdistmeasne	0.05	0.23	0	1	113083	0
beh_stayhome	80.53	24.57	0	100	113083	0
beh_socgathering	90.95	23.35	0	100	113083	0
beh_distance	75.79	27.69	0	100	113083	0
beh_tellsymp	93.07	18.55	0	100	113083	0
beh_handwash	91.90	19.20	0	100	113083	0
chkleavehome	0.60	0.49	0	1	113083	0
leavehome_reason_work	0.229	0.42	0	1	113083	0
leavehome_reason_pet	0.084	0.28	0	1	113083	0
leavehome_reason_physical	0.217	0.41	0	1	113083	0
leavehome_reason_food	0.504	0.50	0	1	113083	0
leavehome_reason_pharmacy	0.156	0.36	0	1	113083	0
leavehome_reason_hospital	0.050	0.22	0	1	113083	0
leavehome_reason_care	0.073	0.26	0	1	113083	0
leavehome_reason_friends	0.049	0.22	0	1	113083	0
leavehome_reason_tired	0.089	0.29	0	1	113083	0
leavehome_reason_bored	0.040	0.20	0	1	113083	0
leavehome_reason_adrenaline	0.002	0.04	0	1	113083	0
leavehome_reason_freedom	0.021	0.14	0	1	113083	0
leavehome_reason_other	0.056	0.23	0	1	113083	0
covid_confirmed	15349	33839	0	636350	112824	259
covid_death	444	1447	0	28326	112824	259
covid_recovered	1668	6919	0	78311	112824	259
covid_recoveryrate	0.06	0.10	0	1.00	112793	290
stringencyindex	70.48	15.84	0	185.71	103153	9930

Upon inspection, there are some issues with the data. The dataset contains 113,083 observations; however, the last five variables in the table contain several missing values that must be dealt with. It is also immediately apparent that the variable *income* contains inaccurate extreme values based on its mean, standard deviation, and maximum value. Moreover, the variable *poorhealth* has a mean and standard deviation of zero, so it will be dropped from the models. These errors must be dealt with as they can be detrimental to the model.

Looking at the demographic variables, the summary statistics reveal that the average age of respondents is close to 39 and the average years of education is 16. Moreover, 43% of respondents are male and 57% are married. On average, respondents reported having three household members in the family. In regards to perceptions, 59% think that the government response to the pandemic is insufficient in their country and 68% believe that the public response to the pandemic is insufficient. It is interesting to see that only 5% deemed social distancing measures as insufficient. This may hint that individuals find the measures to be strict, which may, in turn, induce anxiety as studied later on. Lastly, it is notable that the average recovery rate is 6%; however, this number is influenced by the fact that the survey was conducted in the early stages of the pandemic when the number of recoveries relative to confirmed cases were much lower.

Looking at the dependent variables that measure anxiety, some interesting proportions can be noted. Figure 1 below summarizes the sample means of these variables.

Figure 1. Overview of COVID-19 related Anxiety Dependent Variables
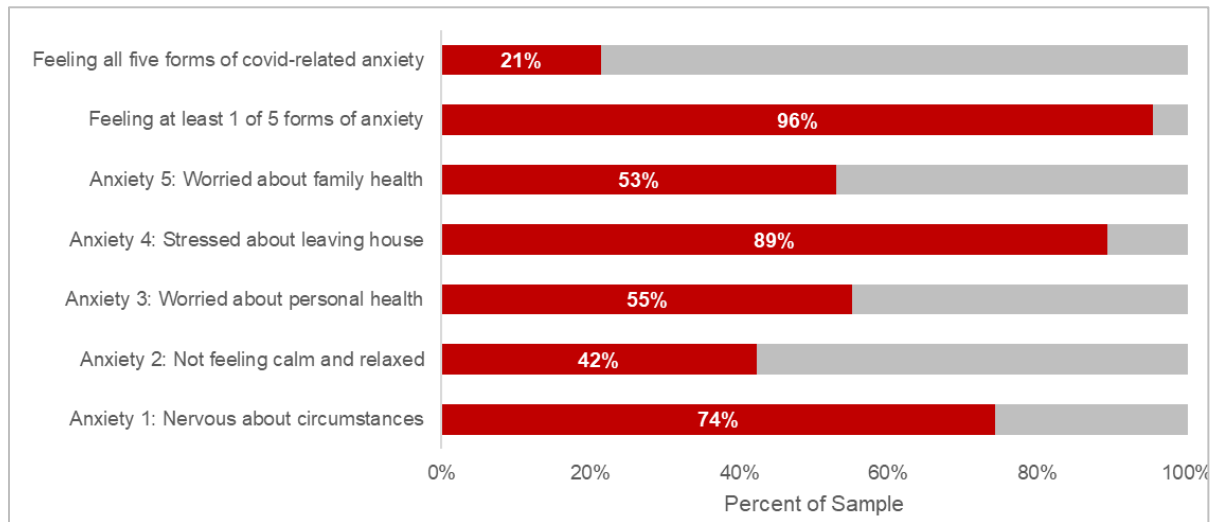
Perhaps the most striking observation from the figure above is that 96% of respondents reported feeling at least one type of anxiety. In addition, 21% of the respondents reported feeling all five types of anxiety in response to COVID-19. Around half of the sample reported feeling anxious about family health (53%) or personal health (55%). 74% reported feeling anxious about current circumstances. A good 89% felt anxious about leaving the house which hints towards general fear and uncertainty to go out of the house because of the pandemic.

3.3. DATA CLEANING

Based on the issues noted above, the process of removing outliers, handling missing values, and dealing with duplicates is performed.

Handling missing values:

Missing values are removed from the following variables: *covid_confirmed, covid_death, covid_recovered, covid_recoveryrate, and stringencyindex*, using the SAS code below (also in found in Appendix B).

```
/*Handling Missing Values*/
data covidanxietydata;
set covidanxietydata;
if cmiss(of _all_) then delete;
run;
```

Removing outliers:

Based on the descriptive statistics, it was noted that the variable income has extreme outliers. This is validated by looking at the distribution as shown in the boxplot below.

Figure 2. Boxplot of Income Showing Extreme Outlier
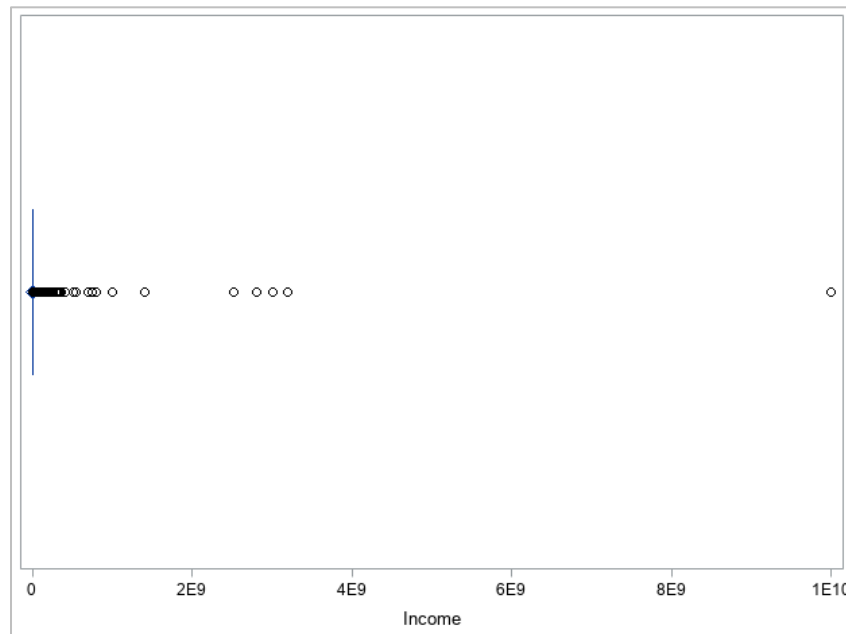
The distribution is extremely skewed and there are several large outliers. Outliers are removed by dropping any rows with a monthly household income of more than $2,000,000 which is the 95th percentile value.

```
data covidanxietydata;
set covidanxietydata;
if income > 2000000 then delete;
run;
```

Figure 3. Descriptive Statistics for Income Variable (Outliers removed)

Analysis Variable : income				
Sum	Mean	Minimum	Maximum	N
6369090935	65291.87	0	2000000.00	97548

After the outliers are removed, the new mean income is $65,292. While technically there still remain outliers, these will be retained to maintain a sizable sample and robust model.

Checking for duplicates:

```
proc sort data = covidanxietydata nodupkey;
by _all_;
run;
```

Lastly, any duplicate records found in the dataset are checked and removed using the code above. However, no duplicate rows were found. After all the cleaning procedures, the resulting data contains 97,548 observations.

3.4. SUBSAMPLE ANALYSIS

Subsample analysis is carried out on the two possible binary outcomes for each of the dependent variables to get a clearer understanding of patterns in the data.

Table 3. Subsample Analysis by Anxiety_all dependent variable

Variable	Anxiety_all = 1		Anxiety_all = 0	
	Mean	Std. Dev	Mean	Std. Dev
age	39.27	12.65	39.34	13.23
education	16.68	4.66	16.28	4.80
income	60674	174750	66575	192450
male	0.32	0.47	0.47	0.50
married	0.59	0.49	0.57	0.49
hhmember	2.90	1.59	2.88	1.73
depression	8.37	5.80	5.03	4.71
extroverted	3.28	1.86	3.46	1.78
critical	2.95	1.80	2.73	1.76
selfdisciplined	4.47	1.34	4.45	1.33
anxious	3.50	1.77	2.45	1.80
newexperiences	3.22	1.84	3.09	1.81
reserved	4.67	1.22	4.54	1.23
sympathetic	2.05	1.76	2.06	1.71
calm	3.57	1.62	4.13	1.47
conventional	2.09	1.64	2.07	1.60
perceivreacinsuf	0.77	0.42	0.56	0.50
govdistrust	0.60	0.49	0.41	0.49
govfactuntruth	0.55	0.50	0.37	0.48
pubperceivreacinsuf	0.81	0.39	0.66	0.47
socdistmeasne	0.05	0.23	0.05	0.22
beh_stayhome	83.23	22.39	80.71	24.04
beh_socgathering	92.95	21.33	90.92	23.20
beh_distance	78.49	26.18	76.08	27.40
beh_tellsymp	94.35	17.26	93.17	18.39
beh_handwash	95.45	14.06	91.21	19.92
chkleavehome	0.55	0.50	0.60	0.49
lhreason_work	0.19	0.39	0.22	0.41
lhreason_pet	0.08	0.27	0.09	0.28
lhreason_physical	0.17	0.37	0.24	0.43
lhreason_food	0.45	0.50	0.51	0.50
lhreason_pharmacy	0.16	0.37	0.14	0.35
lhreason_hospital	0.05	0.21	0.04	0.20
lhreason_care	0.06	0.24	0.07	0.26
lhreason_friends	0.02	0.15	0.05	0.22
lhreason_tired	0.06	0.23	0.10	0.29
lhreason_bored	0.02	0.15	0.04	0.20
lhreason_adrenaline	0.00	0.02	0.00	0.04
lhreason_freedom	0.01	0.09	0.02	0.14
lhreason_other	0.05	0.21	0.06	0.23
covid_confirmed	14321	27058	16061	27817
covid_death	366	969	432	1143
covid_recovered	772	3483	1688	6474
covid_recoveryrate	0.03	0.06	0.05	0.09
stringencyindex	70.36	14.73	70.26	16.19

Looking at the highlighted values in the table above, the mean income of respondents who reported feeling all types of anxieties is lower than those who reported not feeling all types of anxieties. In addition, those feeling all types of anxieties were less likely to be male. In terms of personality, those feeling all types of anxieties have a higher mean depression score, higher mean

general anxiety score, and lower mean calmness score. Finally, those who checked all five types of anxieties were more critical of the government and public response to the pandemic and showed less trust in the government's actions overall.

Table 4. Subsample Analysis by Anxiety_any dependent variable

Variable	Anxiety_any = 1		Anxiety_any = 0	
	Mean	Std. Dev	Mean	Std. Dev
age	39.18	13.05	42.43	13.92
education	16.39	4.76	15.79	4.82
income	65455	189441	61828	173596
male	0.43	0.49	0.56	0.50
married	0.58	0.49	0.61	0.49
hhmember	2.89	1.70	2.85	1.72
depression	5.89	5.18	2.96	3.54
extroverted	3.41	1.80	3.62	1.71
critical	2.79	1.77	2.38	1.74
selfdisciplined	4.45	1.34	4.52	1.27
anxious	2.73	1.84	1.44	1.54
newexperiences	3.13	1.82	2.72	1.80
reserved	4.58	1.23	4.33	1.27
sympathetic	2.07	1.73	1.86	1.64
calm	3.99	1.52	4.54	1.31
conventional	2.08	1.61	1.96	1.55
perceivreacinsuf	0.62	0.49	0.27	0.44
govdistrust	0.46	0.50	0.24	0.42
govfactuntruth	0.42	0.49	0.21	0.41
pubperceivreacinsuf	0.71	0.46	0.40	0.49
socdistmeasne	0.05	0.22	0.09	0.28
beh_stayhome	81.62	23.35	73.58	29.30
beh_socgathering	91.62	22.56	85.86	27.29
beh_distance	76.86	26.96	71.19	30.55
beh_tellsymp	93.61	17.86	89.52	23.23
beh_handwash	92.57	18.19	82.80	28.37
chkleavehome	0.59	0.49	0.69	0.46
lhreason_work	0.209	0.41	0.310	0.46
lhreason_pet	0.084	0.28	0.103	0.30
lhreason_physical	0.221	0.41	0.329	0.47
lhreason_food	0.495	0.50	0.587	0.49
lhreason_pharmacy	0.149	0.36	0.107	0.31
lhreason_hospital	0.044	0.21	0.041	0.20
lhreason_care	0.068	0.25	0.068	0.25
lhreason_friends	0.041	0.20	0.086	0.28
lhreason_tired	0.084	0.28	0.136	0.34
lhreason_bored	0.037	0.19	0.079	0.27
lhreason_adrenaline	0.001	0.03	0.005	0.07
lhreason_freedom	0.017	0.13	0.051	0.22
lhreason_other	0.054	0.23	0.076	0.27
covid_confirmed	15442	27478	20790	30902
covid_death	413	1095	511	1346
covid_recovered	1373	5515	3949	11783
covid_recoveryrate	0.04	0.08	0.07	0.15
stringencyindex	70.38	15.78	68.04	17.81

Unlike in the first subsample analysis, the mean income of respondents who reported feeling any one of the five types of anxiety is higher than those who reported not feeling any type of anxiety. Those feeling any anxiety at all were also more likely to be female. They also had a lower mean age compared to those not feeling any type of anxiety. One reason could be that anxiety tends

to change with age (Hyland et al, 2020). However, this is further validated for statistical significance later in the models. Lastly, those who did not feel any type of anxiety generally came from countries where the recovery rate was higher and the stringency index was lower.

Table 5. Subsample Analysis by Anxiety_1 dependent variable

Variable	Anxiety_1 = 1		Anxiety_1 = 0	
	Mean	Std. Dev	Mean	Std. Dev
age	39.19	12.93	39.71	13.60
education	16.55	4.71	15.81	4.89
income	67871	192466	57714	177198
male	0.40	0.49	0.54	0.50
married	0.58	0.49	0.57	0.50
hhmember	2.91	1.69	2.80	1.74
depression	6.43	5.33	3.79	3.99
extroverted	3.40	1.82	3.50	1.73
critical	2.83	1.78	2.61	1.74
selfdisciplined	4.46	1.34	4.43	1.32
anxious	2.95	1.82	1.86	1.65
newexperiences	3.16	1.83	2.98	1.79
reserved	4.61	1.22	4.43	1.25
sympathetic	2.09	1.74	1.96	1.67
calm	3.90	1.55	4.35	1.38
conventional	2.09	1.62	2.03	1.56
perceivreacinsuf	0.66	0.47	0.42	0.49
govdistrust	0.50	0.50	0.30	0.46
govfactuntruth	0.46	0.50	0.27	0.44
pubperceivreacinsuf	0.74	0.44	0.56	0.50
socdistmeasne	0.05	0.22	0.06	0.24
beh_stayhome	82.00	22.96	79.09	25.67
beh_socgathering	91.94	22.16	89.66	24.59
beh_distance	77.04	26.74	75.35	28.33
beh_tellsymp	93.88	17.49	92.10	19.94
beh_handwash	93.49	16.79	88.15	23.53
chkleavehome	0.57	0.49	0.64	0.48
lhreason_work	0.199	0.40	0.257	0.44
lhreason_pet	0.085	0.28	0.085	0.28
lhreason_physical	0.216	0.41	0.254	0.44
lhreason_food	0.483	0.50	0.545	0.50
lhreason_pharmacy	0.152	0.36	0.133	0.34
lhreason_hospital	0.043	0.20	0.045	0.21
lhreason_care	0.066	0.25	0.076	0.26
lhreason_friends	0.038	0.19	0.058	0.23
lhreason_tired	0.083	0.28	0.098	0.30
lhreason_bored	0.035	0.18	0.050	0.22
lhreason_adrenaline	0.001	0.03	0.002	0.05
lhreason_freedom	0.015	0.12	0.029	0.17
lhreason_other	0.051	0.22	0.065	0.25
covid_confirmed	14268	27075	19840	28925
covid_death	390	1041	498	1281
covid_recovered	974	4527	2999	8766
covid_recoveryrate	0.03	0.07	0.06	0.11
stringencyindex	69.77	15.79	71.79	16.07

The table above shows the subsample analysis by *anxiety_1* variable which indicates whether or not respondents are nervous about current circumstances. Those who were nervous about circumstances were less likely to be male and had a higher mean income, higher mean

depression score, lower mean calm score, stricter perceptions about their government, and belonged to countries with lower recovery rates.

Table 6. Subsample Analysis by Anxiety_2 dependent variable

Variable	Anxiety_2 = 1		Anxiety_2 = 0	
	Mean	**Std. Dev**	**Mean**	**Std. Dev**
age	38.85	12.66	39.68	13.42
education	16.53	4.73	16.24	4.79
income	61100	173567	68434	199328
male	0.36	0.48	0.49	0.50
married	0.59	0.49	0.57	0.49
hhmember	2.87	1.57	2.90	1.79
depression	7.60	5.60	4.38	4.30
extroverted	3.30	1.84	3.51	1.76
critical	2.89	1.77	2.69	1.77
selfdisciplined	4.41	1.36	4.49	1.31
anxious	3.23	1.80	2.26	1.76
newexperiences	3.12	1.84	3.11	1.81
reserved	4.58	1.24	4.55	1.22
sympathetic	2.08	1.74	2.04	1.71
calm	3.63	1.59	4.30	1.39
conventional	2.10	1.62	2.05	1.59
perceivreacinsuf	0.70	0.46	0.53	0.50
govdistrust	0.54	0.50	0.39	0.49
govfactuntruth	0.49	0.50	0.35	0.48
pubperceivreacinsuf	0.76	0.43	0.64	0.48
socdistmeasne	0.05	0.22	0.05	0.22
beh_stayhome	81.59	23.37	81.01	23.96
beh_socgathering	92.23	21.87	90.71	23.49
beh_distance	76.97	26.91	76.33	27.34
beh_tellsymp	93.83	17.77	93.13	18.44
beh_handwash	93.94	16.33	90.77	20.48
chkleavehome	0.58	0.49	0.60	0.49
lhreason_work	0.203	0.40	0.222	0.42
lhreason_pet	0.086	0.28	0.084	0.28
lhreason_physical	0.214	0.41	0.234	0.42
lhreason_food	0.485	0.50	0.510	0.50
lhreason_pharmacy	0.156	0.36	0.141	0.35
lhreason_hospital	0.046	0.21	0.042	0.20
lhreason_care	0.067	0.25	0.069	0.25
lhreason_friends	0.035	0.18	0.049	0.22
lhreason_tired	0.083	0.28	0.090	0.29
lhreason_bored	0.035	0.18	0.042	0.20
lhreason_adrenaline	0.001	0.03	0.002	0.04
lhreason_freedom	0.014	0.12	0.021	0.14
lhreason_other	0.052	0.22	0.057	0.23
covid_confirmed	15368	27524	15918	27764
covid_death	426	1126	412	1094
covid_recovered	1071	4383	1801	6900
covid_recoveryrate	0.03	0.07	0.05	0.09
stringencyindex	69.95	15.29	70.53	16.31

The table above shows the subsample analysis by *anxiety_2* variable which indicates whether or not respondents feel calm or relaxed. A value of 1 indicates that the respondents do not feel calm or relaxed. Those who did not feel calm or relaxed were less likely to be male, had a lower mean income, lower extroversion score, higher depression score, lower calm score, higher general anxiety score, and stricter perceptions about the government.

Table 7. Subsample Analysis by Anxiety_3 dependent variable

Variable	Anxiety_3 = 1		Anxiety_3 = 0	
	Mean	Std. Dev	Mean	Std. Dev
age	39.88	13.43	38.67	12.68
education	16.42	4.71	16.30	4.83
income	65710	192623	64801	184115
male	0.41	0.49	0.47	0.50
married	0.58	0.49	0.58	0.49
hhmember	2.94	1.75	2.83	1.64
depression	6.50	5.45	4.88	4.63
extroverted	3.39	1.81	3.46	1.78
critical	2.86	1.79	2.68	1.76
selfdisciplined	4.46	1.34	4.45	1.33
anxious	3.01	1.83	2.28	1.78
newexperiences	3.21	1.83	3.01	1.81
reserved	4.63	1.22	4.49	1.24
sympathetic	2.06	1.74	2.05	1.70
calm	3.87	1.55	4.18	1.46
conventional	2.08	1.63	2.07	1.58
perceivreacinsuf	0.68	0.47	0.51	0.50
govdistrust	0.52	0.50	0.37	0.48
govfactuntruth	0.48	0.50	0.33	0.47
pubperceivreacinsuf	0.74	0.44	0.63	0.48
socdistmeasne	0.05	0.23	0.05	0.22
beh_stayhome	82.01	23.37	80.38	24.08
beh_socgathering	91.79	22.86	90.86	22.77
beh_distance	76.96	27.21	76.20	27.10
beh_tellsymp	93.83	17.69	92.96	18.68
beh_handwash	93.76	16.67	90.21	21.02
chkleavehome	0.57	0.50	0.62	0.49
lhreason_work	0.206	0.40	0.223	0.42
lhreason_pet	0.081	0.27	0.089	0.28
lhreason_physical	0.180	0.38	0.279	0.45
lhreason_food	0.472	0.50	0.531	0.50
lhreason_pharmacy	0.167	0.37	0.124	0.33
lhreason_hospital	0.051	0.22	0.035	0.18
lhreason_care	0.066	0.25	0.071	0.26
lhreason_friends	0.033	0.18	0.055	0.23
lhreason_tired	0.068	0.25	0.109	0.31
lhreason_bored	0.028	0.17	0.052	0.22
lhreason_adrenaline	0.001	0.03	0.002	0.04
lhreason_freedom	0.013	0.11	0.024	0.15
lhreason_other	0.050	0.22	0.061	0.24
covid_confirmed	14158	27152	17474	28145
covid_death	367	996	478	1224
covid_recovered	1120	4931	1921	6961
covid_recoveryrate	0.04	0.07	0.05	0.09
stringencyindex	70.85	15.13	69.61	16.71

The table above shows the subsample analysis by *anxiety_3* variable which indicates whether or not respondents feel worried about personal health. Those who reported being worried about personal health were less likely to be male, had a higher depression score, higher general anxiety score, and stricter perceptions about the government. Moreover, respondents who were anxious about personal health were less likely to leave home for physical exercise or due to boredom, but more likely to leave home to visit the pharmacy.

Table 8. Subsample Analysis by Anxiety_4 dependent variable

Variable	Anxiety_4 = 1		Anxiety_4 = 0	
	Mean	Std. Dev	Mean	Std. Dev
age	38.96	12.94	42.36	14.03
education	16.40	4.77	16.11	4.78
income	64693	188118	70298	193955
male	0.43	0.49	0.51	0.50
married	0.57	0.49	0.61	0.49
hhmember	2.89	1.69	2.85	1.80
depression	5.96	5.20	4.06	4.42
extroverted	3.41	1.80	3.53	1.78
critical	2.80	1.77	2.53	1.76
selfdisciplined	4.45	1.33	4.46	1.35
anxious	2.76	1.84	1.92	1.74
newexperiences	3.15	1.82	2.84	1.83
reserved	4.59	1.22	4.35	1.31
sympathetic	2.07	1.73	1.93	1.68
calm	3.98	1.52	4.29	1.44
conventional	2.08	1.61	2.02	1.59
perceivreacinsuf	0.63	0.48	0.38	0.49
govdistrust	0.47	0.50	0.31	0.46
govfactuntruth	0.42	0.49	0.28	0.45
pubperceivreacinsuf	0.71	0.45	0.51	0.50
socdistmeasne	0.05	0.22	0.08	0.27
beh_stayhome	81.77	23.23	77.02	27.04
beh_socgathering	91.75	22.45	88.14	25.47
beh_distance	76.93	26.88	73.92	29.28
beh_tellsymp	93.77	17.62	90.60	21.97
beh_handwash	92.84	17.80	86.24	25.44
chkleavehome	0.583	0.49	0.656	0.48
lhreason_work	0.208	0.41	0.259	0.44
lhreason_pet	0.083	0.28	0.100	0.30
lhreason_physical	0.216	0.41	0.310	0.46
lhreason_food	0.492	0.50	0.558	0.50
lhreason_pharmacy	0.151	0.36	0.118	0.32
lhreason_hospital	0.044	0.20	0.043	0.20
lhreason_care	0.069	0.25	0.058	0.23
lhreason_friends	0.040	0.20	0.070	0.26
lhreason_tired	0.081	0.27	0.137	0.34
lhreason_bored	0.035	0.18	0.073	0.26
lhreason_adrenaline	0.001	0.03	0.003	0.06
lhreason_freedom	0.015	0.12	0.043	0.20
lhreason_other	0.053	0.22	0.071	0.26
covid_confirmed	15215	27214	19593	30886
covid_death	409	1087	493	1262
covid_recovered	1306	5223	3012	10113
covid_recoveryrate	0.04	0.07	0.06	0.13
stringencyindex	70.53	15.68	68.21	17.36

The table above shows the subsample analysis by *anxiety_4* variable which indicates whether or not respondents were stressed about leaving the house. Several differences can be observed between those who were stressed about leaving the house versus those who weren't. The former subsample had a lower mean age, lower mean income, higher mean depression score, higher mean anxious score, lower mean calmness score, higher likelihood of not trusting in the government, and belonged to more countries with higher stringency index. The said group was also more stressed about leaving home for pharmacy, but interestingly less stressed about leaving home for other reasons.
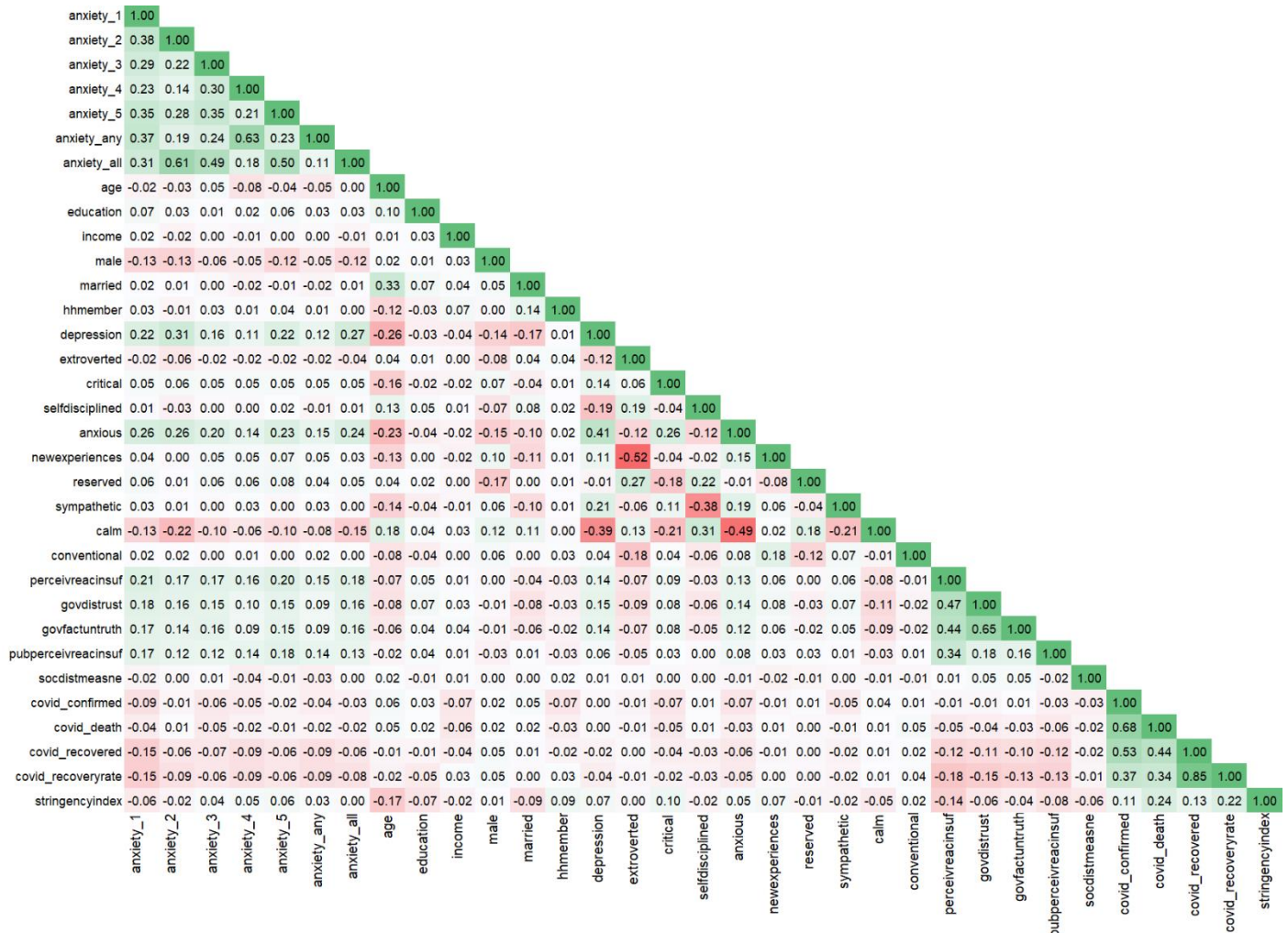
Table 9. Subsample Analysis by Anxiety_5 dependent variable

Variable	Anxiety_5 = 1		Anxiety_5 = 0	
	Mean	Std. Dev	Mean	Std. Dev
age	38.81	12.78	39.90	13.44
education	16.61	4.72	16.08	4.81
income	65174	189603	65425	187801
male	0.38	0.48	0.50	0.50
married	0.58	0.49	0.58	0.49
hhmember	2.95	1.75	2.82	1.64
depression	6.82	5.45	4.57	4.51
extroverted	3.38	1.83	3.47	1.76
critical	2.86	1.79	2.68	1.75
selfdisciplined	4.48	1.35	4.42	1.32
anxious	3.07	1.81	2.22	1.77
newexperiences	3.23	1.83	2.99	1.80
reserved	4.66	1.22	4.46	1.24
sympathetic	2.05	1.74	2.06	1.70
calm	3.87	1.56	4.18	1.45
conventional	2.07	1.63	2.08	1.58
perceivreacinsuf	0.69	0.46	0.50	0.50
govdistrust	0.52	0.50	0.37	0.48
govfactuntruth	0.48	0.50	0.33	0.47
pubperceivreacinsuf	0.77	0.42	0.61	0.49
socdistmeasne	0.05	0.22	0.06	0.23
beh_stayhome	84.47	21.16	77.64	25.81
beh_socgathering	93.11	21.00	89.39	24.57
beh_distance	79.22	25.60	73.66	28.54
beh_tellsymp	94.27	17.04	92.48	19.30
beh_handwash	94.31	15.68	89.68	21.67
chkleavehome	0.539	0.50	0.649	0.48
lhreason_work	0.172	0.38	0.262	0.44
lhreason_pet	0.074	0.26	0.097	0.30
lhreason_physical	0.174	0.38	0.284	0.45
lhreason_food	0.449	0.50	0.555	0.50
lhreason_pharmacy	0.150	0.36	0.144	0.35
lhreason_hospital	0.043	0.20	0.045	0.21
lhreason_care	0.059	0.24	0.078	0.27
lhreason_friends	0.026	0.16	0.062	0.24
lhreason_tired	0.063	0.24	0.113	0.32
lhreason_bored	0.024	0.15	0.056	0.23
lhreason_adrenaline	0.001	0.03	0.002	0.05
lhreason_freedom	0.010	0.10	0.028	0.17
lhreason_other	0.049	0.22	0.062	0.24
covid_confirmed	15256	28075	16163	27183
covid_death	403	1062	434	1157
covid_recovered	1136	4947	1885	6913
covid_recoveryrate	0.04	0.07	0.05	0.09
stringencyindex	71.24	15.27	69.19	16.49

The table above shows the subsample analysis by anxiety_5 variable which indicates whether or not respondents were worried about family health. Those who were worried about family health were less likely to be male, had a higher depression score, higher anxiety score, lower calmness score, stricter perceptions about the government, and belonged to countries with higher stringency index. They were also more likely to stay home based on past behaviors and less likely to leave home for errands or other reasons. Overall, all the subsample analyses generally show similar results as to which independent variables differ most between the 0 or 1 values of the binary anxiety variables. This provides a strong rationale to further investigate these effects statistically.

3.5. CORRELATION MATRIX

Figure 3. Correlation Matrix of Selected Variables

	anxiety_1	anxiety_2	anxiety_3	anxiety_4	anxiety_5	anxiety_any	anxiety_all	age	education	income	male	married	hhmember	depression	extroverted	critical	selfdisciplined	anxious	newexperiences	reserved	sympathetic	calm	conventional	perceivreacinsuf	govdistrust	govfactuntruth	pubperceivreacinsuf	socdistmeasne	covid_confirmed	covid_death	covid_recovered	covid_recoveryrate	stringencyindex
anxiety_1	1.00																																
anxiety_2	0.38	1.00																															
anxiety_3	0.29	0.22	1.00																														
anxiety_4	0.23	0.14	0.30	1.00																													
anxiety_5	0.35	0.28	0.35	0.21	1.00																												
anxiety_any	0.37	0.19	0.24	0.63	0.23	1.00																											
anxiety_all	0.31	0.61	0.49	0.18	0.50	0.11	1.00																										
age	-0.02	-0.03	0.05	-0.08	-0.04	-0.05	0.00	1.00																									
education	0.07	0.03	0.01	0.02	0.06	0.03	0.03	0.10	1.00																								
income	0.02	-0.02	0.00	-0.01	0.00	0.00	-0.01	0.01	0.03	1.00																							
male	-0.13	-0.13	-0.06	-0.05	-0.12	-0.05	-0.12	0.02	0.01	0.03	1.00																						
married	0.02	0.01	0.00	-0.02	-0.01	-0.02	0.01	0.33	0.07	0.04	0.05	1.00																					
hhmember	0.03	-0.01	0.03	0.01	0.04	0.01	0.00	-0.12	-0.03	0.07	0.00	0.14	1.00																				
depression	0.22	0.31	0.16	0.11	0.22	0.12	0.27	-0.26	-0.03	-0.04	-0.14	-0.17	0.01	1.00																			
extroverted	-0.02	-0.06	-0.02	-0.02	-0.02	-0.02	-0.04	0.04	0.01	0.00	-0.08	0.04	0.04	-0.12	1.00																		
critical	0.05	0.06	0.05	0.05	0.05	0.05	0.05	-0.16	-0.02	-0.02	0.07	-0.04	0.01	0.14	0.06	1.00																	
selfdisciplined	0.01	-0.03	0.00	0.00	0.02	-0.01	0.01	0.13	0.05	0.01	-0.07	0.08	0.02	-0.19	0.19	-0.04	1.00																
anxious	0.26	0.26	0.20	0.14	0.23	0.15	0.24	-0.23	-0.04	-0.02	-0.15	-0.10	0.02	0.41	-0.12	0.26	-0.12	1.00															
newexperiences	0.04	0.00	0.05	0.05	0.07	0.05	0.03	-0.13	0.00	-0.02	0.10	-0.11	0.01	0.11	-0.52	-0.04	-0.02	0.15	1.00														
reserved	0.06	0.01	0.06	0.06	0.08	0.04	0.05	0.04	0.02	0.00	-0.17	0.00	0.01	-0.01	0.27	-0.18	0.22	-0.01	-0.08	1.00													
sympathetic	0.03	0.01	0.00	0.03	0.00	0.03	0.00	-0.14	-0.04	-0.01	0.06	-0.10	0.01	0.21	-0.06	0.11	-0.38	0.19	0.06	-0.04	1.00												
calm	-0.13	-0.22	-0.10	-0.06	-0.10	-0.08	-0.15	0.18	0.04	0.03	0.12	0.11	0.00	-0.39	0.13	-0.21	0.31	-0.49	0.02	0.18	-0.21	1.00											
conventional	0.02	0.02	0.00	0.01	0.00	0.02	0.00	-0.08	-0.04	0.00	0.06	0.00	0.03	0.04	-0.18	0.04	-0.06	0.08	0.18	-0.12	0.07	-0.01	1.00										
perceivreacinsuf	0.21	0.17	0.17	0.16	0.20	0.15	0.18	-0.07	0.05	0.01	0.00	-0.04	-0.03	0.14	-0.07	0.09	-0.03	0.13	0.06	0.00	0.06	-0.08	-0.01	1.00									
govdistrust	0.18	0.16	0.15	0.10	0.15	0.09	0.16	-0.08	0.07	0.03	-0.01	-0.08	-0.03	0.15	-0.09	0.08	-0.06	0.14	0.08	-0.03	0.07	-0.11	-0.02	0.47	1.00								
govfactuntruth	0.17	0.14	0.16	0.09	0.15	0.09	0.16	-0.06	0.04	0.04	-0.01	-0.06	-0.02	0.14	-0.07	0.08	-0.05	0.12	0.06	-0.02	0.05	-0.09	-0.02	0.44	0.65	1.00							
pubperceivreacinsuf	0.17	0.12	0.12	0.14	0.18	0.14	0.13	-0.02	0.04	0.01	-0.03	0.01	-0.03	0.06	-0.05	0.03	0.00	0.08	0.03	0.03	0.01	-0.03	0.01	0.34	0.18	0.16	1.00						
socdistmeasne	-0.02	0.00	0.01	-0.04	-0.01	-0.03	0.00	0.02	-0.01	0.01	0.00	0.00	0.02	0.01	0.01	0.00	0.00	-0.01	-0.02	-0.01	0.00	-0.01	-0.01	0.01	0.05	0.05	-0.02	1.00					
covid_confirmed	-0.09	-0.01	-0.06	-0.05	-0.02	-0.04	-0.03	0.06	0.03	-0.07	0.02	0.05	-0.07	0.00	-0.01	-0.07	0.01	-0.07	-0.01	0.01	-0.05	0.04	0.01	-0.01	-0.01	0.01	-0.03	-0.03	1.00				
covid_death	-0.04	0.01	-0.05	-0.02	-0.01	-0.02	-0.02	0.05	0.02	-0.06	0.02	0.02	-0.03	0.00	-0.01	-0.05	0.01	-0.03	0.01	0.00	-0.01	0.01	0.05	-0.05	-0.04	-0.03	-0.06	-0.02	0.68	1.00			
covid_recovered	-0.15	-0.06	-0.07	-0.09	-0.06	-0.09	-0.06	-0.01	-0.01	-0.04	0.05	0.01	-0.02	-0.02	0.00	-0.04	-0.03	-0.06	-0.01	0.00	-0.02	0.01	0.02	-0.12	-0.11	-0.10	-0.12	-0.02	0.53	0.44	1.00		
covid_recoveryrate	-0.15	-0.09	-0.06	-0.09	-0.06	-0.09	-0.08	-0.02	-0.05	0.03	0.05	0.00	0.03	-0.04	-0.01	-0.02	-0.03	-0.05	0.00	0.00	-0.02	0.01	0.04	-0.18	-0.15	-0.13	-0.13	-0.01	0.37	0.34	0.85	1.00	
stringencyindex	-0.06	-0.02	0.04	0.05	0.06	0.03	0.00	-0.17	-0.07	-0.02	0.01	-0.09	0.09	0.07	0.00	0.10	-0.02	0.05	0.07	-0.01	-0.02	-0.05	0.02	-0.14	-0.06	-0.04	-0.08	-0.06	0.11	0.24	0.13	0.22	1.00

Some observations from the correlation matrix include:

- There are moderate correlations among the different binary anxiety variables. Among the five different anxiety types, anxiety_2, which represents respondents who reported not feeling calm or relaxed, is most correlated with anxiety_all, which represents respondents who felt all five types of anxiety.
- Age appears to be negatively associated with depression and anxiety, but positively associated with calmness and self-discipline.
- Among personality traits, there are some moderate correlations. Depression is positively correlated with anxiousness, calmness is negatively associated with depression and general anxiousness, sympathy is negatively associated with self-discipline, and extroversion is negatively associated with openness to new experiences.
- Overall, there is no major concern regarding multicollinearity issues.

4. DATA ANALYSIS AND RESULTS

In order to analyze factors affecting COVID-19 related anxiety, it is useful to first see the effects of various independent variables on any type of anxiety. As such, the first model (Model 0) takes the variable *anxiety_any* as the dependent variable and the listed variables below (in bold) as independent variables. The results are summarized in Table 10 below.

Table 10. Results of Model 0: Anxiety_any as dependent variable

Variable	Estimate	Std. Error	Pr > ChiSq	Avg Marginal Effect
Intercept	-1.633	0.186	<.0001	
age	-0.004	0.001	0.010	-0.014%
education	0.019	0.003	<.0001	0.073%
income	0.000	0.000	0.008	0.001%
male	-0.234	0.035	<.0001	-0.899%
married	0.107	0.037	0.004	0.413%
hhmember	0.002	0.010	0.856	0.007%
depression	0.104	0.006	<.0001	0.400%
extroverted	0.002	0.012	0.885	0.007%
critical	0.024	0.010	0.018	0.092%
selfdisciplined	0.002	0.015	0.887	0.008%
anxious	0.257	0.013	<.0001	0.990%
newexperiences	0.049	0.011	<.0001	0.190%
reserved	0.147	0.014	<.0001	0.565%
sympathetic	-0.023	0.011	0.039	-0.087%
calm	-0.051	0.015	0.001	-0.196%
conventional	0.024	0.011	0.029	0.092%
perceivreacinsuf	0.741	0.043	<.0001	2.853%
govdistrust	0.217	0.050	<.0001	0.835%
govfactuntruth	0.223	0.051	<.0001	0.857%
pubperceivreacinsuf	0.664	0.036	<.0001	2.556%
socdistmeasne	-0.334	0.063	<.0001	-1.287%
beh_stayhome	0.003	0.001	0.000	0.011%
beh_socgathering	0.000	0.001	0.761	-0.001%
beh_distance	0.002	0.001	0.004	0.008%
beh_tellsymp	0.004	0.001	<.0001	0.015%
beh_handwash	0.013	0.001	<.0001	0.049%
chkleavehome	0.046	0.069	0.509	0.176%
lhreason_work	-0.063	0.045	0.161	-0.243%
lhreason_pet	-0.090	0.057	0.112	-0.347%
lhreason_physical	-0.133	0.042	0.002	-0.510%
lhreason_food	-0.068	0.058	0.241	-0.260%
lhreason_pharmacy	0.352	0.055	<.0001	1.356%
lhreason_hospital	-0.087	0.084	0.303	-0.334%
lhreason_care	0.221	0.067	0.001	0.852%
lhreason_friends	-0.121	0.069	0.078	-0.465%
lhreason_tired	-0.120	0.060	0.045	-0.461%
lhreason_bored	-0.119	0.077	0.126	-0.456%
lhreason_adrenaline	-0.479	0.289	0.097	-1.844%
lhreason_freedom	-0.193	0.093	0.037	-0.742%
lhreason_other	-0.248	0.066	0.000	-0.955%
covid_confirmed	0.000	0.000	<.0001	-0.018%
covid_death	0.000	0.000	0.006	0.020%
covid_recoveryrate	-1.427	0.143	<.0001	-5.493%
stringencyindex	0.007	0.001	<.0001	0.026%
AIC (Intercept & Covariates)	29343			
Wald Test	5168 (P<0.001)			
% Concordant (Area under ROC curve)	82.4%			*Independent variables in bold*

The model is significant with an AIC of 29343 and Wald's test p-value of less than 0.001. In addition, ROC curve analysis is one of the most effective ways to evaluate logistic regression models (Mandrekar, 2010). The area under the ROC curve for Model 0 is 82.4%, which indicates a decent model. The ROC curve plot for this model and all models to follow can be found in Appendix B. For interpretation, attention should be drawn to the marginal effects column which is color-coded to show anxiety-increasing effects as red and anxiety-decreasing effects as green. Based on the marginal effects, the following insights can be observed:

- When the respondent's gender is male as opposed to female, the probability of having any type of anxiety is lower by -0.899%. Similar findings were noted by Shevlin et al. (2020) that significantly more females tested positive for COVID-19 related anxiety compared to males.
- Married individuals are 0.413% more likely to feel any type of anxiety as opposed to unmarried individuals.
- Individuals who think that their country's government response to COVID-19 is insufficient are 2.859% more likely to feel any type of anxiety.
- Individuals with higher scores of depression, anxiousness, and reserved in their personality traits are more likely to feel any type of anxiety.
- In terms of behaviors, respondents expecting to leave home to visit the pharmacy are 1.356% more likely to feel any type of anxiety. Those expecting to leave home to care for a family member are 0.852% more likely to feel any type of anxiety. Only these two reasons for leaving home had increasing effects on anxiety; the rest of the variables representing other reasons for leaving home were all associated with lower anxiety. For example, individuals who had to leave home for physical exercise are 0.51% less likely to feel any type of anxiety. Similarly, individuals who had to leave home due to boredom or adrenaline were also less likely to feel any type of anxiety.
- Individuals in countries where the recovery rate is higher are less likely to feel any type of anxiety.

It is evident from Model 0 above that there are several significant factors impacting COVID-19 related anxiety in individuals. However, the effects of these variables could differ across different types of anxiety. Accordingly, the same independent variables must be modeled against each of the five different types of anxieties taken as binary dependent variables. Table 11 below summarizes the coefficient estimates and p-values for Models 1 to 5.

Table 11. Results of Models 1 to 5: Different types of anxieties as dependent variable

Variable	y = Anxiety_1		y = Anxiety_2		y = Anxiety_3		y = Anxiety_4		y = Anxiety_5	
	Estimate	P-value	Estimate	P-value	Estimate	P-value	Estimate	P-value	Estimate	P-value
Intercept	-2.977	<.0001	-2.326	<.0001	-3.822	<.0001	-1.502	<.0001	-4.817	<.0001
age	0.009	<.0001	0.006	<.0001	0.023	<.0001	-0.012	<.0001	0.005	<.0001
education	0.027	<.0001	0.010	<.0001	0.000	0.984	0.010	<.0001	0.021	<.0001
income	0.000	<.0001	0.000	0.005	0.000	0.949	0.000	0.103	0.000	0.082
male	-0.333	<.0001	-0.297	<.0001	-0.054	0.000	-0.124	<.0001	-0.285	<.0001
married	0.235	<.0001	0.270	<.0001	-0.002	0.919	0.083	0.001	0.122	<.0001
hhmember	0.047	<.0001	-0.009	0.041	0.048	<.0001	-0.008	0.254	0.040	<.0001
depression	0.101	<.0001	0.109	<.0001	0.044	<.0001	0.045	<.0001	0.069	<.0001
extroverted	0.011	0.068	-0.052	<.0001	0.030	<.0001	-0.004	0.631	0.012	0.012
critical	-0.007	0.194	-0.017	0.000	0.005	0.247	0.016	0.017	0.001	0.912
selfdisciplined	0.056	<.0001	0.040	<.0001	0.010	0.110	0.011	0.269	0.037	<.0001
anxious	0.255	<.0001	0.161	<.0001	0.166	<.0001	0.147	<.0001	0.182	<.0001
newexperiences	0.014	0.014	-0.067	<.0001	0.047	<.0001	0.037	<.0001	0.041	<.0001
reserved	0.093	<.0001	0.025	0.000	0.081	<.0001	0.146	<.0001	0.088	<.0001
sympathetic	-0.031	<.0001	-0.078	<.0001	-0.048	<.0001	-0.007	0.361	-0.053	<.0001
calm	-0.009	0.200	-0.121	<.0001	-0.025	<.0001	-0.003	0.753	0.018	0.003
conventional	0.029	<.0001	0.018	<.0001	0.009	0.039	0.012	0.099	0.000	0.962
perceivreacinsuf	0.447	<.0001	0.341	<.0001	0.384	<.0001	0.547	<.0001	0.449	<.0001
govdistrust	0.288	<.0001	0.216	<.0001	0.179	<.0001	0.117	0.000	0.144	<.0001
govfactuntruth	0.275	<.0001	0.115	<.0001	0.256	<.0001	0.136	<.0001	0.178	<.0001
pubperceivreacinsuf	0.383	<.0001	0.272	<.0001	0.255	<.0001	0.446	<.0001	0.457	<.0001
socdistmeasne	-0.200	<.0001	-0.070	0.030	0.049	0.120	-0.311	<.0001	-0.019	0.567
beh_stayhome	0.001	0.002	-0.003	<.0001	0.001	0.002	0.001	0.014	0.006	<.0001
beh_socgathering	0.001	0.147	0.001	0.000	-0.001	0.007	0.000	0.731	0.000	0.415
beh_distance	0.002	<.0001	0.001	0.000	-0.001	0.097	0.001	0.105	0.004	<.0001
beh_tellsymp	0.001	0.004	0.000	0.642	0.000	0.421	0.004	<.0001	0.000	0.434
beh_handwash	0.010	<.0001	0.009	<.0001	0.008	<.0001	0.011	<.0001	0.010	<.0001
chkleavehome	0.068	0.056	0.063	0.043	0.205	<.0001	0.110	0.019	0.248	<.0001
lhreason_work	-0.086	0.000	0.018	0.409	0.073	0.001	0.018	0.578	-0.201	<.0001
lhreason_pet	0.003	0.923	-0.040	0.134	-0.083	0.001	-0.122	0.002	-0.229	<.0001
lhreason_physical	0.057	0.012	0.069	0.001	-0.389	<.0001	-0.178	<.0001	-0.373	<.0001
lhreason_food	-0.136	<.0001	-0.041	0.130	-0.196	<.0001	-0.067	0.090	-0.179	<.0001
lhreason_pharmacy	0.131	<.0001	0.016	0.461	0.320	<.0001	0.288	<.0001	0.123	<.0001
lhreason_hospital	-0.176	<.0001	-0.078	0.030	0.295	<.0001	-0.082	0.137	-0.085	0.018
lhreason_care	-0.094	0.004	-0.005	0.865	-0.097	0.001	0.405	<.0001	-0.128	<.0001
lhreason_friends	-0.057	0.158	-0.144	0.000	-0.133	0.000	-0.081	0.105	-0.264	<.0001
lhreason_tired	0.057	0.086	0.002	0.949	-0.165	<.0001	-0.259	<.0001	-0.203	<.0001
lhreason_bored	-0.065	0.165	-0.071	0.104	-0.157	0.000	-0.169	0.002	-0.293	<.0001
lhreason_adrenaline	-0.447	0.031	-0.163	0.438	-0.142	0.477	-0.122	0.593	-0.195	0.389
lhreason_freedom	-0.167	0.006	-0.097	0.105	-0.026	0.650	-0.358	<.0001	-0.208	0.001
lhreason_other	-0.257	<.0001	-0.129	0.000	-0.222	<.0001	-0.214	<.0001	-0.241	<.0001
covid_confirmed	0.000	<.0001	0.000	<.0001	0.000	<.0001	0.000	<.0001	0.000	0.440
covid_death	0.000	<.0001	0.000	<.0001	0.000	<.0001	0.000	0.009	0.000	<.0001
covid_recoveryrate	-1.851	<.0001	-1.345	<.0001	-0.130	0.184	-1.275	<.0001	-0.271	0.007
stringencyindex	-0.007	<.0001	-0.001	0.172	0.009	<.0001	0.009	<.0001	0.008	<.0001
AIC (Intercept & Covariates)	92330		115346		122198		59072		117042	
Wald Test	13437 (P<0.001)		13896 (P<0.001)		10481 (P<0.001)		6494 (P<0.001)		13763 (P<0.001)	
% Concordant (Area under ROC)	77.3%		74.1%		70.0%		73.8%		73.7%	

Based on the model fit statistics, all models are significant. Moreover, the AUC for all models is above 70%. Model 1, which represents anxiety_1 as the dependent variable, has the highest AUC of 77.3%. The ROC curves for all models can be found in Appendix A. To facilitate economic interpretation of the models, the marginal effects are summarized in the table below. Values in red depict numerically positive effects (i.e. undesirable and economically negative) on anxiety whereas values in green depict numerically negative effects (i.e. desirable) on anxiety.

Table 12. Average Marginal Effects for Models 1 to 5

Variable	Anxiety_1	Anxiety_2	Anxiety_3	Anxiety_4	Anxiety_5	Comparison
age	0.144%	0.129%	0.502%	-0.104%	0.093%	
education	0.412%	0.196%	-0.001%	0.082%	0.440%	
income ($1000)	0.006%	-0.002%	0.000%	-0.001%	0.001%	
male	-5.149%	-6.018%	-1.184%	-1.074%	-5.893%	
married	3.621%	5.472%	-0.034%	0.716%	2.529%	
hhmember	0.720%	-0.184%	1.043%	-0.066%	0.830%	
depression	1.558%	2.209%	0.954%	0.388%	1.435%	
extroverted	0.164%	-1.055%	0.652%	-0.032%	0.257%	
critical	-0.101%	-0.343%	0.107%	0.140%	0.010%	
selfdisciplined	0.871%	0.813%	0.210%	0.093%	0.755%	
anxious	3.933%	3.256%	3.615%	1.274%	3.770%	
newexperiences	0.210%	-1.349%	1.017%	0.322%	0.839%	
reserved	1.435%	0.506%	1.762%	1.271%	1.822%	
sympathetic	-0.480%	-1.573%	-1.042%	-0.057%	-1.089%	
calm	-0.142%	-2.455%	-0.546%	-0.026%	0.370%	
conventional	0.446%	0.366%	0.201%	0.103%	0.005%	
perceivreacinsuf	6.894%	6.915%	8.383%	4.748%	9.274%	
govdistrust	4.448%	4.376%	3.901%	1.017%	2.985%	
govfactuntruth	4.246%	2.328%	5.576%	1.180%	3.678%	
pubperceivreacinsuf	5.920%	5.501%	5.565%	3.873%	9.439%	
socdistmeasne	-3.091%	-1.426%	1.065%	-2.696%	-0.387%	
beh_stayhome	0.021%	-0.050%	0.026%	0.012%	0.117%	
beh_socgathering	0.009%	0.027%	-0.021%	0.002%	-0.006%	
beh_distance	0.023%	0.024%	-0.012%	0.007%	0.089%	
beh_tellsymp	0.020%	0.004%	-0.007%	0.034%	-0.007%	
beh_handwash	0.161%	0.176%	0.183%	0.092%	0.213%	
chkleavehome	1.049%	1.271%	4.473%	0.952%	5.130%	
lhreason_work	-1.332%	0.366%	1.589%	0.152%	-4.147%	
lhreason_pet	0.045%	-0.807%	-1.804%	-1.057%	-4.725%	
lhreason_physical	0.876%	1.393%	-8.485%	-1.542%	-7.716%	
lhreason_food	-2.094%	-0.822%	-4.286%	-0.585%	-3.692%	
lhreason_pharmacy	2.029%	0.330%	6.971%	2.497%	2.533%	
lhreason_hospital	-2.720%	-1.583%	6.438%	-0.715%	-1.752%	
lhreason_care	-1.449%	-0.101%	-2.113%	3.512%	-2.638%	
lhreason_friends	-0.887%	-2.912%	-2.896%	-0.702%	-5.458%	
lhreason_tired	0.885%	0.039%	-3.603%	-2.249%	-4.190%	
lhreason_bored	-0.999%	-1.435%	-3.432%	-1.465%	-6.054%	
lhreason_adrenaline	-6.900%	-3.309%	-3.091%	-1.059%	-4.020%	
lhreason_freedom	-2.573%	-1.973%	-0.559%	-3.104%	-4.308%	
lhreason_other	-3.970%	-2.606%	-4.849%	-1.857%	-4.974%	
covid_confirmed (1000s)	-0.128%	-0.046%	-0.051%	-0.035%	-0.006%	
covid_death (100s)	0.215%	0.220%	-0.150%	0.029%	-0.078%	
covid_recoveryrate	-28.577%	-27.254%	-2.841%	-11.060%	-5.605%	
stringencyindex	-0.111%	-0.014%	0.187%	0.075%	0.157%	

The table above unravels several insights relating to how the different variables impact the different types of COVID-19 related anxiety. The marginal effects are expressed as percentages to

indicate percent point increases or decreases in the probability of feeling anxiety per unit increase of each variable. To caveat, Models 1 to 5 are not standardized so the variable scales are not directly comparable to each other. That said, the variables are standardized in the final model (Model 6) to enable relative interpretation of marginal effects. While the table above already visually explains the marginal effects, some selected insights from Models 1 to 5 are summarized below:

- Based on the age variable, older people are more likely to feel anxious especially regarding personal health. Shevlin et al. (2020) found similar results in their study which looked at the UK general population. However, when it comes to anxiety about leaving the house, the effect is reversed and older people are less likely to feel anxious.
- Males are generally less likely to feel COVID-19 related anxiety compared to females. For example, males are 5.149% less likely to feel nervous about current circumstances compared to females. However, this gender differentiation is not as clearly notable for anxiety regarding personal health and anxiety about leaving the house.
- Married individuals are more likely to feel COVID-19 related anxiety compared to unmarried individuals. However, when it comes to anxiety about personal health, being married or not does not have as much of a marginal effect on anxiety.
- Highly educated individuals are more likely to feel anxious about their current circumstances and family's health, relative to other types of anxiety.
- Individuals expecting to leave home for physical exercise are much less likely to feel anxious about personal and family health, but nonetheless still more likely to feel anxious about current circumstances. This is arguably because people who exercise are generally healthier and feel more confident about their health.
- Individuals expecting to leave home to visit the pharmacy or hospital within the next five days are more likely to feel worried about their personal health.
- Individuals with higher scores on the personality traits "depression, "anxious", and "reserved" are more likely to feel COVID-19 related anxiety. This in part coincides with the results of Asmundson et al. (2020) who found that people with pre-existing mental health problems such as depression and anxiety were more adversely impacted by COVID-19.
- Individuals with more critical government perceptions, such as those who deem their country's government response as insufficient, are much more likely to experience COVID-19 related anxiety. In general, variables related to government perceptions have the strongest marginal effects on anxiety versus other factors.
- Among the five different types of anxieties, anxiety about leaving the house is least impacted by the independent variables based on the magnitude of marginal effects. This

implies that – relative to other anxiety types - anxiety related to leaving the house is felt more consistently by different types of people regardless of demographics or behaviors.

- People in countries with higher stringency index are more likely to feel anxious about leaving the house and about personal health, but less likely to feel anxious about current circumstances.

In the next and final model, the *anxiety_all* variable is taken as the dependent variable to understand the "pooled" effects. Moreover, interactions between *income* and *married* variables as well as *age* and *male* variables are added to the model.

Table 13. Results of Model 6: Anxiety_all as dependent variable with Interactions

Variable	Estimate	Std. Error	Pr > ChiSq	Avg Marginal Effect
Intercept	-5.917	0.119	<.0001	
age	0.015	0.001	<.0001	0.213%
male	-0.221	0.057	0.000	-3.140%
age*male	-0.002	0.001	0.119	-0.030%
education	0.012	0.002	<.0001	0.174%
Income (by $1000)	-1.95E-03	0.000	0.005	-0.003%
married	0.227	0.020	<.0001	3.236%
income*married (by $1000)	2.10E-03	0.000	0.027	0.003%
hhmember	0.012	0.005	0.024	0.168%
depression	0.095	0.002	<.0001	1.357%
extroverted	-0.026	0.006	<.0001	-0.370%
critical	-0.008	0.005	0.129	-0.113%
selfdisciplined	0.058	0.007	<.0001	0.825%
anxious	0.205	0.006	<.0001	2.920%
newexperiences	-0.015	0.006	0.008	-0.215%
reserved	0.074	0.008	<.0001	1.047%
sympathetic	-0.081	0.005	<.0001	-1.152%
calm	-0.050	0.007	<.0001	-0.717%
conventional	0.012	0.005	0.024	0.174%
perceivreacinsuf	0.517	0.023	<.0001	7.365%
govdistrust	0.192	0.023	<.0001	2.731%
govfactuntruth	0.232	0.023	<.0001	3.304%
pubperceivreacinsuf	0.405	0.022	<.0001	5.767%
socdistmeasne	-0.023	0.038	0.542	-0.333%
beh_stayhome	0.001	0.000	0.099	0.011%
beh_socgathering	8.58E-06	0.000	0.985	0.000%
beh_distance	0.002	0.000	<.0001	0.034%
beh_tellsymp	-0.001	0.001	0.146	-0.011%
beh_handwash	0.013	0.001	<.0001	0.187%
chkleavehome	0.233	0.037	<.0001	3.321%
lhreason_work	0.030	0.027	0.264	0.430%
lhreason_pet	-0.134	0.033	<.0001	-1.903%
lhreason_physical	-0.263	0.026	<.0001	-3.746%
lhreason_food	-0.148	0.032	<.0001	-2.113%
lhreason_pharmacy	0.128	0.026	<.0001	1.826%
lhreason_hospital	-0.019	0.042	0.657	-0.267%

lhreason_care	-0.125	0.036	0.001	-1.780%
lhreason_friends	-0.314	0.055	<.0001	-4.464%
lhreason_tired	-0.235	0.040	<.0001	-3.342%
lhreason_bored	-0.214	0.061	0.001	-3.043%
lhreason_adrenaline	-0.434	0.341	0.203	-6.181%
lhreason_freedom	-0.225	0.091	0.014	-3.202%
lhreason_other	-0.250	0.042	<.0001	-3.557%
covid_confirmed (1000s)	-1.75E-03	0.000	0.000	-0.025%
covid_death (100s)	4.79E-04	0.000	0.689	0.007%
covid_recoveryrate	-1.695	0.169	<.0001	-24.136%
stringencyindex	0.005	0.001	<.0001	0.065%
AIC (Intercept & Covariates)	86791			
Wald Test	11968 (P<0.001)			
% Concordant (Area under ROC)	76.6%			

The model is significant based on the AIC, Wald test, and AUC of 76.6%. The results are largely consistent with the previous models in terms of the marginal effects of the different factors on COVID-19 related anxiety. The results show that being a male decreases the probability of feeling all types of anxiety by 3.14%. Moreover, being married increases the probability of feeling all types of anxiety by 3.23%. Personality variables such as "depression", "anxious", and "reserved" as well as negative perceptions about the government's pandemic response are again found to be associated with a higher probability of feeling all types of anxiety. It is also notable that respondents expecting to leave home for whatever reason within the next five days are 3.3% more likely to feel all types of COVID-19 related anxiety.

The interaction terms show that income has a different effect on COVID-19 related anxiety for married and unmarried individuals. For unmarried individuals, an increase in income reduces their level of anxiety whereas for married individuals it increases the probability of feeling all types of anxiety, albeit by a small magnitude. This finding aligns with the work of Mann, Krueger, and Vohs (2020) which looked into personal economic anxiety in response to COVID-19. Furthermore, age also has a different impact on anxiety for males versus females. The previous models for the different types of anxieties showed that older people are more likely to feel COVID-19 related anxiety. However, the interaction analysis reveals that this is only true for females. For males, an increase in age slightly decreases the likelihood of feeling all types of COVID-19 related anxiety.

The marginal effect for recovery rate (-24.136%) should be interpreted with caution since one unit of this variable represents 100%. It follows that the marginal effect for every percent increase in recovery rate should be divided by 100, so a unit percentage point increase in recovery rate leads to an effective -0.24% decrease in the probability of feeling all anxiety types. To rule out such scale differences and enable relative interpretation between variables, the average marginal effects on the standardized variables are shown below.

Figure 4. Average Marginal Effects for Model 6 (Standardized Variables)
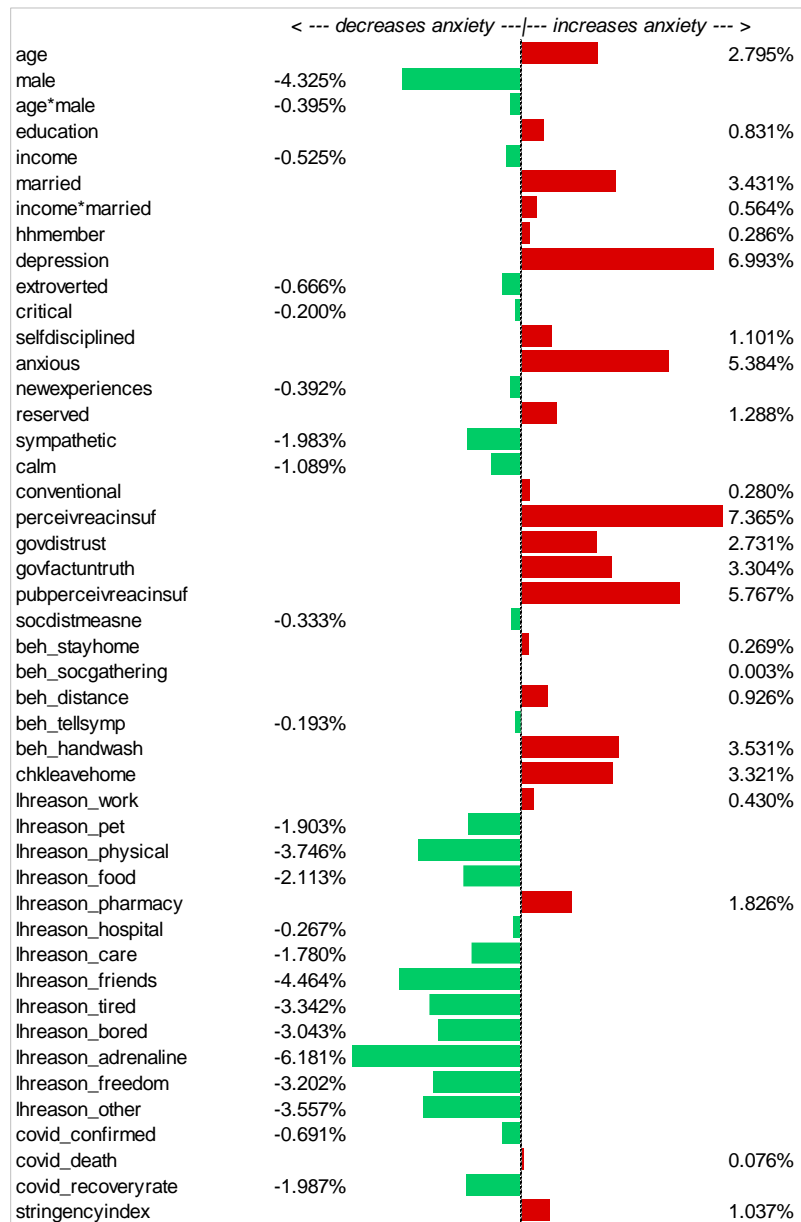
The figure above shows that some of the factors associated with higher levels COVID-19 related anxiety (as indicated by red bars) include: age, being married, a high score on "depression" and "anxious personality traits, frequent handwashing behaviors, beliefs that the government and public response to the pandemic is insufficient, expectation to leave home (especially before visiting the pharmacy), and stringency index. On the flip side, some of the factors associated with lower COVID-19 related anxiety (indicated by green bars) include: being male, having a calm and sympathetic personality, expecting to leave home for any reason other than visiting the pharmacy, and residing in a country with higher recovery rates. Looking at the highest and lowest marginal effects, a negative opinion about the government's response to the pandemic has the strongest

association with higher levels of COVID-19 related anxiety. On the other hand, expectation to leave home due to adrenaline from staying home has the strongest association with lower levels of COVID-19 related anxiety.

What follows are effect plots for Model 6 which help visualize how the predicted probabilities measuring COVID-19 related anxiety change for selected independent variables.

Figure 5. Effect Plot of Age by Gender on Anxiety_all
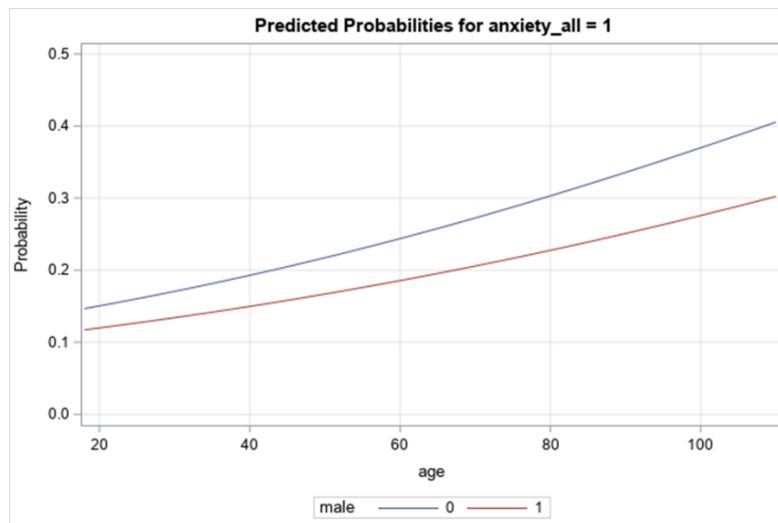
The plot above shows that the probability of feeling all types of COVID-19 related anxiety increases with age in a non-linear fashion. The probabilities are higher and increase more steeply for females (male=0) compared to males (male=1).

Figure 6. Effect Plot of Income by Marital Status on Anxiety_all
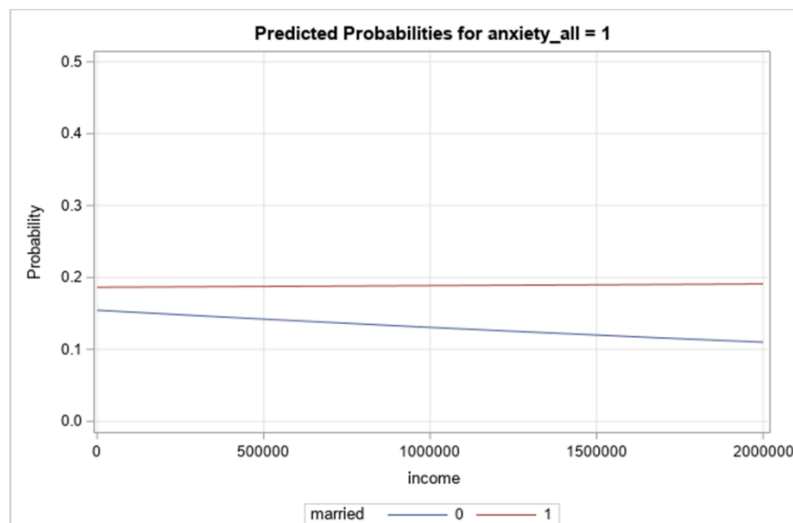
The plot above shows that as income increases, COVID-19 related anxiety decreases for unmarried individuals but modestly increases for married individuals.

Figure 7. Effect Plot of Recovery Rate on Anxiety_all
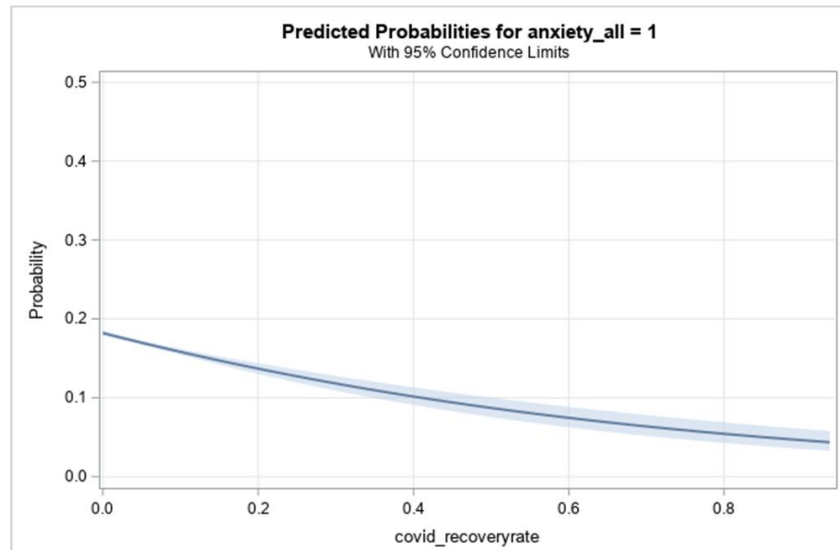
The plot above shows that COVID-19 related anxiety decreases as the recovery rate of COVID-19 cases increases. This makes intuitive sense since the recovery rate measures how well the pandemic is being grappled with and thus a higher recovery rate should relieve some level of anxiety in individuals.

Figure 8. Effect Plot of Stringency Index on Anxiety_all
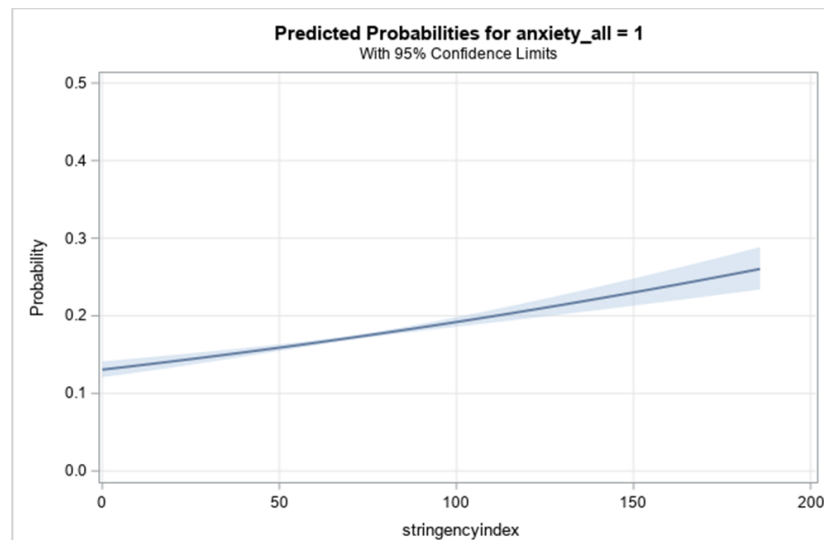
The plot above shows that COVID-19 related anxiety increases as the stringency index increases. This means that as countries impose stricter lockdowns and social distancing measures, the prevalence of anxiety among people also increases. This finding implies that policymakers should consider possible adverse effects on anxiety when devising restrictions and plans in response to the pandemic.

Figure 9. Effect Plot of Handwashing Habits on Anxiety_all
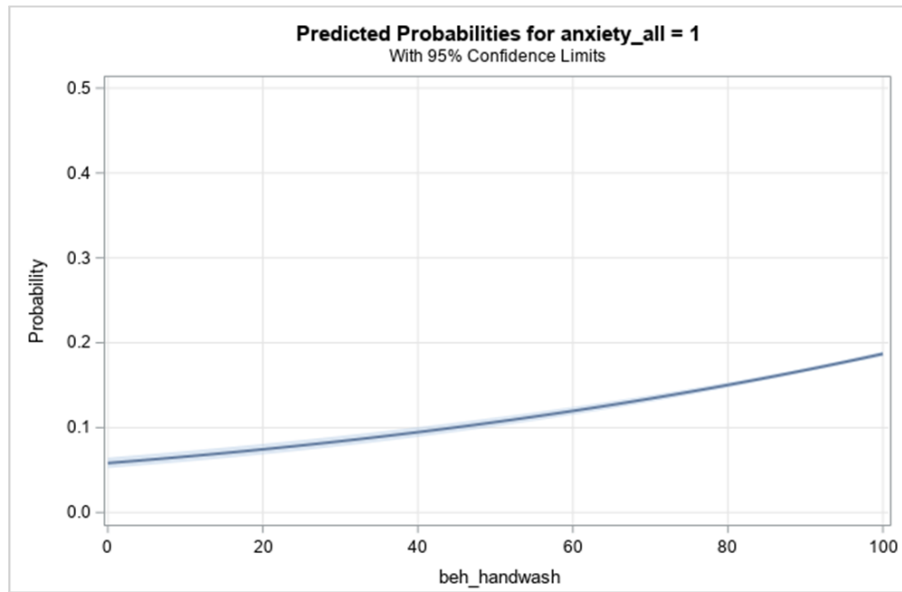
The plot above shows that there is an association between handwashing tendencies and feeling anxiety in response to COVID-19. That is, people who have a tendency of washing their hands a lot are more likely to be experiencing COVID-19 related anxiety. While washing hands is a good practice that promotes physical health, it may be related to being more paranoid, hence resulting in increased feelings of anxiety.

Figure 10. Effect Plot Grid of Personality Traits on Anxiety_all
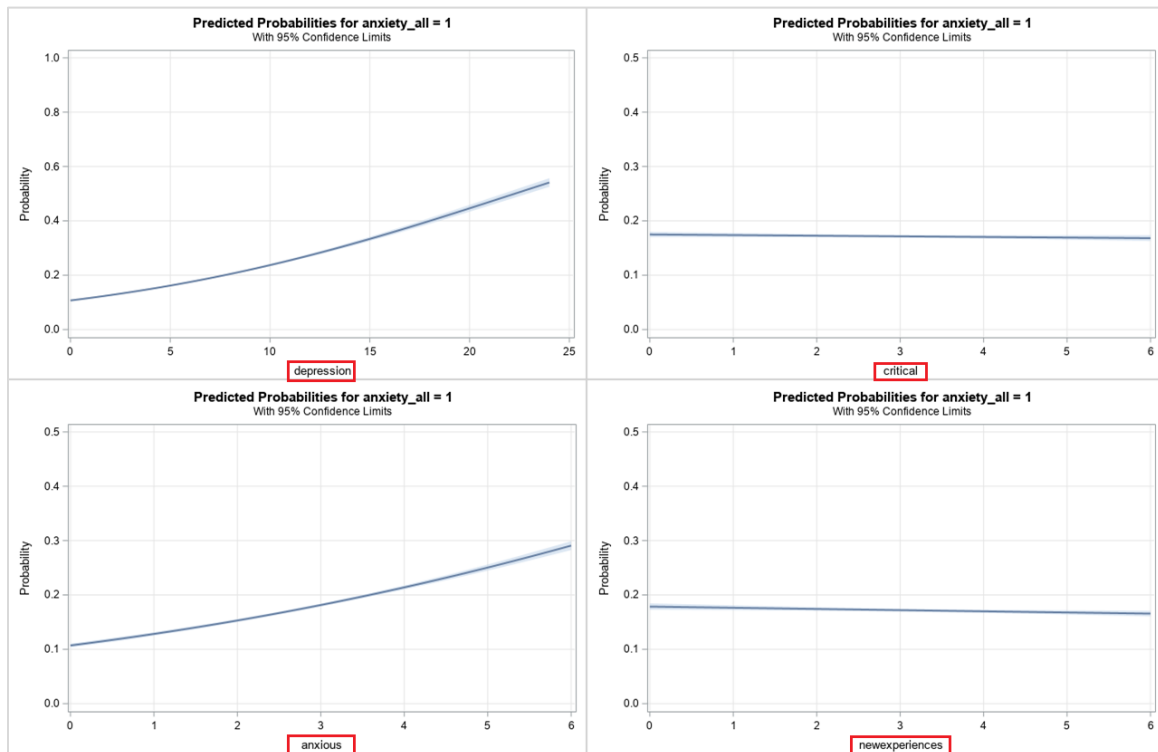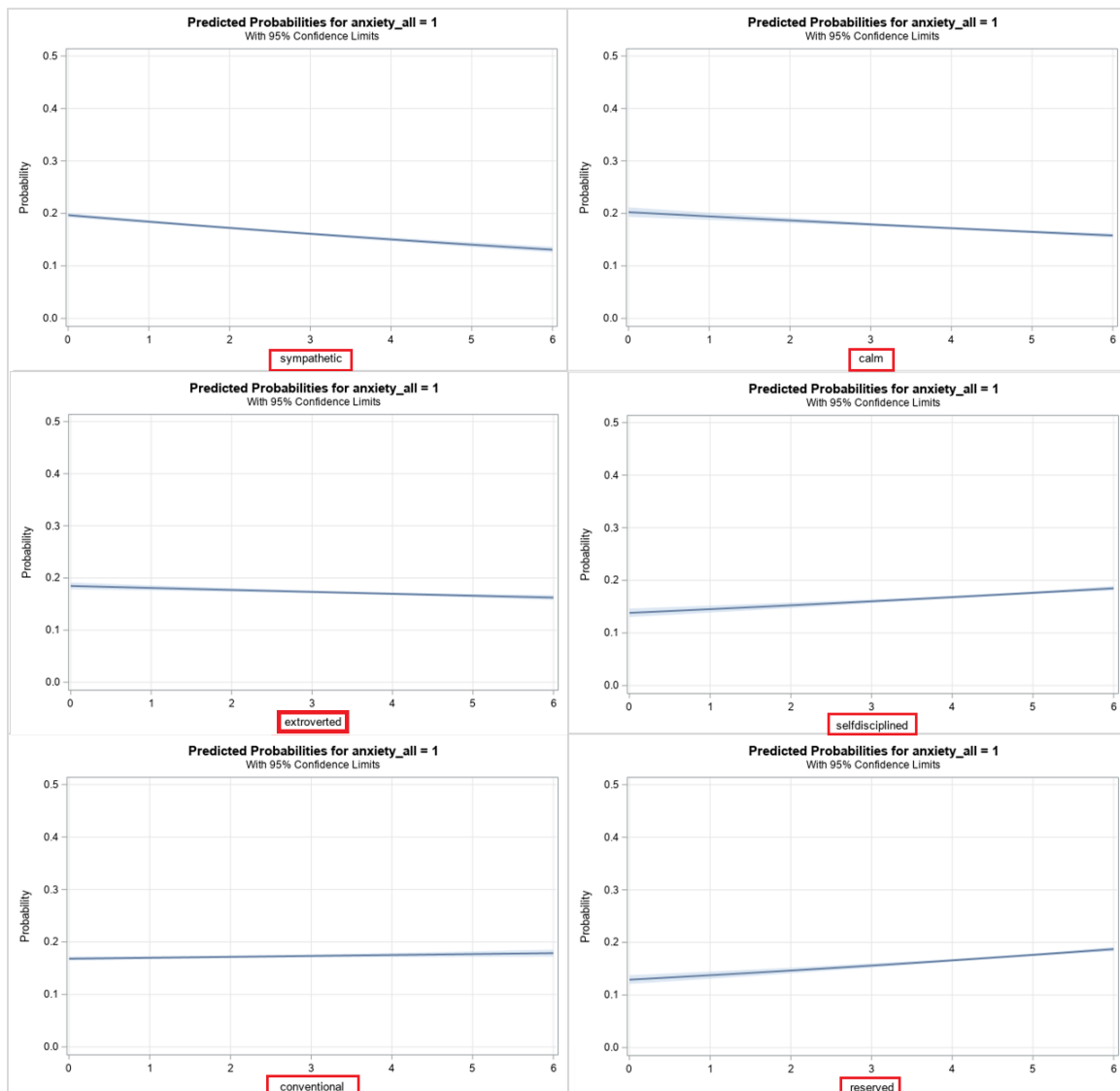
Lastly, the grid above shows the effects of the 10 different personality traits on the probability of feeling COVID-19 related anxiety. The personality traits "depression" and "anxious" and to a smaller extent "reserved" appear to be risk factors for COVID-19 related anxiety. For example, as the personality score for anxiety changes from 0 to 6, the probability of feeling all types of anxiety changes from 10% to 30%. Conversely, higher scores on the personality traits "sympathetic", "calm", and "extroverted" are associated with lower levels of COVID-19 related anxiety. Moreover, higher scores on the remaining personality traits such as "critical", "self-disciplined", and "conventional" show negligible effects on COVID-19 related anxiety. Given that the different personality traits are found to impact COVID-19 related anxiety in different ways, preventive mental health programs can be tailored to individuals based on their personality assessment results.

5. CONCLUSION

The analysis revealed that anxiety in response to COVID-19 is highly prevalent around the world. It was found that 96% of respondents reported feeling at least one type of anxiety and 21% reported feeling all five types of anxiety. Some types of anxiety are more prevalent than others. For example, 74% of respondents felt anxious about current circumstances while only 55% of respondents felt anxious about personal health. Across all models, women were more likely than men to experience COVID-19 related anxiety which is consistent with several other studies. Other factors associated with higher COVID-19 related anxiety include being older, being married, scoring high on "depression" and "anxious" personality traits, showing frequent handwashing behaviors, not trusting the government response to the pandemic, expecting to leave home to visit the pharmacy, and living in areas with heightened restrictions. On the other hand, some factors that were shown to reduce the risk of pandemic-related anxiety include having a calm and sympathetic personality, leaving home for physical exercise, and living in areas with high recovery rates. Interesting dynamics were observed among the different types of anxiety as certain factors affected the certain types of anxiety in different ways. For example, highly educated individuals were found to feel anxious about their current circumstances but not as anxious about other aspects. Moreover, the interaction analysis showed that higher income modestly reduces anxiety in unmarried individuals but does the opposite (i.e. increases anxiety) for married individuals.

It is imperative to understand how these factors underpin COVID-19 related anxiety when developing mental health support programs and preventive strategies during the pandemic. The factors can be used to pinpoint certain types of individuals and population clusters (e.g. women) that are at higher risk of experiencing pandemic-induced anxiety. With this information, targeted initiatives and outreach programs can be offered to prevent or treat pandemic-induced anxiety and other mental health problems. This will help mitigate mental health issues in individuals not only during COVID-19 but also in future pandemics. One limitation of this analysis is that the timeframe of the data spans March to April 2020 during which restrictions were most stringent and people were still adjusting and coping with sudden lifestyle changes. Since humans are highly adaptive, further research can be carried out to see how anxiety in response to COVID-19 changes over a longer period of time as restrictions come and go during the pandemic. As COVID-19 continues to mature as a pandemic with fluctuating levels of restrictions and lockdowns in several countries, increased attention must be given towards mitigating mental health issues such as anxiety in addition to safeguarding physical health.

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APPENDICES

Appendix A – ROC Curves

Figure 11: ROC Curve for Model 0: Anxiety_any as dependent variable:
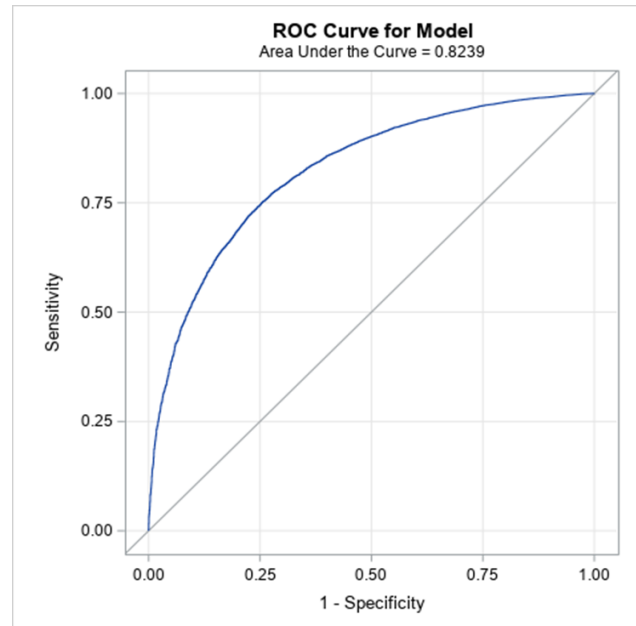
Figure 12: ROC Curve for Model 1: Anxiety_1 as dependent variable:
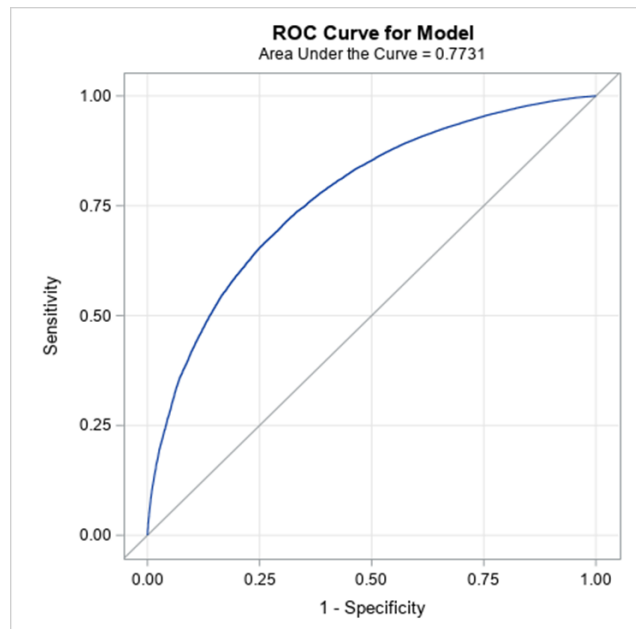
Figure 13: ROC Curve for Model 2: Anxiety_2 as dependent variable:
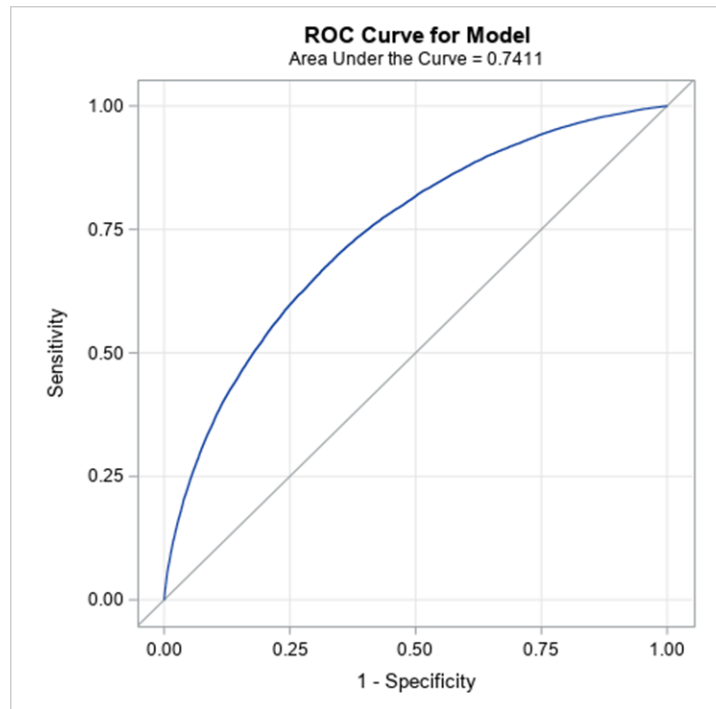
Figure 14: ROC Curve for Model 3: Anxiety_3 as dependent variable:
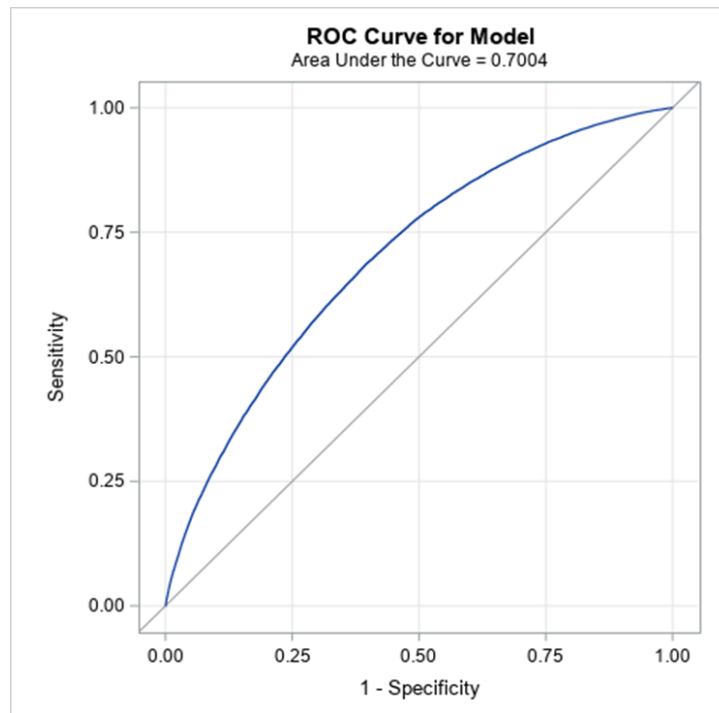
Figure 15: ROC Curve for Model 4: Anxiety_4 as dependent variable:
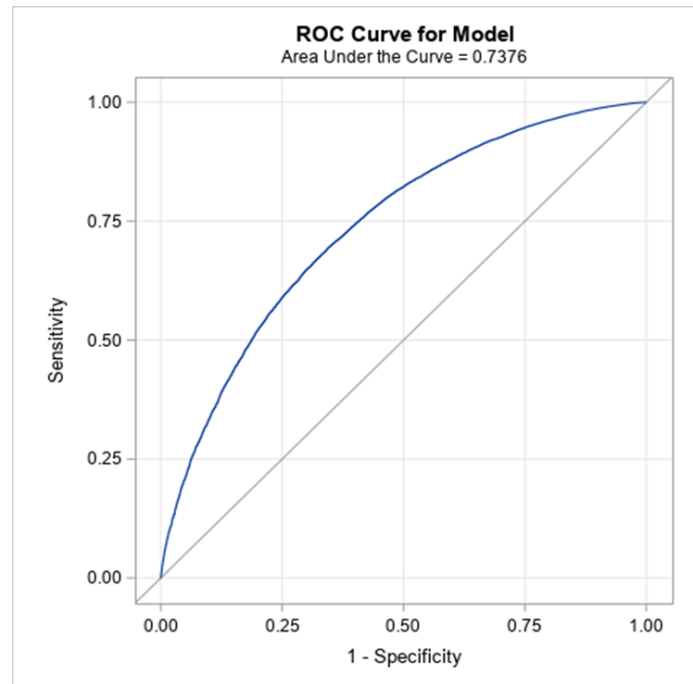
Figure 16: ROC Curve for Model 5: Anxiety_5 as dependent variable:
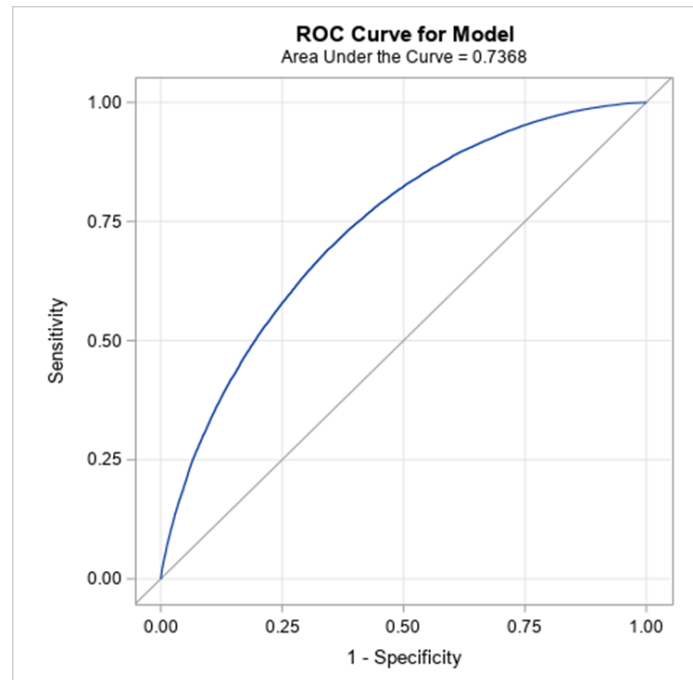
Figure 17: ROC Curve for Model 6: Anxiety_all as dependent variable with interactions:
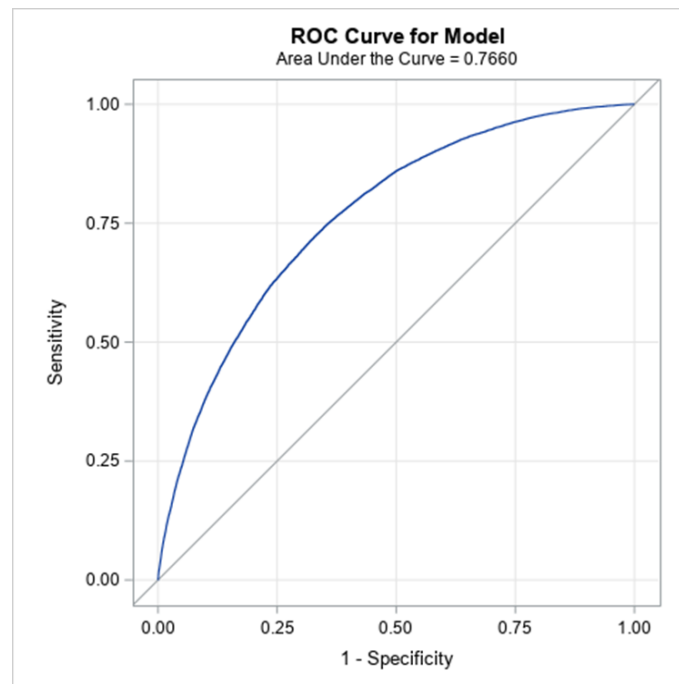
```
/*Import file*/
proc import datafile="C:\Users\user\Google Drive\School\Master of Analytics\
178.724 Applied Econometric Methods\Assignment 2\Assessment2.csv"
out=covidanxietydata dbms=csv replace; getnames=yes;
run;

/*Viewing all data*/
proc contents data=covidanxietydata;
run;

proc print data=covidanxietydata;
run;

/*Calculated fields*/
data covidanxietydata;
set covidanxietydata;
if anxiety_1 + anxiety_2 + anxiety_3 +
   anxiety_4 +  anxiety_5 = 5 then anxiety_all = 1;
else anxiety_all = 0;
if anxiety_1 + anxiety_2 + anxiety_3 +
   anxiety_4 +  anxiety_5 > 0 then anxiety_any = 1;
else anxiety_any = 0;
covid_recoveryrate = covid_recovered / covid_confirmed;
run;


/*Summary stats overall*/
proc means data=covidanxietydata chartype mean std min max n nmiss vardef=df;
var anxiety_1 anxiety_2 anxiety_3 anxiety_4 anxiety_5
anxiety_any anxiety_all
age education income male married hhmember poorhealth
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recovered covid_recoveryrate stringencyindex;
run;

/*Handling Missing Values*/
data covidanxietydata;
set covidanxietydata;
if cmiss(of _all_) then delete;
run;

/*Removing duplicate rows*/

proc sort data = covidanxietydata nodupkey;
by _all_;
run;

/*Outliers*/
/*Box and Whisker Plot*/
proc sgplot data=covidanxietydata noautolegend;
title "Income
(Box and Whisker Plot)";
xaxis label="Income";
hbox income;
run;
title;

proc means data=covidanxietydata chartype mean min p25 p50 p75 p95 max vardef=df;
      var  income;
run;

proc univariate data=covidanxietydata;
```

```
        VAR income;
        HISTOGRAM / NORMAL;
run;

data covidanxietydata;
set covidanxietydata;
if income > 2000000 then delete;
run;

proc means data=covidanxietydata chartype sum mean min max n vardef=df;
        var  income;
run;


/*Sub-samples*/

/*By anxiety_any*/

proc means data=covidanxietydata (where=(anxiety_any=0))
chartype mean std min max vardef=df;
var age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recovered covid_recoveryrate stringencyindex;
run;

/*By anxiety_all*/

proc means data=covidanxietydata (where=(anxiety_all=1))
chartype mean std min max vardef=df;
var age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recovered covid_recoveryrate stringencyindex;
run;

/*By anxiety_1*/

proc means data=covidanxietydata (where=(anxiety_1=0))
chartype mean std min max vardef=df;
var age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recovered covid_recoveryrate stringencyindex;
run;

/*By anxiety_2*/

proc means data=covidanxietydata (where=(anxiety_2=1))
chartype mean std min max vardef=df;
var age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
```

```
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recovered covid_recoveryrate stringencyindex;
run;


/*By anxiety_3*/

proc means data=covidanxietydata (where=(anxiety_3=0))
chartype mean std min max vardef=df;
var age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recovered covid_recoveryrate stringencyindex;
run;


/*By anxiety_4*/

proc means data=covidanxietydata (where=(anxiety_4=0))
chartype mean std min max vardef=df;
var age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recovered covid_recoveryrate stringencyindex;
run;


/*By anxiety_5*/

proc means data=covidanxietydata (where=(anxiety_5=1))
chartype mean std min max vardef=df;
var age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recovered covid_recoveryrate stringencyindex;
run;

/*Correlation Matrix*/
proc corr data=covidanxietydata pearson nosimple;
variable
anxiety_1 anxiety_2 anxiety_3 anxiety_4 anxiety_5
anxiety_any anxiety_all
age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recovered covid_recoveryrate stringencyindex;
run;
```

```
/*Standardizing varibales*/

PROC STANDARD DATA=covidanxietydata MEAN=0 STD=1 OUT=covidanxietydata_sd;
VAR age education income hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
covid_confirmed covid_death covid_recovered covid_recoveryrate stringencyindex;
RUN;

PROC MEANS DATA=covidanxietydata_sd;
RUN;


/*Model 0 Logistic regression - y = anxiety_any*/
ods graphics / imagemap=on ;
proc probit data=covidanxietydata;
model anxiety_any (Event = '1')=
age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recoveryrate
stringencyindex /
d=logistic ;
output out=covidyhat prob=PredictedValues ;
run;

Data cad;
set covidanxietydata;
Zi = -1.636 + -0.0036*age + 0.0189*education + 0*income + -0.2334*male + 0.1081*married +
0.001*hhmember + 0.104*depression + 0.0025*extroverted + 0.0239*critical + 0.0016*selfdisciplined +
0.257*anxious + 0.0494*newexperiences + 0.1468*reserved + -0.0224*sympathetic + -0.0509*calm +
0.0236*conventional + 0.7419*perceivreacinsuf + 0.2184*govdistrust + 0.2219*govfactuntruth +
0.6636*pubperceivreacinsuf + -0.3337*socdistmeasne + 0.0029*beh_stayhome + -0.0002*beh_socgathering
+ 0.0021*beh_distance + 0.0039*beh_tellsymp + 0.0128*beh_handwash + 0.0443*chkleavehome + -
0.064*lhreason_work + -0.088*lhreason_pet + -0.1315*lhreason_physical + -0.0671*lhreason_food +
0.3528*lhreason_pharmacy + -0.0883*lhreason_hospital + 0.222*lhreason_care + -
0.1232*lhreason_friends + -0.119*lhreason_tired + -0.1163*lhreason_bored + -
0.4812*lhreason_adrenaline + -0.196*lhreason_freedom + -0.2473*lhreason_other + 0*covid_confirmed +
0.0001*covid death + 0*covid recovered + -0.9383*covid_recoveryrate + 0.0065*stringencyindex;
probabilities = exp(Zi)/(1+exp(Zi));
run;

ods graphics / imagemap=on ;
proc qlim data=cad METHOD=newrap;
model anxiety_any = age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recoveryrate
stringencyindex / discrete(d=logit);
output out=outqlim marginal;
run;

proc means data=outqlim mean; var Meff_P2:; run;

ods graphics / imagemap=on ;
proc logistic data=covidanxietydata plots(only)=(roc);
model anxiety_any(Event = '1')=
age education income male married hhmember
```

```
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recoveryrate
stringencyindex / link=logit ;;
run;

/*To find marginal effects agnostic to scale (i.e. standardized)*/
ods graphics / imagemap=on ;
proc qlim data=covidanxietydata_sd method=newrap;
model anxiety_any = age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recoveryrate
stringencyindex / discrete(d=logit);
output out=outqlim marginal;
run;

proc means data=outqlim mean; var Meff_P2:; run;

/*Model 1 Logistic regression - y = anxiety_1*/
ods graphics / imagemap=on ;
proc probit data=covidanxietydata;
model anxiety_1 (Event = '1')=
age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recoveryrate
stringencyindex /
d=logistic ;
output out=covidyhat prob=PredictedValues ;
run;

Data cad1;
set covidanxietydata;
Zi = -1.636 + -0.0036*age + 0.0189*education + 0*income + -0.2334*male + 0.1081*married +
0.001*hhmember + 0.104*depression + 0.0025*extroverted + 0.0239*critical + 0.0016*selfdisciplined +
0.257*anxious + 0.0494*newexperiences + 0.1468*reserved + -0.0224*sympathetic + -0.0509*calm +
0.0236*conventional + 0.7419*perceivreacinsuf + 0.2184*govdistrust + 0.2219*govfactuntruth +
0.6636*pubperceivreacinsuf + -0.3337*socdistmeasne + 0.0029*beh_stayhome + -0.0002*beh_socgathering
+ 0.0021*beh_distance + 0.0039*beh_tellsymp + 0.0128*beh_handwash + 0.0443*chkleavehome + -
0.064*lhreason_work + -0.088*lhreason_pet + -0.1315*lhreason_physical + -0.0671*lhreason_food +
0.3528*lhreason_pharmacy + -0.0883*lhreason_hospital + 0.222*lhreason_care + -
0.1232*lhreason_friends + -0.119*lhreason_tired + -0.1163*lhreason_bored + -
0.4812*lhreason_adrenaline + -0.196*lhreason_freedom + -0.2473*lhreason_other + 0*covid_confirmed +
0.0001*covid_death + 0*covid_recovered + -0.9383*covid_recoveryrate + 0.0065*stringencyindex;
probabilities = exp(Zi)/(1+exp(Zi));
run;

ods graphics / imagemap=on ;
proc qlim data=cad1  METHOD=newrap;
model anxiety_1 = age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
```

```
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recoveryrate
stringencyindex / discrete(d=logit);
output out=outqlim marginal;
run;


proc means data=outqlim mean; var Meff_P2:; run;

ods graphics / imagemap=on ;
proc logistic data=covidanxietydata plots(only)=(roc);
model anxiety_1 (Event = '1')=
age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recoveryrate
stringencyindex / link=logit ;
run;


/*Model 2 Logistic regression - y = anxiety_2*/
ods graphics / imagemap=on ;
proc probit data=covidanxietydata;
model anxiety_2 (Event = '1')=
age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recoveryrate
stringencyindex /
d=logistic ;
output out=covidyhat prob=PredictedValues ;
run;

Data cad2;
set covidanxietydata;
Zi = -2.3256 + 0.0064*age + 0.0097*education + 0*income + -0.297*male + 0.27*married + -
0.0091*hhmember + 0.109*depression + -0.0521*extroverted + -0.0169*critical + 0.0401*selfdisciplined
+ 0.1607*anxious + -0.0666*newexperiences + 0.025*reserved + -0.0777*sympathetic + -0.1211*calm +
0.0181*conventional + 0.3413*perceivreacinsuf + 0.216*govdistrust + 0.1149*govfactuntruth +
0.2715*pubperceivreacinsuf + -0.0704*socdistmeasne + -0.0025*beh_stayhome + 0.0014*beh_socgathering
+ 0.0012*beh_distance + 0.0002*beh_tellsymp + 0.0087*beh_handwash + 0.0627*chkleavehome +
0.0181*lhreason_work + -0.0398*lhreason_pet + 0.0687*lhreason_physical + -0.0406*lhreason_food +
0.0163*lhreason_pharmacy + -0.0781*lhreason_hospital + -0.005*lhreason_care + -
0.1437*lhreason_friends + 0.0019*lhreason_tired + -0.0708*lhreason_bored + -
0.1633*lhreason_adrenaline + -0.0974*lhreason_freedom + -0.1286*lhreason_other + 0*covid_confirmed +
0.0001*covid_death + -1.3451*covid_recovered + -0.0007*covid_recoveryrate + 0.0065*stringencyindex;
probabilities = exp(Zi)/(1+exp(Zi));
run;

ods graphics / imagemap=on ;
proc qlim data=cad2 method=newrap;
model anxiety_2 = age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
```

```
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recoveryrate
stringencyindex / discrete(d=logit);
output out=outqlim marginal;
run;

proc means data=outqlim mean; var Meff_P2:; run;

ods graphics / imagemap=on ;
proc logistic data=covidanxietydata plots(only)=(roc);
model anxiety_2 (Event = '1')=
age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recoveryrate
stringencyindex / link=logit ;
run;

/*Model 3 Logistic regression - y = anxiety_3*/
ods graphics / imagemap=on ;
proc probit data=covidanxietydata;
model anxiety_3 (Event = '1')=
age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recoveryrate
stringencyindex /
d=logistic ;
output out=covidyhat prob=PredictedValues ;
run;

Data cad3;
set covidanxietydata;
Zi = -3.8223 + 0.023*age + 0*education + 0*income + -0.0542*male + -0.0016*married + 0.0478*hhmember
+ 0.0437*depression + 0.0299*extroverted + 0.0049*critical + 0.0096*selfdisciplined + 0.1657*anxious
+ 0.0466*newexperiences + 0.0807*reserved + -0.0478*sympathetic + -0.025*calm + 0.0092*conventional
+ 0.3842*perceivreacinsuf + 0.1788*govdistrust + 0.2555*govfactuntruth + 0.2551*pubperceivreacinsuf
+ 0.0488*socdistmeasne + 0.0012*beh_stayhome + -0.0009*beh_socgathering + -0.0005*beh_distance + -
0.0003*beh_tellsymp + 0.0084*beh_handwash + 0.205*chkleavehome + 0.0728*lhreason_work + -
0.0827*lhreason_pet + -0.3889*lhreason_physical + -0.1964*lhreason_food + 0.3195*lhreason_pharmacy +
0.2951*lhreason_hospital + -0.0969*lhreason_care + -0.1327*lhreason_friends + -0.1651*lhreason_tired
+ -0.1573*lhreason_bored + -0.1417*lhreason_adrenaline + -0.0256*lhreason_freedom + -
0.2223*lhreason_other + 0*covid_confirmed + -0.0001*covid_death + -0.1302*covid_recovered +
0.0086*covid_recoveryrate + 0.0065*stringencyindex;
probabilities = exp(Zi)/(1+exp(Zi));
run;

ods graphics / imagemap=on ;
proc qlim data=cad3 method=newrap;
model anxiety_3 = age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
```

```
covid_confirmed covid_death covid_recoveryrate
stringencyindex / discrete(d=logit);
output out=outqlim marginal;
run;


proc means data=outqlim mean; var Meff_P2:; run;


ods graphics / imagemap=on ;
proc logistic data=covidanxietydata plots(only)=(roc);
model anxiety_3 (Event = '1')=
age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recoveryrate
stringencyindex / link=logit ;
run;


/*Model 4 Logistic regression - y = anxiety_4*/
ods graphics / imagemap=on ;
proc probit data=covidanxietydata;
model anxiety_4 (Event = '1')=
age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recoveryrate
stringencyindex /
d=logistic ;
output out=covidyhat prob=PredictedValues ;
run;


Data cad4;
set covidanxietydata;
Zi = -1.5023 + -0.012*age + 0.0095*education + 0*income + -0.1237*male + 0.0825*married + -
0.0076*hhmember + 0.0447*depression + -0.0037*extroverted + 0.0162*critical + 0.0107*selfdisciplined
+ 0.1468*anxious + 0.0371*newexperiences + 0.1464*reserved + -0.0066*sympathetic + -0.003*calm +
0.0118*conventional + 0.5471*perceivreacinsuf + 0.1172*govdistrust + 0.136*govfactuntruth +
0.4463*pubperceivreacinsuf + -0.3107*socdistmeasne + 0.0014*beh_stayhome + 0.0002*beh_socgathering +
0.0008*beh_distance + 0.0039*beh_tellsymp + 0.0106*beh_handwash + 0.1097*chkleavehome +
0.0175*lhreason_work + -0.1218*lhreason_pet + -0.1777*lhreason_physical + -0.0674*lhreason_food +
0.2878*lhreason_pharmacy + -0.0824*lhreason_hospital + 0.4047*lhreason_care + -
0.0809*lhreason_friends + -0.2591*lhreason_tired + -0.1689*lhreason_bored + -
0.1221*lhreason_adrenaline + -0.3576*lhreason_freedom + -0.214*lhreason_other + 0*covid_confirmed +
0*covid_death + -1.2745*covid_recovered + 0.0086*covid_recoveryrate + 0.0065*stringencyindex;
probabilities = exp(Zi)/(1+exp(Zi));
run;


ods graphics / imagemap=on ;
proc qlim data=cad4 method=newrap;
model anxiety_4 = age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recoveryrate
stringencyindex / discrete(d=logit);
output out=outqlim marginal;
```

```
run;

proc means data=outqlim mean; var Meff_P2:; run;

ods graphics / imagemap=on ;
proc logistic data=covidanxietydata plots(only)=(roc);
model anxiety_4 (Event = '1')=
age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recoveryrate
stringencyindex / link=logit ;
run;

/*Model 5 Logistic regression - y = anxiety_5*/
ods graphics / imagemap=on ;
proc probit data=covidanxietydata;
model anxiety_5 (Event = '1')=
age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recoveryrate
stringencyindex /
d=logistic ;
output out=covidyhat prob=PredictedValues ;
run;

Data cad5;
set covidanxietydata;
Zi = -4.8168 + 0.0045*age + 0.0213*education + 0*income + -0.2852*male + 0.1224*married +
0.0402*hhmember + 0.0694*depression + 0.0124*extroverted + 0.0005*critical + 0.0365*selfdisciplined
+ 0.1824*anxious + 0.0406*newexperiences + 0.0882*reserved + -0.0527*sympathetic + 0.0179*calm +
0.0002*conventional + 0.4487*perceivreacinsuf + 0.1444*govdistrust + 0.178*govfactuntruth +
0.4568*pubperceivreacinsuf + -0.0187*socdistmeasne + 0.0057*beh_stayhome + -0.0003*beh_socgathering
+ 0.0043*beh_distance + -0.0003*beh_tellsymp + 0.0103*beh_handwash + 0.2483*chkleavehome + -
0.2007*lhreason_work + -0.2287*lhreason_pet + -0.3734*lhreason_physical + -0.1786*lhreason_food +
0.1225*lhreason_pharmacy + -0.0848*lhreason_hospital + -0.1277*lhreason_care + -
0.2641*lhreason_friends + -0.2027*lhreason_tired + -0.2929*lhreason_bored + -
0.1945*lhreason_adrenaline + -0.2084*lhreason_freedom + -0.2407*lhreason_other + 0*covid_confirmed +
0*covid_death + -0.2712*covid_recovered + 0.0076*covid_recoveryrate + 0.0065*stringencyindex;
probabilities = exp(Zi)/(1+exp(Zi));
run;

ods graphics / imagemap=on ;
proc qlim data=cad5 method=newrap;
model anxiety_5 = age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recoveryrate
stringencyindex / discrete(d=logit);
output out=outqlim marginal;
run;

proc means data=outqlim mean; var Meff_P2:; run;
```

```
ods graphics / imagemap=on ;
proc logistic data=covidanxietydata plots(only)=(roc);
model anxiety_5 (Event = '1')=
age education income male married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recoveryrate
stringencyindex / link=logit ;
run;

/*Model 6 Anxiety_all with Interaction effects*/

ods graphics / imagemap=on ;
proc logistic data=covidanxietydata plots=all;
model anxiety_all (Event = '1')=
age | male education income | married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recoveryrate
stringencyindex / link=logit outroc = rocout;
output out=estimated predicted=estprob l=lower95 u=upper95;
store forplot;
run;


ods graphics / imagemap=on ;
proc qlim data=covidanxietydata_sd method=newrap;
model anxiety_all = age | male education income | married hhmember
depression extroverted critical selfdisciplined anxious
newexperiences reserved sympathetic calm conventional
perceivreacinsuf govdistrust govfactuntruth pubperceivreacinsuf socdistmeasne
beh_stayhome beh_socgathering beh_distance beh_tellsymp beh_handwash
chkleavehome lhreason_work lhreason_pet lhreason_physical
lhreason_food lhreason_pharmacy lhreason_hospital
lhreason_care  lhreason_friends lhreason_tired lhreason_bored
lhreason_adrenaline lhreason_freedom lhreason_other
covid_confirmed covid_death covid_recoveryrate
stringencyindex / discrete(d=logit);
output out=outqlim marginal;
run;

proc means data=outqlim mean; var Meff_P2:; run;


/*Effect Plots*/

/*Age and Gender*/

proc plm source=forplot;
   effectplot slicefit(x=age sliceby=male=0 1) / yrange=(0,0.5);
run;

/*Income and Married*/

proc plm source=forplot;
   effectplot slicefit(x=income sliceby=married=0 1) / yrange=(0,0.5);
run;
```

```sas
/*Recovery Rate*/
proc plm source=forplot;
   effectplot fit(x=covid_recoveryrate) / yrange=(0,0.5);
run;


/*Stringency Index*/
proc plm source=forplot;
   effectplot fit(x=stringencyindex) / yrange=(0,0.5);
run;

/*Washing Hands*/
proc plm source=forplot;
   effectplot fit(x=Beh_handwash) / yrange=(0,0.5);
run;

/*Personality Impact*/
proc plm source=forplot;
   effectplot fit(x=depression) / yrange=(0,1);
run;

proc plm source=forplot;
   effectplot fit(x=critical) / yrange=(0,0.5);
run;

proc plm source=forplot;
   effectplot fit(x=selfdisciplined) / yrange=(0,0.5);
run;

proc plm source=forplot;
   effectplot fit(x=anxious) / yrange=(0,0.5);
run;

proc plm source=forplot;
   effectplot fit(x=newexperiences) / yrange=(0,0.5);
run;

proc plm source=forplot;
   effectplot fit(x=reserved) / yrange=(0,0.5);
run;

proc plm source=forplot;
   effectplot fit(x=sympathetic) / yrange=(0,0.5);
run;

proc plm source=forplot;
   effectplot fit(x=calm) / yrange=(0,0.5);
run;

proc plm source=forplot;
   effectplot fit(x=conventional) / yrange=(0,0.5);
run;

proc plm source=forplot;
   effectplot fit(x=sympathetic) / yrange=(0,0.5);
run;
```