

# Problem Set 2

## Applied Stats II

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1. Fit an additive model. Provide the summary output, the global null hypothesis, and  $p$ -value. Please describe the results and provide a conclusion.

- The fit and summary of the model (on the next page, with odds ratios obtained through a ready function from <https://cimentadaj.github.io/>.

```
1 m1 <- glm(choice ~ ., family = "binomial" (link="logit"),  
2          data = climateSupport)
```

- The global  $H_0$ : all slopes are equal to 0.

```
1 m0 <- glm(choice ~ 1, family = "binomial" (link="logit"),  
2          data = climateSupport)  
3 anova(m0, m1, test = "LRT") #can reject H0
```

- Based on the conducted likelihood ratio test,  $H_0$  can be rejected at any conventional level of significance; at least one predictor is reliable in the model as  $p$ -value is  $< 2.2 * 10^{-16}$ .
- Effect of the increasing number of countries is not necessarily linear: while the odds of policy support increase by 1.6 when told about 80 of 192 participating countries, 160 of 192 countries do not have a statistically reliable effect compared to only 20 participating countries (controlling value of sanctions).
- Controlling the number of participating countries, the effect of possible sanctions for non-compliance is more straightforward: threat of paying 5% of the monthly household costs increases odds of policy support by 0.76, 15% by 0.83, 20% by 1.2, all compared to not paying at all and given a 2% GDP growth.
- The odds of policy support are 0.994 for 20 countries participating in it and no sanctions for non-compliance. They further increase when these conditions are leveraged.

It took 4 iterations to find the maximum likelihood estimates.

Table 1:

	<i>Dependent variable:</i>
	choice
countries.L	1.582*** (0.060)
countries.Q	0.990 (0.038)
sanctions.L	0.759*** (0.033)
sanctions.Q	0.834*** (0.037)
sanctions.C	1.162*** (0.051)
Constant	0.994 (0.022)
Observations	8,500
Log Likelihood	-5,784.130
Akaike Inf. Crit.	11,580.260
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01

2. The code and the result I'm relying upon to answer the following questions are as follows:

```

1 predicted_data <- with(climateSupport, expand.grid(sanctions = unique(
  sanctions),
2
  countries = unique(
  countries)))
3
4 predicted_data <- cbind(predicted_data, predict(m1,
5                                     newdata = predicted_data,
6                                     type = "response",
7                                     se = TRUE))
8
9 predicted_data <- within(predicted_data,
10   {PredictedProb <- plogis(fit)
11   LL <- plogis(fit - (1.96 * se.fit))
12   UL <- plogis(fit + (1.96 * se.fit))
13   })
14 xtable::xtable(predicted_data)

```

	sanctions	countries	fit	se.fit	residual.scale	UL	LL	PredictedProb
1	15%	80 of 192	0.48	0.01	1.00	0.62	0.61	0.62
2	None	80 of 192	0.52	0.01	1.00	0.63	0.62	0.63
3	5%	80 of 192	0.56	0.01	1.00	0.64	0.63	0.64
4	20%	80 of 192	0.44	0.01	1.00	0.61	0.60	0.61
5	15%	160 of 192	0.56	0.01	1.00	0.64	0.63	0.64
6	None	160 of 192	0.59	0.01	1.00	0.65	0.64	0.64
7	5%	160 of 192	0.64	0.01	1.00	0.66	0.65	0.65
8	20%	160 of 192	0.52	0.01	1.00	0.63	0.62	0.63
9	15%	20 of 192	0.40	0.01	1.00	0.60	0.59	0.60
10	None	20 of 192	0.43	0.01	1.00	0.61	0.60	0.61
11	5%	20 of 192	0.48	0.01	1.00	0.62	0.61	0.62
12	20%	20 of 192	0.36	0.01	1.00	0.59	0.58	0.59

- For the policy in which nearly all countries participate [160 of 192], increasing sanctions from 5% to 15% decreases the odds that an individual will support the policy by 0.01. We can interpret PredictedProb directly because we applied type 'response' to the R 'predict' function.
- The estimated probability that an individual will support a policy if there are 80 of 192 countries participating with no sanctions is 0.63.
- The answers to the two previous questions should not change much from an inclusion of an interaction because they address the same reference levels of two categorical variables. Due to the lack of statistical reliability for some though the coefficients might vary to a larger extent, not changing the substantive interpretation in terms of the magnitude and direction of such conditional effect.

According to the Likelihood ratio test, there is no evidence of a reliable interaction predictor (p-value = 0.3912). Therefore, the inclusion of an interaction is not appropriate.

```
1 anova(m1, m2, test = "LRT") #there's no evidence of a reliable  
    interaction predictor
```