POL 51
The Scientific Study of Politics
Sections A03 & A04

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Today's Plan

- Review regression
- Important information

Multiple variable regression

- Used to model more than one independent variable

  $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ \ldots \ + \beta_n X_n$
- In `R` code: `lm(Y ~ X1 + X2 + X3, dataset)`

Interpreting multiple variable regression

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ \ldots \ + \beta_n X_n$$

- β_0: the predicted value of Y when **all** independent variables equal zero
- β_1: the expected change in Y associated with a one-unit increase in X_1, holding all other X variables constant
- β_2: the expected change in Y associated with a one-unit increase in X_2, holding all other X variables constant
- β_n: the expected change in Y associated with a one-unit increase in X_n, holding all other X variables constant

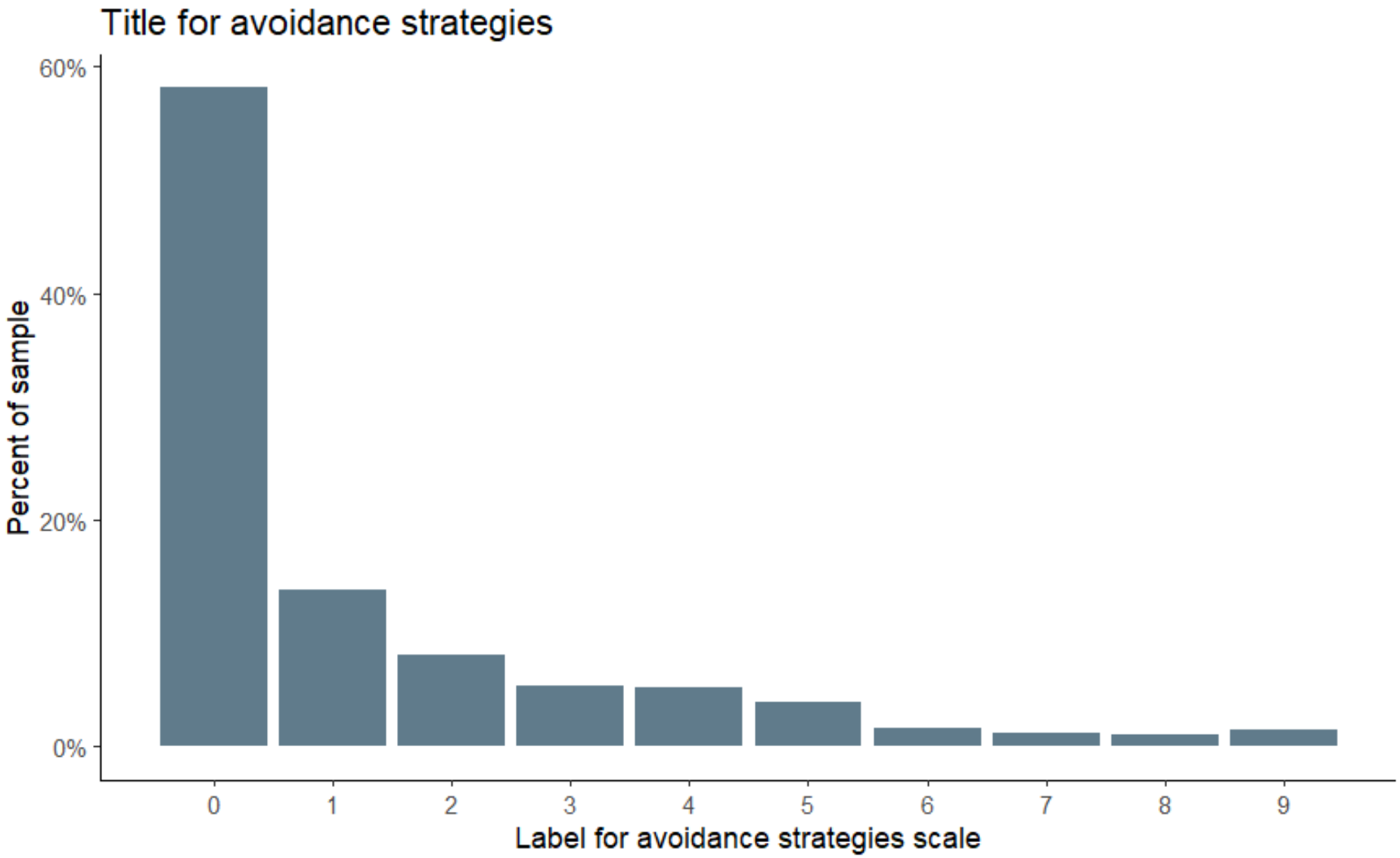
LINAS Project Code/Examples

- You will plot your chosen dependent variable
- Use the shell code, changing the dependent variable name, labels, and scale for the x-axis if necessary
- Change colors, styles, themes if necessary

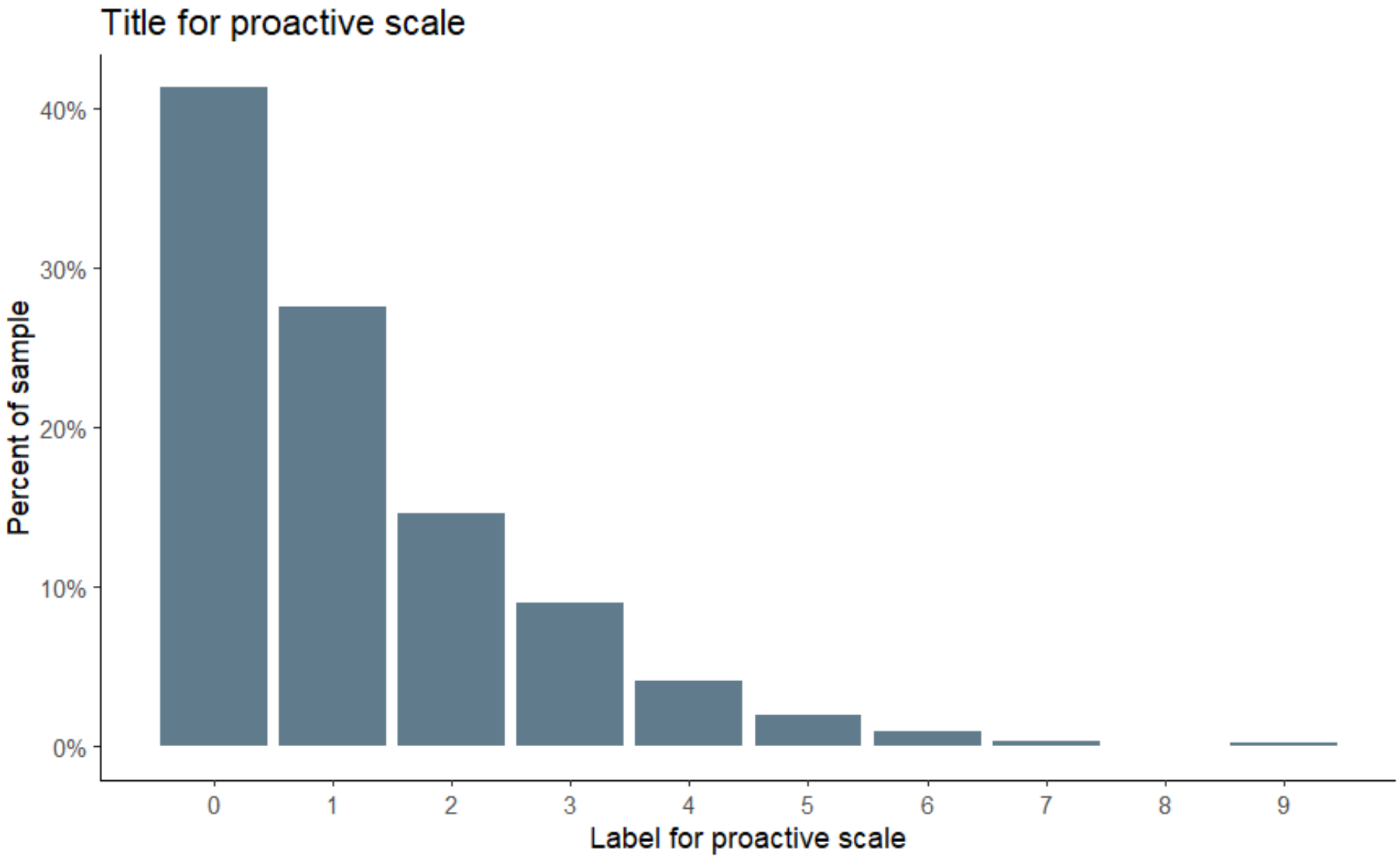
```
dvplot1 <-ggplot(linas.1, aes(x = dependent_variable, y = after_stat(count/sum(count)))) +
  geom_bar(fill = "lightskyblue4")   +
  scale_y_continuous(labels = percent) +
  scale_x_continuous(breaks=seq(0,9,1)) +
  labs(title="Title",
       y="Percent of sample",
       x="Label for dependent_variable") +
  theme_classic()

dvplot1
```

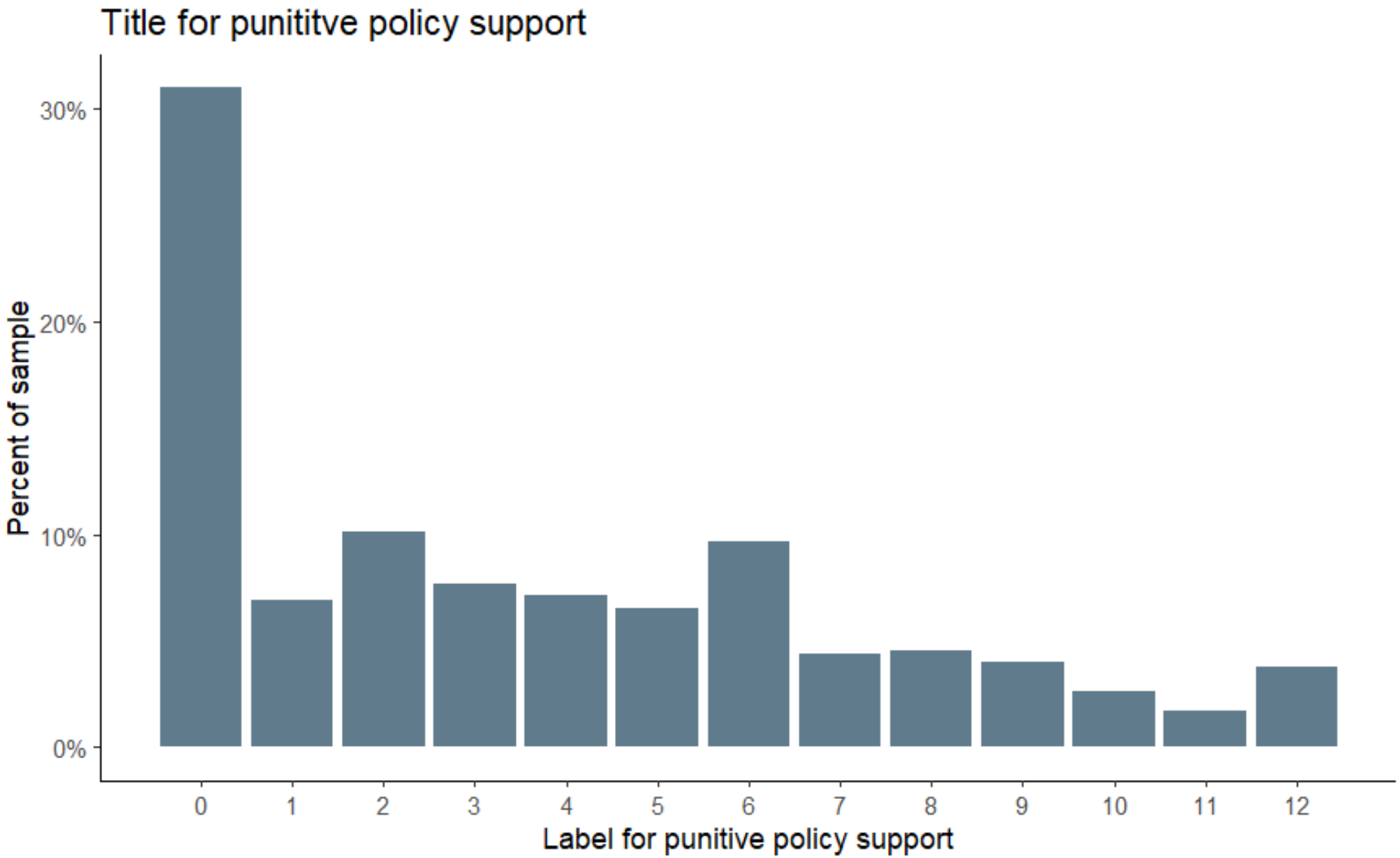
Example


Title for avoidance strategies
60%
40%
20%
0%
Percent of sample
0
1
2
3
4
5
6
7
8
9
Label for avoidance strategies scale

Example


Title for proactive scale
40%
30%
20%
10%
0%
Percent of sample
0
1
2
3
4
5
6
7
8
9
Label for proactive scale

Example


Title for punititve policy support
Percent of sample
30%
20%
10%
0%
0
1
2
3
4
5
6
7
8
9
10
11
12
Label for punitive policy support

Regression in R

- We use the function `lm()` in R to run a regression model
- Remember that linear regression is minimizing the errors to estimate a linear relationship between variables
- For the project, this is the shell code to follow:

```
model <- lm(dependent_variable ~ independent1 + independent2 + independent3 + independent4,
            data = linas.1,
            weights = weight)

summary(model)
```

- Change the dependent variable and include all of your independent variables (must include gender and political party)

Regression example

- We are going to use the example question: which Latino immigrants support punitive immigration policies?
- The independent variables will be gender, political party, and immigrant identity

```
model <- lm(support_draconian ~ gender + pidthree + immigrant_identity,
            data = linas.1,
            weights = weight)

summary(model)
```

Example regression output

```
lm(formula = support_draconian ~ gender + pidthree + immigrant_identity,
    data = linas.1, weights = weight)

Weighted Residuals:
     Min       1Q   Median       3Q      Max
-10.3453  -2.1968  -0.6274   2.2645  10.9054

Coefficients:
                   Estimate Std. Error t value             Pr(>|t|)
(Intercept)         8.19514    0.44465  18.431 < 0.0000000000000002 ***
genderFemale       -0.45872    0.19905  -2.304               0.0214 *
pidthreeInd./Other -2.56488    0.27646  -9.277 < 0.0000000000000002 ***
pidthreeDemocrat   -3.74048    0.25337 -14.763 < 0.0000000000000002 ***
immigrant_identity -0.48118    0.09731  -4.945          0.000000894 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 3.131 on 994 degrees of freedom
  (1 observation deleted due to missingness)
Multiple R-squared:  0.2065,    Adjusted R-squared:  0.2033
F-statistic: 64.67 on 4 and 994 DF,  p-value: < 0.0000000000000022
```

Interpret regression output

We get the regression equation:
$\textit{Support Punitive} = 8.20 - 0.46(\textit{Female}) - 2.56(\textit{Ind.}) - 3.74(\textit{Dem.}) - 0.48(\textit{Imm. ID})$

- **Intercept = 8.2**
  - The expected level of support for the baseline group:
  - Male, Republican, no immigrant identity
- Thinking about the scale of support (0-12), the level of support is high

Interpret regression output

- **genderFemale = -0.46 ***
  - We compare this value to the baseline category (men)
  - Women Latino immigrants score about 0.5 lower for support for punitive policies compared to men, holding party and immigrant identity constant
- Women in the dataset are slightly less supportive of punitive policies than men
- On the scale, a woman Republican with no immigrant identity scores about 7.7 in predicted support for punitive policies
- This is significant at the 0.05 level

Interpret regression output

- **pidthreeInd./Other = -2.56 *****
  - We compare this value to the baseline category (Republican)
  - Independent/Other Latino Immigrants score 2.56 points lower on the support scale than Republicans, holding gender and immigrant identity constant
- Independents/Other are substantively less supportive than Republicans, scoring about 5.6 on the scale
- This relationship is highly statistically significant

Interpret regression output

- **pidthreeDemocrat = -3.74 *****
  - We compare this value to the baseline category (Republican)
  - Democrat Latino Immigrants score 3.74 points lower on the support scale than Republicans, holding gender and immigrant identity constant
- Democrats are substantively less supportive than Republicans, scoring about 4.5 on the scale
- This relationship is highly statistically significant

Interpret regression output

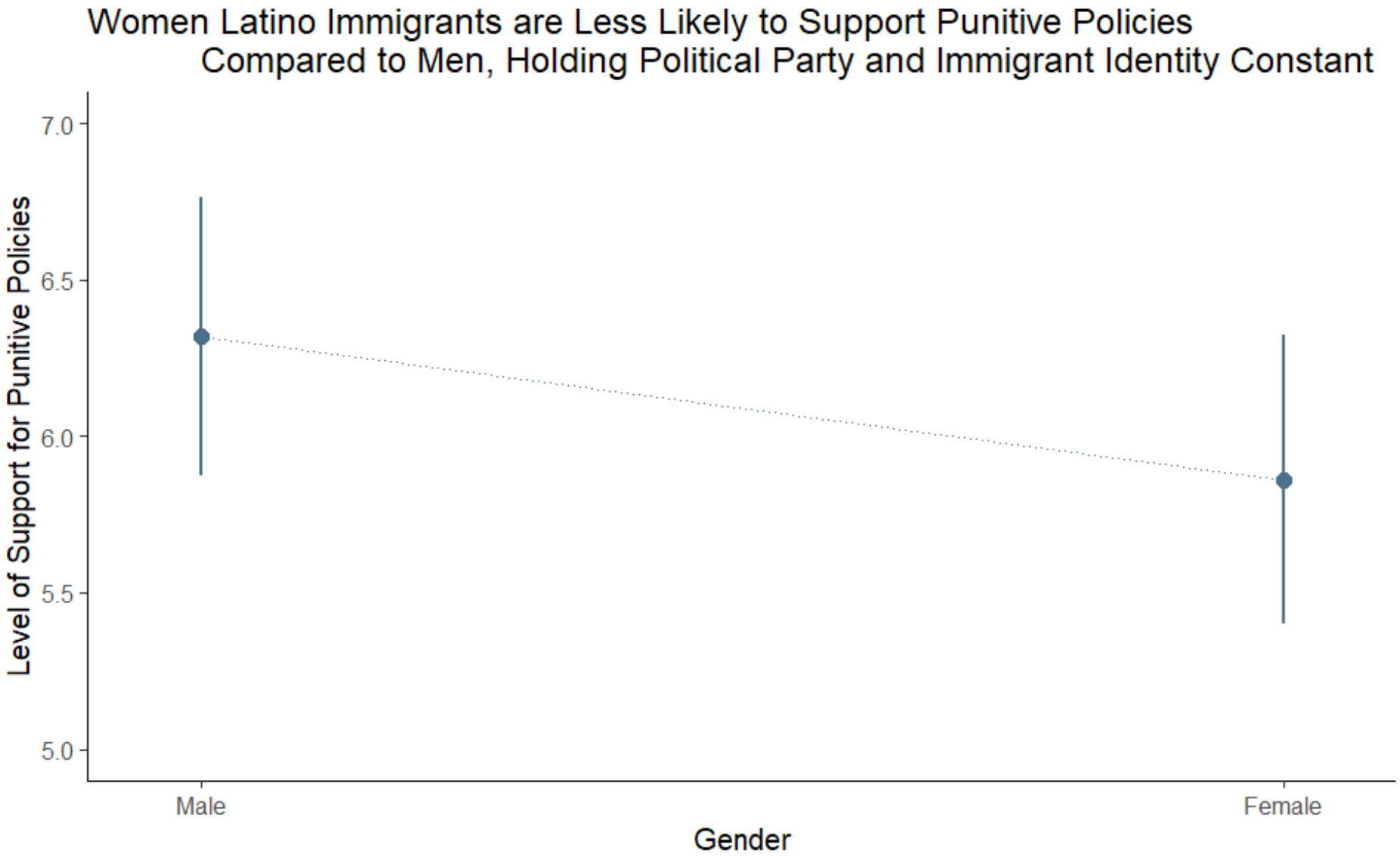
- **immigrant_identity = -0.48 *****
  - This is a continuous independent variable
  - Immigrants who strongly identify as immigrants score about 0.5 lower on support for punitive policies compared to those who do not identify as immigrants
- Feeling connected to an immigrant identity reduces support for punitive policies
- Every one unit increase in immigrant identity reduces support for punitive policies by about 0.5
- This relationship is highly statistically significant

Prediction plot

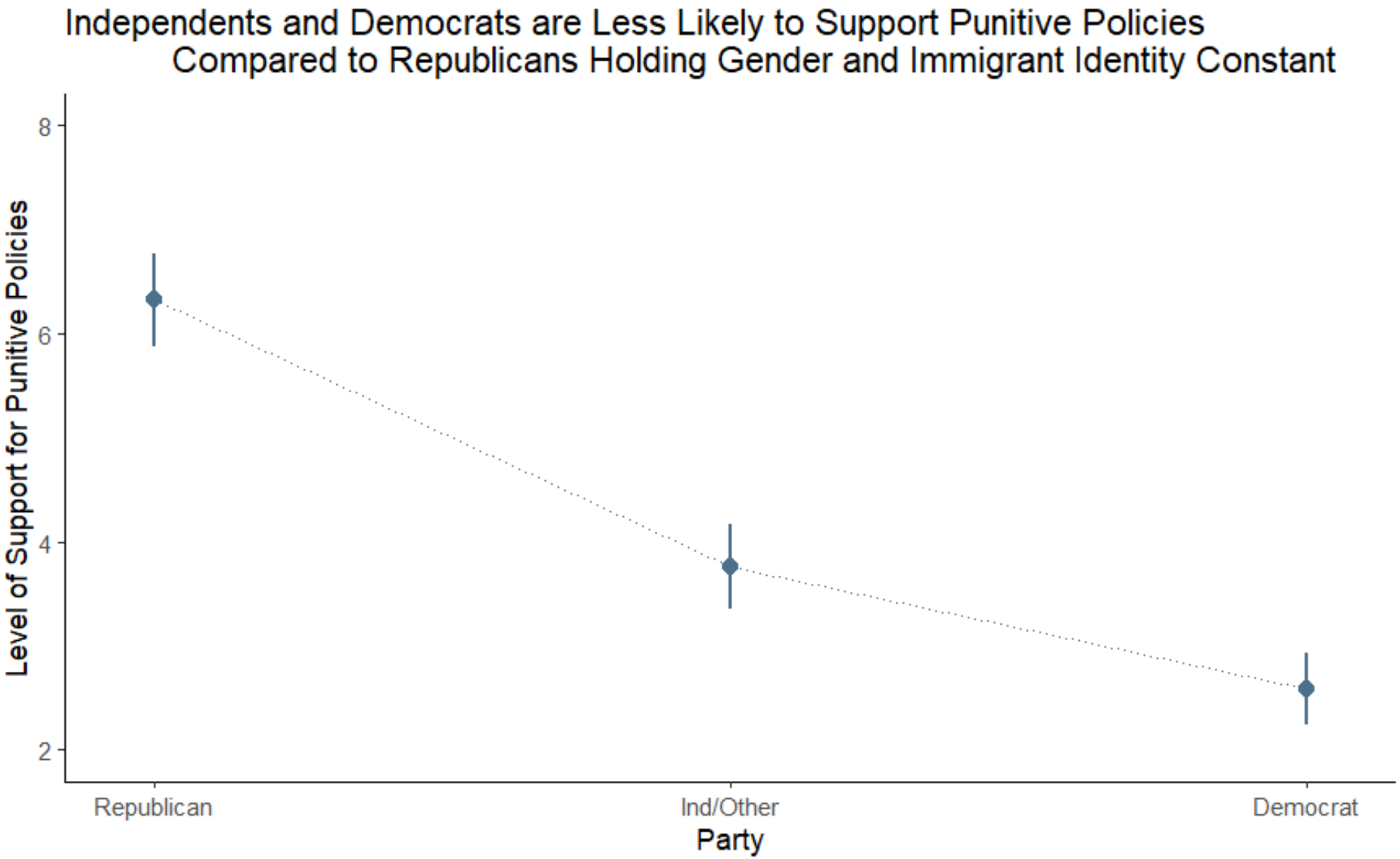
- To see each of the independent variable's estimates, we can use a prediction plot
  - Using the shell code, make sure the model object is your regression model, change the term to the specific independent variable you want to plot
  - Change title, labels, and y-axis scaling if needed
  - Change colors, styles, and themes to make it look professional

```
plot_model(model, type = "pred",
           terms = c("Independent Variable"), ci.lvl = .95,
           title="Title",
           axis.title=c("Independent Variable", "Dependent Variable"),
           colors=c("skyblue4")) +
  geom_line(color="skyblue4", linetype=3, linewidth=.4) +
  ylim(0,9) +
  theme_classic()
```

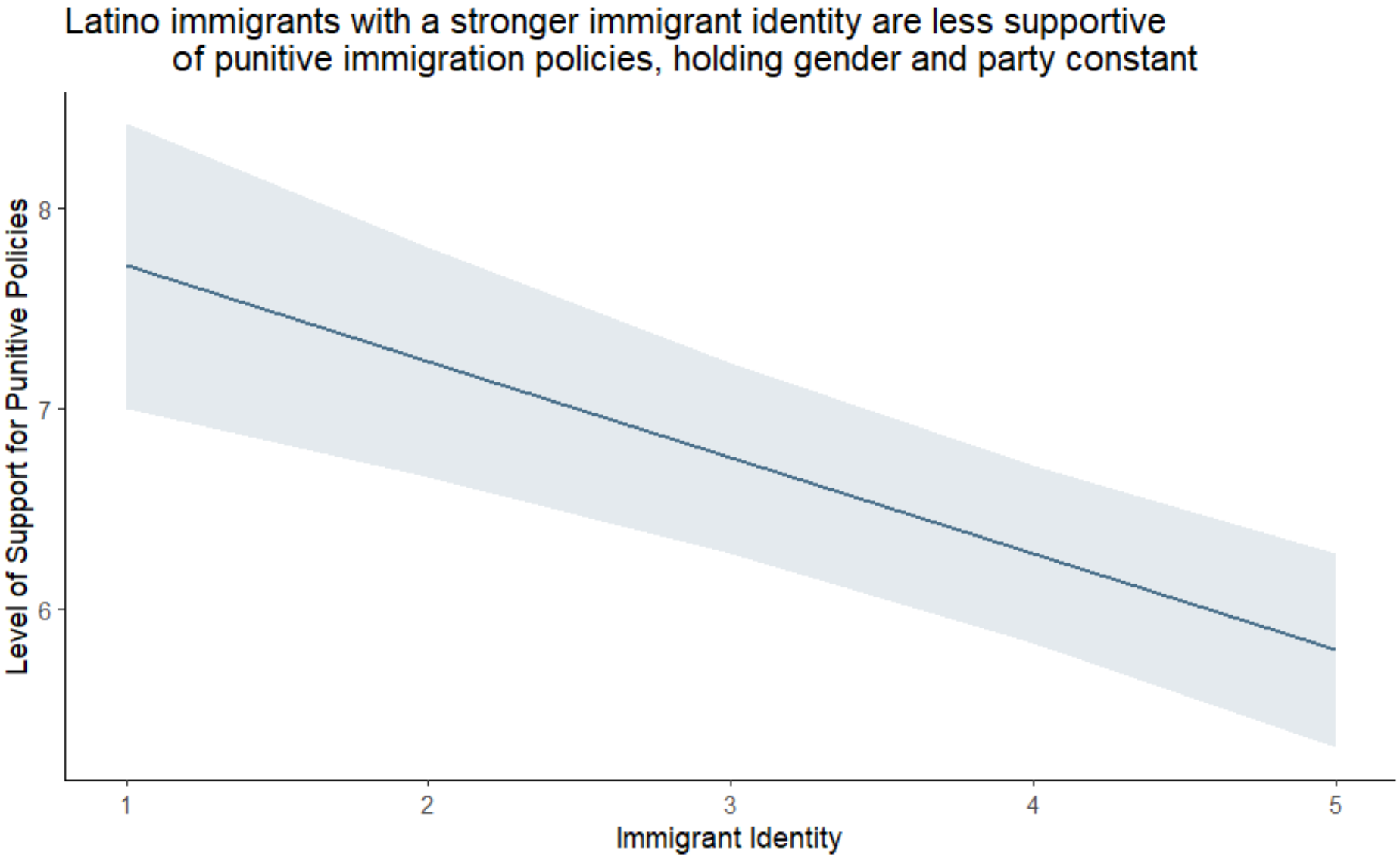
Example for gender



Example for party



Example for immigrant identity



Key takeaways from the example

- **Key takeaway: Women, Democrats, Independents, and those with strong immigrant identities are all significantly less supportive of punitive immigration policies compared to Republican men with no immigrant identity.**
- We can write out our regression equation that models the relationship between the independent variables and dependent variable
- Inserting values for the independent variables, we can make predictions about the estimated level of support for punitive policies

$$\textit{Support Punitive} = 8.20 - 0.46(\textit{Female}) - 2.56(\textit{Ind.}) - 3.74(\textit{Dem.}) - 0.48(\textit{Imm. ID})$$

LINAS Project To Do's

- Plot your dependent variable
- Run your linear regression model
- Plot each of your independent variables in a prediction plot (minimum 4 plots)
- Add explanations and interpretations where required

Important information

- Email: aloehrke@ucdavis.edu
- To do:
  1. LINAS Project 2 due 12/5 at 11:59pm for 8% EC
  2. LINAS Project 2 due 12/7 at 11:59pm for 5% EC
  3. LINAS Project 2 due 12/9 at 11:59pm for 3% EC
  4. LINAS Project 2 due 12/11 at 11:59pm (final deadline)
- **Please fill out the course evaluation for this class! Leave any comments about your thoughts on the course and section. I take these seriously to aid in my teaching to help students reach their learning objectives.**

Thank you all for a great quarter!