7 – Joint Hypothesis Tests

- Recap
- Confidence sets

Exercise

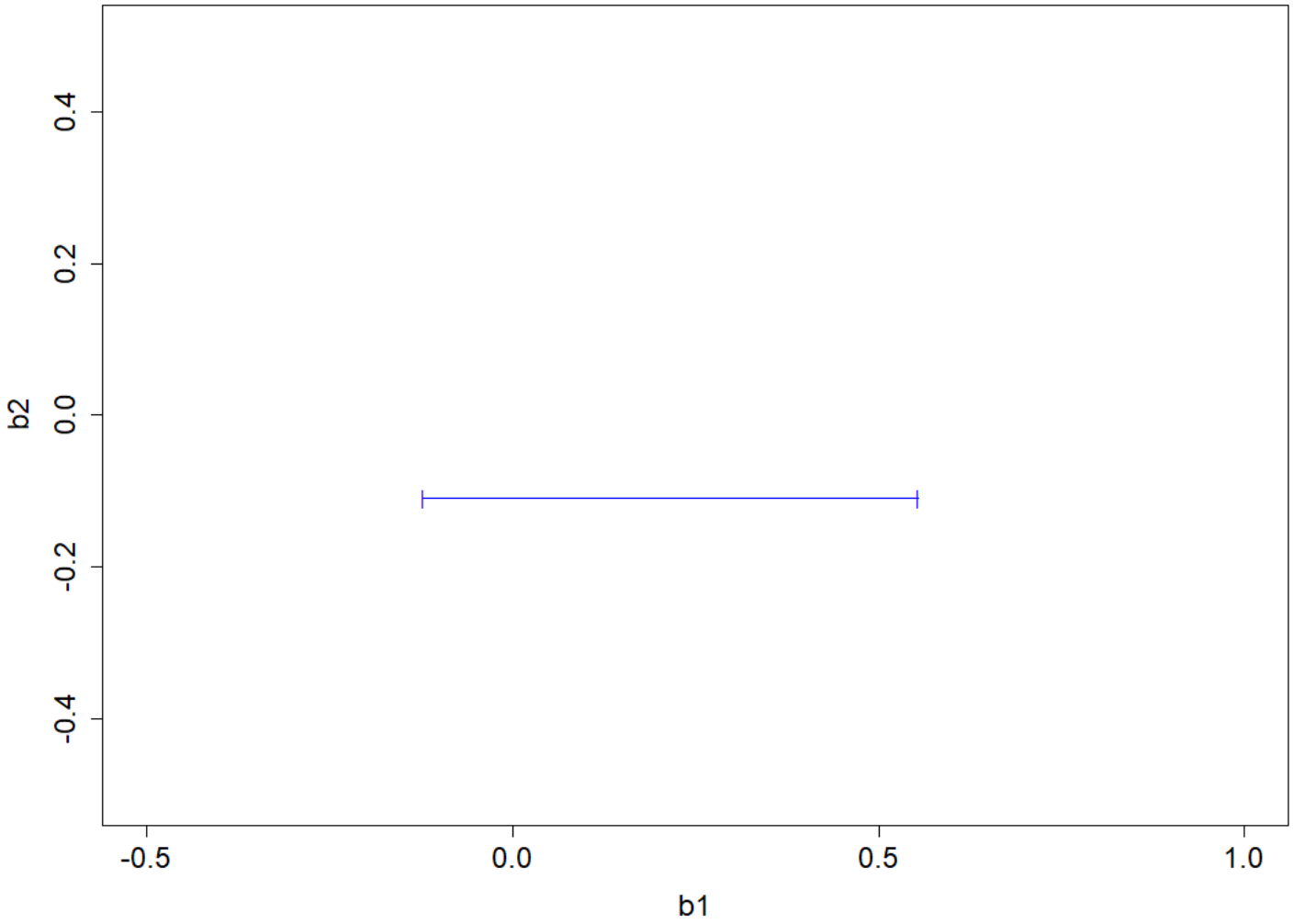
```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  -0.6246     0.4660  -1.340    0.182
X1            0.2161     0.1723   1.255    0.211
X2           -0.1092     0.1153  -0.946    0.345
X3            2.9384     0.1092  26.914   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 6.575 on 196 degrees of freedom
Multiple R-squared:  0.7921,  Adjusted R-squared:  0.7889
F-statistic: 248.9 on 3 and 196 DF,  p-value: < 2.2e-16
```

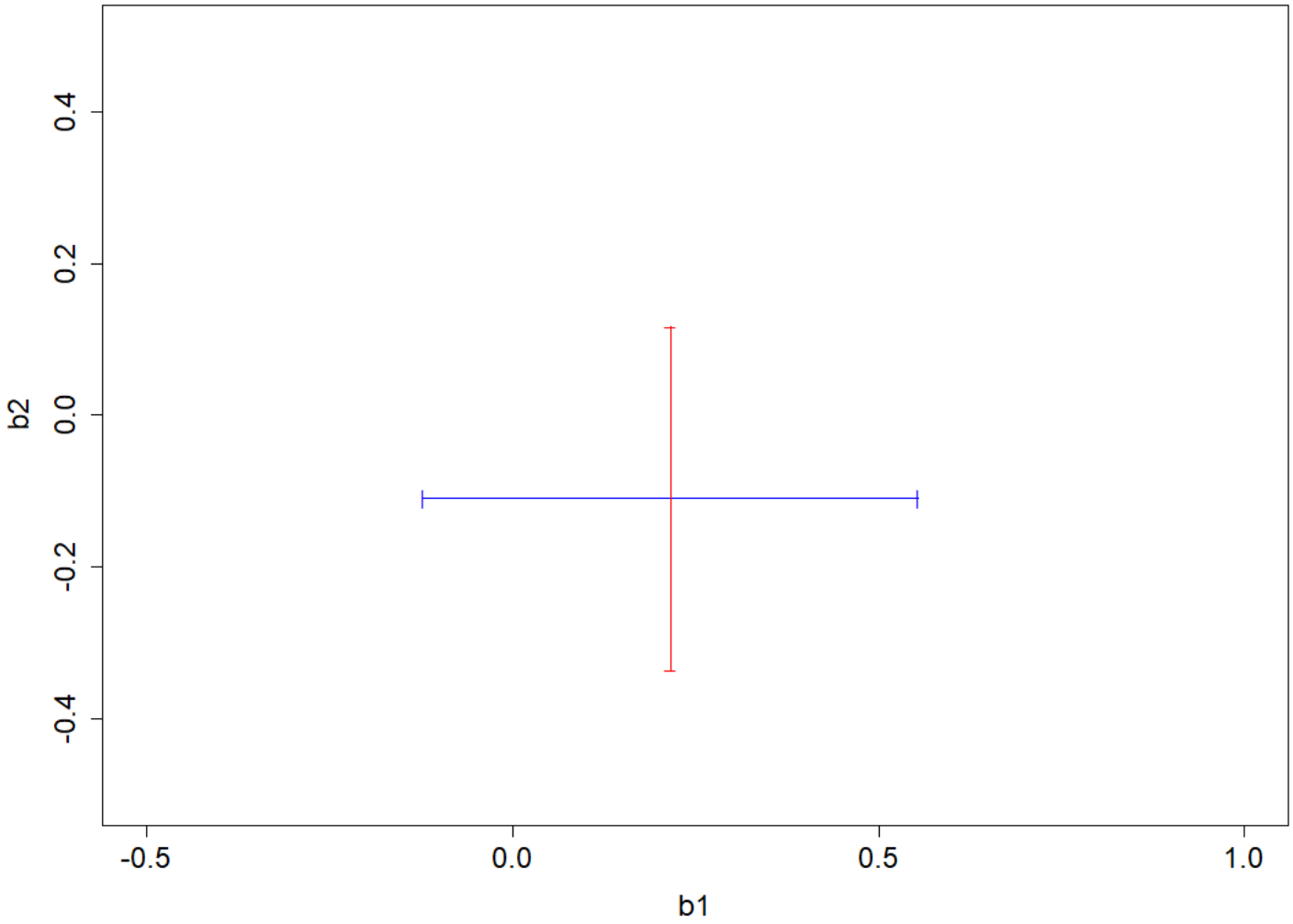
a) Calculate the 95% CI for b_1

b) Calculate the 95% CI for b_2

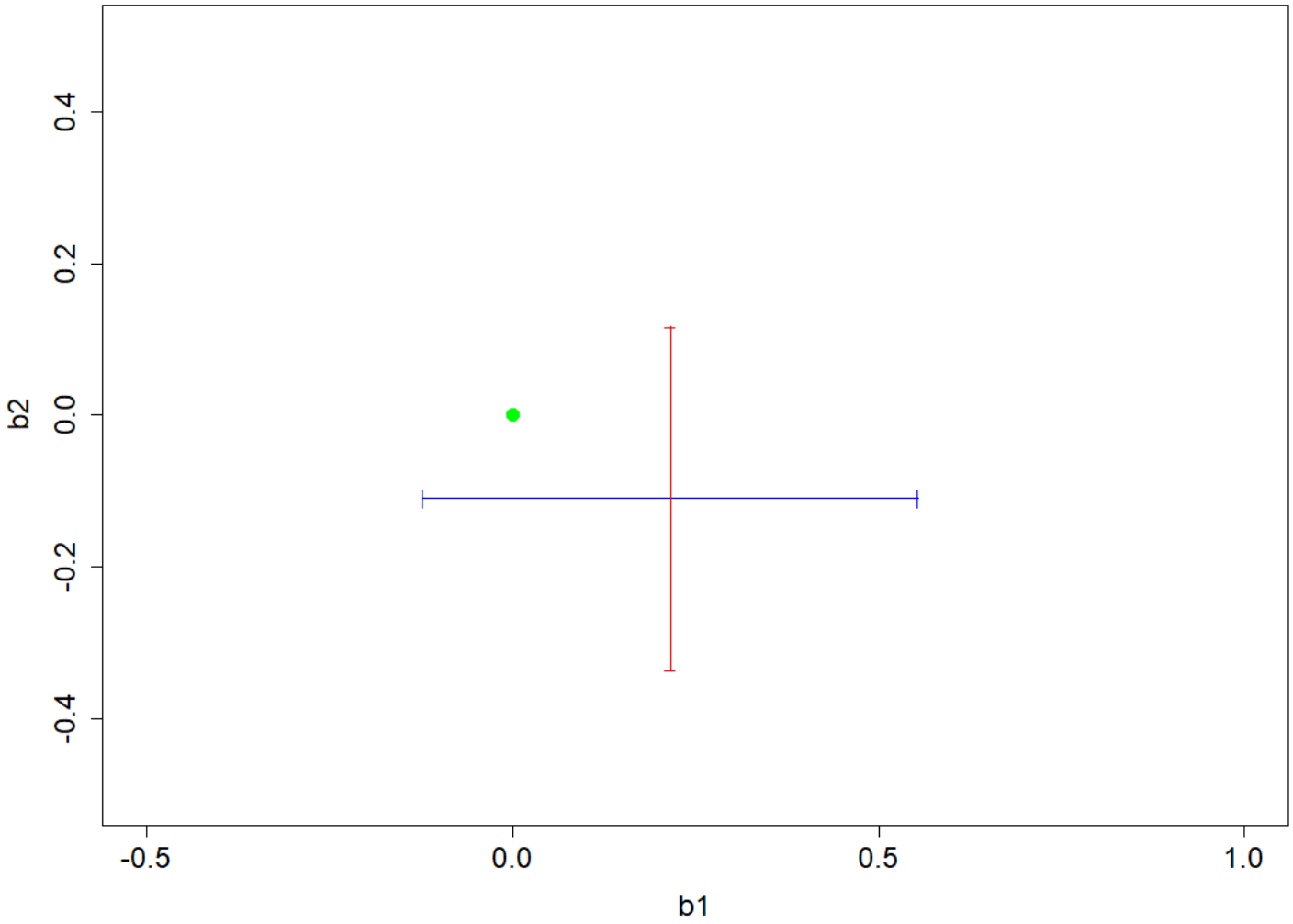
a)



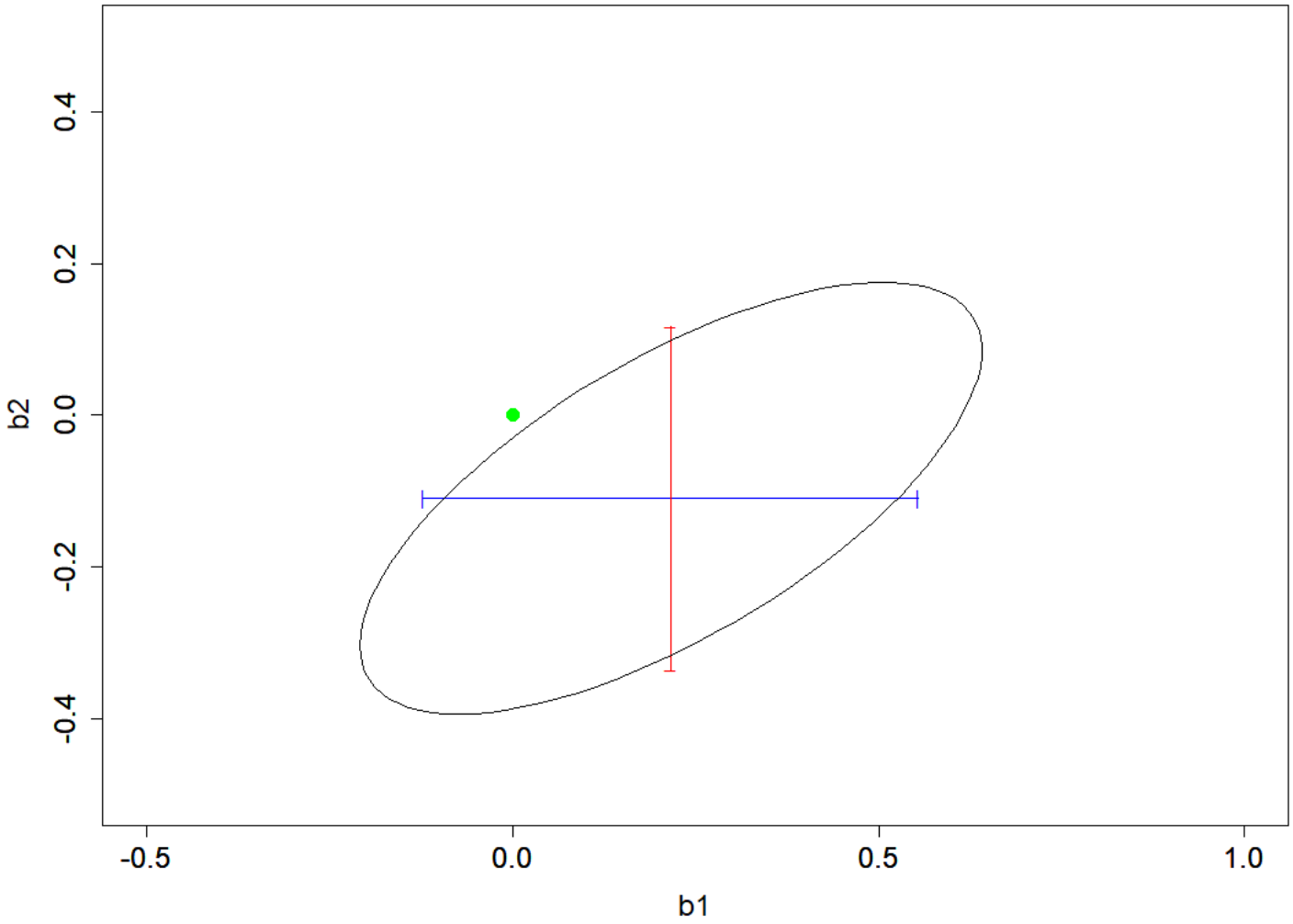
b)



Null hypothesis



Confidence set for b_1 & b_2: reject the null!



- the idea of confidence sets reinforces the idea that individual *t*-tests can't be used for joint hypotheses
- confidence sets aren't used in practice (in econometrics)

Aside: the overall F-test

A good idea might be to test if all of the variables are garbage:

$$H_0: \beta_1 = \beta_1 = \ldots = \beta_k = 0$$

$$H_A: \text{at least one } \beta \neq 0$$

- the intercept is not tested
- this "overall F-test" is usually reported by your econometric software

```
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Residual standard error?

Now we know what all of this R output means.

Model selection/building

- We will typically be interested in studying the marginal effects of a few variables
- Other variables are included to avoid OVB
- So, estimate several "candidate" models – maybe start big
- Use judgement
- Use t-tests/F-tests to select among models
- Don't just try to maximize R^2

Presenting results

Now that we have lots of variables in our models, and several different estimated models, we should present our results in tables, and include:

- dependent variable
- estimated regression coefficients
- standard errors
- significance codes (e.g. **)
- measures of fit
- *n*
- relevant F-stats (if any)

Dependent variable: *Price*. n = 1728.

Regressor	Model (1)	Model (2)	Model (3)
Intercept	20.27 (19.71)	22.46* (9.99)	17.51* (6.98)
Lot.Size	7.60*** (2.24)	7.29*** (2.05)	7.41*** (2.04)
Waterfront	120.20*** (15.54)	119.20*** (15.44)	120.40*** (15.33)
Age	-0.13* (0.06)	-0.14* (0.06)	-0.14* (0.06)
Land.Value	0.00*** (0.00)	0.00*** (0.00)	0.00*** (0.00)
New.Construct	-45.44*** (7.31)	-45.16*** (7.28)	-44.50*** (7.14)
Central.Air	9.95** (3.48)	9.90** (3.47)	9.65** (3.39)
fuel3	-10.93 (12.13)		
fuel4	-4.38 (5.02)		
heat3	-10.45* (4.19)	-10.53* (4.17)	-10.55* (4.16)
heat4	-0.08 (12.32)	-9.94* (4.04)	-9.98* (4.04)
sewer2	4.85 (17.12)		
sewer3	3.32 (17.07)		
Living.Area	0.07*** (0.00)	0.07*** (0.00)	0.07*** (0.00)
Pct.College	-0.11 (0.15)	-0.10 (0.15)	
Bedrooms	-7.84** (2.57)	-7.64** (2.56)	-7.75** (2.55)
Fireplaces	1.04 (2.99)	1.06 (2.98)	
Bathrooms	23.11*** (3.37)	23.04*** (3.34)	23.14*** (3.33)
Rooms	3.02** (0.96)	3.05** (0.96)	3.04** (0.96)
$\bar{R}^2$	0.65	0.65	0.65
F-statistic against Model (1)		0.40	0.35

Coefficient is statistically significant at the 5% (*), 1% (**), and 0.1% (***).