Hypothesis Testing with Hank

Does the Length of a Pickup Line Affect the Probability of a First Date?

EC 320 — Introduction to Econometrics

August 3, 2026

Introducing Hank

Meet Hank.

Hank has decided to take a data-driven approach to dating.

He's tired of rejection and ready to trust the power of regression.

His question: *Does the length of his pickup line actually affect his odds of getting a first date?*

What Hank Wants to Test

Hank wants to test whether the **length of his pickup line** affects his probability of getting a first date.

Research Question
Does the number of words in Hank's pickup line change the probability that his match agrees to a first date?

Hank's theory:

"Maybe shorter lines are better... or maybe poetry impresses?"

Question: The Hypothesis Being Tested

Choose (a–d) the correct set of hypotheses.

Hank's goal is to test whether pickup line length affects the probability of a first date.

A) $H_0 : \beta_1 > 0$ vs. $H_1 : \beta_1 = 0$

B) $H_0 : \beta_1 = 0$ vs. $H_1 : \beta_1 \neq 0$

C) $H_0 : \beta_1 < 0$ vs. $H_1 : \beta_1 > 0$

D) $H_0 : \beta_1 = 0$ vs. $H_1 : \beta_1 < 0$

The True Model and Setup

Hank's true model:

$$\text{FirstDate}_i = \beta_0 + \beta_1(\text{Length}_i) + u_i$$

where:

- $\text{FirstDate}_i = 1$ if his match goes on a first date, 0 otherwise
- $\text{Length}_i =$ number of words in the pickup line

Hank matches with **62 people**, randomly selects one of the following three pickup lines each time, and runs a regression:

Pick up Lines

1. “’Sup.”
2. “Hey, I think we’d make a great dataset together.”
3. “Hey, I couldn’t help but notice our correlation coefficient approaching one.”

Regression Results: Round 1

Hank runs the regression and gets:

$$\hat{\beta}_1 = 0.020, \quad \text{se}(\hat{\beta}_1) = 0.0125, \quad n = 62.$$

Task (10% level): Test $H_0 : \beta_1 = 0$ (two-sided).

- Compute the t-statistic.
- Find the two-sided critical value using `qt()` with $df = n - 2$.
- Decide: reject or fail to reject.

Bonus: If $n = 82$ (same $\hat{\beta}_1$ and se formula), how do the se and t change? What about testing at 5% instead of 10%?

Global F-test: Do pickup-line length + intercept explain anything?

Model:

$$\text{FirstDate}_i = \beta_0 + \beta_1(\text{Length}_i) + u_i, \quad n = 62$$

Suppose $R^2 = 0.03$.

Test (all slopes zero): $H_0 : \beta_1 = 0 \quad \text{vs.} \quad H_1 : \beta_1 \neq 0.$

$$F = \frac{(R^2/k)}{(1 - R^2)/(n - k - 1)}, \quad k = 1,\ df_1 = 1,\ df_2 = n - k - 1$$

Compute: F, the critical value $F_{df_1, df_2; 0.95}$, and your decision.

Conclusion of Part 1

Decision: Based on your F and the critical value, do you reject H_0?

Takeaway (if you failed to reject): Length alone explains very little...

Multiple Regression

Hank Consults with an Expert

Hank: Prof. Hall, I've tried everything. Three whole pickup lines!

Prof. Hall: Could it be that some people won't say yes regardless—because they don't find your profile attractive?

Hank: So there's another variable affecting both line performance and saying yes?

Prof. Hall: Exactly.

Omitted Variable Alert

You may have an **omitted variable** problem.

Exogeneity (population)
If $\mathbb{E}[u_i \mid X] = 0$, then $\mathrm{Cov}(X, u) = 0$.

Interpretation: Nothing outside the model should be correlated with both the regressor(s) and the error.

Sample OLS Orthogonality (reminder)
With an intercept, OLS residuals satisfy

$$\sum_i \hat{u}_i = 0 \quad \text{and} \quad \sum_i (x_i - \bar{x})\, \hat{u}_i = 0.$$

If "attractiveness" affects both Length and FirstDate, then $\mathbb{E}[u_i \mid X] \neq 0$ unless we control for it.

Conversation Continues

Hank: I need a variable that captures whether someone finds me attractive.

Prof. Hall: Precisely. What could proxy for that?

Hank: I think I know...

Brainstorm

Hank thinks: how can we *measure* attractiveness in a linear, continuous way?

Class prompt: What continuous feature could plausibly raise both

- the effectiveness of a pickup line, and
- the probability of a first date?


ACCESSORIES!

Hank Extends His Experiment

Hank now will test the impact of the length of a pick-up line on the first date, but will add in a variable for the **number of accessories he is wearing.**

Each person Hank tries to match with will see one of the following.

Hank Extends His Experiment

Hank Extends His Experiment

Re-introducing Hank's Research Question

Question (conditional effect): *Holding attractiveness fixed, does the number of words in Hank's pickup line change the probability of a first date?*

True model:

$$\text{FirstDate}_i = \beta_0 + \beta_1 \, \text{Length}_i + \beta_2 \, \text{Accessories}_i + u_i$$

Hank now matches with $n = 303$ people and runs the regression.

Results: Coefficients & Inference (compute in class)

Model: FirstDate on Length and Accessories, $n = 303$.

Estimates (se in parentheses):

$$\begin{aligned} \hat{\beta}_1 \text{ (Length)} &= 0.015\ (0.0048) \\ \hat{\beta}_2 \text{ (Accessories)} &= 0.012\ (0.0052) \end{aligned}$$

$$k = ? \qquad df = n - k - 1 = ?$$

Tasks:

1. Two-sided tests for $H_0 : \beta_1 = 0$ and $H_0 : \beta_2 = 0$.
2. **Global F-test** for {Length, Accessories} jointly: suppose $R^2 = 0.18$.
   Compute $F = \dfrac{(R^2/k)}{(1 - R^2)/(n - k - 1)}$ with your k, n.
3. Decide at 5% in each case.

Even MORE

MORE! - Kylo Ren

Figure 1: Hank thinks there must be other reasons he is not getting more dates.

Thinking Bigger: Other Continuous Covariates

Hank suspects other factors may affect both attractiveness and first-date probability:

- **MagicSkill**$_i$ (0–10)
- **MomRelationship**$_i$ (0–10)
- **PokemonCards**$_i$ (# owned)

Larger model:

$$\text{FirstDate}_i = \beta_0 + \beta_1 \,\text{Length}_i + \beta_2 \,\text{Accessories}_i + \beta_3 \,\text{MagicSkill}_i + \beta_4 \,\text{MomRelationship}_i + \beta_5 \,\text{PokemonCards}_i + u_i$$

Estimation

Hank estimates two regressions:

- **Model 1 (smaller):** only *Length* and *HatQuality* $\Rightarrow$ Sum of Squared Residuals ($\text{SSR}_{\text{small}}$) $= 41.25$
- **Model 2 (larger):** adds *MagicSkill*, *MomRelationship*, *PokemonCards* $\Rightarrow$ $\text{SSR}_{\text{large}} = 37.60$

Compute in-class:

1. Calculate the new R^2 for Model 2 assuming $\text{TSS} = 50.25$.
2. Use that new R^2 to perform the marginal inclusion test on the next slide.

Marginal Inclusion Test (partial F)

Question: Do $\{$*MagicSkill, MomRelationship, PokemonCards*$\}$ add any explanatory power beyond $\{$*Length, Accessories*$\}$?

$$H_0 : \ \beta_3 = \beta_4 = \beta_5 = 0 \qquad H_1 : \ \text{At least one } \beta_j \neq 0$$

You are given:

$$\text{SSR}_{\text{smaller}} = 41.25, \quad \text{SSR}_{\text{larger}} = 37.60, \quad \text{TSS} = 50.25, \quad n = 303.$$

Compute:

1. $R^2_{\text{smaller}} = 1 - \text{SSR}_s/\text{TSS}, \quad R^2_{\text{larger}} = 1 - \text{SSR}_\ell/\text{TSS}.$
2. Partial F with $q = 3$ added variables:
$$F = \frac{(R^2_\ell - R^2_s)/q}{(1 - R^2_\ell)/(n - k_\ell - 1)}, \quad k_\ell = 5.$$
3. Decision at 5%.

A Second Date?

Stretch Question: Second-Date Probability

Hank wonders: do pickup-line length effects carry over to a **second date**?

Naive model:

$$\text{SecondDate}_i = \gamma_0 + \gamma_1 \,\text{Length}_i + v_i$$

He considers adding whether a first date happened:

$$\text{SecondDate}_i = \gamma_0 + \gamma_1 \,\text{Length}_i + \gamma_2 \,\text{FirstDate}_i + v_i$$

Discussion prompt (class):

- Should the first date be included in this regression? Why or why not?