(a) Which study design would you recommend and why?

*41 of 45 (91%) (84%) students chose Design 2 and discussed the home-to-home variation in prices (~20%), accounting for possible sources of variation (~11%), possible confounding variables (~9%), using the same homes (~44%). Two were vague. Those picking Design 1 focused on random assignment, larger sample sizes, or causation.*

(b) Explain why random assignment is important to use in Design 1.

*Most students referred to preventing confounding (~40%) or creating similar groups (20%). Most didn’t elaborate/provide an example, but some were very good. Weaker answers only referred to “bias” (~14%) or reducing variation in home prices (~7%) or the ability to draw causation (~9%). A few answers referred to generalizability (~4%) or “to draw conclusions” or were inconsistent. Communication seemed stronger in (a).*

**2024/2025:**

A p-value of 0.22 equates to failing to reject the null hypothesis, which means that there is evidence of no difference in the appraisal prices given by these two appraisers.

Do you agree with this conclusion? If not, how would you change the statement? (If you rewrite the statement, use language the loan officer can understand.)

Results were very similar to 2023: *About 10% of students agreed with the statement or incorrectly reworded the conclusion. Most reworded in terms of “insufficient [not strong enough, not significant, not convincing] evidence of a difference” (59%) or “no evidence of a difference” (30%). Again, some confusion on where the adjective “significant” belongs (e.g., “conclude there is no significant difference between the two appraisers”, “no/not enough evidence of a significant difference”). Only one student reworded in terms of the average.*

(f) Consider the following interpretation of this p-value:

The p-value of 0.22 refers to about a 22% chance of the data being completely random.

Do you agree with this interpretation? If not, how would you change the statement? (If you rewrite the statement, use language the loan officer can understand.)

*For 45 students, two did not complete this question, one agreed with the statement, and one said the only problem was needing more context.*

*41 students*

* *Single responses: chance of the same results, chance the data are random, chance there is no difference, p-value is not about probability of something being random*

*36 students (80%)*

* *56% referenced the null hypothesis and 22% referenced “by chance alone”, 3 talked about repeating the study, repeated simulation, repeated comparisons*
* *31% referenced the (observed) difference, but most gave vague/generic descriptions of the statistic: data (14%), outcomes (3%), results (35%). Two referenced test statistic, others referenced the z-score, true results, data being random, significant difference*
* *56% described a tail probability*
* *22 of 43 students put their descriptions into context; 3 included the mean or average descriptor*

*Overall, about 44% made a statement about the null hypothesis*

(g) The loan officer is concerned that a distribution of appraisal values does not follow a normal distribution. The loan officer suggests using more than 20 homes in the study to address this issue. How would you respond?

* *3/45 students did not answer*
* *Some (3) just defaulted to larger samples are always better or discussed other benefits (e.g., accuracy, power, better picture)*
* *30/42 students said yes. Some of these (~10) were ambiguous (e.g., “may be helpful”) inconsistent (e.g., talking about distribution of means and distribution of data interchangeably) and/or focused on how this would make the analysis more valid, improve normality of residuals, or that normality wasn’t always required/could use other methods. One said the np condition was already met.*
* *5/42 said no and seemed to understand the distinction. 4 others said no but the explanation was ambiguous or mixed.*

**Problem 3**

Consider the following regression model for predicting home prices ($100,000) from age (years), square footage (1,000 sq ft), and number of bedrooms.

Text, letter

Description automatically generated

(a) A real estate agent is concerned by the negative coefficient on the number of bedrooms because their experience suggests that having more bedrooms is associated with more expensive homes. How would you respond?

* *1 student did not finish*
* *13/44 primarily referenced how the coefficient was adjusted for the other variables in the model (but not usually well explained), two with very good explanations. Some referenced the adjustment but also interaction [1].*
* *7/44 primarily focused on multicollinearity (3) or discussed how this would likely increase square footage as well (3) or that it would be difficult to hold square footage constant (1). Some went on to discuss interaction [1].*
* *8/44 suggested exploring an interaction between the two variables (though often probably meant multicollinearity, e.g., “inner relationship”*
* *7/44 focused on how the bedroom variable was less significant (6) or insignificant (1)*
* *Other explanations offered: negative intercept, missing variables, other factors, outliers*

(b) The agent is also concerned that square footage only adds $4.14 to the price of the house. How would you respond? (changed question order)

* *1 did not answer*
* *52% addressed units on both variables*
* *11% really only addressed the explanatory and 22% really only addressed the response*
* *11% really didn’t address units or focused on other variables (2%)*

(c) The real estate agent then includes an interaction between age and square footage in the model. The coefficient of this *age x sqft* term is -0.0207 (p-value = 0.0009). Explain to the real estate agent how to interpret this interaction in context.

* *1 did not answer*
* *36% gave a reasonable interpretation in context.*
* *23% gave a “partially correct” interpretation, examples:*
  + *As age increases, the impact of square footage decreases (no price)*
  + *Interpreted the slope of sq ft for age = 0 (only)*
  + *“Knowing information about one variable will affect the other variable on predicting the price…”*
  + *Age and sqrt ft include the amount of value each variable add to the price of the home.*
* *18% worded in terms of “if you increase both variables by one”*
* *9% said this indicated a negative relationship between size and age and 1 indicated this corresponded to an association between the two EVs/can’t consider in insolation*
* *4% interpreted in terms of an associated coefficient*
* *6.5% focused only on the significance of the coefficient*