



## “FRAPPY” {Free Response AP Problem...Yay!}

The following problem is taken from an actual Advanced Placement Statistics Examination. Your task is to generate a complete, concise statistical response in 25 minutes. You will be graded based on the AP rubric and will earn a score of 0-4. After grading, keep this problem in your binder for your AP Exam preparation.

A study was designed to explore subjects' ability to judge the distance between two objects placed in a dimly lit room. The researcher suspected that the subjects would generally overestimate the distance between the objects in the room and that this overestimation would increase the farther apart the objects were.

The two objects were placed at random locations in the room before a subject estimated the distance (in feet) between those two objects. After each subject estimated the distance, the locations of the objects were rerandomized before the next subject viewed the room.

After data were collected for 40 subjects, two linear models were fit in an attempt to describe the relationship between the subjects' perceived distances ( $y$ ) and the actual distance, in feet, between the two objects.

$$\text{Model 1: } \hat{y} = 0.238 + 1.080 \times (\text{actual distance})$$

The standard errors of the estimated coefficients for Model 1 are 0.260 and 0.118, respectively.

$$\text{Model 2: } \hat{y} = 1.102 \times (\text{actual distance})$$

The standard error of the estimated coefficient for Model 2 is 0.393.

### **Scoring:**

(a) Provide an interpretation in context for the estimated slope in Model 1.

(b) Explain why the researcher might prefer Model 2 to Model 1 in this context.

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(c) Using Model 2, test the researcher's hypothesis that in dim light participants overestimate the distance, with the overestimate increasing as the actual distance increases. (Assume appropriate conditions for inference are met.)

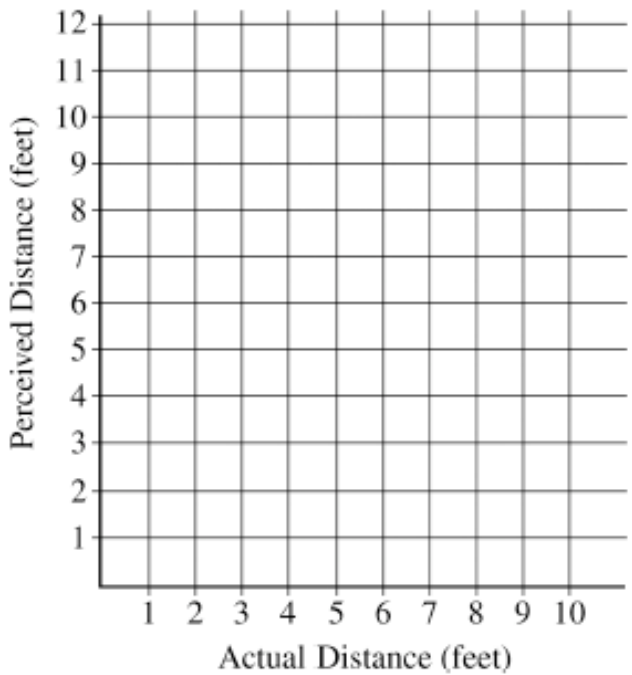
**E P I**

The researchers also wanted to explore whether the performance on this task differed between subjects who wear contact lenses and subjects who do not wear contact lenses. A new variable was created to indicate whether or not a subject wears contact lenses. The data for this variable were coded numerically (1 = contact wearer, 0 = noncontact wearer), and this new variable, named “contact” was included in the following model.

Model 3:  $\hat{y} = 1.05 \times (\text{actual distance}) + 0.12 \times (\text{contact}) \times (\text{actual distance})$

The standard errors of the estimated coefficients for Model 3 are 0.357 and 0.032, respectively.

(d) Using Model 3, sketch the estimated regression model for contact wearers and the estimated regression model for noncontact wearers on the grid below.



(e) In the context of this study, provide an interpretation of the estimated coefficients for Model 3.