

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

Instruction: Answers gain no point if there is no explanation, calculation, or if it is not understandable.
Answers can be in either English or Chinese.

1. [15pts] Answer the following questions. Please clearly show all necessary math, and explain your examples/answers with enough (and no more than enough) words to explicate the relevant concepts.
 - a. [5pts] What is *mutually exclusive*? What is *independent*? Show these two concepts in probability symbols, $P(\cdot)$.
 - b. [10pts] Assume X and Z are two events. Can these two events be mutually exclusive **and** independent simultaneously?
2. [15pts] There are 100 geniuses in a country. 50 of them are party X 's supporters, 40 are party Y 's supporters, and 10 are party Z 's supporters. The percentages of the geniuses in these three groups who read *The Dummy Times*—a famous newspaper—are known to be 30, 60, and 40 percent, respectively. If you see one of these geniuses is reading the *Dummy Times*, find the probability that she or he is a supporter of party Y .
3. [20pts, 10pts each] Assume that variables x and y have the following joint PDF:

$$f(x, y) = \frac{12}{5} x(2 - x - y); 0 < x < 1; 0 < y < 1$$
$$= 0 \text{ otherwise}$$

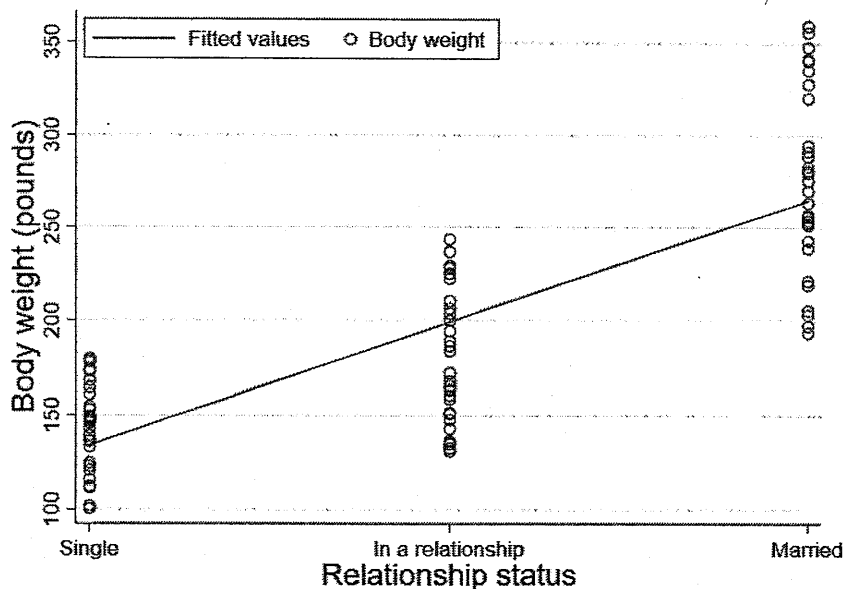
- a. Find $P(x > 0.5)$ and $P(y < 0.5)$
 - b. What is the conditional density of X given that $Y = y$, where $0 < y < 1$?
4. [20pts, 10pts each] Explain the difference(s) between the following pairs of terms with enough (and no more than enough) words [Answer with only mathematical symbols, but without explanations gain no points]:
 - a. Level of significance and confidence coefficient
 - b. Type II error and power of a test

5. [20pts] A scientist has data on relationship status and body weight for 12 participants and observe the following statistics:

Participant	Relationship status	Body weight (pounds)	Participant	Relationship status	Body weight (pounds)
1	Married	260	7	Married	230
2	Single	150	8	In a relationship	200
3	In a relationship	180	9	Single	160
4	Married	300	10	Married	360
5	In a relationship	190	11	Single	130
6	Single	140	12	In a relationship	210

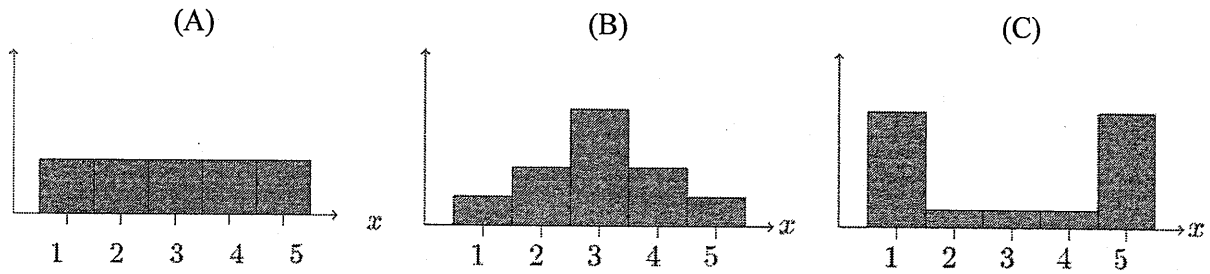
After seeing these statistics, he believes that being settled in a relationship or married will make people fat. Here is his logic: individuals may feel more comfortable in eating more foods high in fat and sugar when they are no longer need to look attractive and slim to attract a potential partner. Especially for married individuals who do not need to compete with others in the marriage-market.

In order to confirm his believe, he gathers a group of scientists and collect more data on relationship status and body weight. He and his colleagues collect a huge amount of data and plot the following graph (each circle represents an individual):



After seeing this graph, he and his fellow scientists claim that “falling in love causes you fat” because individuals who were settled in a relationship or marriage tended to gain more weight. Do you agree? If you agree, provide at least two reasons that make you agree with their claim. If you disagree, provide at least two confounding factors that make you disagree with their claim. Explain your logic in detail.

6. [10pts] Here are the probability mass function for 3 random variables:



Please order the graphs from smallest to biggest standard deviation. Please clearly show all necessary math, and explain your examples/answers with enough (and no more than enough) words to explicate your ideas.