

# Midterm 2

Show all your work

Name: \_\_\_\_\_

Score: \_\_\_\_/40

**Problem 1:** Lily's Restaurant serves three fixed-price dinners costing \$12, \$15, and \$20. For a randomly selected couple dining at Lily's, let  $X$  be the cost of the woman's dinner and  $Y$  be the cost of the man's dinner. The joint pmf of  $X$  and  $Y$  is given in the following table:

$p(x, y)$		$y$		
		12	15	20
$x$	12	0.05	0.05	0.00
	15	0.05	0.10	0.20
	20	0.10	0.35	0.10

- a. Compute the marginal pmf's of  $X$  and  $Y$ , i.e.,  $p_X(x)$  and  $p_Y(y)$ . You may use the space around the table to help you.

Score: /2

- b. Find  $P(X \leq 15 \text{ and } Y \leq 15)$ . Describe the probability in words.

Score: /2

- c. Are  $X$  and  $Y$  independent? Justify your answer.

Score: /2

- d. What is the expected total cost of dinner for a couple? Show how you obtain your answer.

Score: /2

**Problem 2:** Hastings, Cassiar, and McGill streets feed into Iron Workers' Memorial Bridge entrance. Suppose that between 7 am and 7:30 am on a weekday morning, the number of vehicles coming from each road onto the bridge is a random variable, with expected value and standard deviation as given in the table.

	Hastings	Cassiar	Mcgill
Expected value:	800	1000	600
Standard deviation:	16	25	18

- a. What is the expected total number of vehicles entering the bridge at this point during the period?

Score: /1

- b. What is the variance of the total number of entering vehicles? Specify any assumption made about the relationship between the number of vehicles on the different streets.

Score: /2

**Problem 3:** Capilano U Publishing House is interested in estimating the strength of the bindings produced by a particular binding machine. Strength can be measured by recording the force required to pull the pages from the binding. If this force is measured in pounds, how many books should be tested to estimate the average force required to break the binding to within 0.1 pound with 95% confidence? Assume that  $\sigma$  is known to be 0.8.

Score: /3

**Problem 4:** An Ironman competition consisting of swimming, cycling, and running is one of the more strenuous amateur sporting events. A research article reports on a study involving 9 male participants. Maximum heart rate (beats/min) was recorded during the performance of each of the three events. For swimming, the sample mean and sample standard deviation were 188.0 beats/min and 7.2 beats/min, respectively. Assuming that the heart-rate distribution is (approximately) normal, construct a 98% CI for true mean heart rate of Ironman participants while swimming.

- Name the test required for the confidence interval.
- State all parameters with their corresponding values.
- All calculator usage must be stated with its results listed.
- Summarize giving 2-decimal place accuracy with a complete sentence regarding reliability and precision.

Score: /5

**Problem 5:** Minor surgery on horses under field conditions requires a reliable short-term anesthetic producing good muscle relaxation, minimal cardiovascular and respiratory changes, and a quick, smooth recovery with minimal aftereffects so that horses can be left unattended. A research article reports that for a sample of 73 horses to which ketamine was administered under certain conditions, the sample average lying-down time was 18.86 min and the standard deviation was 8.6 min.

a. Does this data suggest that true average lying-down time under these conditions is less than 20 minutes?

- Use a significance level of 0.10.
- Define your variables and identify parameters.
- State hypotheses.
- Name the test and your test statistic.
- Shade the corresponding rejection region to your test with its value.
- State your conclusion with a complete sentence.

b. Define a Type I error.

c. Find Type II error to 3 decimal places when the true mean is 21 minutes.

Score: /8

**Problem 6:** As the population ages, there is increasing concern about accident-related injuries to the elderly. A research paper reported on an experiment in which the maximum lean angle—the furthest a subject is able to lean and still recover in one step—was determined for both a sample of younger females (21–29 years) and a sample of older females (67–81 years). The following observations are consistent with summary data given in the article:

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YF:	29,	34,	33,	27,	28,	32,	31,	34,	32,	27
OF:	18,	15,	23,	13,	12					

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Does the data suggest that true average maximum lean angle for older females is more than 10 degrees smaller than it is for younger females? State and test the relevant hypotheses at significant level 0.10.

- Define your variables and identify parameters.
- State hypotheses.
- Name the test and your test statistic.
- Write both input and output values from your calculator.
- State your conclusion with a complete sentence.

Score:     /6

**Problem 7:** An article reports the following data on total iron for four types of iron formation: carbonate, silicate, magnetite, and hematite.

carbonate:	20.5	28.1	27.8	27.0	28.0
silicate:	26.3	24.0	26.2	20.2	23.7
magnetite:	29.5	34.0	27.5	29.4	27.9
hematite:	36.5	44.2	34.1	30.3	31.4

Carry out an analysis of variance  $F$  test at significance level 0.01, and summarize the results in an ANOVA table.

Source of Variation	df	Sum of squares	Mean Square	$f$	$p$
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- Define your variables and identify parameters.
- State hypotheses.
- What is the definition of the test statistic  $f$ ?
- How many treatments does the report contain?
- How many observations does each treatment have?
- Find the explicit value of the test statistic at  $\alpha = 0.01$ .

- State your conclusion with a complete sentence.

Score: /7