



“Investing in Africa’s future”

**COLLEGE OF HEALTH, AGRICULTURE & NATURAL SCIENCES**

**NACP 204: RESEARCH METHODS**

**END OF SECOND SEMESTER FINAL EXAMINATIONS**

**APRIL 2023**

**LECTURER: PROF. C. L. ABERCROMBIE**

**DURATION: 3 HOURS**

## INSTRUCTION

Answer all 10 questions. Note that some offer you the choice of two or more options. For some questions you will need the abbreviated Chi-Square table copied at the end of this paper.

(60 marks total)

1. Using Google Earth, an ecologist classified a 1000-hectare landscape into five ecotypes: Wetland (10%), Mopane woodland (30%), Rocky outcrops (5%), New-growth bush (30%), and Agricultural fields (???%). The ecologist instrumented 3 Serval cats with radio-collars and obtained 50 habitat-use locations for each cat. Her null hypothesis was that Servals used habitat-types according to each type's proportional abundance. She analyzed her data by Chi-Square.

- (a) What percent of land was in Agricultural fields? (1 mark)
- (b) How many degrees of freedom will be in the Chi-Square analysis? (3 marks)
- (c) What is the Chi-Square critical value for an  $\alpha$ -level of  $P = 0.05$ ? (1 mark)

2. An Agricultural Extension Agent is evaluating a traditional treatment said to protect goats from a tick-borne disease that is extremely common in the area of interest. He somehow acquires a random sample of 50 goats from the area. Remarkably, the goats' owners have kept records of which goats were treated and which were not. A blood test can usually determine whether a goat has been subject to the disease ("Sick") or not ("Not Sick"). However, the test is far less than perfect, and diagnosis is uncertain ("Ambiguous") about 15% to 25% of the time. The agent records the following data, which you should analyze by Chi-Square techniques.

		DIAGNOSIS		
		NOT SICK	SICK	AMBIGUOUS DIAGNOSIS
RECEIVED TREATMENT	YES	15	10	5
	NO	5	10	5

- a) What is  $H_0$ ? (3 marks)
- b) What is  $H_A$ ? (1 mark)
- c) What is the Chi-Square value for this study? (Please show your work.) (4 marks)
- d) What is the critical Chi-Square value for  $\alpha = 0.05$ ? (1 mark)
- e) From the Chi-Square table, one learns that  $P$  is between \_\_\_\_\_ and \_\_\_\_\_. (2 marks)
- f) What do you decide about the null hypothesis? (1 mark)

**3. There are two options for Question 3. Select and answer only one.**

**OPTION A.** Explain concisely the relative advantages of **fully structured interviews** *versus* **loosely structured interviews**. Indicate the conditions (and associated research questions) under which one interview-strategy would be superior to the other. (8 marks)

**OPTION B.** A wealthy research organization contemplates an extensive test of maize cultivars under various conditions. The intent would be to test 5 different cultivars (variable name: CULTIVAR) with **4 replications** in every treatment-combination cell. The tests will be conducted across 5 different soil-types (variable name: SOIL) in 4 different areas (variable name: AREA).

(a) Write the model-statement for a **fully factorial ANOVA**. I'll get you started: (4 marks)

$$\text{YIELD} = f(\text{CULTIVAR}, \text{SOIL}, \dots)$$

(b) How many test-plots will be required to conduct the study as planned? Show your work. (The right answer will illustrate why the organization needs to be WEALTHY.) (4 marks)

4. A researcher tests an organic food-additive on underperforming dairy cattle. She obtains an appropriate sample of 10 cows. From dairy records she learns the milk production for each cow over the past week. She initiates the additive treatment for two weeks, and then she measures milk production for a week. The data look ok for a t-test.

(a) What kind of t-test is appropriate? Explain briefly. (2 marks)

(b) Would the best expression of  $H_A$  indicate one or two tails? (1 mark)

(c) How many degrees of freedom would the test have? (1 mark)

**5. There are two options for Question 5. Select and answer only one.**

**OPTION A.** A large and extremely wealthy UM Church in Dallas, Texas, USA, has established a program "to do something about food security in Africa." The founders of the program heard a missionary talk about a small village in southern Masvingo Province, Zimbabwe. Knowing that you are an expert in agricultural research, these people are willing to give you \$100,000US to help the people of that village avoid food shortages, particularly during droughts. You are absolutely determined to spend the money wisely, but you know only these few facts about the village: (1) its resident population is about 500; (2) many men work in Harare or even South Africa, so > 50% of the farmers are women; (3) the rainfall for 2007 was 675mm; (4) outside food assistance (you don't know what) was needed in 2022. You also heard a rumor that in some years baboons raid the maize fields, but you don't know whether that's true.

So, concisely explain what information you would need most in order to spend the money wisely, and explain how you would use techniques covered in this course to obtain that information. (10 marks)

**OPTION B.** A researcher is testing the effect of two different diets (Diet A and Diet B) on weights (kg) of broilers raised for 4 weeks. The researcher has an 8-bird experimental grow-out pen in each of two very different locations on his University campus. It's not easy, but 4 birds in each location are fed exclusively on Diet A and four are fed exclusively on Diet B. The data look like this:

	Diet A	Diet A	Diet A	Diet A	Diet B	Diet B	Diet B	Diet B
Location 1	1.4	1.5	1.5	1.6	1.3	1.4	1.4	1.4
Location 2	1.3	1.2	1.2	1.3	1.2	1.2	1.1	1.4

The researcher decides to analyze her data with fully factorial ANOVA using the following model: **Weight = f(Diet, Location, Diet\*Location)**.

(a) Explain the meaning of the interaction term. (5 marks)

The analysis produces the following table:

	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p-value</i>
Rows	0.225625	1	0.225625	57	6.77E-06
Columns	0.050625	1	0.050625	12.78947	0.003809
Inter	0.000625	1	0.000625	0.157895	0.698079
Within	0.0475	12	0.003958		
Total	0.324375	15	0.021625		

- (b) What is the row-variable? (1 mark)  
 (c) Is the row-variable statistically significant? (1 mark)  
 (d) What is the column-variable? (1 mark)  
 (e) Is the column-variable statistically significant? (1 mark)  
 (f) Comment appropriately on the interaction term. (1 mark)

6. Explain concisely what the following formula tells you to do. (3 marks)

$$\text{Var}(X) = \frac{\sum_{i=1}^n (X_i - X_{\text{ave}})^2}{n - 1}$$

7. In an early-stage test of a Layer Additive (which will be very expensive until it is mass produced), a researcher obtains a sample of 11 Khaki Campbell ducks, supplements their daily

diets with various amounts of the additive, and counts their egg production for a month. Data, scatterplot, and computer output are given below.

Y (eggs)	20	20	19	22	24	23	24	26	25	28	27
X (additive)	0	1	2	3	4	5	6	7	8	9	10

The following table is part of the output generated by a computer program for regression.

	<i>Coefficients</i>	<i>Standard Error</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	19.22727273	0.597553937	1.32931E-10	17.87551181	20.57903364
X (g additive)	0.845454545	0.10100505	1.53906E-05	0.616965247	1.073943844

- Write the regression (least-squares) equation; round coefficients to 2 decimal places. (3 marks)
- What is the P-value for the slope coefficient (round to 2 decimal places)? (1 mark)
- Which coefficient—slope or intercept—is more important for evaluating the effect of the diet additive? (2 marks)
- What is the best estimate for the number of eggs that would be produced by a duck receiving 5g of additive? (3 marks)

8. An abbreviated portion of a questionnaire-design we discussed in class is reproduced below.

- What's the most serious problem with the instructions for addressing this question? (2 marks)
- How would you rewrite the instructions to make the questionnaire better? (2 marks)

On the following scale, please indicate by a tic mark the potential importance to your poultry enterprise of the following improvements:

**More reliable electronic power.**

1 \_\_\_\_\_ 2 \_\_\_\_\_ 3 \_\_\_\_\_ 4 \_\_\_\_\_ 5 \_\_\_\_\_

**Improved market for eggs.**

1 \_\_\_\_\_ 2 \_\_\_\_\_ 3 \_\_\_\_\_ 4 \_\_\_\_\_ 5 \_\_\_\_\_

9. There are two options for Question 9. Select and answer only one.

**OPTION A.** What is the basic difference between the Internet search engines *scholar.google.com* and *google.com*? (2 marks)

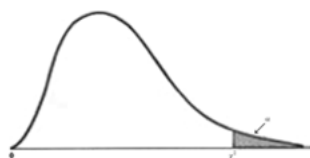
**OPTION B.** In the class you took this semester, what did your instructor claim was the most important thing to remember about writing a solicited proposal? (2 marks)

10. There are three options for Question 10. Select and answer only one.

**OPTION A.** Please explain the differences between *descriptive statistics* and *inferential statistics*? (3 marks)

**OPTION B.** Concisely explain the difference between a single-stage cluster sample and a two-stage cluster sample. (3 marks)

**OPTION C.** A researcher sent questionnaires to a random sample of 100 Africa University graduates. Fifty of the questionnaires were returned, and 80% of the respondents reported that they were “*Very well satisfied*” with their University experience. Explain whether you would be willing to generalize from this study to the entire population of graduates—and explain why or why not. (3 marks)



Chi Square Distribution Table							
d.f.	$\chi^2_{.25}$	$\chi^2_{.10}$	$\chi^2_{.05}$	$\chi^2_{.025}$	$\chi^2_{.010}$	$\chi^2_{.005}$	$\chi^2_{.001}$
1	1.32	2.71	3.84	5.02	6.63	7.88	10.8
2	2.77	4.61	5.99	7.38	9.21	10.6	13.8
3	4.11	6.25	7.81	9.35	11.3	12.8	16.3
4	5.39	7.78	9.49	11.1	13.3	14.9	18.5
5	6.63	9.24	11.1	12.8	15.1	16.7	20.5
6	7.84	10.6	12.6	14.4	16.8	18.5	22.5
7	9.04	12.0	14.1	16.0	18.5	20.3	24.3
8	10.2	13.4	15.5	17.5	20.1	22.0	26.1

**End of Examination Paper**