MATH108 10FA Final B
[answers in web view] Total points: 150

Name:_____
Student ID:_____

> Let the words of my mouth and the meditation of my heart
> Be acceptable in Your sight, O LORD, my Rock and my Redeemer.
> -- Psalm 19:14

- Please show all your work! No partial credit will be given for incorrect answers with no work shown.
- Please draw a box around your final answer.
- You are only permitted to use your own calculator and writing implements. Cell phones should be muted and left in your pocket or bag.
- All relevant tables are attached to the back. You may detach them for your reference.
- Assume $\alpha = 0.05$ everywhere unless indicated otherwise.
- For t-tests on two groups, if the df is not given, you may use the conservative estimate of $df = \min(n_1, n_2) - 1$.

1. Human beta-endorphin (HBE) is a hormone secreted by the pituitary gland under conditions of stress (like exams!). Suppose we wish to determine whether blood concentration of **HBE** (pg/mL) is higher for a group of men **jogging** as compared to a group of men **resting**.

   (a) Name the **variable(s)** which need to be measured, indicate their levels of measurement, and whether each is a predictor or outcome variable. **[2]**

   (b) State the null and alternate **hypotheses**, both in words and in appropriate notation. Which statistical test(s) would be appropriate? **[3]**

   (c) Data for this experiment are given below. Sketch **boxplots** for the data, on a common axis (number line). **[4]**

								Mean:	**SD:**
Jogging:	60	58	62	49	51	58	54	56	4.7958
Resting:	41	37	51	60	28	35		42	11.6276

   (d) Run an appropriate **parametric** test and bracket the *p*-value. **[5]**

(e) State the **conclusion** from this test, and interpret it in the context of the original research question. [2]

(f) Using the same data, perform an appropriate **non-parametric** test and bracket the *p*-value. [4]

(g) State the **conclusion** from this test, and interpret it in the context of the original research question. [2]

(h) Which test do you think is more **appropriate** for this data, the parametric or the non-parametric test? Why? [2]

2. Does HBE concentration in men increase after they exercise? Data from a study of 6 men are below.

							Mean	SD
Before:	42	58	38	50	49	48	47.5	6.921
After:	47	57	44	53	49	53	50.5	4.722

(a) Name the **variable(s)** which need to be measured, indicate their levels of measurement, and whether each is a predictor or outcome variable. [2]

(b) State the null and alternate **hypotheses**, both in words and in appropriate notation. Which statistical test(s) would be appropriate? [3]

(c) Run an appropriate **parametric** test and bracket the *p*-value. [5]

(d) State the **conclusion** from this test, and interpret it in the context of the original research question. [2]

(e) Using the same data, perform an appropriate **non-parametric** test and bracket the *p*-value. [3]

(f) State the **conclusion** from this test, and interpret it in the context of the original research question. [2]

(g) Which test do you think is more **appropriate** for this data, the parametric or the non-parametric test? Why? [2]

3. Indicate the **level of measurement** for each of the following variables as categorical (G), ordinal (O), discrete (D), or continuous (C). [6]

   (a) Location of injury: e.g., knee, lower back, shoulder, chest, etc.

   (b) Number of correct answers on a multiple-choice test

   (c) Number of children in a family, coded as 0, 1, 2, or "at least 3"

   (d) Blood glucose level (mg/dLi)

   (e) Whether a woman is pregnant or not

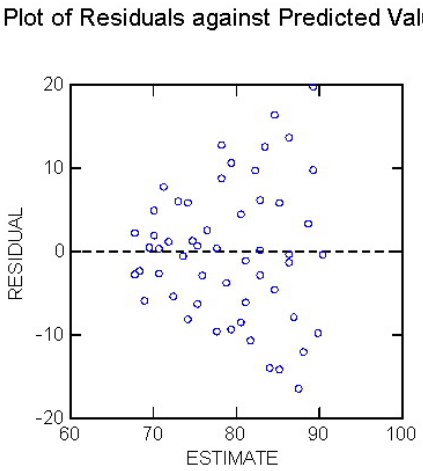
   (f) Strength of family bonds, rated as "Very Strong", "Somewhat Strong", "Weak", or "Very Weak"

4. Suppose that in a study half of the participants are **nurses** and 80% of the participants consider their jobs to be **high-stress**. Consider the probability that a participant in the study is a nurse who considers his/her job to be high-stress.

   (a) What is the **minimum** possible value for this probability? Draw a **Venn** diagram illustrating this situation. [3]

(b) What is the **maximum** possible value for this probability? Draw a **Venn** diagram illustrating this situation. **[3]**

5. Below is a **residual plot** for a linear regression model relating blood pressure to age (data from UNC SOCI709 course). From this plot, is there evidence to indicate that any of the **assumptions** of regression may have been violated? Sketch a possible **scatterplot** of blood pressure versus age that would reflect this residual plot. *(Hint: generally, blood pressure increases with age.)* **[5]**



6. In a study of Canadian nurses, say that 70% of the nurses work in **hospitals**, and one quarter of the nurses habitually **smoke**. 20% of all the nurses in the study are smokers who work in hospitals.

   (a) For **each** of the three probabilities given (70%, 25%, 20%), express the probability in **notation** (e.g., P(smoke)) and draw a **Venn diagram**, shading in the relevant region (draw three separate Venn diagrams). **[3]**

   (b) In this study, what is the chance that a nurse working in a hospital smokes? **[3]**

   (c) In this study, is working in a hospital **independent** of smoking? Why or why not? **[3]**

7. Does **income** level (low, middle, high) have an impact on **caloric intake** (calories per day)?

   (a) Name the **variable(s)** which need to be measured, indicate their levels of measurement, and whether each is a predictor or outcome variable. **[2]**

   (b) What is the appropriate parametric statistical **test** to run? **[1]**

   (c) State the null and alternate **hypotheses**, both in words and in notation. **[2]**

   (d) Data for this experiment are given below. **Run** an appropriate test and bracket the *p*-value. **[5]**

Low-income:	1200	1800	2400
Middle-income:	1200	1350	
High-income:	2100	2200	

   (e) State the **conclusion** from this test, and interpret it in the context of the original research question. **[2]**

   (f) What are the **assumptions** of the statistical test you performed? Is there evidence to suggest that any of these assumptions have been violated in this dataset? **[3]**

8. In a study of BC nurses, an analysis was run to determine whether which nursing **school** the nurse graduated from had an impact on **salary**.

   (a) What are the **variables** which need to be measured for each individual? For each variable, indicate its level of measurement and whether it is a predictor or outcome variable. **[2]**

(b) What is the appropriate parametric statistical **test** to run? [1]

(c) State the null and alternate **hypotheses**, both in words and in appropriate notation. [3]

(d) The data were collected and an appropriate analysis run, obtaining a *p*-value of 0.07. State the **conclusion** of the analysis, and interpret it in the context of the original research question. [2]

(e) The ***p*-value** was 0.07. What does this number '0.07' mean, in the context of the research question? 0.07 of what? [3]

9. The average number of hours of exercise per week was measured for a number of urban dwellers and rural dwellers. A 95% **confidence interval** for the difference of means (urban - rural) is (-0.27, 1.23). Based on this information, indicate whether each of the following statements is "True" or "False". (Please write the entire word, "True" or "False".) [6]

   (a) Urban dwellers exercise an average of between 0.27 hrs less and 1.23 hrs more per week than rural dwellers.

   (b) 95% of urban dwellers exercise between 0.27 hrs less and 1.23 hrs more per week than rural dwellers.

   (c) We are 95% certain that urban dwellers exercise between 0.27 hrs less and 1.23 hrs more per week than rural dwellers.

   (d) With 95% confidence, the difference in hrs/week of exercise between urban and rural dwellers in this study is between -0.27 and 1.23.

   (e) At a 5% level of significance, this study is unable to find a difference in amount of exercise between urban and rural dwellers.

   (f) There is no difference in the amount of exercise for urban and rural dwellers.

10. For BC nurses, is being **married** independent of working **over 60 hours/week**? The number of participants in each category is listed in the table below.

	Married	**Not Married**
≤ 60hrs	150	80
> 60hrs	90	80

   (a) What is the **population** of interest? [1]

(b) Name the **variable(s)** which need to be measured, indicate their levels of measurement, and whether each is a predictor or outcome variable. [2]

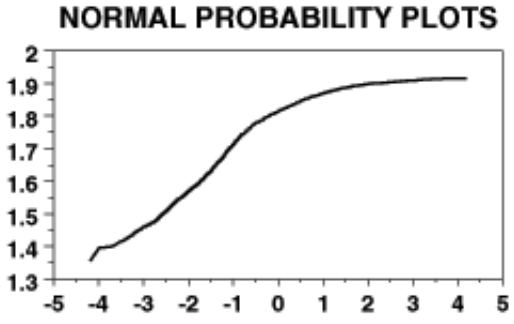
(c) State the null and alternate **hypotheses**, both in words and in appropriate notation. Which statistical test(s) would be appropriate? [3]

(d) Run the appropriate test and bracket a ***p*-value**. [4]

(e) State the **conclusion** from this test, and interpret it in the context of the original research question. [2]

11. The following is a **normal probability plot** of potassium concentration in a number of geologic samples. The horizontal axis is expected normal scores (*n*-scores), and the vertical axis is observed potassium concentration (this orientation matches the textbook). **How** does the distribution differ from a normal distribution? **Sketch** the distribution, highlighting where it is non-normal. [4]

[Data from USGS Open-File Report 2005-1231.]



12. A particular FDG-PET (fludeoxyglucose positron-emission tomography) screening test for non-Hodgkin's lymphoma has a 15% false-positive rate (85% specificity) and 90% sensitivity (i.e., 90% of lymphomas are caught by the screening process).

(a) Suppose the screening test is applied to 200 patients, of which 80 have non-Hodgkin's lymphoma. Draw an **event tree** for the outcomes of the test, and **label** the tree with probabilities for each branch of the tree. [4]

(b) On average, how many people in this group will **test positive** for non-Hodgkin's lymphoma? [3]

(c) If a patient tests positive using this test, what is the probability that the patient **really** has non-Hodgkin's lymphoma? [2]

13. Does blood vitamin **B12** level (pg/mL) have an impact on **depressive** symptoms (Beck Depression Inventory (BDI-II), on a scale from 0-63 points)?

(a) What is the **population** of interest? [1]

(b) Name the **variable(s)** which need to be measured, indicate their levels of measurement, and whether each is a predictor or outcome variable. [2]

(c) What is the appropriate parametric statistical **test** to run? [1]

(d) State the null and alternate **hypotheses**, both in words and in notation. [2]

(e) A study with 60 participants results in the following data:
$SS_X = 1{,}350{,}000$, $SS_Y = 9{,}000$, $SS_{XY} = -70{,}000$.
Find the **slope** of the best-fit line, indicate its **units**, and **interpret** the slope in light of the model for vitamin B12 and depression. (Keep at least 4 significant figures in the slope.) [3]

(f) The **average** vitamin B12 level in the study was 500 pg/mL, and the average BDI score in the study was 45 points. Find the **equation** of the best-fit line, and interpret the **intercept** of the line in light of the model. [3]

(g) Find the **correlation** between vitamin B12 level and depressive level in this study. [2]

(h) What **fraction** of the variability in depressive levels in this study is explained by the linear relationship with vitamin B12 levels? [2]

(i) Describe the **distribution** of BDI depressive levels predicted by the linear model when vitamin B12 levels are at 600 pg/mL. [4]

(j) Answer the original research question: bracket a p-value, state your conclusion, and interpret it in light of the original research question. [4]