<u>Instructions for writing the assessment (FINAL EXAM):</u>

1. The exam is attached below. You must complete and submit your assessment by 12 PM (Windsor time) of Dec. 20, 2023

2. Compile your completed assessment in one single, clear and readable pdf document with a file name that contains your ``Name'' and your ``Student ID number''.

3. To submit the pdf file containing your answers, you must upload it to the Brightspace course site.

4. All assessments are open book assessments. You are not allowed to communicate or interact with anyone or anything during the exam time. You are not allowed to consult with or receive help from anyone or anything in matters concerning the exam.

Please show the detailed derivations of your answer.

Question # 1 [12 pts]

Twenty-eight applicants interested in working for the Food Stamp program took an examination designed to measure their aptitude for social work. A stem-and-leaf plot of the 28 scores (sample data) appears below.

Stems	Leaves
4	6
5	9
6	3688
7	026799
8	145667788
9	1234788

Leaf unit = 1.0

a) Find mean, median, and standard deviation of the data. What can you say about the shape of this distribution? Explain.
b) Find the inter-quartile range of the data.
c) Are there any unusual observations or outliers exist in the data? Justify your answer.

Question # 2 [6 pts]

One hundred shoppers at a local shopping mall were categorized by age and gender as shown in the frequency distribution below. One shopper is selected at random from that group of 100 shoppers.

	Age Group			
Gender	Under 25 years (A_1)	25 - 40 years (A_2)	Over 40 years (A_3)	**Total**
Male (M)	15	13	12	40
Female (F)	24	18	18	60
Total	39	31	30	100

a) If the randomly selected shopper is male, what is the probability that he is under 25 years of age?
b) What is the probability that the randomly selected shopper is female or over 40 years of age?
c) Are gender of the shopper and age independent events? Justify.

Question # 3 [10 pts]

The distribution of IQ scores for high school graduates is normally distributed with mean 400 and standard deviation 80.

      a) What is the 90th percentile of this distribution of the IQ scores?
      b) Find the IQ scores that form the boundaries of the middle 60% of the distribution of the scores.
      c) What is the probability that a randomly selected score exceeds 375?

Question # 4 [8 pts]

    (a) An airline finds that 5% of the persons making reservations on a certain flight will not show up for the flight. If the airline sells 160 tickets for a flight that has only 155 seats, what is the probability that a seat will be available for every person holding a reservation and planning to fly? (5 marks)

    (b) A process control engineer wishes to estimate the true proportion of defective computer chips with a margin of error of no more than 0.09 and with probability 0.90. How many observations does the engineer need to include in the sample to achieve his goal? (3 marks)

Question # 5 [10 pts]

The proportion of individuals with an Rh-positive blood type is 85%. You have a random sample of $n = 500$ individuals.

      a) What are the mean and standard deviation (standard error) of the sampling distribution of $\hat{p}$, the sample proportion with Rh-positive blood type?
      b) Is the distribution of $\hat{p}$ approximately normal? Justify your answer.
      c) What is the probability that the sample proportion $\hat{p}$ lies between 83% and 88%?
      d) Within what limits would you expect the sample proportion to lie 99% of the time?

Question # 6 [12 pts]

Ten adults with symptoms of diabetes were randomly selected and a random blood glucose test was administered before and after a medication. Their blood glucose level readings were gathered before and after the medication; and the results are shown below.

Adult	1	2	3	4	5	6	7	8	9	10
Before medication	11.7	12.9	10.2	11.4	10.1	11.3	10.9	13.3	11.2	11.0
After medication	10.5	11.1	9.8	8.4	7.9	8.1	6.9	11.0	8.3	8.6

a) Are the samples independent? Justify your answer.
b) Do the data provide sufficient evidence to indicate whether the medication has been effective in decreasing blood glucose level? Test using the critical value approach with $\alpha = 0.05$.
c) Find the approximate p-value for the test and interpret its value using $\alpha = 0.05$.
d) Find a 90% confidence interval for the difference in average blood glucose levels between the two groups. Based on this interval, can one conclude that there is a significant difference in average blood glucose level between the two groups? Justify your answer. Are your findings consistent with that in (a)?

Question # 7 [10 pts]

The weights in grams of 10 males and 10 female juvenile ring-necked pheasants are given below:

Males		Females	
1384	1672	1073	1058
1286	1370	1053	1123
1503	1659	1038	1089
1627	1725	1018	1034
1450	1394	1146	1253

a) Use a statistical test to determine if the population variance of the weights of the male birds differs from that of the females. Find the approximate p-value for the test and compare it with $\alpha = 0.05$.
b) Based on the results of the analysis in part (a), test whether the average weight of juvenile male ring-necked pheasants exceed that of the females by more than 300 grams. Use $\alpha = 0.05$. Interpret your results.

Question # 8 [12 pts]

Suppose two independent random samples were taken. The following data were recorded:

Quebec: $n_1 = 150$, Number of deaths due to cancer $= x_1 = 47$
Rest of Canada: $n_2 = 1000$, Number of deaths due to cancer $= x_2 = 291$

a) Suppose the scientists have no preconceived theory concerning which proportion parameter is the larger and they wish to detect only a difference between the two parameters, if it exists. What should they choose as the null and alternative hypotheses for a statistical test?

b) What type of error could occur in testing the null hypothesis in (a), if H_0 is false?

c) Test the hypotheses in (a) by using an appropriate test statistic. Draw your conclusions. Use the significance level $\alpha = 0.01$.

d) Use a 99% confidence interval to estimate the actual difference between the cancer death proportions for the people in Quebec versus rest of Canada. Does your confidence interval estimate provide the same conclusion as in part (a)? Justify your answer.

Question # 9 [10 pts]

A fruit grower wants to test a new spray that a manufacturer claims will *reduce* the loss due to insect damage. To test the claim, the grower sprays 200 trees with the new spray and 200 other trees with the standard spray. The following data were recorded:

	New Spray	Standard Spray
Mean yield per tree $\bar{x}$ (kg)	109	103
Sample variance s^2	445	372

a) Do the data provide sufficient evidence to conclude that the mean yield per tree treated with the new spray exceeds that for trees treated with the standard spray? Perform the test using the critical value approach with $\alpha = 0.05$.

b) Find the p-value for the test and draw your conclusions using $\alpha = 0.05$.

c) Construct a 95% confidence interval for the difference between the mean yields for the two sprays. Based on this interval, can you conclude that there is a significant difference between the mean yields for the two sprays? Justify your answer.

Question # 10 [10 pts]

The fasting blood glucose level of a randomly selected person was measured for seven days, and the following readings were made: $7.0, 7.7, 6.8, 7.1, 7.1, 6.1, 7.3$. It is reasonable to assume the glucose level distribution is normal. A diabetes researcher would like to study the variability in the fasting blood glucose level readings for this person. The researcher believes that fasting blood glucose never varies more than $0.64 \; mmol^2/L$.

(a) Test the appropriate hypotheses to determine if the sample data present sufficient evidence to reject the researcher's claim. Use the critical value approach with $\alpha = 0.05$.

(b) What is the approximate p-value for the test statistic? Draw your conclusion using α = 0.05.

(c) Estimate the population variance using a 90% confidence interval. Based on this interval, can we infer at the 90% confidence that the population variance is significantly less than 1?