Math 323

Lab 5

Note: answers may vary depending on rounding.
Review computer instructions from lab 4. Redo questions from lab #4 using the computer (z and t). Redo questions from lab #5 using the computer (χ^2 and F). **You need to use the computer for the next quiz.**

1. The manufacturer of an over-the-counter pain reliever claims that its product brings pain relief to headache suffers in less than 3.5 minutes, on average. In order to be able to make this claim in its television advertisements, the manufacturer was required by a particular television network to present statistical evidence in support of the claim. The manufacturer reported that for a random sample of 50 headache sufferers, the mean time to relief was 3.3 minutes and the standard deviation was 66 seconds.
   (a) Does this data support the manufacturer's claim? Test using a 5% significance level. [t = 1.2856, tcrit = -2.01, No (fail to RHo), or you can use zcalc=-1.2856 , zcritical= -1.645 if using the tables]
   (b) In general, do large p-values or small p-values support the manufacturer's claim? Explain. [small p-values]
   (c) What type of error could have been committed in (a)? [type II]

2. The average total blood protein in a healthy adult is 7.25 grams per decilitre. A series of 8 blood tests were run on a particular patient over several days giving the following results:
   7.23 7.25 7.28 7.29 7.32 7.26 7.27 7.24

   (a) At a 5% significance level, do these test results indicate this patient has the total blood protein level of a healthy adult? [tcalc = 1.6951, tcrit = ±2.365 ,yes]
   (b) Find the p-value. [.134]
   (c) At what levels of significance would you come to a different conclusion in (a)? [$\alpha > .134$]
   (d) What type of error could have been made in (a)? [Type II]

3. The reputations (and hence the sales) of many businesses can be severely damaged by shipments of manufactured items that contain an unusually large percentage of defectives. A manufacturer of alkaline batteries wants to be reasonably certain that fewer than 5% of its batteries are defective. Suppose 300 batteries are randomly selected from a very large shipment. Each is tested and 10 defective batteries are found. Will this sample provide sufficient evidence to the manufacturer that this shipment will be satisfactory at a 1% significance level? [zcalc=-1.3272, zcrit = -2.33, No (fail to RHo)]

4. The owner of a small publishing firm thinks that business has improved lately. Last year the daily revenue for the firm was $5,000 on average. A random sample of 20 recent days reveals a mean daily revenue of $5,200 with a standard deviation of $507
   (a) Do the data support the owner's belief? Use the P-value for the appropriate statistical test. { $P(t \geq 1.7642) = 0.0469$, since p-value is small (< .05), we Rho}
   (b) Suppose that testing was carried out at a 5% significance level. What would be you conclusion? Use the results of (a)(i.e. the p-value) to make your decision. Explain why you reached your decision, and, hence, your conclusion. {p-value < α, Rho}
   (c) Same question as (b) except now assume that $\alpha = 0.01$. {p-value > α, Fail to RHo}
   (d) At what levels of significance would you come to a different conclusion in (a) (Fail to RHo when $\alpha < .0469$)

5. A cereal manufacturer sells boxes of cereal that list the weight as 19 oz. A random sample of 60 boxes had a mean fill of 19.2 oz with a standard deviation of 0.67 oz. Would this data indicate that the actual mean fill of all boxes of this cereal differs from the weight listed on the box?
   (a) Carry out the appropriate hypothesis test to answer this question, using a 5% significance level. {$t_{calc} = 2.312 > 2.001$, RHo, using z: zcalc=2.312>1.96 RHo if using tables}
   (b) Determine the p-value of the test carried out in (a) {0.0242 or .0104 using z}

(c) At what levels of significance would you come to a different conclusion in (a)? (Fail to RHo when α <.0242 or .0104)

6. Suppose that a machine dispenses sand into bags. A random sample of 100 bags is taken from a new machine and the standard deviation is 14kg. The population standard deviation is known to be 18kg.
   (a) Test at the 5% significance level that the new machine is better. [χ^2crit = 77.0463, χ^2calc =59.8889, RHo]
   (b) Find the p-value. [.0007]

7. Last year, the mean number of books borrowed per cardholder at a major university was 18.2 books per semester with a st.deviation of 4.2. A random sample of 25 cardholders showed the following results for this semester: s^2=6.17.
   (a) The library administration would like to know whether this semester's variance is the same as last semester's at the 1% significance level. What assumptions were made? [χ^2crit = 9.88623, 45.5585, χ^2calc=8.3946, RHo]
   (b) What type of error could have been made in (a)? [Type I]
   (c) Find the p-value. [.0014]
   (d) At what levels of significance would you come to a different conclusion? [α <.0014]

8. The standard deviation of weights of the population of women is 29lb. Listed below are the weights (in pounds) of nine randomly selected supermodels.
   125 119 128 128 119 127 105 123 115
   (a) Use a 0.01 significance level to test the claim that weights of female supermodels vary less than the weights of women in general. [χ^2crit = 1.646482, χ^2calc=0.5398g, RHo]
   (b) Find the p-value. [.0002]

9. Business schools A and B reported the following summary of GMAT verbal scores:

	N	$\bar{x}$	s^2
A	11	34.75	48.59
B	13	33.74	44.68

   (a) At the 5% significance level, is the variance of school A greater than school B? [Fcrit = 2.75, Fcalc = 1.0875, Fail to RHo]
   (b) Find the p-value and explain what it means in the context of the question. [.4388]
   (c) At what levels of significance would you come to a different conclusion in (a)? [α >.4388]
   (d) At the 5% significance level, test to see if the means are the same. [tcalc=.3617,tcrit = -2.074, +2.074, Fail to RHo]
   (e) Find the p-value for (d). [.721]

10. 16 alkaline and 16 heavy-duty Radio shack batteries were placed individually in a circuit consisting of two flashlight bulbs wired in parallel, a switch, a battery holder, and a Hewlet Packard 427-A analog DC voltmetre. Each battery was drained to a reference failure voltage of 0.9 volts and the time to failure (min) was measured.:

Alkaline				Heavy-duty			
105	141	147	158	29	22	22	27
140	143	108	125	26	17	22	23
116	139	146	134	23	27	23	24
140	149	142	140	22	25	22	26

   Assume the populations of times to failure is normally distributed.
   (a) Test the hypothesis at the 0.05 level that the two types of batteries have the same population variances. [F crit = .3497, 2.86, Fcalc=26.9141, Rho]
   (b) What type of error could have been made in (a)? [Type I]

11. Two marathon training procedures are tried for comparison purposes. Their efficacy is to be determined in a marathon race. Assume race times are normally distributed and variances are not equal. The following results were observed:

	No. In sample	mean race time	s.d of race times
Procedure 1	15	150 min	12 min
Procedure 2	26	170 min	15 min

(a) Test that procedure 2 on average takes longerj than procedure 1 at $\alpha = 0.025$ [tcrit = 2.145, tcalc =4.6812, Rho]
(b) Find the p-value. [.0002]
(c) At what levels of significance would you conclude that the two procedures are the same? [α <.0002]

12. A large brokerage house wants to see if the percent of new accounts valued at over $50,000 has changed over the year. A random sample of 900 accounts opened last year showed that 27 were over $50,000 in size. A random sample of 1,000 accounts opened this year showed 44 that were in excess of $50,000. Has there been a change in the percent of new accounts valued at over $50,000?
    (a) Carry out the appropriate statistical test at a 1% significance level. [zcrit = -2.575, +2.575, zcalc=-1.607, Fail to RHo]
    (b) Determine the minimum level of significance to conclude that the data indicates that there has been a change. [p-value=0.1074]

13. Let p1 denote the percentage of people who were unemployed in March, and let p2 denote the percentage of people who were unemployed in August. Suppose that during late March, the government instituted policies designed to lower the unemployment rate. We want to test whether the policies were effective in reducing unemployment at $\alpha = 0.05$. In March, in a random sample of 1000 people, 75 were unemployed. During August, in an independent random sample of 1000 people, 65 were unemployed. What is your conclusion? [zcrit = 1.645, zcalc=0.8764, Fail to RHo]

14. A USA Today study reported the longest average workweeks for non-supervisory employees in private industry to be mining (45.4 hours) and manufacturing (42.3 hours). The same article reported the shortest average workweeks to be retail trade (29 hours) and services (32.3 hours). A study conducted in the state of Illinois found the following results:

Industry	N	Ave hours per week	Standard deviation
Mining	15	47.3	5.5
Manufacturing	10	43.5	4.9

Assuming that there is a statistically significant difference in the variability of hours per week worked in the mining and manufacturing industries
(a) Does the Illinois data suggest that non-supervisory employees in the mining industry, on average, work more hours per week than their manufacturing industry counterparts? Regulate the probability of type I error at 5 percent. [tcrit = 1.833, tcalc=1.808. Fail to RHo]
(b) What is the p-value of your results in (b)? [0.0528]

15. Of a random sample of 100 stocks on the Toronto Stock Exchange, 32 made a gain today. A random sample of 100 stocks on the Montreal Stock Exchange showed 27 stocks making a gain.
    (a) Does the data suggest there is a statistically significant difference between the proportion of stocks making gains on the two exchanges? Use $\alpha = 0.05$. [zcrit = -1.96, +1.96, zcalc=0.7753, Fail to RHo]
    (b) What type of error could have been made in (a)? [Type II]
    (c) Find the p-value. [.4382]

16. In a province wide poll of 2000 men and 2010 women, 980 and 1025 women report that they are opposed to the death penalty in ALL circumstances.
    (a) Test the claim at a level of significance of 5% that women are less likely to favour the death penalty than men. What is your conclusion? [zcrit = 1.645, zcalc=1.2665, Fail to RHo]
    (b) Find the p-value. [.1020]

17. Independent random samples taken at two local liquor stores provide the following information regarding customers' purchases.

Store	Bob's Booze	Len's Liquor Emporium
N	46	39
Mean	$52.40	$61.75
s^2	$9.50	$7.25

Assuming that there does exist a difference in the variability between the two liquor stores, does the data indicate that the average purchases at Len's exceed those at Bob's by more than $5, on average? Test at $\alpha = 0.05$. [zcrit = 1.645, zcalc=6.9441, RHo]