Homework 7   Due on March 17

§9.2: 1, 2, 5, 13, 15, 20.
§9.3: 3, 5.
§9.4: 2, 6, 9.
§9.5: 2, 5, 7, 12.

§9.2: Testing $H_0 : \mu_X = \mu_Y$

Question 9.2.1   Some states that operate a lottery believe that restricting the use of lottery profits to supporting education makes the lottery more profitable. Other states permit general use of the lottery income. The profitability of the lottery for a group of states in each category is

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State Lottery Profits

For Education		For General Use	
State	% Profit	State	% Profit
New Mexico	24	Massachusetts	21
Idaho	25	Maine	22
Kentucky	28	Iowa	24
South Carolina	28	Colorado	27
Georgia	28	Indiana	27
Missouri	29	Dist. Columbia	28
Ohio	29	Connecticut	29
Tennessee	31	Pennsylvania	32
Florida	31	Maryland	32
California	35		
North Carolina	35		
New Jersey	35		

Source: *New York Times*, National Section, October 7, 2007, p. 14.

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Test at the $\alpha = 0.01$ level whether the mean profit of states using the lottery for education is higher than that of states permitting general use. Assume that the variances of the two random variables are equal.

Question 9.2.2   As the United States has struggled with the growing obesity of its citizens, diets have become big business. Among the many competing regimens for those seeking weight reduction are the Atkins and Zone diets. In a comparison of these two diets for one-year weight loss, a study found that seventy-seven subjects on the Atkins diet had an average weight loss of $x = -4.7$ kg and a sample standard deviation of $s_X = 7.05$ kg. Similar figures for the seventy-nine people on the Zone diet were $y = -1.6$ kg and $s_Y = 5.36$ kg. Is the greater reduction with the Atkins diet statistically significant? Test for $\alpha = 0.05$.

Question 9.2.5   The University of Missouri–St. Louis gave a validation test to entering students who had taken calculus in high school. The group of ninety-three students receiving no college credit had a mean score of 4.17 on the validation test with a sample standard deviation of 3.70. For the twenty-eight students who received credit from a high school dual-enrollment class, the mean score was 4.61 with a sample standard deviation of 4.28. Is there a significant difference in these means at the $\alpha = 0.01$ level?

Question 9.2.13   An executive has two routes that she can take to and from work each day. The first is by interstate; the second requires driving through town. On the average it takes her 33 minutes to get to work by the interstate and 35 minutes by going through town. The standard deviations for the two routes are 6 and 5 minutes, respectively. Assume the distributions of the times for the two routes are approximately normally distributed.
(a) What is the probability that on a given day, driving through town would be the quicker of her choices?
(b) What is the probability that driving through town for an entire week (ten trips) would yield a lower average time than taking the interstate for the entire week?

Question 9.2.15   If $X_1, X_2, ..., X_n$ and $Y_1, Y_2, ..., Y_m$ are independent random samples from normal distributions with the same σ^2 prove that their pooled sample variance, S_p^2, is an unbiased estimator for σ^2.

Question 9.2.20   Two popular forms of mortgage are the thirty-year fixed-rate mortgage, where the borrower has thirty-years to repay the loan at a constant rage, and the adjustable rate mortgage (ARM), one version of which is for five years with the possibility of yearly changes in the interest rate. Since the ARM offers less certainty, its rates are usually lower than thse of fixed-rate mortgage. Test this hypothesis at the $\alpha = 0.01$ level usng the following sample of ortgage offerings for a loan of $250,000. Do not assume the variances are equal.

40-year fixed	ARM
3.525	2.923
3.625	3.385
3.383	3.154
3.625	3.363
3.661	3.226
3.791	3.283
3.941	3.427
3.781	3.437
3.660	3.746
3.733	3.438

Question 9.3.3   Among the standard personality inventories use by psychologists is the thematic apperception test (TAT) in which a subject is shown a series of pictures and is asked to make up a story about each one. Interpreted properly, the content of the stories can provide valuable insights into the subject's mental well-being. The following data show

the TAT results for 40 women, 20 of whom were the mothers of normal children and 20 the mothers of schizophrenic children. In each case the subject was shown the same set of 10 pictures. The figures recorded were the numbers of stories (out of 10) that revealed a positive parent–child relationship, one where the mother was clearly capable of interacting with her child in a flexible, open-minded way.

TAT Scores									
Mothers of Normal Children					Mothers of Schizophrenic Children				
8	4	6	3	1	2	1	1	3	2
4	4	6	4	2	7	2	1	3	1
2	1	1	4	3	0	2	4	2	3
3	2	6	3	4	3	0	1	2	2

(a) Test $H_0 : \sigma_X^2 = \sigma_Y^2$ versus $H_0 : \sigma_X^2 \neq \sigma_Y^2$, where σ_X^2 and σ_Y^2 are the variances of the scores of mothers of normal children and scores of mothers of schizophrenic children, respectively. Let $\alpha = 0.05$.

(b) If $H_0 : \sigma_X^2 = \sigma_Y^2$ is accepted in part (a), test $H_0 : \mu_X = \mu_Y$ v.s. $H_0 : \mu_X \neq \mu_Y$ with the same α.

Question 9.3.5 Raynaud's syndrome is characterized by the sudden impairment of blood circulation in the fingers, a condition that results in discoloration and heat loss. The magnitude of the problem is evidenced in the following data, where twenty subjects (ten "normals" and ten with Raynaud's syndrome) immersed their right forefingers in water kept at 19°C. The heat output (in cal/cm 2 /minute) of the foreifinger was then measured with a calorimeter.

	Normal Subjects		*Subjects with Raynaud's Syndrome*
Patient	Heat Output (cal/cm^2/min)	Patient	Heat Output (cal/cm^2/min)
W.K.	2.43	R.A.	0.81
M.N.	1.83	R.M.	0.70
S.A.	2.43	F.M.	0.74
Z.K.	2.70	K.A.	0.36
J.H.	1.88	H.M.	0.75
J.G.	1.96	S.M.	0.56
G.K.	1.53	R.M.	0.65
A.S.	2.08	G.E.	0.87
T.E.	1.85	B.W.	0.40
L.F.	2.44	N.E.	0.31
	$\bar{x} = 2.11$		$\bar{y} = 0.62$
	$s_X = 0.37$		$s_Y = 0.20$

Test that the heat-output variances for normal subjects and those with Raynaud's syndrome are the same. Use a two-sided alternative and the 0.05 level of significance.

Question 9.4.2 In a study designed to see whether a controlled diet could retard the process of arteriosclerosis, a total of 846 randomly chosen persons were followed over an eight-year period. Half were instructed to eat only certain foods; the other half could eat whatever they wanted. At the end of eight years, 66 persons in the diet group were found to have died of either myocardial infarction or cerebral infarction, as compared to 93 deaths of a similar nature in the control group. Do the appropriate analysis. Let $\alpha = 0.05$.

Question 9.4.6 Suppose $H_0 : p_X = p_Y$ is being tested against $H_1 : p_X = p_Y$ on the basis of two independent sets of one hundred Bernoulli trials. If x, the number of successes in the first set, is sixty and y, the number of successes in the second set, is forty-eight, what P-value would be associated with the data?

Question 9.4.9 A utility infielder for a National League club batted .260 last season in three hundred trips to the plate. This year he hit .250 in two hundred at-bats. The owners are trying to cut his pay for next year on the grounds that his output has deteriorated. The player argues, though, that his performances the last two seasons have not been significantly different, so his salary should not be reduced. Who is right?

Question 9.5.2 Male fiddler crabs solicit attention from the opposite sex by standing in front of their burrows and waving their claws at the females who walk by. If a female likes what she sees, she pays the male a brief visit in his burrow. If everything goes well and the crustacean chemistry clicks, she will stay a little longer and mate. In what may be a ploy to lessen the risk of spending the night alone, some of the males build elaborate mud domes over their burrows. Do the following data suggest that a male's time spent waving to females is influenced by whether his burrow has a dome? Answer the question by constructing and interpreting a 95% confidence interval for $\mu_X - \mu_Y$. Use the value $s_p = 11.2$.

% of Time Spent Waving to Females	
Males with Domes, x_i	Males without Domes, y_i
100.0	76.4
58.6	84.2
93.5	96.5
83.6	88.8
84.1	85.3
	79.1
	83.6

Question 9.5.5 Suppose that $X_1, X_2, ..., X_n$ and $Y_1, Y_2, ..., Y_m$ are independent random samples from normal distributions with means μ_X and μ_Y and known standard deviations σ_X and σ_Y, respectively. Derive a $100(1 - \alpha)\%$ confidence for $\mu_X - \mu_Y$.

Question 9.5.7 One of the parameters used in evaluating myocardial function is the end diastolic volume (EDV). The following table shows EDVs recorded for eight persons considered to have normal cardiac function and for six with constrictive pericarditis (192). In order to test $H_0 : \mu_X = \mu_Y$, can one assume that the two variances are euqal? Answer the question by constructing a 95% confidence interval for σ_X^2/σ_Y^2.

Normal, x_i	Constrictive Pericarditis, y_i
62	24
60	56
78	42
62	74
49	44
67	28
80	
48	

Question 9.5.12 Suicide rates in the United States tend to be much higher for men than for women, at all ages. That pattern may not extend to all professions, though. Death certificates obtained for the 3637 members of the American Chemical Society who died over a twenty-year period revealed that 106 of the 3522 male deaths were suicides, as compared to 13 of the 115 female deaths. Construct a 95% confidence interval for the difference in suicide rates. What would you conclude?