Math 121 **Test Questions** **Spring 2010**

Chapters 13 and 14

1. (10 pts) The first-semester enrollment at HSC was 1120 students. If all entering freshmen classes were the same size and there were no attrition, then one would expect the 1120 students to be divided equally among freshmen, sophomores, juniors, and seniors. The actual enrollments, by class, are

	Class	Freshman	Sophomore	Junior	Senior
Enrollment	Actual	314	305	261	240
	Expected				

   (a) Fill in the expected enrollments under the above hypothesis.

   (b) Test the hypothesis that enrollment is uniform across the classes. Use $\alpha = 0.05$.

2. (10 pts) Normally when one rolls a die, he shakes it up in his hand and then rolls it. That procedure produces a uniform distribution of numbers 1 through 6. I was wondering whether the distribution would still be uniform if I rolled the die without shaking it up first. So I rolled an ordinary die 120 times without shaking it up. Each time, I began with the number 1 facing up and just rolled the die onto the table. The following table shows the results.

Number	1	2	3	4	5	6
Count	10	14	16	25	23	32

   Test the hypothesis that the results come from a uniform distribution, i.e., the hypothesis that $p_1 = p_2 = p_3 = p_4 = p_5 = p_6 = \frac{1}{6}$, at the 1% level of significance.

3. (10 pts) I modified the `randInt` function on my TI-83 in such a way as to simulate a loaded die that lands 1, 2, or 3 each with probability 10%, 4 or 5 each with probability 20%, and 6 with probability 30%. Then I tested my creation by simulating 100 rolls of the loaded die. The results are shown in the following table.

Value	1	2	3	4	5	6
Frequency	8	11	14	29	15	23

   Test the hypothesis that the distribution from which these numbers were taken is 10%, 10%, 10%, 20%, 20%, 30% for the values 1, 2, 3, 4, 5, 6, respectively. Test at the 1% level of significance.

4. (12 pts) The Richmond Times-Dispatch reported the number of incidents of crime for 24 cities and counties in the central Virginia area for 2007 and 2008. The following table shows the data for a random sample of 10 of those cities and counties.

City/County	No.of Incidents 2007	2008
Ashland	312	283
Colonial Heights	799	852
Dinwiddie County	485	553
Goochland County	223	234
Hanover County	1140	1189
Henrico County	10518	10795
Hopewell	1166	1302
King William Co.	58	50
Petersburg	2947	3154
Richmond	10971	9759

(a) (10 pts) Use the count data to test the hypothesis that the two distributions are the same from 2007 to 2008, that is, the populations are homogeneous. Test at the 5% level of significance.

(b) (2 pts) Under the assumption of homogeneity, find the expected number of incidents of crime in Ashland in 2007.

5. (12 pts) According to an article in the *Richmond Times-Dispatch*, Nov. 14, 2008, there were 6190 vehicle crashes involving deer in Virginia last year.[1] The article divided the crashes into three categories depending on the type of road: interstate highway, primary road, or secondary road. One might expect the crashes on the interstate to be the most severe and the ones on the secondary roads to be the least severe because of the difference in speed. One might be wrong. The following table shows the number of accidents and the number of injuries in each category.

Type of road	Interstate	Primary	Secondary
No. of crashes	765	3505	1920
No. of injuries	59	281	145

(a) (10 pts) Test the hypothesis that the two distributions are the same, that is, the populations are homogeneous. Test at the 5% level of significance.

(b) (2 pts) Find the expected number of injuries for each category under the assumption of homogeneity.

6. (12 pts) Every year the National Survey of Student Engagement (NSSE) is conducted on all participating campuses. HSC has participated in 2003 and 2007. One of the questions on the 2003 survey was "Discussed ideas from your readings or classes with others outside of class" and the student responds with "Never," "Sometimes," "Often," or "Very Often." The table below shows the results for HSC and for all liberal arts colleges.

[1] `http://www.inrich.com/cva/ric/search.apx.-content-articles-RTD-2008-11-14-0161.html`

	Never	Sometimes	Often	Very Often
HSC	7	54	52	39
All LA colleges	266	2305	3142	2468

(a) (8 pts) Conduct a test, at the 5% level of significance, to determine whether the two populations (HSC students, all LA college students) are homogeneous.

(b) (2 pts) According to the null hypothesis, what is the expected number of HSC students who very often discussed ideas from reading with others outside of class?

7. (12 pts) In a sample of 42398 traffic deaths in 2002, investigators determined whether speeding was a factor and whether the road was straight or curved at the site of the accident. They reported the following data.

	Straight	Curved
Speeding	8359	5304
Not Speeding	23139	5596

(a) (2 pts) Identify the two variables in this study.

(b) (8 pts) Conduct a test, at the 5% level of significance, to determine whether the two variables are independent.

(c) (2 pts) According to the null hypothesis, what is the expected number of traffic deaths on straight roads in which speeding was a factor?

8. (25 pts) Is a college's average SAT score a good predictor of what it charges for tuition? A random sample of 10 colleges produced the following data[2].

College	SAT-Math (x)	Tuition (in \$1000s) (y)
Bennington College	560	33
Calvin College	605	19
Queens College	535	11
Flagler College	560	9
Grove City College	636	10
Indiana Univ. of Pa.	534	12
Lafayette College	665	30
Manhattanville College	550	25
Marlboro College	590	27
Mercer University	587	23

(a) (5 pts) Use these data to find the least-squares regression line. Write the equation.

[2]Princeton Review and `CNNMoney.com`

(b) (3 pts) Find the correlation coefficient.

(c) (3 pts) What does this correlation coefficient in this problem tell us about the association between these two variables?

(d) (4 pts) *According to the model*, an increase of 10 in the average SAT-Math score for a college would correspond to what change in the expected tuition?

(e) (4 pts) The average SAT-Math score at Hampden-Sydney College is 573. Use this value and the model to predict the tuition at HSC. (According to CNNMoney.com, HSC's tuition is $21,878.)

(f) (3 pts) In this model, which is the explanatory variable and which is the response variable?

(g) (3 pts) Someone might object to this model by pointing out that it does not take into account important factors such as whether the college is private or the college's location (private colleges and colleges in the northeast are typically more expensive). What is the statistical term for these factors?

9. (32 pts) The Project on Student Debt recently published a report on student debt after graduation from college in 2007. The report included figures on the average amount of debt by state (average for Virginia is $18,084) and percentage of students who graduate with debt (percentage for Virginia is 59%). A random sample of 10 states provides the following data.[3]

State	Average Debt ($1000s) ($x$)	Percentage with Debt (y)
Alaska	25.0	53
Alabama	20.9	61
Delaware	17.4	50
Indiana	21.3	60
Kansas	18.5	61
Massachusetts	21.1	63
Ohio	22.0	67
Pennsylvania	23.6	71
Rhode Island	23.2	67
South Carolina	20.2	59

(a) (4 pts) On the graph paper below, draw a scatter plot of the data.

(b) (3 pts) Based on your scatter plot, describe the relationship between average debt and percentage of graduates with debt.

(c) (5 pts) Find the equation of the regression line.

(d) (4 pts) Find the correlation coefficient. What does it tell us about the relationship?

[3] `www.projectonstudentdebt.org`

(e) (3 pts) Find the coefficient of determination. What does it tell us about the relationship?

(f) (4 pts) Given that SST = 629.6, find SSR and SSE.

(g) (4 pts) The average debt in Alabama is \$20,921. Use the regression line to predict the percentage of graduates with debt in Alabama. (The actually percentage is 61%.)

(h) (5 pts) At the 5% level of significance, test for the significance of the model. That is, test the hypotheses $H_0 : \beta = 0$ and $\rho = 0$ vs. $H_1 : \beta \neq 0$ and $\rho \neq 0$.