Math 107 - Test 4
April 6, 2007
(102 points)

Pledged KEY

1. (25 points) Among 290 children who were not wearing seat belts, 50 were severly injured. Among 123 children using seat belts, 16 were severly injured (based on data from "Morbidity Among Pediatric Motor Vehicle Crash Victims: The Effectiveness of Seat Belts," by Osberg and Di Scala, *American Journal of Public Health*, Vol. 82, No. 3). Is there sufficient sample evidence to conclude that the rate of severe injuries is higher for children not wearing seat belts. Test the claim using $\alpha = 0.01$ and the P-value method. **Show all calculations.**

Check the Assumptions $n\hat{p}_1 = 50$, $n\hat{q}_1 = 240$, $n\hat{p}_2 = 16$, $n\hat{q}_2 = 107$

Null Hypothesis $H_0: p_1 \le p_2$

Alternative Hypothesis $H_1: p_1 > p_2$

Test Statistic $z = 1.07$

$$\bar{p} = \frac{50+16}{290+123} = \frac{66}{413} \qquad \bar{q} = \frac{347}{413}$$

$$z = \frac{\frac{50}{290} - \frac{16}{123}}{\sqrt{\left(\frac{66}{413}\right)\left(\frac{347}{413}\right)\left(\frac{1}{290} + \frac{1}{123}\right)}} \approx 1.07$$

P**-value** $.1423$

$$P\text{-value} = P(z > 1.07) = .5 - .3577 = .1423$$

Decision and Reason Fail to reject H_0 since P-value $> \alpha$.

Summarize: There is not sufficent evidence to conclude that the rate of severe injuries is higher for children not wearing seat belts.

2. (35 points) The following sample data represents measured nicotine contents of randomly selected filtered and non-filtered king-size cigarettes. All measurements are in milligrams, and the data are from the Federal Trade Commission. Use a 0.05 significance level to test the claim that the mean nicotine amount of filtered king-size cigarettes is less than the mean nicotine level of non-filtered king-size cigarettes. **Assume samples are from populations that are normally distributed. Show all calculations.**

Filtered Kings	Non-filtered Kings
$n_1 = 21$	$n_2 = 8$
$\overline{X}_1 = 0.94$	$\overline{X}_2 = 1.65$
$s_1 = 0.31$	$s_2 = 0.16$

(a) Show that the samples come from populations with the same variance.

Null Hypothesis $H_0: \sigma_1^2 = \sigma_2^2$

Test Statistic $F = \frac{s_1^2}{s_2^2} = \frac{.31^2}{.16^2} \approx 3.75$

Critical Value $F_{crit} = 4.47$

Decision and Reason Fail to reject H_0 since $3.75 < 4.47$

Summarize: We cannot reject claim that two populations have the same variance.

(b) Test the claim in the original problem statement.

Null Hypothesis $H_0: \mu_1 \geq \mu_2$

Alternative Hypothesis $H_1: \mu_1 < \mu_2$

Test Statistic $t = -6.13$

$$s_p^2 = \frac{20 \cdot .31^2 + 7 \cdot .16^2}{27} \approx .0778$$

$$t = \frac{.94 - 1.65}{\sqrt{(.0778)\left(\frac{1}{21} + \frac{1}{8}\right)}} \approx -6.13$$

Problem 3 continued

Critical Value(s) $t_{crit} = -1.703$

Decision and Reason Reject H_0 since $-6.13 < -1.703$.

Summarize: There is sufficient evidence to conclude that the mean nicotine amount of filtered king-size cigarettes is less than the mean nicotine level of non-filtered king-size cigarettes.

3. (12 points) Matching (write the appropriate letter in the provided blank):

f	Euler	a. Proved Fundamental Theorem of Algebra
e	Newton	b. Theory of Games; Development of the Atomic Bomb
d	Cantor	c. Presented 23 Unsolved Problems in Math
a	Gauss	d. Set Theory and Transfinite Cardinal Numbers
c	Hilbert	e. Developed Calculus at the age of 23
b	vonNeumann	f. Solved Bridges of Königsberg problem; "Supreme Calculator"

4. (30 points) Captopril is a drug designed to lower systolic blood pressure. When subjects were tested with this drug, their systolic blood pressure readings (in mm of mercury) were measured before and after the drug was taken, with the results given below ("Essential Hypertension Effect of an Oral Inhibitor of Angiotension-Converting Enzyme," by MacGregor, et al., *British Medical Journal*, Vol. 2.). Is there sufficient evidence to support the claim that captopril is effective in changing systolic blood pressure? Use $\alpha = 0.02$ and the Confidence Interval method. **Assume all variables are normally distributed.**

Subject	A	B	C	D	E	F	G	H	I	J	K	L
Before	200	174	197	170	179	182	193	209	185	155	169	210
After	191	170	177	167	159	151	176	183	159	145	146	177

Null Hypothesis $H_0: \mu_D = 0$

Alternative Hypothesis $H_1: \mu_D \neq 0$

Confidence Interval $10.59 < \mu_D < 26.41$

$\bar{D} = 18.5 \quad s_D = 10.086 \quad t_{\alpha/2} = 2.718$

$E = 2.718 \times \frac{10.086}{\sqrt{12}} \approx 7.91$

Decision and Reason Reject H_0 since 0 is not in 98% CI.

Summarize:

There is sufficient evidence to support the claim that captopril is effective in changing systolic blood pressure.