Math 450
Test 3
4.6.12

CWID: KEY

Show all of your work.

1. Voters from four states cast their votes for two presidential candidates (see below). Test the hypothesis that states have a common probability for favoring candidate B. Use $\alpha = 10\%$

	Candidate A (q)	Candidate B (p)
State 1	30	80
State 2	100	250
State 3	80	200
State 4	40	120

$H_0: p_i = \frac{650}{900} = .7\bar{2}$

$\chi^2 = 0.827 \overset{?}{>} \chi^2_{.9}(3) = 6.25$, no.

Accept common p.

2. **We wish to test the equivalence of h bivariate distributions. The observed values are in the form o_{xyz}: x = 1..r, y = 1..c, z = 1..h., where z designates the particular population from which an r x c matrix of observations is drawn. Set up the test statistic for this test, including the exact rejection rule, with the appropriate number of degrees of freedom. Explain your answer.**

Test Statistic $= \chi^2 = \sum_x \sum_y \sum_z \dfrac{(o_{xyz} - \hat{e}_{xyz})^2}{\hat{e}_{xyz}}$

where $\hat{e}_{xyz} = \left(\sum_x \sum_y o_{xyz}\right) \dfrac{\left(\sum_z o_{xyz}\right)}{N}$

$N = \sum_x \sum_y \sum_z o_{xyz}$

Reject H_0 if $\chi^2 > \chi^2_{(r-1)(c-1)(h-1)}(1-\alpha)$

3. **Test this data for the statistical independence of X (1..4) and Y (a..c) at the 5% significance level. State the p-value.**

Reject Independence

Test Statistic = 2681.5

df = 6

p-value = 0

4. **Here is data representing travel time to work in minutes. Test for Normality at the 5% level. State the p-value.**

Reject Normality

$N = 124089$, $\bar{x}_g = 24.92$, $s_g = 14.57$

Test Statistic $= 34800.72$ $df = 9$

p-value $= 0$

5. **Based on the following data, the admissions director believes that the median SAT of her sample is at least 1200. Is she correct at the 10% level of significance? State the p-value.**

SAT: 1150, 1205, 1300, 1100, 1090, 1250, 1280, 1400, 1205, 1350

$H_0: m \geq 1200$

$H_a: m < 1200$

Test Stat = # above 1200 = 7

$B(7; 10, .5) = .9453 > .1$

Accept Ho.

6. **Twelve soccer players test two brands of shoes – one on each foot. The durability (measured in weeks) for each shoe type is given below. Use a nonparametric test to decide whether shoe 1 is better than 2 at the 1% level. State the p-value.**

Shoe 1	5	4	5	4	6	5	4	4	5	3	7	9
Shoe 2	4	3	6	5	4	4	6	3	6	5	4	7
$S_1 - S_2$	1	1	−1	−1	2	1	−2	1	−1	−2	3	2

$H_0: D_1 \geq D_2$

$H_a: D_1 < D_2$

$T^+ = 7$ $\qquad B(7; 12, .5) = .80 \not< .1$

p-value

Accept H_0.

7. **Ten sets of twins take a standardized test with and without a tutor. Their scores are given below. Use the Wilcoxon Paired-Sample Signed-Rank Test to determine whether tutoring is effective. Use a 5% level of significance.**

No Tutor	**125**	**115**	**130**	**140**	~~**140**~~	**115**	**140**	**125**	**140**	**135**
Tutor	**110**	**122**	**125**	**120**	~~**140**~~	**124**	**123**	**137**	**135**	**145**
	15	−7	5	20	0	−9	17	−12	5	−10

H_0: Tutor $\geq$ No Tutor

H_a: Tutor $<$ No Tutor

+	+	−	−	−	−	+	+	+
5	5	7	9	10	12	15	17	20
1.5	1.5	3	4	5	6	7	8	9

$T^- = 18 \overset{?}{<} 8$ no

Accept H_0.

8. **Test the hypothesis that F(x)=F(y) vs. the alternative that X is stochastically larger than Y if the following data are gathered:**
Use $\alpha = 5\%$.

X	**5**	**4**	**3**	**5**	**2**	**4**	**2**	**2**	**4**	**3**
Y	**2**	**2**	**3**	**4**	**1**	**3**	**3**	**5**		

$H_0: F(x) = F(Y)$

$H_a: F(x) < F(Y)$

U_Y = # times an x precedes a y

$= 0 + 1 + 2 + 0 + 5 + 1 + 5 + 5 + 1 + 2$

$= 22 \overset{?}{<} 20$ No

Accept H_0.