Biometry, Math 2520

Midterm Exam 2 Solutions

1. A sample of size 625 has an average of 22.3, a standard deviation of 4.9, and skewness of -.03. Compute the following confidence intervals:

   (a) A 95% confidence interval for μ.

   $t_{.05,[624]} = 1.96$, $s_{\overline{Y}} = \frac{4.9}{\sqrt{625}} = .196$; their product is .38416, so the endpoints are $22.3 \pm .38416$, so the interval is $(21.91584, 22.68416)$. Rounding is okay of course.

   (b) A 99% confidence interval for γ_1.

   $t_{.01,[\infty]} = 2.576$, $s_{g_1} = \sqrt{\frac{6}{625}} = .09798$; their product is .2524, so the endpoints are $-.03 \pm .2524$, so the interval is $(-.2824, .2224)$.

2. Perform an analysis of variance with the following data. In addition, perform 2 planned tests; compare groups 1 and 2 against groups 3 and 4, and groups 1 and 3 against groups 2 and 4, and verify that these tests are orthogonal.

	Group 1	Group 2	Group 3	Group 4
n	15	15	15	15
$\sum Y$	263	219	272	254
$\overline{Y}$	$17.5\overline{3}$	14.6	$18.1\overline{3}$	$16.9\overline{3}$
$\sum y^2$	179	164	106	128

$\overline{\overline{Y}} = 16.8$

For orthogonality, the coefficients are $1, 1, -1, -1$ and $1, -1, 1, -1$ (these could vary by a sign of course) and so the dot product is $1 \cdot 1 + 1 \cdot -1 + -1 \cdot 1 + -1 \cdot -1 = 1 - 1 - 1 + 1 = 0$.

Source	SS	df	MS	F_s	significance
Among groups	107.6	3	35.87	3.48	$p = .0217$ 5%
1 and 2 vs. 3 and 4	32.26	1	32.26	3.133	$p = .0822$ ns
1 and 3 vs. 2 and 4	64.07	1	64.07	6.22	$p = .00156$ 1%
Within groups	577	56	10.30		
Total	684.6	59			

3. In the U.S., over the $n = 18$ years from 1987-2004, there were 67 amusement ride fatalities, occurring with the following frequencies(Source: U.S. Consumer Product Safety Commission, DTHS and IPII):

Number of fatalities (Y)	Number of years (f)	fY	y	fy^2	Expected Poisson frequencies	Deviation from expectation
0	1	0	-3.72	13.85	0.44	+
1	1	1	-2.72	7.41	1.62	-
2	3	6	-1.72	8.90	3.02	-
3	3	9	-0.72	1.56	3.74	-
4	5	20	0.28	0.39	3.48	+
5	2	10	1.28	3.27	2.59	-
6	1	6	2.28	5.19	1.61	-
7	1	7	3.28	10.74	0.85	+
8	1	8	4.28	18.30	0.40	+

$\overline{Y} = 3.722$ $s^2 = 4.09477$ $CD = 1.100$
Test the following hypotheses.

(a) The coefficient of dispersion is equal to 1.
$H_0 : CD = 1$, $H_1 : CD \neq 1$ $X_s^2 = (n-1)\,CD = 17 \cdot 1.100 = 18.7$ Since $CD > 1$, we only need to find the upper critical values: $\chi^2_{.025,[17]} = 30.19$, so we accept the null hypothesis that $CD = 1$

(b) The variance is equal to 2.
$H_0 : \sigma^2 = 2$, $H_1 : \sigma^2 \neq 2$. $X_s^2 = \frac{(n-1)s^2}{2} = \frac{17 \cdot 4.09477}{2} = 34.81$. $p = .0131$, so we reject the null hypothesis at 5% significance, but accept H_0 at 1% significance.

(c) Is this data Poisson distributed?
Since the deviations are fairly randomly distrubuted between +s and -s and we accepted the hypothesis that $CD = 1$, all the evidence points toward this data being Poisson. In particular, these accidents are independent and any additional knee-jerk precautions taken shortly after one occurs don't make any difference. More positively phrased, the usual precautions are fine.