1. (10 points) Are the teams that play in the World Series evenly matched? To win a World Series, a team must win 4 games. *If the teams are evenly matched, we would expect the number of games played in the World Series to follow the distribution shown in the first 2 columns of the table below. The third column represents the actual number of games played in each World Series from 1930 to 2007. Does the data support the distribution that would exist if the teams were evenly matched? Use the $\alpha = 0.05$ level of significance. Use the p-value method.

Number of Games	Probability	Observed Frequency	E Expected Frequency
4	0.125	15	$E = np = (77)(0.125) = 9.625$
5	0.25	15	$E = np = (77)(0.25) = 19.25$
6	0.3125	17	$E = np = (77)(0.3125) = 24.0625$
7	0.3125	30	$E = np = (77)(0.3125) = 24.0625$

$$n = 77$$

Hyp. Test

$H_0: P_4 = 12.5\%, P_5 = 25\%,$
$P_6 = P_7 = 31.25\%$

$H_1:$ Not all p's are as stated in H_0.

$P_4 =$ The probability that a world series will take exactly 4 games to complete

$P_7 = $ - - - - - - - exactly 7 - - - - - -.

Test stat

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

$$= \frac{(15-9.625)^2}{9.625} + \cdots + \frac{(30-24.0625)^2}{24.0625}$$

$$= 7.477922078$$

p-value

$\alpha = 0.05$ $df = k-1 = 4-1 = 3$

p-value $= P(\chi^2 > 7.477922078)$

$= 0.0581284502$

Is p-value $< \alpha$?
$0.0581284502 < 0.05$?

No!

7.477922078
χ^2-dist.
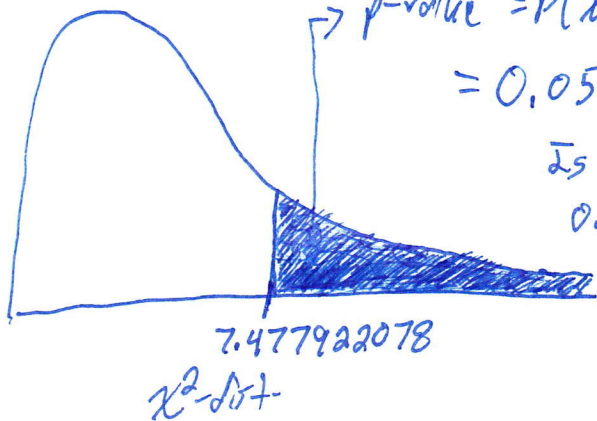
Conclusion

Do not reject H_0!

Not enough evidence to say that the teams that meet at the world series are not evenly matched

Extra Credit (10 points) By the mid-1990s, Kristen Gilbert had been working for several years as a nurse at the Veteran's Administration Hospital in Northampton, Massachusetts. For a time, she had been one of the nurses that others most often looked up to. Lately, other nurses became increasingly suspicious that something was wrong. To them, if felt like more people were dying when Gilbert was working than when she wasn't and so *they suspected that Gilbert may have played a part in the murder of these patients. An investigation was* launched and data for 1641 random shifts at this hospital were collected and is summarized in the table below. Test the claim that a death occurring during a shift at this hospital is independent of whether or not Gilbert was working on that shift. Use the rejection region method. (Since this is a serious accusation, use a 0.01 significance level)

Death on Shift?

		Yes	No	
Gilbert present?	Yes	40	217	257
	No	34	1350	1384
		74	1567	1641

E's

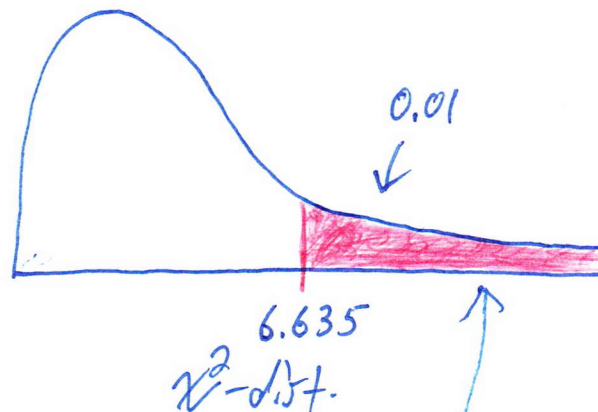| 11.589	245.411
62.411	1321.589

Hyp. Test

H_0: Death on a shift is independent of Gilbert's presence

H_1: Death on a shift depends on Gilbert's presence

Rejection Region

$\alpha = 0.01$ $df = (r-1)(c-1) = (2-1)(2-1) = (1)(1) = 1$

0.01

6.635

χ^2-dist.

Test stat

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

$$= \frac{(40-11.589)^2}{11.589} + \cdots + \frac{(1350-1321.589)^2}{1321.589}$$

$$= \boxed{86.48421433}$$

Conclusion

Reject H_0!

Evidence suggests that a death on a shift depends on Gilbert's presence.

Some formulas you may need:

$$E = pn \qquad df = k - 1 \qquad \chi^2 = \sum \frac{(O-E)^2}{E}$$

$$\chi^2 = \sum \frac{(O-E)^2}{E} \qquad E = \frac{(row\ total)(column\ total)}{grand\ total} \qquad df = (r-1)(c-1)$$