AP Stats **13.1, 3, 4**

13.1 a) $P(\chi^2 > 1.41) =$ **.4941**

use χ^2cdf(1.41, 1000, 2) ← df; 1000 ← some large #

b) $P(\chi^2 > 19.62) =$ **.0204**

χ^2cdf(19.62, 1000, 9)

13.3 a) H_0: The marital status distribution for 25-29 year olds is the same as that of the general population.

H_a: The distributions are not the same.

b)

exp. counts	never married	married	widowed	divorced
	.2326(500)	.6031(500)	.07(500)	.0443(500)
	116.3	301.55	35	47.15

c) $\frac{(260-116.3)^2}{116.3} + \frac{(220-301.55)^2}{301.55} + \frac{(0-35)^2}{35} + \frac{(20-47.15)^2}{47.15}$

$\chi^2 = 177.56 + 22.05 + 35 + 15.63$

$\chi^2 = 250.24$ with $df = 3$

d) $p\text{-value} = 5.798 \times 10^{-54} \approx 0$ Reject H_0

We have evidence to conclude that there is a difference between the marital status distribution of 25-29 year olds and the general population.

13.4 H_0: The ethnicity distribution of Phd recipients in 1994 is the same as it was in 1981.

H_a: The distributions are different

Wht.	189	exp. 236.7	(Put in L_1 and L_2
Blk.	10	11.7	then in L_3
Hisp.	6	4.2	$L_3 = (L_1 - L_2)^2 \div L_2$
Asian	14	8.1	
Am. In.	1	1.2	$\chi^2 = \text{sum}(L_3)$
N. Alien	80	38.4	

$$\chi^2 = \frac{(189 - 236.7)^2}{236.7} + \cdots = 60.03 \quad df = 5$$

p-value ≈ 0 Reject H_0

We have evidence to conclude that the distributions of PhDs are different from 1981 and 1996.

b) The greatest changes occurred among non-resident aliens (80 is much larger than the expected 38.4) and among whites (only 189 compared to the expected 237).

AP Stats | 13.10, 12 |

13.10

Flavor	Grape	Lemon	Lime	Orange	Strawberry	
observed	530	470	420	610	585	2615
exp.	523	523	523	523	523	total

H_0: colors are uniformly distributed
H_a: colors are not uniformly distributed

$$\chi^2 = \frac{(530-523)^2}{523} + \frac{(470-523)^2}{523} + \cdots = 47.57 \quad df = 4$$

$P(\chi^2 > 47.57) = 1.16 \times 10^{-9}$ Reject H_0
We have evidence to conclude that Trix cereal is not uniformly distributed (or that our box is not a random sample.)

13.12

Part	I	II	III	IV	
observed	95	105	135	165	total = 500
exp. values	125	125	125	125	

$\chi^2 = 7.2 + 3.2 + .8 + 12.8 = 24 \quad df = 3$
p-value $= 2.5 \times 10^{-5} \approx 0$ Reject H_0
We have evidence to conclude that the wheel is not balanced. The largest difference is in category IV: win nothing (the 165 is more than we would expect, 125). Maybe the game is rigged so that people will not win prizes.

AP Stats 13.13, 14

13.13

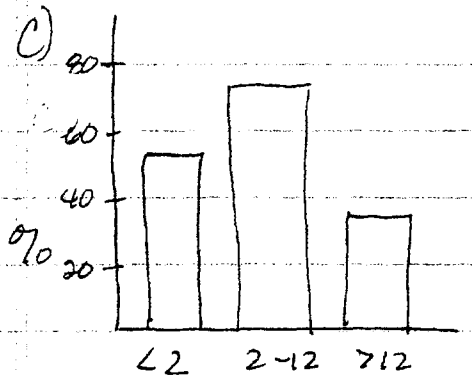
	Ex. Curr - Hrs < 2	2-12	> 12	total
C+	11	68	3	82
D or F	9	23	5	37
total	20	91	8	119

a) r x c ⇒ 2 x 3

b) 11/20 = 55% 68/91 = 74.7% 3/8 = 37.5%

Some (not too much) time in ex. curr. activities seems to be good for grades

c)



d)

	< 2	2-12	> 12
C+	(13.78)	62.71	5.51
D/F	6.22	28.29	2.49

$\frac{82 \cdot 20}{119}$

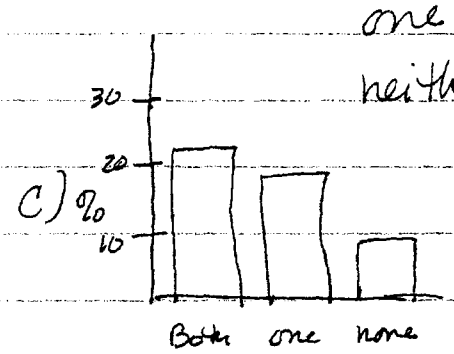
e) The C-or-better grades are lower than expected for < 2 and > 12 but higher than expected for 2-12 hrs. of ex. curr. activities.

3.14 a) 3 x 2

b)

	smokes	doesn't	
Both	400 (22%)	1380	1780
one	416 (19%)	1823	2239
neither	118 (9%)	1168	1286

c)



d) There is no difference in the proportion of students who smoke among the different parent groups. (Parents' smoking habits have no effect on student's smoking).

3.14

e)

	Smokes	(exp)	Doesn't	(exp)	
both	400	(332.5)	1380	(1447.5)	1780
one	416	(418.2)	1823	(1820.8)	2239
none	188	(253.3)	1168	(1102.7)	1356
totals	1004		4371		(5375)

f) More students smoke than expected if both parents smoke. Fewer students smoke than expected when neither parent smokes.

AP Stats **13.15, 16, 19, 21**

13.15 a) $\frac{(11-13.78)^2}{13.78} + \frac{(68-62.71)^2}{62.71} + \frac{(3-5.51)^2}{5.51} + \frac{(9-6.22)^2}{6.22}$

$+ \frac{(23-28.29)^2}{28.29} + \frac{(5-2.49)^2}{2.49} =$

$\frac{7.7284}{13.78} + \frac{27.9841}{62.71} + \frac{6.3001}{5.51} + \frac{7.84}{6.22} + \frac{27.9841}{28.29} + \frac{6.3001}{2.49}$

$.561 + .446 + 1.143 + 1.260 + .589 + 2.530 = 6.529$

b) p-value $= 1 - .9687 = .0313$

Reject Ho. We conclude that there is a relationship between hours spent in extra-curricular activities and performance in the course.

c) The col. 3 row 2 term contributes the most to χ^2. Too much time spent on activities seems to hurt academic performance.

d) The study demonstrates <u>association</u> not causation. Certain types of students may tend to spend a moderate amount of time on activities and also study hard in their classes.

13.16 a) $13.709 + 3.149 + .012 + .003 + 16.83 + 3.87 = 37.566$

b) p-value $= 1 - 1 = 0$ Reject Ho.

We conclude that there is a relationship between parents' smoking habits and those of their children.

c) $C_1 R_1$ (both / smoke) 13.709

$C_2 R_1$ (both / doesn't) 16.829

When both parents smoke many more students smoke than expected. When neither smoke, fewer students smoke

13.16 d) The study demonstrates <u>association</u> not causation.

13.19 a)

	Grade received (expected)	
	≥ C	D/F
wanted ≥ C	5 (9.6)	9 (4.4)
≥ B	41 (44.1)	23 (19.9)
A	27 (20.7)	3 (9.3)
A+	9 (7.6)	2 (3.4)

b) 2 out of 8 expected counts are less than 5.

c) $\chi^2 = 14.98608114$

p-value = .001829

$df = (4-1)(2-1) = 3$

d) Students with <u>high goals</u> show a higher grade than expected. Those with low expectation (C or better) did worse than expected.

13.21

	total	Black	% Black (a)
Household	2455	172	7.01
Non household	1191	167	14.02
Teachers	659	86	13.05

% of Blacks is .0987

b)

	Black	Non-black
Household	172 (142)	2283 (2213)
Non-H	167 (118)	1024 (1073)
Teacher	86 (65)	573 (594)

c) All expected counts are greater than 5.

H_0: There is no relationship between worker class and race.

H_a: There is a relationship.

d) $df = (3-1)(2-1) = 2$ $\chi^2 = 53.19$ p-value < 0.0005

e) There is a relationship between worker class and race. Black workers are more likely to be in non-household or pre-school teacher positions.