**AP Statistics- Chapter 13 Answers**

**CH13H1**

**P.785 #1-5**

**#1**

1. Counts will be obtained from the samples, so this is a problem about comparing proportions.
2. This is an observational study comparing random samples selected from two independent populations

**#2**

1. Scores will be obtained from the samples so this is a problem about comparing means.
2. This is an experiment because the researchers are imposing a treatment and measuring a response variable. Since these are volunteers, we will not be able to generalize the results to all gamers.

**#3**

1. Two samples. The two segments are used by two independent groups of children
2. Paired data. The two segments are both used by each child

**#4**

1. Single sample. The sample mean will be compared with the known concentration.
2. Two samples. The mean concentration in 10 beakers with the new method will be compared to the mean concentration in 10 different beakers with the old method.

**#5**

1. Hₒ:$μ$t=$μ$c versus Hₐ:µt > µc, where µt and µc are the mean Improvement of reading abilities in the treatment and control groups respectively
2. The treatment group is slightly skewed left with a greater mean and smaller standard deviation (x=51.48, s=11.01) than the control group (x=41.52, s=17.15)
3. Randomization was not possible because existing clauses were used

**P.791 #7, 8,9,11 p.801 #13-15**

**#7**

1. The hypothesis should involve µ1 and µ2 rather than x1 and x2
2. The sample means are not independent. We would not need to compare the scores of the 10 boys to the scores for the 10 girls
3. We need the p-value to be small to reject Hₒ. A large p-value like this gives us no reason to doubt Hₒ.

**#8**

1. Answers will vary. Examine random digits: if the digit is even then use design A; otherwise use Design B.
2. Use a two sided alternative (Hₒ;µa=µb versus Hₐ:µa $\ne $µb0 because we presumably have no prior suspicion that one design will be better than the other.
3. Both sample sizes are the same(n1=n2=30), so the appropriate degrees of freedom would be 29
4. Because 2.045< t < 2.150 and the alternative is two sided, Table c tells us that 0.04<P-value <0.05. We would reject Hₒ and conclude that there is a difference in the mean daily sales for the two designs.

**#9**

1. We want to test Hᵒ:µt=µc versus Hᵃ:µt > µc. The test statistic is t= 2.311, and 0.01<P-value<0.02 with DF=20. The p-value is less than 0.05 so the data gives good evidence that the new activities improve mean drp score.
2. A 95% confident interval for µt-$µ$c is (51.48-41.52)$\pm $2.086 ×$\sqrt{\frac{11.01^{2}}{21}+\frac{17.15^{2}}{23}=2.311}$, and (0.97, 18.94) with DF=20. We estimate the mean improvement in reading ability using the new reading activities, compared to not using them, over a 8 week period to be between 1.23 and 18.68 points,

**#11**

1. Because the sample sizes are so large, the t procedures are robust against non-Normality in the populations.
2. A 90% confidence interval for µm-µf is (1884.52 - 1360.39) ± 1660×$\sqrt{\frac{1368.37^{2}}{675}+1037.46^{2}/621}$= ($412.68, $635.58) using DF=100 ;( $413.54, $634.72) using DF=620; and ($413.62, $634.64) using DF= 1249.21. We are 90% confidence that the difference in mean summer earnings is between $413.62 and $634.64 higher for men
3. The sample is not really random, but there is no reason to expect that the method is used should introduce any bias. This is known as systematic sampling.
4. Students without employment were excluded, so the surveys can only extend to employed undergraduates.

**#13**

1. We want to test Hᵒ:µr=µw versus Hᵃ:µr$>$µw, where µr and µw are the mean percent change in polyphenols for men who drink red and white wine, respectively. The t test statistic is t=$\frac{5.5-0.23}{\sqrt{\frac{2.52^{2}}{9}+3.29^{2}/2}}$=-3.81, with DF=8 and 0.0025<P-value <0.005.
2. The value is of the test statistic is the same; but DF=14.97 and the P-value is 0.00085. The more complicated degrees of freedom give a smaller and less conservative P-value.
3. This study appears to have been a well-designed experiment, so it does prove evidence of causation

**#14**

1. A 95% confidence interval for µr=µw is (5.5-0.23) ± 2.306 $\sqrt{\frac{2.52^{2}}{9}+3.29/9}$=(2.08%, 8.45%).
2. With DF=14.97 t\* =2.132, and the confidence interval is 2.32% to 8.21%. There is very little difference in the resulting confidence intervals.

**#15**

1. We want to test Hᵒ:µs = µn versus Hᵃ:µs >µn, where µs and µn are the mean knee velocities for skilled and novice female competitive rowers respectively. The test statistic is t=3.1583, and he P-value=0.0052. Since 0.0052<0.01, we reject Hᵒ at the 1% significance level and conclude that the mean knee velocity is higher for skilled rowers
2. Using DF= 9.2, the critical value is t\*=1.895. Since 1.895>1.8612, the margin of error would be larger, so the confidence interval would be slightly wider.

**P.804 17-19, 23, 24**

**#17**

1. Two sample t-test
2. Paired t test
3. Paired t test
4. Two sample t test
5. Paired t test

**#18**

s

Sample mean

n

Treatment

|  |  |  |  |
| --- | --- | --- | --- |
| IDX | 10 | 116.0 | 17.71 |
| Untreated | 10 | 88.5 | 6.01 |

1. Use DF=9
2. This is a completely randomized design with one control group and one treatment group. The easiest way to carry out the randomization might be to number the hamsters from 1-20. Use the SRS applet and out 20 balls in the population hopper. Select 10 balls from the hopper. The 1o hamsters with these numbers will be injected with IDX. The other 10 hamsters will serve as the control group.

**#19**

1. Yes. The test statistic for testing Hᵒ:µ1=µ2 versus Hᵃ: µ1 > µ2is t=$\frac{116-88.5}{\sqrt{\frac{17.71^{2}}{10}+\frac{6.01^{2}}{10}}}$ = 4.65. With either DF=9 or DF= 11.04, we have a significant result, so there is strong evidence that IDX prolongs life.

**#23**

1. The difference between the average female (55.5) and male (57.9) self-concept scores was so small that it can be attributed to chance variation in the samples (t=-0.83, DF=62.8, P-value=0.4110). Based on this sample we have no evidence that mean self-concept scores differ by gender.
2. Random assignment allows us to make a cause and effect conclusion.

**#24**

1. If the loggers had known a study would be done, then they might have cut down fewer trees in order to reduce the impact of logging
2. Random assignment allows us to make a cause-and-effect conclusion
3. We want to test Hᵒ:µU=µL versus Hᵃ:µU > µL, where µU and µL are the mean number of species in unlogged and logged plots, respectively. The test statistic is t= $\frac{17.5-13.67}{\sqrt{\frac{3.53^{2}}{12}+\frac{4.5^{2}}{9}}}$ = 2.11, with DF= 8 and 0.025<P-value<0.05. Logging does significantly reduce the mean number of species in a plot after 8 years at the 5% level but not at the 1% level.
4. (1.75-13.67)±1.860 x $\sqrt{\frac{3.53^{2}}{12}+\frac{4.5^{2}}{9}}$ = (0.46

, 7.21). We are 90% confident that the difference in the means for unlogged and logged plots is between 0.46 and 7.21 species.

**P.821 #33, 34, 38, 39**

**#33**

1. Hᵒ should refer to the population proportions p1 and p2, not sample proportions
2. Confidence intervals account only for sampling error.

**#34**

1. Let p1= proportion of households in which no message was left and contract was eventually made and p2= the proportion of households in which a message was left and contact was eventually made. We want to test Hᵒ:p1=p2 versus Hᵃ:p1 < p2. The combined sample proportion is parameter population c =$\frac{58+200}{100+291}$=0.66, and the test statistic is z= $\frac{0.52-0.687}{\sqrt{0.66(1-.066)(\frac{1}{100}+\frac{1}{291})}}$ = -1.95, with p-value=0.0256. Yes. At the 5% level, there is good evidence that leaving a message increases the proportion of households that are eventually contacted.
2. Let p1=the proportion of households in which no message was left but the survey completed and p2= the proportion of households in which a message was left and the survey was completed. We want to test Hᵒ:p1=p2 versus Hᵃ:p1<p2 . The combined sample proportion is parameter pop. C = $\frac{33+134}{100+291}=$0.427, and the test statistic is z=$\frac{0.33-0.46}{\sqrt{0.427(1-0.427)(\frac{1}{100}+\frac{1}{291})}}$= -2.28, with a P-value =0.0113. Yes at the 5% level there is good evidence that leaving a message increases the proportion of households who complete the survey.
3. A 95% confidence interval for the difference p1-p2 when dealing with eventual contact is (-0.218, 0.003). A 95% confidence interval for the difference p1-p2 when dealing with completed surveys is (-0.239, -0.022). Although these effects do not appear to be large, anything you can do to improve non response in the random sample when you are dealing with hundreds (or thousands) of surveys is useful.

**#38**

1. We must have two simple random samples of high school students Illinois; one for freshmen and one for seniors.
2. c) The sample proportion of freshmen who have used anabolic steroids is *p hat f =* $\frac{34}{1679}$ =0.0203. Since the number of successes (34) and the number of failures(1645) are both atleast 10, the z confidence interval can be used. A 95% confidence interval for PF is 0.0203±1.96$\sqrt{\frac{0.0203\*0.9797}{1679}}$ = (0.0135, 0.0270).
3. The sample proportion of freshmen who have used anabolic steroids is $p hat$s = $\frac{24}{1336}$ =0.0176. Notice that the 0.0176 falls in the 95% confidence interval for plausible values of Pf from part (b), so there is no evidence of a significant difference in the two proportions.

**#39**

We want to test Hᵒ: p1=p2 versus Hᵃ:p1$\ne $ p2. From the output, z=-3.45 with a P-value =0.0006, showing a significant difference in the proportion of children in the two age groups who sorted the products correctly. A 95% confidence interval for p1-p2 is (-0.503, -0.514). With 95% confidence we estimate that between 15.4% and 50.3% more 6- to 7 year olds can sort new products into the correct category than 4- to 5- year olds.

**P.827 #41, 42, 44, 45,46,47,48**

**#41**

1. This is a two sample t test. The two groups of women are independent
2. DF=45-1=44
3. The sample size are large enough, n1=n2 =45, that the averages will be approximately normal, so the fact that the individual responses do not follow a normal distribution has little effect on the reliability of the t procedure.

**#42**

1. This is an observational study because the researchers simply observed the random samples of women; they did not impose any treatments.
2. We want to test Hᵒ: pN = pB versus Hᵃ: pN > pB. Not that *p hat c* =$\frac{286+164}{539+292}$ =0.5145, and z= 0.0748 and z =$\frac{0.5306-0.5616}{\sqrt{0.7448}(1-0.5145)(\frac{1}{539}+\frac{1}{292})}$ =-.086, with P-value = 0.3898. Since 0.0398>0.05, there is insufficient evidence of a difference between Hispanic and white drivers. For the size of the difference construct a 95% CI. A 95% CI interval for pH-pW is (-0.1018, 0.3898). With 95% confidence, we estimate the difference in the proportions of Hispanic and white drivers who wear seat belts are in between -0.10 and 0.04.

**#44**

1. We want to test Hᵒ:µt =µc0 versus Hᵃ:µt>µc where µt is the mean difference for the control group. The conditions for interference are satisfied. The test statistic is t= $\frac{11.4-8.25}{\sqrt{\frac{3.17^{2}}{10}+\frac{3.69}{8}}}$ = 1.91, with 0.025<P-value< 0.05 and DF= 7. The p-value is less than 0.05, so the data gives good evidence that the positive subliminal message brought about greater improvement in math scores than the control.
2. A 90% confidence interval for µt- µc is (11.40- 8.25) ± 1.895$\sqrt{\frac{3.17^{2}}{10}+\frac{3.69^{2}}{8}}$= (0.03, 6.27) with DF=13. With 90% CI we estimate the mean difference in gains to be 0.235 to 6.065 points better for the treatment group.
3. Many students will probably describe the design as a complketely randomized design for two groups , with a twist instead of measuring one response variable on each individual, two measurements are made, and we compare the differences.

**#45**

1. A 99% CI for Pm –Pw is (0.9226, 0.6314) ± 2.576 x $\sqrt{\frac{0.9226\*0.0774}{840}+\frac{0.6314\*0.3686}{1077}}$ = (0.2465, 0.3359). Yes because the 99% CI interval does not contain 0.
2. We want to test Hᵒ:µm=µw versus Hᵃ: µm$\ne $µw. The test statistic is t = $\frac{272.40-274.7}{\sqrt{\frac{59.2^{2}}{840}+57.5^{2}/1077}}$ = -0.87, with a P=value close to 0.4. Since 0.4> 0.01 the difference between the mean sores of men and women is not significant at the 1% level.

**#46**

1. Matched pairs t
2. Two-sample t
3. Matched pair t

**#47**

1. A 99% CI for µOPT- µWIN is (7638-6595) ± 2.581$\frac{\sqrt{289^{2}}}{1362}+\frac{247^{2}}{1395}$= (1016.55, 1069.45).
2. We can use t-procedures because the sample sizes are both so large.

**#48**

1. We want to test Hᵒ:µp=µc versus Hᵃ:µp>µc; t= $\frac{193-174}{\sqrt{\frac{68^{2}}{26}+\frac{44^{2}}{23} }}$=1.17, with a p – value close to 0.125. Since 0.125>0.05, we do not have strong evidence that pets have higher mean cholesterol than do clinic dogs,
2. A 95% CI for µp-µc is (193-174) ± 2.074 $\sqrt{\frac{68^{2}}{26}+\frac{44^{2}}{23}=\left(-14.5719, 52.5719\right).}$ with 95%, we estimate the difference in the mean cholesterol levels between pets and clinic dogs to be between -14 and 53mg/dl and 221 mg/dl.
3. Answers may vary. One problem could be that sample of pets are from owners who might be more conscientious about their pets’ health than those who don’t take their pets to the clinic.