2007 Multiple Choice Solutions AP Stats

1. C By definition (about) 50% of observations fall between the 1st and 3rd quartile, so there are approximately 100 students between Q1 and Q3, and thus there are about 100 children with heights between 43 and 48 inches.
2. E While it would be difficult to pursue a census in the first four situations, it would not be impossible. Lake Michigan is simply too vast to ensure that EVERY single fish in the lake is documented.
3. C An orange at the 67th percentile (percentage of observations to the left!) has a z-score of 0.44. We have $z = \frac{x-\mu}{\sigma} \to 0.44 = \frac{x-\mu}{0.3}$, so the difference ($x-\mu$) is 0.132; a positive difference means that the diameter of an orange at the 67th percentile is 0.132 ABOVE the mean. Note that any answer involving an orange below the mean can be ruled out, because any percentile above 50% is above the mean for an approximately normal distribution.
4. A Use the formula $\left(\hat{p}_1 - \hat{p}_2\right) \pm z^*_{90\%}\sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$. Eliminate answer choice B&D immediately, for the critical values are for 95% CIs. Eliminate C&E for doing some sort of strange pooling – we never pool for confidence intervals.
5. C Eliminate A&B – The null is always a statement of innocence – and the null must always be EQUAL to a certain value. We wish to see if there is enough evidence to suggest the alternative hypothesis is correct, and that alternative is the claim of the safety group – greater than 65 mph.
6. B. The probability that a coin lands heads on ANY flip is ½ - coin flips are independent events. What has happened on previous flips has no bearing on future probabilities.
7. D A – false. Median of A = (192+200)/2=196. Median of B = (121+143)/2 = 132.
   B – False: Range of A = 373-126 = 247. Range of B = 229-58 = 171.
   C – False: Q3 for A is (249+302)/2 = 275.5. Q3 for B is (165+173)/2=169 which is not larger than Q3 for A.
   E – False: Q1 for A is 180; Q1 for B is 99.5. Thus, IQR for A is 95.5; IQR for B is 73.5.
   D is the only possibility left – also note that A's distribution is skewed positively (to the right), and B is approximately symmetrical, so the mean for A is larger than the median for A, which is already larger than the median for A, which should be about the same as the mean for A, due to symmetry.
8. C Since P(X>115) looks at an upper tail probability, and 115 is 15 units above the mean, we want to find a lower tail probability for a value 15 units below the mean, since the normal distribution is symmetrical. P(X<85) does the trick.
9. B This is a convenience sample, so the people most likely to respond are the ones with strong feelings.
10. C Changing units never affects the correlation coefficient, since it is a unitless measure. That calculation of r involves standard deviations, and someone who is, for instance, 1 meter from the mean will have the same standard deviation as someone 100 cm (or 1000 mm for that matter) from the mean.
11. C In a binomial situation, we must have the following situation: 1) success/failure (yes:

success = a 6, failure = not a 6) 2) independence (yes: one random number does not affect the next) 3) a fixed number of trials (yes: n = 20), and 4) a fixed probability of success (yes: p = 0.1). Thus the situation is binomial, and with the process repeated 100 times, the distribution will be approximately binomial with n = 20 and p = 0.1.

12 E Median is the middle value. Since we don't know what individual values are in each sample, we cannot know what the median value of the combined sample.

13 D A t-value of 3.27 will certainly result in a p-value less than 0.05. Using 320 as a very conservative estimate of the number of degrees of freedom, $2P(t_{320} > 3.27) = 0.00119$. Thus, with the low *p*-value, we reject the null and go for the alternative hypothesis. But one should be able to come to this conclusion WITHOUT using a calculator, based upon the size of the *t*-value.

14. B We always block on variables that we believe will have the largest effect on the response variable. Since men and women may respond significantly differently, we can reduce variability in our response by blocking on gender.

15. D The distribution with the largest standard deviation will have the largest number of values the farthest away from the mean. D fits this description, as there are very few values in the center (where the mean will be, approximately, due to symmetry) and most are at the extremes of the distribution.

16. E Probabilities are based upon what should happen "in the long run". Here we use past information to make a reasonable guess about how likely it is that the flight is on time.

17. A We reject the null when the chi-squared value is GREATER than the critical value. At the 5% significant level with 3 degrees of freedom, the chi-squared critical value is 7.81. This large chi-squared value indicates that it is unlikely that our observed differences between observed and expected values were due to chance alone, and thus our model is inconsistent with the observed values.

18 B Check until you find a statement that is true. The correct answer is B: people with Positive attitudes were type B 12/37 = 32.4% of the time, people with neutral attitudes were type B 9/20 = 45% of the time, and people with negative attitudes were type B 19/43 = 44.1% of the time.

19 B Since the weights of the containers vary widely, but the sum weight of the containers is always about the same (call this weight S), we can say that as one container gets heavier (call its weight x) , the other must be lighter (call its weight S – x). $S - x$ is an equation with a negative slope and thus negative relationship. This indicates a negative correlation. Linearity comes from the form of the weight equation for the second container.

20 E E is incorrect because a subset containing sample of nothing but units from one stratum is not possible.

21. D Since $\hat{p}$ is the proportion of those in the sample who say "yes", we have $n\hat{p} = (100)(4/100) = 4 < 10$, so the interval is not valid.

22. E An adult grey whale which weighs 24,000 kg would have a z-score of 1.5, since $1.5 = \frac{24,000 - 18,000}{4,000}$. Now a male humpback whale which is 1.5 SDs above the mean would have a weight of 30,000+1.5(6,000) = 39,000 lbs.

23. B Remember that we have LESS variability with a larger sample size, thus the sampling distribution will be taller and SKINNIER with a larger sample size. Thus, Distribution

I has a larger sample size than Distribution II.

24. D Notice that there is an outlier between 90 and 100 minutes in the histogram. The next largest possible time that is NOT an outlier falls between 60 and 70 minutes, so the right whisker should extend to a value in this interval. This eliminates all answers except C and D. Now find the median. The median value falls between the 13^{th} and 14^{th} sample in a sample of size 26, and this will occur in the 20 to 30 minute bin, so the median should fall in that interval. D is the only boxplot that has this feature.

25. C We don't and CAN'T know the population standard deviation, so we use the sample's standard deviation. Since we know that a sample is smaller than the population, we also know that it has greater variability. Using a t-distribution allows us to compensate for this extra variability, with the fatter tails of a t-distribution. Larger sample sizes decrease this variability, which is why the t-distribution approaches the normal distribution as our sample size gets larger and larger.

26. C Remember: $E(Y-X)=E(Y)-E(X)$, so we have $E(Y-X) = 9\text{-}10 = \text{-}1$. Now, since the variables are independent, we have $Var(Y-X)=Var(Y)+Var(X)$, or in other words, $SD(Y-X)=\sqrt{SD^2(Y)+SD^2(X)}=\sqrt{4^2+3^2}=5$. Since the combination of two normal, independent random variables is also normal, C is the correct answer.

27. B Since the test is 2 sided, the alpha level associated with a confidence interval is alpha = 1 – Confidence Level. At the 90% Confidence level, we have an alpha level of .10, and since p < alpha, we reject the null, meaning that 0 will NOT be contained in the interval of feasible values. Similarly, at the 93% confidence level, p < alpha = 0.07, so we reject the null. However, at the 95% confidence level, alpha is 0.05 which is GREATER than p = 0.054. We fail to reject the null, and know that the associated interval WILL contain 0. All other confidence intervals listed are wider than the 95% interval, so these will capture 0 as well. Thus, the 93% CI is the largest interval LISTED which does not capture 0.

28. E Height and arm span are two quantitative variables, and since we are looking for a linear relationship, our first job would be to look at a scatterplot, and to run a linear regression on the data. A t-test for the slope of a regression line will let us know if the relationship we find is significant. *Note: do not enter this information on your calculator!!!!!!!!!!!!!*

29. E The median for B lies below 30, thus at least 50% of the petal lengths are less than 30 mm. On the other hand, Q1 for A lies at about 30, so about 25% of the petal lengths fall below 30 for species A.

30. B When sample size quadruples, interval length is cut in half; similarly, if sample size is multiplied by a factor of 9, the interval length is one-third the length of the original. Thus is because the formula for standard error contains a $\sqrt{n}$ term in the denominator. Quadrupling *n* pulls out a factor of 2 after taking the square root.

31. A Once again, we block on the variable that has the largest effect on the response variable. In this case, car size is associated with the response variable (stopping distance), so we choose this variable.

32. E Power can be increased by increasing sample size or by increasing the alpha level.

33. B An estimator should have low bias and low variability. Low bias means that the distribution of the estimator should be centered at or very near the true value of the parameter. Low variability should mean that the spread is as small as possible. A has

low bias but large variability. B has low bias and low variability (which is why it is the correct answer!). C has large variability, and is centered at about 1.5 or 2, which is different than the true parameter. D has low variability (narrow range), but is centered at around 2. E has the same problem as D.

34. A This statement is another way of saying we are 95% confident that the true proportion of residents who support offering incentives to high tech industries for building plants falls in the interval (0.49, 0.59). Note that if the true proportion actually IS in the interval, it must be no more than 5 units away from the point estimate (0.54).

35. D A – Bad! No randomness employed. Flies must be randomly assigned to treatments (or vice versa)
B – Bad! The first 20 flies may be systematically different than the second 20 and so on.
C – Bad! The first 40 flies have no chance of being assigned to group C.
D – Good ☺ Each fly has an equal chance of being assigned to each different group.
E – Seems to be good – what is the problem? It doesn't guarantee 20 in each group! BAAAAD – in THIS case ☺ Read the problem carefully!

36. D Note that P(A) + P(B) + P(C) = 1. Now:
   I. FALSE - A and C cannot be independent. Since the events are mutually exclusive, if one occurs, we know that the other does NOT. So, if A occurs, P(C) = 0. A & B independent would mean that knowing that A occurred would not affect the probability that C occurred, but here it clearly does.
   II. TRUE - Since the events are mutually exclusive, they cannot happen at the same time, and thus the probability of BOTH occurring is 0.
   III. TRUE - $P(B \text{ or } C) = P(B) + P(C) - P(B \cap C)$, but B and C are mutually exclusive, so $P(B \cap C)$=0, giving us the equation as given.

37. A Note that the *p*-value is 0.076, meaning that we fail to reject the null at the 5% significance level, but we would reject at the 10% significance level. But, at the 10% level we would conclude that the mean weight of baseball players is significantly lower than the mean weight of hockey players. So don't get tripped up by the wording of C.

38. E In a game of chance, outcomes are independent. Thus, probabilities multiply. Now, if we add the scores, we can obtain the values 0, 1, 2, 3, and 4. Thus A, B, C are right out. This is not binomial since the probability of success is not fixed. E is the only answer possible. How can we get 0? 0 + 0. This can only happen one way, and the probability of it occurring is (0.3)(0.3) = 0.09. We can get 1 by getting a 0 then a 1 OR 1 then a 0. The probability is (0.3)(0.4)+(0.4)(0.3) = 0.24, and so on.

39 A In order to use a 2 proportion z-test, the samples must be independent of *each other*. The proportion of people preferring candidate B is not independent of candidate A since they were selected from the same sample.

40. E Model A is clearly NOT appropriate, since there is a large curve in the residuals plot. Model B shows random scatter in the residuals plot, with no evidence of a non-linear relationship. Thus, the relationship between x and log y is approximately linear.