Reminders for AP Stats Exam

Describing Data

IQR is a number
Many students write things like "The IQR goes from 15 to 32." Every AP grader knows exactly what you mean, namely, "The box in my boxplot goes from 15 to 32," but this statement is not correct. The IQR is defined as Q3-Q1 which gives a single value. Writing the statement above is like saying "17 goes from 15 to 32." It just doesn't make sense.

Be able to construct graphs by hand
You may be asked to draw boxplots, stemplots, histograms or other graphs by hand. The test writers have become very clever and present problems in such a way that you cannot always depend on your calculator to graph for you.

Label, Label, Label
Any graph you are asked to draw should have clearly labeled axes with appropriate scales. If you are asked to draw side-by-side boxplots, be sure to label which one is which.

Refer to graphs explicitly
When answering questions based on a graph, you need to be specific. Don't just say, "The female times are clearly higher than the male times." Instead say, "The median female time is higher than the first quartile of the male times." You can back up your statements by marking on the graph. The graders look at everything you write and often marks on the graph make the difference between two scores.

Look at all aspects of data
When given a set of data or summaries of data be sure to consider center, spread, shape and outliers. Often a question will focus on one or two of these areas. Be sure to focus your answer to match.

It's skewed which way?
A distribution is skewed in the direction the tail goes, not in the direction where the peak is. This sounds backwards to most people, so be careful.

Slow down
The describing data questions appear easy, so many students dive in and start answering without making sure they know what the problem is about. Make sure you know what variables are being measured and read the labels on graphs carefully. You may be given a type of graph that you have never seen before.

Regression

Graph first, calculate later
The most important part of the regression process is looking at plots. Regression questions will frequently provide a scatterplot of the original data along with a plot of residuals from a linear regression. Look at these plots before answering any part of the question and make sure you understand the scales used.

Is it linear?
Remember that an r value is only useful for data we have already decided is linear. Therefore, an r value does not help you decide if data is linear. To determine if data is linear, look at a scatterplot of the original data and the residuals from a linear regression. If a line is an appropriate model, the residuals should appear randomly scattered.

Computer Output
It is very likely that you will be given computer output for a linear regression. If you can read the output correctly, these questions are normally easy. You should be able to write the regression equation using the output and also be able to find values of r and r-squared. Most software packages provide the value of r-squared. If you are asked for the value of r, you will need to take the square root of r-squared and look back at the slope to determine if r should be positive or negative.

Interpreting r
If asked to interpret an r value, be sure to include strength, direction, type and the context. A good interpretation would be something like, "There is a weak positive linear relationship between the number of math classes a person has taken and yearly income."

Collecting Data

Experiments vs. Samples
Many students confuse experimentation with sampling or try to incorporate ideas from one into the other. This is not totally off base since some concepts appear in both areas, but it is important to keep them straight.

The purpose of sampling is to estimate a population parameter by measuring a representative subset of the population. We try to create a representative sample by selecting subjects randomly using an appropriate technique.

The purpose of an experiment is to demonstrate a cause and effect relationship by controlling extraneous factors. Experiments are rarely performed on random samples because both ethics and practicality make it impossible to do so. For this reason, there is always a concern of how far we can generalize the results of an experiment. Generalizing results to a population unlike the subjects in the experiment is very dangerous.

Blocking vs. Stratifying
Students often ask, "What is the difference between blocking and stratifying?" The simple answer is that blocking is done in experiments and stratifying is done with samples. There are similarities between the two, namely the dividing up of subjects before random assignment or selection, but the words are definitely not interchangeable.

Blocking
In blocking we divide our subjects up in advance based on some factor we know or believe is relevant to the study and then randomly assign treatments within each block. The key things to remember:

1. You don't just block for the heck of it. You block based on some factor that you think will impact the response to the treatment.
2. The blocking is not random. The randomization occurs within each block essentially creating 2 or more mini experiments
3. Blocks should be homogenous (alike) with respect to the blocking factor.

You have learned how to analyze the results of one special type of blocked design, namely, matched pairs. In matched pairs you subtract each pair of values which eliminates the variation due to the subject.

Stratified Sampling vs. Cluster Sampling
Many students confuse stratified and cluster sampling since both of them involve groups of subjects. There are 2 key differences between them:

1. In stratified sampling we divide up the population based on some factor we believe is important, but in cluster sampling the groups are naturally occurring
2. In stratified sampling we randomly select subjects from each stratum, but in cluster sampling we randomly select one or more clusters and measure every subject in the selected cluster(s).

Final Thoughts
It is especially important to stay focused when answering questions about design. Too many students get caught up in minor details but miss the big ideas of randomization and control. Always remember that your mission in responding to questions is to demonstrate your understanding of the major concepts of the course.

Inference

Not every problem involves inference
You have spent most if not all of this semester on inference procedures. This leads many students to try to make every problem an inference problem. Be careful not to turn straightforward probability or normal distribution questions into full-blown hypothesis tests.

Hypotheses are about populations

The point of a hypothesis test is to reach a conclusion about a population based on a sample. We don't need to make hypotheses about the sample. When writing hypotheses, conclusions and formulas, be careful with your wording and symbols so that you don't get the population and the sample mixed up. If you are using symbols in your hypotheses they will always be Greek letters or p.

Check Conditions

Checking conditions is not the same thing as stating them. Checking means actually showing that the conditions are met by the information given in the problem. For example, don't just write "np>10." Write "np = (150)(0.32) = 48 > 10." Everyone knows you can do the math in your head or on your calculator, but writing it down makes it very clear to the reader that you're tying the condition to the problem rather than just writing a list of things you memorized.

Confidence Intervals have conditions too

Confidence intervals have the same conditions as their matching tests, and you need to check them just as carefully.

Link conclusions to your numbers

Don't just say "I reject Ho and conclude the mean heart rate for males is greater than 78." This sentence doesn't tell us why you rejected Ho. Instead, say "Since the p value of 0.0034 is less than 0.05, I reject Ho and ….." Also, don't ever say you are going to *accept* a hypothesis.

Be consistent

Make sure your hypotheses and conclusion match. If you find an error in your computations, change your conclusion if necessary. Even if your numbers are wrong, you will normally get credit for a conclusion that is correct for your numbers. If you get totally stuck and can't come up with a test statistic or p value, make them up and say what you would conclude about them.

Interpreting a confidence interval is different than interpreting a confidence level

Interpreting the confidence interval usually goes something like, "I am 95% confident that the proportion of AP Stats students who are highly intelligent is between 88% and 93%" or "The superintendent should give seniors Fridays off since we are 99% confident that between 72% and 81% of parents support the plan."

Interpreting a confidence level usually goes something like, "If this procedure were repeated many times, approximately 95% of the intervals produced would contain the true proportion of parents who support the plan."