CREDIT: The questions on this document were written by Erik Packard, PhD, Associate Professor of Mathematics at Colorado Mesa University.

Match with problems 1, 2, 3 and 4.

A) Find the sample mean then go +/− (# from t-table)*(Sample SD)

B) Find the sample percentage (how many successes out of total) +/− (a z-number)* $\sqrt{\frac{p'q'}{n}}$

C) Follow the steps to do ANOVA

D) Find the best guess for y using the line of best fit then go +/−

$$(t\text{-table }\#)\sqrt{\frac{\sum\left(y^2\right)-b\sum y-m\sum(xy)}{n-2}}\sqrt{1+\frac{1}{n}+\frac{(x_0-\overline{x})^2}{\sum\left(x^2\right)-\frac{\left(\sum x\right)^2}{n}}}$$

1. (8 pts) You want to find a 90% CI for the mean number of hours people study for a Chemistry final exam. You will get a sample of people and ask them how many hours they study.

   A)

2. (8 pts) You want to give a 95% CI for the number of rebounds an NBA player will get in a game where they get 22 points. You will pick 20 NBA players and 1 game for each and record their points and rebounds.

   D)

3. (8 pts) You want to give a 99% CI for the percentage of people that study more than 30 hours for a Chemistry final exam. You will get a sample of people and ask them how many hours they study.

   B)

4. (8 pts) You want to prove at the 5% that there is some difference in the average number of people in a car entering Colorado National Monument between cars with Colorado plates, Utah plates, Arizona plates, and cars with other states. You will get 30 different cars of each type and find out how many people were inside.

   C)

5. Suppose there is a population of size 15 that has a mean of 105 and a standard deviation of 20. If you were to get all 2562890625 samples of size 8 with replacement (so repeats could occur) and find all these sample means,

A) (7 pts) What would be the mean of all those sample means?

The mean of all those sample means would be 105.

B) (10 pts) What would be the standard deviation of all those samples means?

The standard deviation of all those samples would be $\frac{\sigma}{\sqrt{n}} = \frac{20}{\sqrt{8}}$.

6. (7 pts) Use Row 99 of the table of random digits to pick 3 different letters from the alphabet (A-Z). Row 99 is 33167 35411 27473 13393 17714 59680 30888 98213 93364 03219.

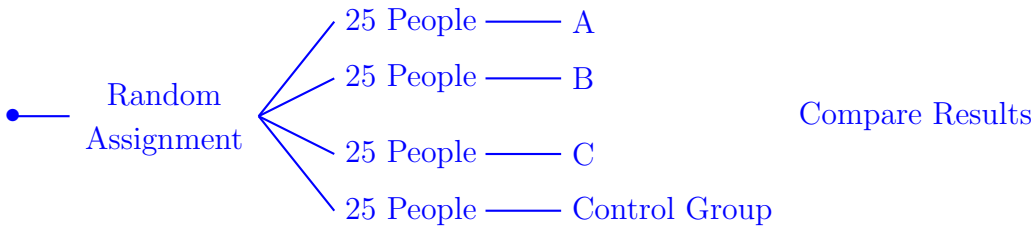
   Number letters A 01, B 02, etc. Pick 2 digits at a time until you get three numbers between 01 and 26.

   Row 99: 33**16**7 354**11** 27473 13393 **17**714 59680 30888 98213 93364

   16 = P
   11 = K
   17 = Q

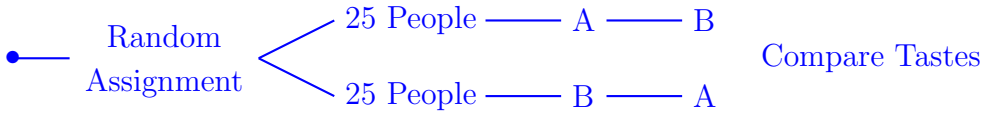
7. (8 pts) 100 people that are about 50 pounds overweight are to be in an experiment that tests 3 weight loss programs (A, B, and C). Give the outline of a completely randomized experiment that also has a control group.

   Outline:



8. (8 pts) 50 people are to be used to compare to sodas, brand A and brand B. Give the outline of a matched pairs experiment where each person serves as their own control. Should we tell them which brand they are tasting each time? No (Yes/No)

   Outline:



9. Suppose you have 50 groups of 15 people with the common cold and you decide to try 50 different common items (one for each group) to see if they will cure the common cold. You do one HT at the 5% significance level for each of the 50 groups. Assume that in fact none of these items cure the common cold.

A) (6 pts) What is the chance on one particular test you will make a mistake and conclude that the item cures the common cold?

5% or less.

B) (6 pts) What is the chance you will make at least one mistake in doing all 50 HTs.

The opposite of making at least one mistake = No Mistakes.

The probability of making no mistakes is $({}_{50}\mathtt{C}_0)(0.95)^{50}(0.05)^0 = 0.0769$

The answer is $1 - 0.0769 = 0.9231$.

10. (6 pts) Suppose you are doing a HT to try to prove the mean depth of snow in a certain area is over 100". You have a random sample of 20 depths and calculate $t_{\text{Data}} = 2.539$. Tell what the p-value is and give its meaning in everyday terms.

p-value = 0.01. This means that if the mean depth of snow in a certain area is not over 100", then the chance of finding as strong or stronger evidence suggesting that the mean depth of snow in a certain area is over 100" is 0.01.

11. (5 pts) Suppose you are doing a HT to prove the mean depth of snow in a certain area is over 100". You have a sample of 20 depths picked from the deepest areas and you have one depth of 1256"! And with this data you obtain a p-value of 0.0000551. What is the meaning of this p-value?

The p-value has no meaning as the data is not random, it is clearly biased toward deeper areas.

12. (5 pts) Lou Dobbs of Fox Business channel asks his viewers "Do you think the petty investigation into Donald Trump done by Mueller and his corrupt far-left friends at the department of justice should finally come to an end?" Here people decide for themselves if they wish to go online and answer the question. Will the margin of error in a confidence interval take into account this for sure bias from this very bad sample?

No, the margin of error in the CI only takes luck into account.

The rest are worth 1 point each.

13. Which is always possible, an experiment or an observational study?

Observational Study.

14. Give an example in which an experiment changed the conclusions of an observational study.

Women with menopause undergoing hormone replacement therapy to reduce the number of heart attacks from occurring.

15. What was the lurking variable that in observational studies made it appear that hormone replace at menopause made women have fewer heart attacks?

How much the women cared about their health.

16. How could it be proven that wine is better than beer or hard liquor when it comes to health?

    It could be proven by conducting an experiment.

17. Give a bias with Mall Sampling other than against tough looking individuals and in favor of teenagers.

    In favor of retired people.

18. Are volunteer response samples good?

    No.

19. The AFA (American Family Association) has online polls. Usually these polls will have what kind of bias?

    Bias that's in favor of their views.

20. Suppose a large city is deciding whether or not to use tax money to build a new stadium for its NFL football team. A newspaper is curious what residents think and so they send out a mail questionnaire (that instantly makes it clear the NFL team is affected, but it's not clear until you read closer that tax money is involved) to 10,000 addresses picked at random. Do you think all 10,000 questionnaires will be returned?

    No.

21. Does the wording of a question have much effect on the answers?

    Yes.

22. Give an example in which the wording of a question could make quite a difference.

    Do you think the nation is spending more money on "Welfare" vs. "Help for the poor"?

23. We wish to perform an experiment to see whether an online version of a Statistics course is better than an in-class version. We have data from two teachers. Teacher A teaches an online class and the average grade point for the students in this class is 2.94. Teacher B teaches a regular class and the average grade point in this class was 2.33. So we conclude the online version is better. Three distinct problems are better students might be more likely to take the online class, Teacher A might be easier, and luck.

24. What is a control group?

    A group that gets no treatment in order to assess the effectiveness of the actual treatment.

25. Give an example of how lack of realism can cause problems in an experiment.

    TV commercials with a captive audience vs. how normal people watch TV.

26. If you have an outlier that is found to be a real piece of data, should you remove it?

    No.

27. Give an example where a SRS is called for and not met, but probably does not cause any bad problems.

    Adults with normal vision, but using students in a psychology class.

28. A small difference that nobody would care about in the real world, but we are really sure about is statistically significant, but not practically significant?

29. When doing HTs is it best to first look at the data you collect before deciding on H_0 and H_a?

    No.

30. Generally speaking is there more concern with doing HTs and CIs with small sample sizes or large sample sizes?

    There's more concern in doing HTs and CIs with small samples sizes.

31. If you reject an H_0 assuming more degrees of freedom than you actually have, will you be able to reject H_0 with the correct degrees of freedom?

    No.

32. Suppose you assume $\mu = 40$ and $s = 8$ and $n = 16$ and $\overline{x} = 42$ and you are trying to prove $\mu > 40$. Would it be better or worse if $\overline{x} = 43$?

    Yes.

33. You are comparing two means and your sample sizes are 50 and 80. The samples are random. There are no outliers and the shapes of the sample data are very close. Do you think it is OK to do HT or CI?

    Yes.

34. You are comparing two means and your sample sizes are 50 and 80. The samples are random. There are two minor outliers and the shapes of the sample data are very close. Do you think it is OK to do HT or CI?

    Yes.

35. You are studying a mean and have a sample of size 10. The sample data is symmetric with no outliers and the data was collected at random. Do you think it is OK to do HT or CI?

    Yes.

36. You are studying the mean drying time of paint on 2×4's sold by a home improvement store and your sample is 40 boards in which you choose 10 shipments spaced out over several months and then chose 4 boards from each at shipment (one off the top, two from

the middle, and one off the bottom). It's not a SRS, but do you think it would still be OK to do a HT or CI?

Yes.

37. When subtracting proportions from two independent samples {X with sample size n_X and proportion p_X and Y with sample size n_Y and proportion p_Y} the standard deviations from X and Y are $\sqrt{\frac{(p_X)(q_X)}{n_X}}$ and $\sqrt{\frac{(p_Y)(q_Y)}{n_Y}}$

38. Suppose $p_X = 0.40$ and $p_Y = 0.40$ and $n_X = 140$ and $n_Y = 120$, what will be the approximate shape of $(p_X)' - (p_Y)'$?

Normal.

39. With a Test for Independence why are the Es = (Row Total)(Column Total)/(Grand Total)? For E that is for Row 2 and Column 3, E should be (Grand Total)(P(R2 & C3)) $= n\big(P(\text{R2})P(\text{C3})\big)$ because we assume that H_0 is true which is that the rows and columns are independent. The best estimate for P(R2) = (R2 Total)/n and for P(C3) = (C3 Total/n) making the estimate (R2 Total)(C3 Total)/n.

40. With a Test for Independence why are the Es = (Row Total)(Column Total)/(Grand Total)? For E that is for Row 2 and Column 3, E should be (Grand Total)(P(R2 & C3)) $= n\big(P(\text{R2})P(\text{C3})\big)$ because we assume that H_0 is true which is that the rows and columns are independent. The best estimate for P(R2) = (R2 Total)/n and for P(C3) = (C3 Total/n) making the estimate (R2 Total)(C3 Total)/n.

41. Suppose you have three normal populations with equal variances and you find $\overline{x}_1 = 5$, $s_1 = 11$, $\overline{x}_2 = 7$, $s_2 = 12$, $\overline{x}_3 = 9$, and $s_3 = 13$. Would you have better evidence for a difference in population means if $\overline{x}_3 = 10$ instead?

Yes.

42. Suppose you have three normal populations with equal variances and you find $\overline{x}_1 = 5$, $s_1 = 11$, $\overline{x}_2 = 7$, $s_2 = 12$, $\overline{x}_3 = 9$, and $s_3 = 13$. Would you have better evidence for a difference in population means if $s_3 = 10$ instead?

Yes.

43. Two advantages of Non-parametric statistics are that they tend to be less assumptions and easy to apply.

44. Give a disadvantage of non-parametric statistics.

Wasteful Information.