1. A study of iron deficiency among infants compared samples of infants following different feeding regimens. One group contained breast-fed infants, while the children in another group were fed a standard baby formula without any iron supplements. Here are summary results on blood hemoglobin levels at 12 months of age:

|  |  |  |  |
| --- | --- | --- | --- |
| Group | n | Mean | s.d. |
| Breast-fed | 23 | 13.3 g/dl | 1.7g/dl |
| Formula-fed | 19 | 12.4g/dl | 1.8g/dl |

1. Is there significant evidence that the mean hemoglobin level is higher among breast-fed babies? State H0 and HA and carry out a pooled t-test. Give the P-value. What is your conclusion?
   1. Hypotheses where BF is Breast-fed and FF is Formula-fed
      1. Ho: mean BF = mean FF and
      2. Ha: mean BF *is not = to* mean FF
   2. Pooled t-test:
      1. Compute estimate of population standard deviation, Sp ()
      2. Compute SE
      3. Compute t-ratio (pooled t-statistic)
      4. Find p-value (or p-value boundaries from t-table)
      5. Conclusion: There is (\_\_evidence\_\_) in the data that (\_\_treatment\_\_) have (\_\_effect\_\_) in (\_\_conditions of study\_\_)
         1. There is very weak evidence in the data that the breast-fed babies have more iron at 12 months than formula-fed babies.
2. Give a 95% confidence interval for the mean difference in hemoglobin level between the two populations of infants.
   1. T\* is 2.021 from the t-table (95% column, row based on d.f.)
   2. Estimate of difference
   3. SE
   4. 95% CI = [estimated difference] +/- [t\* x (se)]
3. State the assumptions that your procedures in (a) and (b) require in order to be valid.
   1. Observations are independent between experimental units.
   2. Population standard deviances are equal.
   3. Population values follow a normal distribution.
4. Using the rule-of-thumb check if the variances of the groups are roughly equal.
   1. **Rule of thumb is that the ratio of SDs are between .3 and 3?????**

2. To investigate the effect of a new hay fever drug on driving skills, a researcher studies 24 individuals with hay fever: 12 who have been taking the drug and 12 who have not. All participants then entered a simulator and were given a driving test which assigned a score to each driver as given in the file *hayfever.txt*. Use a software to answer the following questions.

1. Obtain side-by-side boxplots of the scores. Do you think the variabilities within groups are roughly equal?
   1. It seems that the distributions are roughly equal. The mean scores are similar with the boxes and whiskers covering similar ranges.
2. Is there any difference between the average driving scores between the two groups? Write down the null and the alternate hypotheses clearly describing any notation you use. Compute the pooled t-statistic and the p-value.
   1. Let MeanDrug = mean score from drugged individuals and MeanCont = mean score from control individuals
      1. Ho: MeanCont = MeanDrug
      2. Ha: MeanCont is not = to MeanDrug
   2. Pooled t-stat is 0.10041
   3. P-value is 0.9209
3. Write your decision and conclusion under the given context.
   1. There is no evidence in the data for any effect of the drug.
4. Find 90%, 95% and 99% confidence intervals for the mean difference. How does the width of the confidence interval change with confidence level?
   1. 90%: -2.684 to 3.017
   2. 95%: -3.276 to 3.609
   3. 99% -4.512 to 4.845
5. Check graphically for the normality assumption.
   1. Side by side QQ plots
      1. In both cases the points roughly lie along a straight line, therefore, there is no convern for violating the normality assumption

3. The Wade Tract in Thomas County, Georgia, is an old-growth forest of longleaf pine trees (Pinus palustris) that has survived in a relatively undisturbed state since before the settlement of the area by Europeans. Foresters who study these trees are interested in how the trees are distributed in the forest. One question is: Do the trees in the northern part tend to have bigger trunks than the trees in the southern part? To that end a group of researchers divided the tract into northern and southern halves and take random samples of 30 trees from each half. The diameters in centimeters (cm) of the sampled trees are given in *pinetrees.txt*.

1. To answer the study question, write down the null and the alternate hypotheses clearly explaining any notation you use. Compute a test statistic and a p-value. State any assumption you make.
   1. Let N = mean trunk diameter in the north half of the forest, and S = mean trunk diameter in the south half of the forest
      1. Ho: N = S
      2. Ha: N ≠ S
   2. T-statistic: -2.6286
   3. P-value: 0.01096
   4. Assumptions:
      1. The observations of tree trunk diameter are independent between experimental units
      2. Population standard deviations are equal
      3. Population values follow a normal distribution
2. Write your decision and conclusion under the given context.
   1. There is some/strong evidence in the data that the mean tree trunk diameter is different between northern and southern halves of the forest.
3. Check your assumptions
   1. Graphically: side by side boxplots
      1. The distribution of sample data between groups does not appear to be equal (boxes are different sizes, north part has lower mean than south part)
   2. Graphically: side-by-side QQ-plots.
      1. Although most of the values follow a straight line, there is some variation around that and there could be non-normal sample data. **Dutta says that this is a clear violation of normality.**
   3. Using rule-of-thumb: Compute the ratio of the standard deviations of the groups. Comment on your findings.
      1. Depending on which is on top:
         1. North divided by South: 1.227
         2. South divided by North: 0.814
      2. From StatSleuth3:
         1. The ratios above show that there is some difference in the sample standard deviations of the groups. In these cases the t-ratio does not follow a t-distribution, however, theory shows that the t-tools remain fairly valid when the S.D.s are unequal as long as the sample sizes are roughly the same. In this case, we have exactly equal sample sizes and therefore I would conclude that there is not enough evidence to reject our pooled t-test conclusion.
         2. Dutta again says that the rule of thumb is that the ratio should fall between 0.3 and 3
         3. BUT it makes a difference which is on top and could lead to different conclusions