

Circle the multiple testing or estimation procedure that would be most appropriate in each situation described below.

1. You have conducted a completely randomized experiment with 5 treatments. The mean of the data points corresponding to treatment 3 is greater than any of the other observed treatment means. Based on this observation, you would like to know if it is safe to conclude that  $\mu_3$  is greater than each of  $\mu_1$ ,  $\mu_2$ ,  $\mu_4$ , and  $\mu_5$ .

Bonferroni                  Dunnett                  Hsu                  Tukey                  None

2. You have conducted a completely randomized experiment with 5 treatments. Based on the treatments chosen for your experiment, you are primarily interested in knowing which of the treatments has a mean that is different from  $\mu_1$  (the mean for treatment 1).

Bonferroni                  Dunnett                  Hsu                  Tukey                  None

3. You have conducted a completely randomized experiment with 5 treatments. You would like to know about any differences among the 5 treatment means. You want to use a method that, with 95% confidence, will result in no mistaken claim of a difference between means that are in fact identical.

Bonferroni                  Dunnett                  Hsu                  Tukey                  None

4. You have conducted a completely randomized experiment with 5 treatments. Based on the treatment structure, there are 6 contrasts of the 5 treatment means that you are interested in estimating. You would like to obtain a set of 6 confidence intervals for the 6 contrasts. For each contrast, you would like to use a method that will give a confidence interval that contains the parameter that it is trying to estimate with probability 95%.

Bonferroni                  Dunnett                  Hsu                  Tukey                  None

5. You have conducted a completely randomized experiment with 5 treatments. Based on the treatments that you have chosen for your experiment, there are 6 contrasts of the 5 treatment means that you are interested in estimating. You would like to obtain a set of 6 confidence intervals for the 6 contrasts using a method that gives confidence intervals that all contain the parameter estimated with simultaneous coverage probability 95%.

Bonferroni                  Dunnett                  Hsu                  Tukey                  None

6. You have conducted a completely randomized experiment with 5 treatments. You would like to produce a list of treatments that will contain the treatment with the largest mean with confidence 95%.

Bonferroni                  Dunnett                  Hsu                  Tukey                  None

7. How many tests does it take to compare every treatment mean to every other treatment mean if an experiment has 10 treatments?

8. Suppose you are conducting a completely randomized experiment with 3 observations for each of 10 treatments. For each treatment, you would like to compute a confidence interval that will contain that treatment's true mean. You would like to use a method that will give 10 confidence intervals that all simultaneously contain the true means they are trying to estimate with probability 0.95. What  $t$ -value will you use when constructing your confidence intervals?

9. Suppose you have tested whether each of 8 different contrasts of means in an experiment is zero and have observed the  $p$ -values below.

Contrast	1	2	3	4	5	6	7	8
$p$ -value	0.001	0.010	0.042	0.049	0.063	0.109	0.432	0.772

Your goal is to identify the contrasts that are not 0.

a) Provide a list of non-zero contrasts using a method that will declare a contrast to be non-zero only 1% of the time in cases when the contrast is actually zero.

b) Provide a list of non-zero contrasts using a method that will declare a contrast to be non-zero only 5% of the time in cases when the contrast is actually zero.

c) Provide a list of non-zero contrasts using a method that will declare one or more zero contrasts to be non-zero with probability no larger than 0.05.

d) Suppose that in truth contrasts 1, 2, 3, and 5 are not equal to zero, and contrasts 4, 6, 7, and 8 are equal to zero. For each of parts (a) through (c), determine the number of type I and type II errors made.