

## Midterm exam - practice

1. Consider the output shown below.

One-Sample Z				
Test of mu = 30 vs not = 30				
The assumed standard deviation = 1.2				
N	Mean	95% CI	Z	P
16	31.2000	(30.6120, 31.7880)	?	?

- Fill in the missing values in the output. What conclusion would you draw?
  - Is this a one-sided or two-sided test?
  - Use the output and the normal table to find a 99 percent CI on the mean.
  - What is the  $P$ -value if the alternative hypothesis is  $H_1: \mu > 30$
  - What is the  $P$ -value if the hypotheses are  $H_0: \mu = 29$  versus  $H_1: \mu \neq 29$ ? Show your work.
2. True or false question - only circle "true " or "false".
- true or false? In a Graeco-Latin Square design two nuisance factors are blocked.
  - true or false? Type II error is the probability that we fail to reject a false null hypothesis.
  - True or false? From the central limit theorem, if a sample size is large, then the shape of a histogram of the sample will be approximately normal, even if the population distribution is not normal.
3. The diameter of a ball bearing was measured by 12 inspectors, each using two different kinds of calipers. The results were:

Inspector	Caliper 1	Caliper 2	Difference	Difference^2
1	0.265	0.264	0.001	0.000001
2	0.265	0.265	0.000	0
3	0.266	0.264	0.002	0.000004
4	0.267	0.266	0.001	0.000001
5	0.267	0.267	0.000	0
6	0.265	0.268	-0.003	0.000009
7	0.267	0.264	0.003	0.000009
8	0.267	0.265	0.002	0.000004
9	0.265	0.265	0.000	0
10	0.268	0.267	0.001	0.000001
11	0.268	0.268	0.000	0
12	0.265	0.269	-0.004	0.000016
			$\sum = 0.003$	$\sum = 0.000045$

Part of Output

**Paired T-Test**

Paired T for Caliper 1 - Caliper 2

	N	Mean	StDev	SE Mean
Caliper	12	0.266250	0.001215	0.000351
Caliper	12	0.266000	0.001758	0.000508
Difference	12	0.000250	0.002006	0.000579

(a) Construct a hypothesis test for the difference between the means of the population of measurements represented by the two samples.

(b) Find the  $t$ -value and  $P$ -value for the test in part (a).

(c) Construct a 95 percent confidence interval on the difference in the mean diameter measurements for the two types of calipers.

4. The following output was obtained from a computer program that performed ANOVA on an experiment.

ANOVA: y versus A, B					
Source	DF	SS	MS	F	P
A	3	?	?	?	?
B	?	280.378	?	?	?
Error	9	58.797	?		
C. Total	15	347.653			

(a) Fill in the blanks in the ANOVA table. You can use bounds on the  $P$ -values.

(b) How many levels were used for factor  $B$ ?

(c) What conclusions would you draw about this experiment?

5. An experiment was conducted to test the effects of nitrogen fertilizer on lettuce production. Five rates of ammonium nitrate were applied to four replicate plots in a design below. The data are the number of heads of lettuce harvested from the plot.

Treatment (lbs N/acre)	Heads of Lettuce/plot	Mean	St. D.
0	100, 120, 90, 140	112.50	22.1736
50	130, 135, 145, 175	146.25	20.1556
100	148, 140, 150, 158	149.00	7.3937
150	145, 160, 165, 162	158.00	8.9069
200	130, 150, 155, 160	148.75	13.1498

The following ANOVA table is obtained from SAS.

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	?	4939.300000	?	?	?
Error	?	?	?		
Corrected Total	?	8553.800000			

- Identify what design this is.
- Fill in the missing values (indicated by “?”) in the ANOVA table.
- Test whether the nitrogen fertilizer affects the lettuce production at the 0.05 level of significance.
- What is the estimate of the population variance?
- The researcher further uses the following contrast to investigate the relationship between the fertilizer and lettuce production. C1: -2 -1 0 1 2

The result on testing C1 is reported below:

Contrast	DF	Contrast SS	Mean Square	F Value	Pr > F
c1	?	?	1817.1607	?	?

fill in the missing values.